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Plant type	Shoot Extract					Root Extract				
	Conc. %	Root length (cm)	Shoot length (cm)	Intact plant length (cm)	Inhibition %	Conc. %	Root length (cm)	Shoot length (cm)	Intact plant length (cm)	Inhibition %
Okra	0	*25.7 a**	27.8 a	53.5a	-	0	25.7a	27.8a	53.5a	-
	5	25.00a	26.77a	51.77a	3.23	1	24.50a	27.00a	51.50a	3.73
	10	24.50a	25.95a	50.45a	5.70	2	23.87a	25.65a	49.52a	7.43
Sorghum	0	21.6a	27.2a	48.8a	-	0	21.7a	27.2a	48.9a	-
	5	13.00b	17.25b	30.25b	38.03	1	9.8b	25.5ab	35.3b	27.6
	10	6.00c	5.50c	11.50c	76.44	2	9.4b	22.6b	31.9 b	34.6



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THE ROLE OF AGRICULTURE AND FORESTRY IN DECREASING THE RURAL DEPOPULATION IN IRAQI KURDISTAN REGION

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ABSTRACT

This research was carried out to analyze the positive impact of agricultural and forestry sectors on rural depopulation in Kurdistan region depending on their benefits, includes the availability of production factors (land, labor, capital, and technology) of agriculture which have total land area of 3,670,613 hectare, Increasing the cultivable lands 10% annually with total growth rate of 5.9%, Increasing in water storage capacity 10% annually with total growth rate of 5.6% and other facilities. So forestry sector, its total area 24771640 dounam with suitable environmental conditions, which can present many benefits and opportunities in rural depopulation which increasing overtime, the statistical data show that the average rural population rate in the region reached to 22,4% of the total, and there are rising in urbanization level which has negatively impacted employment trends. While the demographic situation indicates that half the Region's population is consumers and the rest is producers, responsible for supporting themselves and the consumer groups. This situation is likely to cause pressure on the available economic resources, and pose a threat to the labor market and its capacity to create new job opportunities depending on the agriculture and forestry sectors by dependence policies to reduce the unregulated population motion towards urban areas through prioritizing rural areas development, encouraging investment in these areas, and creating elements of attraction and settlement for migrating manpower.

KEY WORDS: *Agriculture; Forestry; Depopulation; Kurdistan Region.*

INTRODUCTION

Out-migration has become a fact of life in rural. For almost every year, the number of people leaving rural communities has far exceeded the number of those moving in. Most migrants are young adults and families with young children who move to urban centers in search of jobs or for better access to education, health care and other services, Higgins (2008). Those who remain are aging and there are often not enough year-round residents to support the maintenance of schools, medical clinics, shopping centers, and other facilities residents of larger towns and cities often take for granted.

Socio-economic factors also play a significant role in decreasing the population of remote regions because they are the main elements affecting the migration of the rural population. Technical progress resulting in an increased mechanization of agriculture has enabled rapid agricultural development. With the increase of production, prices for agriculture commodities decreased. However, the disparities among regions have increased. Mountainous, arctic, and drier areas face particular difficulties on global markets, since production costs in such areas are higher and

transportation infrastructure is less developed, hence marketing and processing are constrained, United Nation(2006). The lack of agricultural competitiveness is therefore a major factor of depopulation in areas where agriculture and forestry are the main economic activities. Diversely, in regions with important urban or tourist centers, possibilities of off-farm employment are high and part-time farming becomes important. But we can see that Agriculture and forestry therefore continue to play a major role in maintaining natural resources and cultural landscapes as a precondition for other human activities in rural areas. Different types of agricultural practices and land use have an effect on natural resources, notably biodiversity, water and soil, and climate change, and finally they lead to increasing the rural migration, this role may be apply in Kurdistan Region of Iraq for getting the benefits of large agricultural and forestry areas in decreasing the rural- urban migration in future.

The problem of this research related to above mentioned, in addition to that, all societies characterized by migration from rural areas to the city but in different levels according to development degrees and evolution, where the

reverse depopulation started in development countries while increased in developing countries. It is the case in Kurdistan Region that the depopulation increasing because of unavailability of living requirements which provided by the city, for that there are needs to take attention to this problem and finding solution for it. For that we presented the following hypothesis "we assume that the agriculture and forestry can investigate good levels of living needs and labor opportunities in rural areas which may cause reverse depopulation in future which is ongoing to this time".

The objective of this research is to use the extension to raise the standard of living of the rural people by helping them in using their natural resources like land, water and livestock in the right way. Rural people are helped in planning and implementation of their family and village plans for increasing agricultural production, improving existing forestry. The specific objectives of agricultural and forestry extension for rural depopulation are to develop the people, to disseminate the useful and practical information relating to agriculture and forestry, including improved seed, fertilizers, implements, pesticides, improved cultural practices, dairying, poultry, nutrition and other aspects, to promote better social, natural, recreational, intellectual and spiritual life among the people, and to improve economic and social policies involving population as a whole for reaching depopulation. Some who's work in this direction such as: Somsala (1963). Who applied agricultural extension methods in Southeast Asia with particular reference to Thailand. on the part of the rural population. His result was a complete agricultural extension program is required, which included more six extension methods for developed the rural population. D. Carr (2009). In his study reviews the state of knowledge and develops a conceptual model for researching frontier migration in the developing world with a focus on Latin America. Since only a small fraction of migrants move to forest frontiers, identifying people and place characteristics associated with this phenomenon could usefully inform policies aimed at forest conservation and rural development. Yet population scholars train their efforts on urban and international migration while land use/cover change researchers pay scant attention to these migration flows which directly antecede the most salient footprint of human occupation on the

earth's surface: the conversion of forest to agricultural land. Surchev (2010). Stated in his research the definitions of concepts "rural area" and "farming area" and the differences between the two terms. In the paper he was presented the objectives of the National strategic plan for rural development and the main economic indicators of rural development were described. Also analyzed the typical problems inherent in the rural areas and the ways to resolve them.

Mahanta and Das (2012). Studied the Deterioration of common property resources which increased the incidence of poverty level because poor people depend on forest resources. Earnings of rural people are mostly the combination of income from private property and common property resources. Reduction in common property resources reduces earnings of rural people leading them to migrate to nearby urban areas in search of livelihood. Thus, there is a link between common property resource degradation, poverty and migration. On the basis of these arguments, an attempt has been made to study the linkage between common property resource degradation and migration in the state of Assam. With the help of thirty variables at two points of time, 1991 and 2001, thirteen indicators have been constructed to represent demographic, natural resource and livestock related indicators. Factor analysis has been used to find the linkages between common property resource degradation and migration. The study finds that decreasing common property resources distress out rural people to urban areas in search of livelihood. Gimba, and Kumshe (2012). Examined the causes and effects of rural-urban migration in Borno state with particular reference to Maiduguri Metropolis. A survey was carried out amongst 150 respondents drawn from within the metropolis and the results indicates that the major causes of rural urban migration are; search for better education, employment, and business opportunities. Others are identified as poverty, unemployment, famine, and inadequate social amenities in the rural areas. While some of the effects of rural-urban migration are; rural-urban migration brings pressure on urban housing and the environment, high rate of population growth in the urban centers also lessens the quality of life, overpopulation encourages crime rate in the society and rural-urban migration slows down the pace of development of the rural areas. It is recommended that the Government should strive to provide

social amenities and facilities in the rural areas and also provide jobs for the citizens in the rural areas. In addition to this Vocational training centers should be established in the rural centers for training of the productive youths for self employment.

Rural Depopulation and why we walk to stop it:

Rural-urban migration is a feather of most countries. It has existed ever since the specialized functions of cities – as opposed to large settlements – began to be defined thousands of years ago. The steam gathers a major national problem. Rural depopulation is a demographic phenomenon with economic causes, it occurs when rural people perceive that cities offer a better deal, jobs, income and services available than their current settlement, its roots lie in rural push and urban pull. Price (1989).

Push relates to low incomes and declining job opportunities, low income elasticity of demand for food and displacement of agriculture labor by machines, while the surplus of rural labor gives low wage bargaining power and sometimes declining real wages. Forestry-based communities, often relegated to the least productive and tractable land, are additionally handicapped by a harsh and inhospitable environment for human habitation. As workers leave demand for services in rural communities shrinks. Specialized services (retail, education, health religious, cultural, welfare) which need substantial population before they can be efficiently provided are at risk. The number of establishments offering other services decline, restricting choice. Owners and employees of these services depart too, accelerating the downwards trend of population and spending power.

Why stop depopulation?

The more affluent acquire private. Transport further, reducing demand for and quality of rural public transport. Some cultures and broader prospective marital choice added to economic pull factors. Apart from rural areas with special functions ancillary to cities- dormitory areas for commuters or areas with environment favorable for retirement.

Many reasons are given for resisting depopulation:- Price (1989).

1- Social justice migration hurts those left behind, often those least equipped to sustain hardship

Political stability: - areas whose problems are seen to be neglected by governments become cradles of unrest: great urban concentrations supply the focus of revolutions.

3- Cultural continuity: long established communities are repositories of the folk-tradition on which the nation's identity depend.

4- Strategic safety: for countries not self-sufficient in agricultural and forestry products, there is insurance value in maintaining rural skills and local knowledge in case they are needed in times of war and other national crises.

5- Economic rationality the more directly economic reasons fall under several headings:

a) Use of the labor force with low opportunity cost (due to the high unemployment or underemployment), with beneficial effect on GNP.

b) Maintaining rural infrastructure and services throughout the year, so that it is available in the tourist season (if any).

c) Saving the social cost of building urban infrastructure for migrants.

d) Negative externalities of urban over-expansion (high rates of crime, diseases and mental ill-health)

e) Countering false information on prospects of jobs. Income and facilities in cities, which leads to over-estimation of benefits of migration.

f) Avoiding further unemployment in cities, where often many excess workers chase a limited pool of jobs: an extra migrant obtains a job only at the expense of already- resident workers.

These reasons appeal to benefits of remaining in a rural location, and not to migrating to the cities.

Relative efficacy of agriculture and forestry in halting depopulation:

However, agriculture has a complex relationship with natural resources and the environment, and attributing specific environmental effects to agriculture is difficult and not fully understood. Agriculture is a major user of land and water resources yet needs to maintain the quantity and quality of those resources in order to remain viable. Agriculture generates waste and pollution yet it also conserves and recycles natural resources, and changes landscapes and habitats for wildlife. Many of the environmental effects are confined to the sector itself, but off-farm effects are also important. The impacts are often concentrated locally and

regionally, although some are of national and international significance.

As a major user of natural resources, agriculture has a significant impact, and the preservation of rural landscapes is generally not considered a priority for government financial assistance, although there are concerns relating to the loss of rural land to urban development in certain areas, and to rural depopulation. In addition to the many benefits of agriculture which characterized in decreasing the rural-urban migration. Employment is the crux of rural depopulation and although the employment within a whole country can be created by a combination of policies on taxation and money supply, employment in rural areas depend on more specific measures provision of free services, infrastructures subsidies or tax advantages, imposition of restrictions or directives, or simply locating government activities in target areas. Debates about rural depopulation and forestry employment tend to be emotional and illogical.

Yarkova and Georgiev (2007). Limited the factors of Conditions and opportunities to increase the employment rate in rural regions of Bulgaria by the Strengths: Favorable soil and climatic conditions for the production of various products; Rich traditions in the production of a number of agricultural raw materials Weaknesses: Unfavorable demographic trend in the rural regions; bad basic infrastructure; low productivity in agricultural farms.

Opportunities: Expanded access of Bulgarian producers to the EU market; support to the agricultural producers' income; creation of employment outside the agriculture; Threats: Increased competitive pressure on the domestic market; deepening of the development differences of the urban and rural regions; negative consequences of natural disasters; dropping out of entirely depopulated villages from the network of the villages.

For historical and economic reasons forests are often abundant in economically undeveloped countries or regions. In a world where the prices of rural raw materials are often static or falling at present, tourism based on the natural beauty of forests. And their setting offers valuable and

increasing income, for many countries in the form of precious foreign exchange. For example, the economic impact of forestry in Mississippi's economy (forest product, hunting, wildlife, and recreation) gave 21.9 billion dollar, 189,830 jobs full and part time, and 5.9 billion values added in 2010. Mississippi University (2010).

The case of Iraqi Kurdistan Region:

Depending on the information from the ministry of planning in Kurdistan Region we can see that there are increasing in GDP per capita income in the region from 524,426 ID in 2004 to 5,342,450 ID in 2011, that means there are development in all the region sectors, including the population and the agriculture. The Region's population increased from about 3,910,329 million inhabitants in 2003 to 4,382,167 million inhabitants in 2008, at an increase rate of 12.07%. In 2010, population was 5,351,276 billion, with an increase rate of 22%, compared to 2008 and 36.8% in comparison to that of 2003. Population is expected to rise to about 6,314,505 million in 2016, if the growth rate remained the same as in the past five years, in terms of birth and mortality rates and other relevant changes, we must refer here that the population in Kurdistan region faced very hard conditions because of the previous regime which caused different types of migration and depopulation specially from the rural places which left bad situations in these places and became backward areas and livable, this is the main reason of depopulation.

The Environment-wise from available figures and statistics which based on ration book (rations distribution) in 2007, and IHSES results, indicate that population distribution by environment (urban/rural area) was 77.6% urban population against 22.4% rural population. At the level of the governorates, the urban population in Erbil was the highest (81.6% urban population in the governorate center, district and sub-district) against 18.4% rural population; in Sulaymaniyah 78.8% against 21.2%; and in Duhok 72.4% against 27.6%, as the table (1) demonstrates. Ministry of Planning (2012).

Table (1) :- Population by Environment in Iraqi Kurdistan Region.

Governorate	Population%		
	Governorate Center	Districts and sub-Districts	Rural Areas
Erbil	50.9	30.7	18.4
Duhok	25.9	46.5	27.6
Sulaymaniyah	33.4	45.4	21.2
Average	36.7	40.9	22.4

Source: Results of IHSES, 2006/2007, and ration book details (2007)

The commercial sector registered the highest employment rate (14.321.7%) followed the Education 15.4% and government sector (15.4%), the agricultural sector (13.2%), and building and construction sector (1.3%). Urbanization impacted the nature of employment tendencies which were negatively reflected on the employment structure, especially after 2003. Rate of workers involved in non commodity sectors rose from 54.1% in 2006 to 66.1% in 2009, of overall number of manpower, reflecting a failure by the commodity activity sectors (manufacturing industry, mining, agriculture...etc.) to accommodate manpower increase. Only 22.4% of total manpower worked in these sectors in 2009. Which highlights the negative impact of increased urbanization level reaching about 77.6% in 2008. This also shows that the shift of manpower from rural areas to the cities was not due to industrial or other attractive factors, as it was the case throughout the historical

stages of development in the advanced countries, but it was caused by factors of expelling from the rural areas. Ministry of Planning (2012).

The agricultural and forestry activities in Iraqi Kurdistan region have generally many distinctive features that distinguish it from other economic activities, including high sensitivity to the natural, seasonal and biological circumstances; particularity of agricultural management; as well as the association of this activity with ensuring an essential human need and food security. These aspects as a whole are influenced by the policies adopted throughout their different development stages. About the Agricultural Land, large areas of cultivable land are available in the Region. Total area of rain fed and an irrigated land is over 1,535,794 hectares, representing 41.84% of the Region's total area. The remaining 58,15% is uncultivated and shown in table(2).

Table (2) :- Area of lands (hectare), in Iraqi Kurdistan Region 2010

Governorate	Total Area	Rain fed Lands	Irrigated Lands	Total Cultivable Lands	Uncultivable Lands
Erbil	1514120	580645	45635	626280	887840
Duhok	931398	254892	46650	301542	629856
Sulaymaniyah	1042808	232700	59299	291999	131020
Germyan	802076	300151	15822	315973	486103
Total	3670613	1368388	167406	1535794	2134819
%	100%			41.84%	58.15%

Source: MAWR/KRG

Total areas of forests and rangelands reached 24771640 hectares and 8005951 dounam

respectively, distributed as indicated in the table (3):

Table (3) :- areas of forests and rangelands (dounam) in Iraqi Kurdistan Region 2010

Governorate	Artificial Forest	Natural Forests	Rangelands	Roc Area	Total	%
Erbil	18769	1477033	1603128	597312	3696242	14.92%
Duhok	16024	1138907	2396428	8129769	11681128	47.17%
Sulaymaniyah	8172	4220867	2172948	530725	6932712	27.99%
Germyan	4139	74053	1833446	549920	2461558	9.94%
Total	47103	6910859	8005951	9807726	24771640	
%	0.19%	27.90%	32.32	39.59%		100%

Source: MAWR/KRG

CONCLUSION

Agricultural sector is one of the oldest sectors regulated by different legislations due to its importance as one of the earliest crafts practiced by man, the fact that large numbers of population work in it as a basic source of living, and its important position as food provider for all population. Also forestry sector has an important role in the society of the region, because of its large area and multi benefits. These two sectors

can create many employment opportunities in rural locations and they can play a good role in stop depopulation, and in the opposite migration from urban to rural, if these sectors take care and development in right ways. After 2003, unemployment problem received more attention by the government, given its rising rates, diverse tendencies and causes. The circumstances of the past years intertwined with the present conditions, causing unemployment levels to reach 14% in 2009, table (4) show that:

Table (4):- Unemployment rate of working age population, in Iraqi Kurdistan Region 2009.

Governorate	Unemployment Rate%			
	Center	Outskirts	Rural Areas	Average
Erbil	7.24	16.03	23.9	13.22
Duhok	14.26	18.2	17.51	16.91
Sulaymaniyah	10.45	13.36	11.26	11.88
Average	10.65	15.86	17.55	14

Source: KRSO/ Ministry of Planning /KRG

The difference becomes even more evident when we compare urban areas with the rural districts. Several available cases can be cited to confirm the declining unemployment rates in urban areas, compared with the rates in the rural areas, outlined in the previous table. These rates emphasize that unemployment has taken on a geographical dimension, with unemployment being concentrated at specific locations. The Governorate of Duhok registered the highest unemployment rate, reaching 16.91%.

For that decision making must be take such as supporting integrated rural development, to reduce unregulated population movement caused by urbanization, in addition to encouraging investment in the rural areas, and developing

farming and forestry resources such as wood production and recreation, supporting the sectors that absorb large numbers of manpower use of labor-intensive and low-capital production approaches, such as forestry services sector. The results of these operations will reducing migration to the cities, and resettling the migrating from the rural areas, that mean preparing a spatially well-balanced employment policy and increasing investment in rural areas. Also I think that exploring land use change can help illuminate migration processes and determinants. The process driving deforestation is cyclical: resource pressure among rural populations induces depopulation, but land use adaptations to population and resource pressures generally

precede demographic responses. Therefore, the relative success of rural households in adapting to changing conditions by modifying land use and strategies of resource use a critical determinant of out-migration and, ultimately, deforestation in many areas of forest land which have bad growth.

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KNOWLEDGE LEVEL OF TOMATO FARMERS ONPOSTHARVEST TECHNIQUES IN HALABJAGOVERNORATE, KURDISTAN REGION OF IRAQ

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ABSTRACT

The main objective of the study is determining the knowledge level of Tomato farmers on post-harvest techniques in Halabja governorate. Samples of 120 tomato farmers were selected randomly representing 24% of the study population. The research data were collected using a questionnaire specially prepared to determine the knowledge level of the targeted farmers. The results revealed that a majority of the respondents (57.5%) had medium knowledge level about post-harvest techniques. Significant relationship founded between knowledge level of tomato farmers and (age, level of education, Land tenure, years of working in Agriculture, years of cultivating tomato crop) while no significant relationship founded between respondents knowledge level and following variables (Farm size, social participation, Attitudes toward agriculture extension, urban contact, sources of information and training). The 5 greatest factors affecting tomato farmers abilities in marketing their production are (The large number of wounded and infected fruit, the lack of a suitable place for grading, Lack of refrigerated storehouses for storing the crop in nearby locations of tomato fields. Abuse cutting method have its bad effect on marketable, Lack of knowledge and skills on how to conduct proper storage process.

KEYWORDS: Agricultural Extension, Knowledge Level, tomato farmers, postharvest.

INTRODUCTION

In order to achieve economic and social development, it requires to direct efforts towards rural development. The role of agriculture, which is the predominant economic activity in rural areas, is crucial in the eradication of poverty and food insecurity. The rural population depends on agriculture for both their incomes and their food supply. (Abod , 2011).

The agricultural sector is going now through a phase of rapid change to meet the growing demand for food in a sustainable manner, the growing competition at the international level and the lack of employment opportunities as a result of increased labor productivity and reduced government subsidies for agricultural products. Therefore, the development of agriculture industry to meet these rapid changes needs farmers and growers to be well prepared and this is the main duties of Agriculture Extension services. (Van den Ban et al. 1996).

Agriculture represents one of the main sectors of the Iraqi economy (including

Kurdistan region), provides food to 30% of the population who are mainly rural residents, it operates approximately 20% of the workforce. Provide the raw materials for other industries, as well as export. Hence the more interest in this sector, its problems and development needed due to the importance of its role in the socio-economic development process of Iraq. (Abod, 2011).

Despite the remarkable progress in increasing the production of agricultural crops, vegetables and productivity averages, but the production has been impacted by significant post-harvest waste. Primary factors responsible for post-harvest waste include poor pre-harvest measures, adoption of poor production techniques, non-application of pre-harvest recommended treatments /practices, harvesting at improper stage and improper care at harvest; and post-harvest problems, packaging in bulk without sorting and grading of produce, improper transportation and storage, and distant and time consuming market distribution. These wastes bring low return to growers, processors and traders, this also affect the national

economy, reduce exports and foreign exchange earnings (Kader, 1992).

In Iraq, tomato is one of the most important crops in terms of cultivated area and the amount of production, accounting 28 % of the cultivated area and production of summer vegetables and 25% of the total cultivated area and production of winter vegetables. In addition, there is poor or absent post-harvest handling facilities in Iraq and Kurdistan region. They factors which lead to high post-harvest losses. Post-harvest of product losses can exceed 30% and even reach 50% of total food production, depending on the type of products and the storage conditions Storage losses therefore contribute considerably to the reduction of available foodstuffs. Post-harvest losses from producer to the consumer may be as high as 50% in fresh vegetables .This means that half of what is produced never reaches the consumer for whom it was grown, and the effort and money required to produce it are lost too. (Hanush, 2001).

Therefore, it is essential to preserve the tomatoes by using any of the food preservation techniques and to be made available in an acceptable form throughout the year at relatively minimum cost.

Alkholy (1984) reported that there is a significant waste in agricultural crops, vegetables and fruits production yearly as a result of poor storage, lack of adequate facilities and technologies and using of unsustainable options. Therefore, the agriculture extension can play a successful role in educating farmers in marketing and reduce loses to a minimum, by overcoming the problems of agricultural production through application of modern agricultural and post-harvest techniques, which are suitable to farmers abilities and local environmental conditions.

There is shortage of researches in the area of post-harvest techniques in Kurdistan and Iraq. Therefore, this study has been conducted to answer the following questions: What are the levels of tomato farmers' knowledge on post-harvest techniques in Halabja governorate? What are the variables affecting the tomato farmers' knowledge level? What are the problems and obstacles of using post-harvest techniques?

The study will be helpful to policymakers, administrators and industrialists as well as researchers in carrying out improvement in

tomato crop production and post-harvest technologies aimed at minimizing post-harvest losses.

Objectives of the Study

The aim of the study is determining the knowledge level of tomato farmers on post-harvest techniques in Halabja governorate, the specific objective are:

1. To determine the knowledge level of tomato farmers on post-harvest techniques.
2. To determine the knowledge level of the tomato farmers in all of the studied post-harvest technologies disciplines.
3. To determine the relationship between knowledge level of tomato farmers on post-harvest techniques and the independent variables: (Age, Educational level, Land tenure, Farm size, Years of working in agriculture, Years of tomato cultivation, Social participation, Attitudes toward agriculture extension, Sources of information about the tomato crop, Urban contact, Participation in training).
4. To determine the significance of the problems and obstacles of applying post-harvest techniques and tomato marketing in Halabja governorate.

Hypotheses of the Study

The following hypotheses will be tested:

There is no significant correlation between knowledge level of tomato farmers as a dependent variable and each of the following independent variables: (Age, Educational level, Land tenure, Farm size, Years of working in agriculture, Years of tomato cultivation, Social participation, Attitude towards agriculture extension, Sources of information about the tomato crop, Urban contact, Participation in training).

MATERIALS AND METHODS

Population of study

The target population of the study is comprised of all tomato farmers in Halabja governorate (502 farmers). A sample of 120 farmers was randomly selected representing 24% of the study population.

To achieve the objectives of this study a questionnaire of four parts was designed: the first part includes a set of questions to recognize personal and functional characteristics of the targeted farmers. The second part includes a scale of 29 multiple chose questions to measure

the Knowledge level of tomato farmers in post-harvest technologies, which consists of five stages (Collecting and cleaning, Sorting and grading, Packaging, Transporting and Storing). The third part includes a set of questions to determine the main problems and constraints of tomato marketing in Halabja governorate.

In assuring the reliability and validity of the tests, the pretest results show a Cron Bach alpha value of 0.761. The data were analyzed statistically using Percentages, mean scores,

simple correlation, Chi square and Spearman Brown coefficient

RESULTS AND DISCUSSIONS

1. Determining the knowledge level of the tomato farmers in post-harvest technologies

The knowledge level scores of respondents tomato farmers in Halabja governorate, ranged from 7 to 23 against the possible range from 0 to 29. Based on the knowledge level scores, the respondents were classified into three categories.

Table1:-Shows knowledge level of the tomato farmers in post-harvest technologies

Categories	Frequency	%
Low 12 and Less	20	16.66
Medium 13-17	69	57.51
High 18 and more	31	25.83
Total	120	100

The results presented in Table-1 revealed that the highest proportion of the respondents (57.51 %) had medium knowledge level about post-harvest techniques. Then followed by high (25.83%) and low (16.66%) categories respectively. The finding indicates that overall knowledge level of respondents in descending order from moderate to low. This may be due to that the high majority of the tomato farmers in the targeted area (95%) have not received any training on post-harvest techniques (Table-13). Therefore, comprehensive training programs are needed for tomato farmers to improve their knowledge and skills in post-harvest technologies. The results were in conformity with the results of previous studies such as Raghavendra et al (2006). They reported that the majority of the farmers had medium level of knowledge rather than high knowledge about cultivation practices and postharvest technologies.

2. Determining the knowledge level of the tomato farmers in all of the studied post-harvest technologies disciplines

The results indicate to the low knowledge level of the respondents in most of the studied areas. This shows that respondents might not have training and other extension educational activities. Therefore, the agriculture extension department in the targeted area should work on the improvement of the training opportunities on post-harvest techniques. The results also indicate that the packaging discipline is in the forefront of the studied areas in terms of the knowledge level with a mean of 4.63, followed by transporting with a mean of 3.4. This may be due to that the tomato farmers have more experience in these two. The sorting and grading tomato, collecting and cleaning and storing areas ranked fifth, fourth and third, respectively. According to the knowledge level of the respondents, this requires effective extension programs in the targeted areas to raise the farmers' knowledge about the importance of post-harvest techniques to minimize the losses in tomato production.

Table(2) :- Rank order of post-harvest techniques disciplines according to the Tomato farmers knowledge level

No	Areas	Limits of scores	Average	Rank
3	Packaging tomato crop	0 - 8	4.63	1
4	Transferring tomato crop	0 - 5	3.4	2
5	Storing tomato crop	0 - 6	3.14	3
1	Collecting and cleaning tomato	0 - 6	2.48	4
2	Sorting and grading tomato	0 - 4	2.31	5

3. Determining the relationship between social and personal characteristics of the tomato farmers and their knowledge level of post-harvest techniques.

1- Age

Age is considered as one of the important personal characteristics that influence the level of knowledge and implementation of the farmers of new technologies.

The result reveals that high proportion of the tomato farmers (45%) are below 30 years old of age, followed by 33% aged between 31 to 50 years, only 22% of them were 51 years old or older. These results showed that majority of the farmers in the studied area are young, below 50 years of age. These categories of farmers are well placed for training and are open for the extension activities. Thus, there is a great need for the policy

planners, extension administrators and other development departments to target this category of farmers before planning and implementation of development program.

To assess the relationship between age and level of knowledge of tomato farmers' simple correlation is used to test the null hypothesis that "there is no relationship between respondent's age and knowledge level of Post-harvest techniques". As shown in the Table-3, the (r) value (0.310) indicates a rejection of the null hypothesis. This implies that there is significant relationship between age of respondents and their level of knowledge of post-harvest techniques. May be the reason is that the respondents acquire more information whenever they penetrated into the age. The result corresponds with AL-Kashab (2013).

Table(3):- Shows distribution of respondents according to their age

No	Categories	Frequency	%	Correlation
1	Less than 30	54	45	0.310**
2	31-50	40	33.33	
3	51 and more	26	21.66	
Total		120	100	

2- Level of education

Education level influences farmers' access to information as well as their ability to understand technical aspects of innovations which largely affects crop production decisions (Rahman, 2003).

Table-4 shows most of the tomato farmers in the targeted area (25.83%) have primary school qualification, 22.5 % of them have Middle School, followed by 15% illiterate and 13.33% secondary school and only 11.66% have diploma and Bachelor degrees. This implies that the largest proportion of the tomato farmers 75% have mid-school or lower qualifications. The results shows

that at 0.05% level of significance, the research hypothesis (Ho2) that there is no significant relationship between Tomato farmers knowledge level of post-harvest techniques and their level of education is rejected ($X^2 = 26.58$). This suggests that there is significant relationship between respondents' knowledge level and their level of Education .May be the reason is that the high level of education among the farmers is likely to result in a better understanding of post-harvest technologies. The result corresponds with (Al-Taiy, 2012) and (AL-Kashab, 2013) and disagree with (AlTalib, 2007)

Table(4):- Shows distribution of respondents according to their level of education

No	Education level of farmers	Frequency	%	Chi-square
1	Illiterate	18	15	26.580*
2	Read and write	14	11.66	
3	Primary	31	25.83	
4	Middle school	27	22.5	
5	Secondary	16	13.33	
6	Institute	8	6.66	
7	Bachelor	6	5	
Total		120	100	

3- Land tenure

Having rights over the land provides the power to make decisions or to be involved in the decision making process about the land use. Also noted that technology adoptability relies on who makes the decision which is determined by access and control over land (Chanza , 2011).

Table-5 shows high proportions of the respondents (59.16%) belong to the land ownership category, followed by 24.16 % contract. To find the relationship between the land tenure and respondents knowledge level about

post-harvest techniques, the chi square was used. The results shows that there is a significant relationship (chi square = 6.55) between the two variables at the probability level (0.01). This means that the hypothesis “there is no significant relationship between knowledge level of respondent and land tenure” was rejected. The reason may be because the ownership of land might have an economic power and status attribute, especially where it is legally owned. This result does not agree with (AITalib, 2007).

Table5: -Shows distribution of respondents according to the land tenure

No	Type of acquisition	Frequency	%	Chi-square
1	Property	71	59.16	6.553**
2	Contract	29	24.16	
3	Rent	17	14.16	
4	Participation	3	2.5	
Total		120	100	

4- Farm size

Farm sizes play a significant role in the farmer adoption and implementation of new technologies. A number of researchers reported that there is an inverse relationship between farm size and productivity. While some researchers also found a positive relationship between farm size and productivity but still some studies do not support the hypothesis that farm size affect the productivity.

Tomato farmers were distributed according to the farm Size into three categories (Table-6) .The results reveal that the highest percentage of tomato farmers in the targeted area (52.5%) has small farms,2 Donums or less, followed by 25.88% of

them farms between (2.5 to 5 Donums) and only 21.66% has farm with more than 5 Donums.

The results indicate that at 0.5% level of significance. The research hypothesis “that there is no significant relationship between knowledge level of respondent and size of farm” is accepted with correlation coefficient r equals -0.153. This suggests that there is no significant relationship between the knowledge level of tomato farmers in the targeted and their farm size. This means that there is lack knowledge on post-harvest techniques of majority of the tomato farmers regardless their farm size; because of unavailability of technology of preservation among the farmers in the targeted area .This result agree with Hanush (2001).

Table(6): -Shows distribution of respondents according to the farm size

No	Categories	Frequency	%	Correlation
1	(2 or Less) Donum	63	52,5	-0.153
2	(2.5 – 5) Donum	31	25.88	
3	6 and more	26	21,66	
Total		120	100	

5- Years of working in agriculture

The respondents were distributed according to years of work in agriculture into three categories as shown in Table-7.

The results reveal that the highest percentage of tomato farmers (36.66%) has working experience less than 10 years, followed by farmers with 11 to 20 years' of experience (35%) and only 28.33% has more than 21 years working experience in agriculture.

The results indicate that at 1% level of significance, the research hypothesis “that there is

no significant relationship between the knowledge level of the respondent and years of working in agriculture” is rejected.

This suggests that there is a significant relationship between tomato farmers knowledge level on post-harvest techniques and years of working in agriculture ($r = 0.339$). These confirm that the farmer gained more information and their level of knowledge was increase when they have more working experience in agriculture.

Table7: -Shows distribution of respondents according to years of working in agriculture

No	Categories	Frequency	%	Correlation
1	1-10	44	36.66	0.339**
2	11-20	42	35	
3	21 and more	34	28.33	
Total		120	100	

6- Years of work in tomato cultivation

Tomato farmers were distributed according to years of work in cultivation of tomatoes into three categories as shown in Table -8 The results in Table-8 reveal that the highest percentage of tomato farmers (36.66%) has less than 9 years working experience in cultivating tomato crop, followed by 30.83% with experience between 10 to 18 years and only 32.5% of them have experience more than 19 years in cultivating tomato.

The result above shows that majority (67.49 %) of the farmers have less than 18 years of experience in tomato production. This could also have an effect on post-harvest losses in tomato production. The low years of experience in tomato production might also be responsible for their lack of knowledge about preservation technologies.

The results indicate that at 1% level of significance, the research hypothesis (that there is no significant relationship between the knowledge

level of the respondent and years of working in tomato cultivation) is rejected. This suggests that there is a significant relationship between tomato farmers knowledge level on post-harvest techniques and years of working in tomato cultivation ($r = 0.295$). This result corresponds with (Al-Tai, 2012).

Table (8): -Shows distribution of respondents according to years of work in the cultivation of tomatoes

No	Categories of years of work in tomatoes	Frequency	%	Correlation
1	1-9	44	36.66	0.295**
2	10-18	37	30.83	
3	19 and more	39	32.5	
Total		120	100	

7- Social participation

Tomato farmers participated in this study was distributed according to their social participation into three categories as shown in Table-9.

The results reveal that the highest percentage of tomato farmer (50.83%) fell within the second category (21-27), followed by (32.5%) as first category (14-20) and only 16.66%) were third category (28 and more), this mean that most of the respondent have mid to low social participation.

Correlation Coefficient was used to find the relationship between the knowledge level of respondents and social participation. The results

indicate that at 5% level of significance, the research hypothesis (that there is no significant relationship between the knowledge level of the respondent and social participation) is accepted. This suggests that there is no significant relationship between tomato farmers knowledge level on post-harvest techniques and social participation ($r= 0.094$). The reason may be because the majority of the respondents (83.33%) have low to medium participation .This result agree with the study AL-Kashab (2013) and not agree with (Mande et al. 2007).

Table(9): - Shows distribution of respondents according to social participation

No	Categories of social participation	Frequency	%	Correlation
1	Low 14-20	39	32.5	-0.094
2	Medium 21-27	61	50.83	
3	High 28 and more	20	16.66	
Total		120	100	

8- Tomato farmer attitudes towards agricultural extension

Tomato farmers in the targeted area were distributed according to their attitudes towards agricultural extension into three categories as shown in Table -10 The results reveal that the 52.5% of respondents have neutral attitudes toward agriculture extension in the targeted area, 28.33% of the respondents have negative view about agriculture extension and only 19.16% of them have positive attitude toward agriculture extension.

Table-10 shows that at 0.1% level of significance, the research hypothesis that (there is no significant relationship between knowledge level of the respondents and their attitudes towards agriculture extension) is accepted ($r = 0.147$). This suggests that there is no significant relationship between knowledge level of respondent and attitude towards agriculture extension variable. May be the reason is that majority of the respondents (80 .83%) have neutral or negative attitudes toward extension organization in the targeted area. This result does not agree with Hanush (2001).

Table(10):- Shows distribution of respondents according to attitude towards agricultural extension

No	Categories	Attitudes	Frequency	%	Correlation
1	20-25	Negative	34	28.33	0.147
2	26-31	Neutral	63	52.5	
3	32 and more	Positive	23	19.16	
Total			120	100	

9- Sources of information about the tomato crop

The respondents' tomato farmers were divided into three categories according to what sources of information they use (High, Mid. and low). (table 11).

The results reveal that the largest proportion of the respondents (52.5%) fell within the mid category, followed by 35% within the low category and only 12.5% were within high category of using the agriculture information sources.

The results indicate that at 5% level of significance, the research hypothesis that (there is no significant relationship between knowledge level of respondent and degree of information resources use) is accepted ($r=-0.0457$). The reason may be because the majority of the respondents (87.5%) belong to low or medium use of information sources on post-harvest technologies. This result does not agree with the study (Mande, and other 2007) but agree with the study (AL-Kashab, 2013).

Table(11): -Shows distribution of respondents according to the sources of information about the tomato crop:

No	Categories	Frequency	%	Correlation
1	Low 11-17	42	35	-0.0457
2	Medium 18-24	63	52.5	
3	High 25 and more	15	12.5	
Total		120	100	

10- Urban contact

The respondents were divided into three categories according to their urban contact (High, Mid. and Low) table 12.

The results reveal that the largest proportion of the respondent (50%) fell within the mid category, followed by (26.66%) of them within the low category and only 23.33% fell within the high category of urban contact.

The results indicate that at 5% level of significance, the research hypothesis (that there is no significant relationship between knowledge level of respondent and urban contacts) is accepted ($r= -0.003$). This suggests that there is no significant relationship between knowledge level of respondent and urban contacts. The reason may be because of high ratio of the targeted farmers belong to mid or low urban contacts.

Table(12): -Shows distribution of respondents according to urban contact

No	Categories	Frequency	%	Correlation
1	Low 2-10	32	26.66	-0.003
2	Medium 11-19	60	50	
3	High 20 and more	28	23.33	
Total		120	100	

11- Training (number of sessions)

The respondents were divided into two categories according to their participation in extension training (trained and not trained) table - 13 Table-13 clearly indicates that most of the respondent 79.61% have not participated in any extension trainings while only (20.83%) of the respondents have attended extension training. The results indicate also that at 5% level of significance, the research hypothesis that(there

is no significant relationship between knowledge level of respondent and training) is accepted ($r=0.088$). The reason may be because the largest proportion of respondents did not participate in any training which reflects a lack of trainings provided for the tomato farmers on post-harvest technologies in the targeted areas. This result does not agree with the study (Al-Samawi and Ahmed A, 2005).

Table (13): -Shows distribution of respondents according to training (number of sessions)

No	Number of sessions	number of people	%	r
1	0	95	79.16	
2	1	25	20.84	0.088
Total	1	120	100	

Problems and constraints of tomato marketing

It seen from the table -14 that all the mentioned problems had the average significant scores between (2.15 and 2.7) Low and high, it implies that tomato farmers in the targeted area suffer from all the mentioned problems in marketing their tomato production.

The Data on the table (14) reveals that the 5 greatest problems that affects tomato farmers abilities in marketing their production in the targeted area are (The large number of wounded and infected fruit) with average (2.7), this followed by the problem of (The lack of a suitable place for grading) with average (2.683), (Lack of refrigerated storehouses for storing the crop in nearby locations of tomato fields) with average (2.675), (Abuse cutting method have its bad effect

on marketable) with average (2.658), (Lack of knowledge and skills on how to conduct proper storage process) with average (2.65).

May be the reason is unavailability of storage facilities in the area and lack of basic knowledge on the post-harvest practices. The reason for their lack of preservation knowledge of adequate methods could be as a result of lack of awareness by the extension workers themselves or the farmers on various ways by which they can go about preserving their produce (Ayandiji, 2014).

Therefore, an effective extension program needed to improve the tomato farmers' knowledge and skills in practicing post-harvest techniques and to educate them on the various ways that can be used in preserving their produce from losses.

Table(14):- Shows the results of the tomato marketing problems in the targeted area as identified by the respondents.

No.	Problems	Limits of score	Average	Rank
1	The large number of wounded and infected fruit	1-3	2.7	1
2	The lack of a suitable place for grading	1-3	2.683	2
3	Lack of refrigerated storehouses for storing the crop in nearby locations of tomato fields	1-3	2.675	3
4	Abuse cutting method have its bad effect on marketable	1-3	2.658	4

5	Lack of knowledge and skills on how to conduct proper storage process	1-3	2.650	5
6	Lack of availability of good transportation in a timely manner	1-3	2.533	6
7	Unavailability of trained workers	1-3	2.525	7.5
8	High labor costs	1-3	2.525	7.5
9	Difficulty to access information in a timely manner	1-3	2.508	9
10	High storage costs	1-3	2.492	10
11	Lack of experience in packing operations	1-3	2.475	11
12	High prices of packaging materials	1-3	2.458	12
13	Inadequacy of containers	1-3	2.425	13
14	Lack of appropriate forms and sizes of packing containers	1-3	2.317	14
15	Lack of marketing information in magazines and newsletters guidance	1-3	2.216	15
16	The lack of clear criteria for grading	1-3	2.15	16

CONCLUSIONS

1- The study revealed that majority of the tomato farmers in Halabja governorate had medium knowledge level in post-harvest practices. This mean that the targeted farmers lack fundamental knowledge about post-harvest handling practices especially sorting and grading tomato, collecting and cleaning and storing. So effectives training courses are needed to improve their knowledge and skills in post-harvest technologies with focusing on the mentioned disciplines.

2- The variables age, education, land tenure, year of working in agriculture, years of cultivating tomato crop were found as important factors related significantly with the knowledge level of the tomato farmers about post-harvest practices. Therefore, these factors may be taken into consideration for creating more awareness between tomato farmers in Halabja governorate about the importance of post-harvest practices and greater degree of participation of them in Agriculture extension activities.

3- Based on the results and observations made during the survey, the large quantities of tomato are harvested each season in the targeted area, but post-harvest processing and preservation techniques are not available. Therefore, tomato spoils very early because of lack of appropriate

system of preservation and processing. To reduce the post-harvest losses and over supply to the markets, it is essential that the surplus and over ripe produce be separated and processed.

So tomato farmers in the targeted area need to be trained about the harvest techniques of packaging and processing of tomato crop.

4- Absence of proper storage and marketing facilities, farmers are forced to sell their products at throw away prices. Sometimes farmers do not even get the transportation costs back, so they would rather dump their produce near the market area than taking them back to home.

Recommendations

Based on the results of this study, the following recommendations are made for policy makers to take actions to reduce the post-harvest losses thereby increasing the standard of living of the tomato producers in Halabja governorate.

1- Training initiatives on post-harvest handling of perishable products such as tomato should be encouraged and follow ups, feedback and adoption measurement should be conducted periodically for sustainability.

2- Provision of good storage facilities to store the produce that are harvested before they are being taken to the market. This will help to reduce the losses that occur at the farm level.

3- Agricultural extension staff in the targeted area needs to be trained and retrained to respond well to their functions of communicating and assisting farmers to make decisions on adoption of post-harvest handling practices.

4- Establishment of farmers market and cooperative marketing should be encouraged to reduce losses related to marketing functions.

5- Research needs to be conducted on the storage of tomato crop and farmers be informed about the results of the storage in order to avoid the losses.

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RECORDING THREE SPECIES OF *Paradiplozoon* (MONOGENEA) FROM CYPRINID FISHES IN SOME WATERSHEDS IN SHARBAZHER AREA, SULAIMANI CITY, NORTH OF IRAQ

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ABSTRACTS

During April 2015 to the end of October 2015, a total of 72 freshwater fishes belonging to three species from family Cyprinidae (*Chondrostoma regium*, *Garra rufa* and *Squalius lepidus*) were captured from some watersheds of Sharbazher area in the northeast of Sulaimani city, Kurdistan Region, Iraq. The study revealed the existence of three species of monogeneans belonging to the genus *Paradiplozoon*. These included *P. amurense* from gills of *S. lepidus*, *P. bingolensis* from the gills of *G. rufa*, and *P. vojteki* from gills of *C. regium*. The record of *P. bingolensis* in the present study is considered as the first record in Iraq, and *P. amurense* in Kurdistan Region. Also, *Chondrostoma regium* was regarded as a new host in Iraq for *P. vojtek*. Full description and morphometrics of these parasites were demonstrated.

KEYWORDS: *Paradiplozoon amurense*, *P. bingolensis*, *P. vojteki*, Fish, Sharbazher area.

INTRODUCTION

Among the major groups of fish parasites, monogeneans are the most important which they cause severe damage to skin and gills, especially for carp fingerlings under extensive fish culture practice and their direct life cycles and fish crowding are good conditions for their easy spread among fishes (Bauer *et al.*, 1969; Amlacher, 1970).

The Class Monogenea includes 62 families, of which the family Diplozoidae has seven genera (MonoDB, 2014). This family includes parasites that inhabit the gill filaments of fish as ectoparasites, and usually parasitize on cyprinid fishes. They have direct life cycle in which an egg hatches to uniformly ciliated free-swimming larvae called oncomiracidia which invade a fish host and developed into the larval stage diporpa. The individual diporpa can't reach sexual maturity until attached to another diporpa and twist their bodies permanently and grow into an adult stage (Bykhovskaya-Pavlovskaya *et al.*, 1962; Duijn, 1973).

The adult body is divided into two parts: a foliate anterior part which lies before the cross containing most intestinal organs and vitellaria, and a posterior part which lies behind the cross, has minute folds and divided into three sections: anterior section carrying genital glands, midsection with terminations of intestinal trunk and posterior section (attaching disc) with ventral surface bearing four pairs of attachment clamps and one pair of small median hooks (Pugachev *et al.*, 2010).

According to the shape of the posterior part of the body, members of the family Diplozoidae are divided into five genera (*Paradiplozoon*, *Eudiplozoon*, *Diplozoon*, *Inustiatus* and *Sindiplozoon*). The determination of species is based mainly on the shape of clamp sclerites, length of median hooks and host specificity (Gussev, 1985).

The main purpose of the present investigation is to identify *Paradiplozoon* on fishes of the family Cyprinidae from Sharbazher area in Kurdistan region, Iraq. There is no any report on fish parasites fauna of Sharbazher area.

MATERIALS AND METHODS

Site Description: Sharbazher is a mountainous area located in the northeast of Sulaimani city. It has a steep slope and topography which is covered mainly by oak forest, valleys and foothills. The area lied between latitudes of 35° 55' and 36° 00' and between longitudes 45° 30' and 45° 40'. The Lesser Zab River passes through the area from east to west which supplies water to Dukan Lake. This region is rich with many water bodies such as springs, karezes, stream, watersheds and basins the most popular water bodies in this region are Siwail basin, Kunamasi basin, Gogasur basin, Mawakan basin, Dolbeshik watershed and Bardaspi watershed (Barzinji, 2013).

Sampling: A total of 72 freshwater fishes, were collected from some watersheds of Sharbazher area from April 2015 to the end of October 2015. The fish specimens were weekly collected by gill netting, basket and electro fishing method. The fishes were placed in a cold box with local water and transferred to laboratory as soon as possible and examined. The fishes were identified according to Coad (2010).

In the laboratory, the fishes were measured for total length and standard length. Gills of the both sides were removed and placed in separate Petri dishes containing normal saline and examined for monogeneans under dissecting microscope (Amlacher, 1970). Monogeneans were detached from the gills with a strong water current or picked up with fine needles or small pipette and transferred to a Petri dish containing normal saline then transferred on to slide and gently pressed by the cover slide, fixed in glycerine-alcohol, transferred into clean glycerine. The cover slide was then framed by varnish (Lucký, 1981; Neifar and Euzet, 2007). Photos were taken with Sony Optical camera, 16.1 mega pixels. Measurements of parasite were achieved by an Olympus ocular micrometer and the terms were used as recommended by Gussev (1985).

RESULT AND DISCUSSION

During the present investigation, a total of 72 freshwater fish specimen belonging to three species from family Cyprinidae were captured from some watersheds of Sharbazher area. These included 10 *Chondrostoma regium*, 50 *Garra rufa* and 12 *Squalius lepidus*. The study revealed the existence of three species of monogeneans

belonging to the genus *Paradiplozoon*. The following is a brief account on these parasites.

***Paradiplozoon amurense* (Akhmerov, 1974)**

Host: *Squalius lepidus* Heckel, 1843

Site infection: gill filaments

Prevalence of infection: 16.66%

Mean intensity of infection: 2

Locality: Siwail basin

Description: The total body length of adult worm is 3.8-5.8 mm, anterior part 2.5-3.7 mm, posterior part 1.5-2.2 mm, the size of first clamp 0.06-0.08x0.08x0.140 mm, second clamp 0.06-0.08x0.13-0.17 mm, third clamp 0.07-0.09x0.12-0.18 mm and fourth clamp 0.06-0.010x0.12-0.18 mm, the length of median hook is 0.018-0.022 mm, handle 0.040-0.045 mm, the diameter of suckers 0.06-0.10 mm, egg size 0.25-0.30x0.08-0.16 mm (Fig. 1).

The measurements of *P. amurense* in our study is in general similarity with those of Gussev (1985) and Pugachev *et al.* (2010). This parasite was recorded for the first time in Iraq by Al-Nasiri (2010) from the gills of *Cyprinion macrostomum* from Tigris River at Tikrit city, Salah Al-Deen Province. After that, it was recorded from the same host as well as from *Barbus luteus*, which is a synonym of *Carasobarbus luteus* by Al-Jubori (2013). No further host was reported after that. So, *Squalius lepidus* in this present study is considered as a new host for this parasite in Iraq. Also, this parasite is considered as the first one in Kurdistan Region.

***Paradiplozoon bingolensis* Cívá ová, Koyun *et* Koubková, 2013**

Host: *Garra rufa* (Heckel, 1843)

Site infection: gill filaments

Prevalence of infection: 16%

Mean intensity of infection: 2.25

Locality: Qalachwalan River

Description:

The body of adult worms is X-shaped and divided into anterior and posterior parts, between them fusion region present. The anterior part of body contains vitellaria and digestive tract. The posterior part contains male and female reproductive organs, terminal part of digestive tract, and attachment apparatus. Attachment apparatus consist of four pairs of clamps and one pair of the central hooks on the ventral side of each opisthaptor. The clamps of *P. bingolensis* are generally thick and built from strong sclerites. The anterior end of the median plate is slightly rounded. Rectangular anterior joining sclerite is

connected to the proximal tip of anterior jaw. The posterior end of the median plate narrows and terminates with a wide rounded sclerite with an opening; the posterior joining sclerite is short. The sclerites of the anterior and posterior jaws are very massive; the sclerites of the posterior jaws are not divided into two parts as in other species of *Paradiplozoon*. The sclerites of the anterior jaws are turned upwards in the medial line and connected with the anterior joining sclerite of the medial plane. The median hooks are true to type, situated near the first pair of clamps.

The total body length of adult worm is 4.1-4.5 mm, the size of first clamp 0.15×0.11 mm, the second clamp 0.20×0.15 mm, the third clamp 0.20×0.16 mm and the fourth clamp 0.20×0.15 mm, the length of the median hook 0.018-0.020 mm, size of eggs 0.03-0.040×0.125-0.140 mm (Fig. 2).

The description and measurements of *P. bingolensis* in the present study are closed to those recorded by Cívá ová *et al.* (2013) in which they were found on the gill of the same host from the Göynük Stream, a tributary of the Murat River, Ilicalar-Bingöl, Turkey. This parasite was never been recorded from any fish species in Iraq before. Therefore, the present record is considered as the first record in Iraq.

By recording of this parasite (*P. bingolensis*) in the present study, a total of 14 species of *Paradiplozoon* become known from different species of fishes in Iraq and most of them were found on gills of cyprinid fishes (Mhaisen and Abdul-Ameer, 2014).

***Paradiplozoon vojteki* (Pej och, 1968)**

Host: *Chondrostoma regium* (Heckel, 1843)

Site infection: gill filaments

Prevalence of infection: 10%

Mean intensity of infection: 2

Locality: Dolbeshik watershed

Description:

Total body length of the worm is 3.5-5.0 mm, width 0.7-0.9 mm, diameter of suckers 0.08-0.12 mm, width of the first clamp 0.09-0.12 mm, width of each of the last three clamps 0.18-0.24 mm, length of median hook with its spike 0.02 mm, handle 0.035-0.040 mm, size of egg 0.25×0.13 mm (Fig. 3).

The description and measurements of *P. vojteki* in our study are similar to those reported by Gussev (1985). This parasite was recorded for the first time in Iraq by Al-Saadi (2007) from the gills of *Barbus xanthopterus* (synonym of *L.*

xanthopterus) from Al-Husainia Creek, Karbala Province. Later on, it was reported from the same host (Al-Saadi *et al.*, 2009, 2010) as well as from *A. vorax*, which is a synonym of *L. vorax* (Al-Sa'adi, 2007; Al-Jubori, 2013) and *B. luteus*, which is a synonym of *C. luteus* (Al-Jubori, 2013).

No further host was reported after that. So, *Chondrostoma regium* in this present study is considered as a new host for this parasite in Iraq. Also, this parasite is considered as the first one in Kurdistan Region.

According to the index catalogue of parasites and diseases agents of fishes of Iraq (Mhaisen, 2015), 16 species of diplozoids were found in Iraqi freshwater fishes. These included 14 species of *Paradiplozoon* (*P. amurense*, *P. barbi*, *P. bingolensis*, *P. bliccae*, *P. cyprini*, *P. ergensi*, *P. homoion*, *P. kasimii*, *P. leucisci*, *P. megan*, *P. pavlovskii*, *P. rutili*, *P. tadjikistanicum* and *P. vojteki*), one species of *Eudiplozoon* (*E. nipponicum*), and one species of *Diplozoon* (*D. paradoxum*). In addition to these species, some unidentified adult and larval (diporpa larvae) specimens of the genus *Diplozoon* were reported from some different fish hosts.

Among this number, ten species were recorded in Kurdistan Region namely, *P. amurense*, *P. barbi*, *P. bingolensis*, *P. cyprini*, *P. homoion*, *P. kasimii*, *P. leucisci*, *P. pavlovskii*, *P. tadjikistanicum* and *P. vojteki* from Dokan Lake, Darbandikhan Lake, Lesser Zab River, Greater Zab River and some small water bodies (Abdullah, 1990; Abdullah and Mhaisen, 2004; Mama and Abdullah, 2012; Abdullah and Abdullah, 2015; Abdullah and Nasraddin, 2015).

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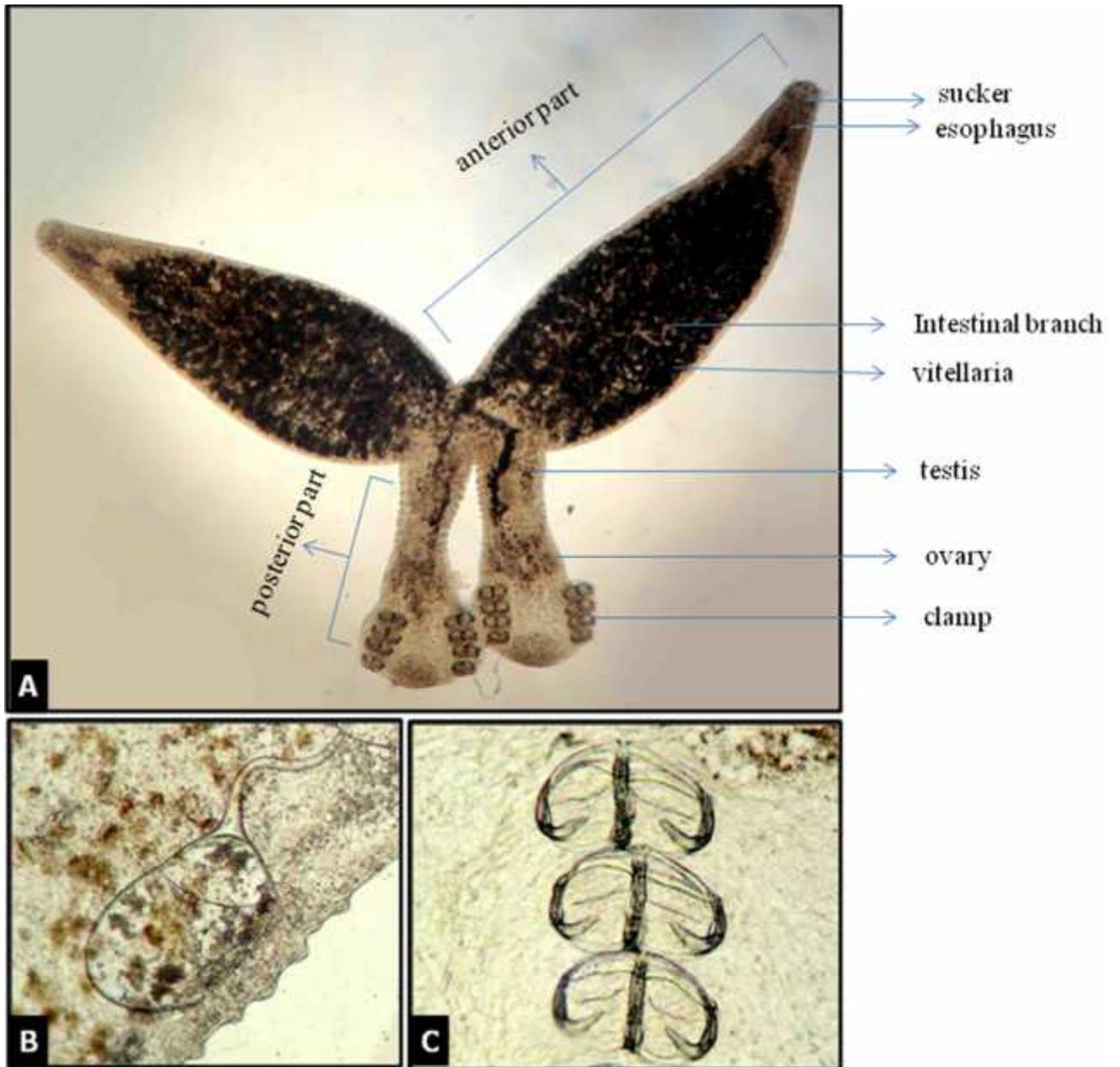


Fig. (1): *Paradiplozoon amurense*
A- Photomicrograph of the worm (20x)
B- Photomicrograph of the egg (100x)
C- Photomicrograph of the clamps (100x)

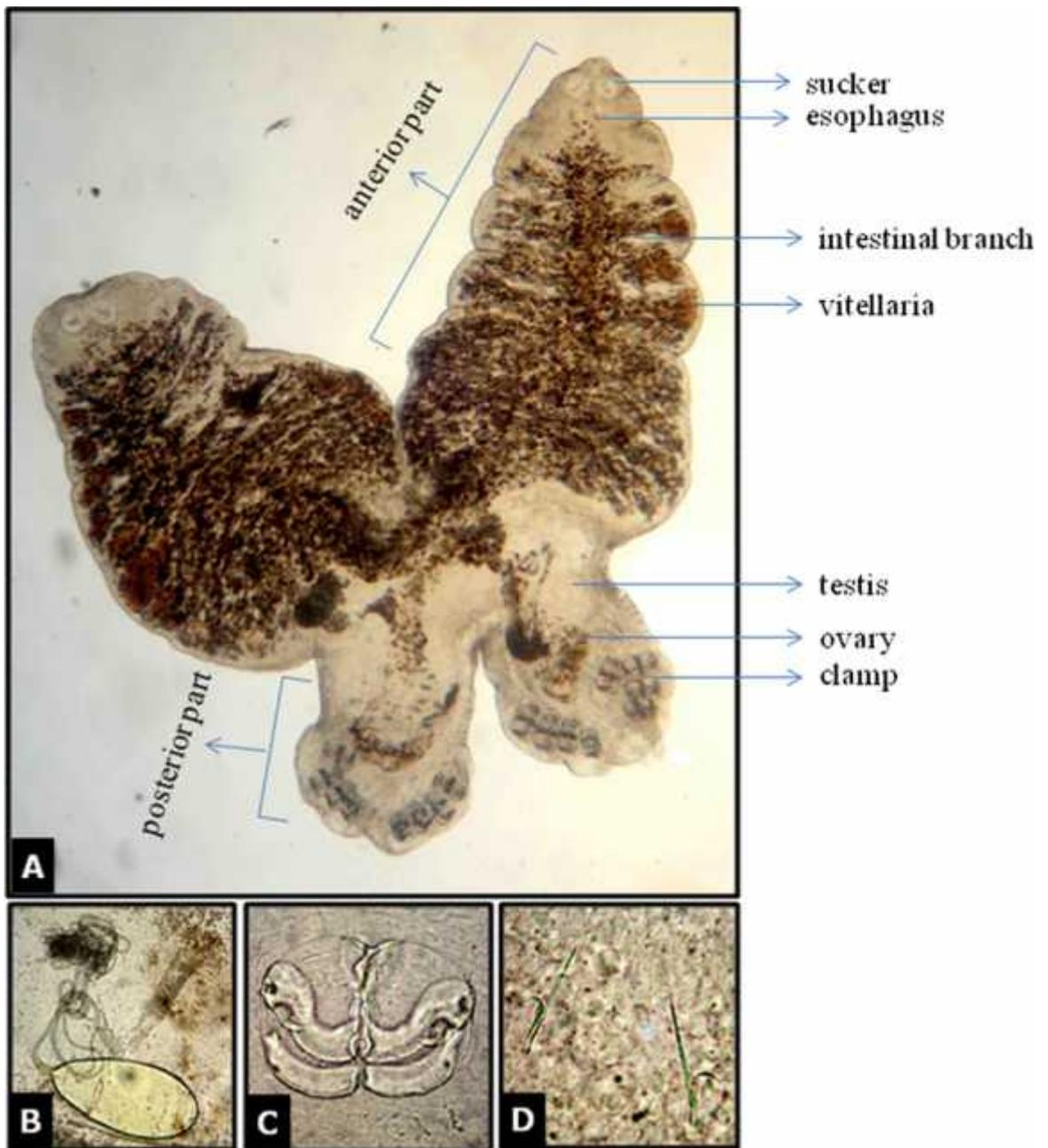


Fig. (2): *Paradiplozoon bingolensis*
A- Photomicrograph of the worm (20x)
B- Photomicrograph of the egg (150x)
C- Photomicrograph of the clamp (150x)
D- Photomicrograph of the median hocks (400x)

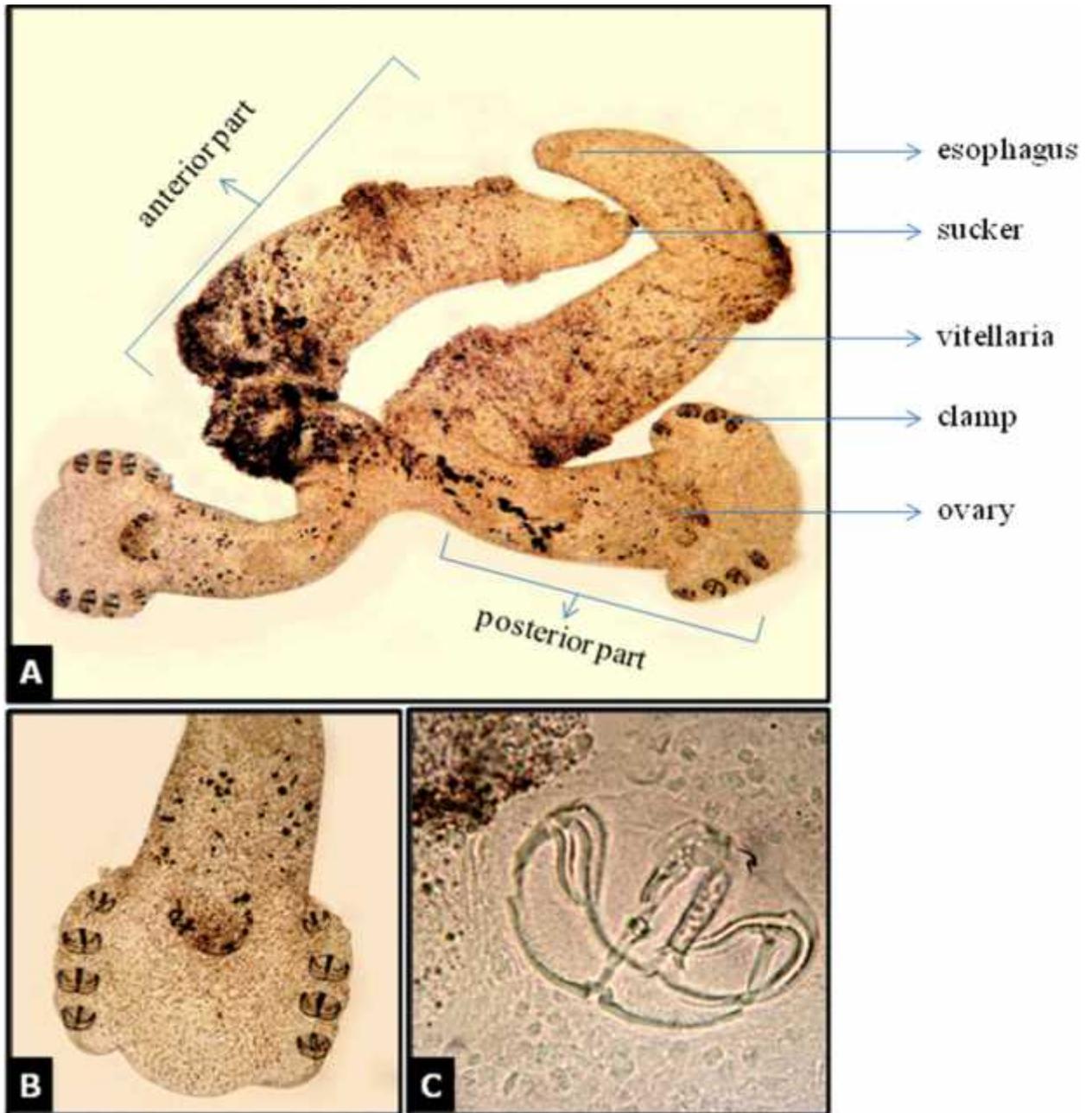


Fig. (3): *Paradiplozoon vojteki*
A- Photomicrograph of the worm (20x)
B- Photomicrograph of posterior part of the worm (20x)
C- Photomicrograph of the clamp (150x)

EFFECTS OF FEED FORM, BROILER HYBRID AND THEIR INTERACTION ON THE PRODUCTIVE PERFORMANCE AND CARCASS CHARACTERISTICS

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ABSTRACT

This study was conducted to investigate the effect of feed form and broiler hybrids on growth performance and chick portions in Poultry Research Hall/College of Agriculture/Salahaddin University-Erbil. A total of 640 day-old broilers were reared for 42 days. Two hybrids (Ross and Cobb) birds were allotted randomly to two dietary treatments (mash and pellet form) with four replicates per treatment and 40 birds per replicate. The results showed that pelleted feed resulted in significant ($p < 0.05$) higher performance and higher mortality rate. The hybrid of the bird showed significant response in the body weight, weight gain and feed intake but the feed conversion and the mortality were insignificant. The interaction between feed form and birds hybrid affected significantly on broiler performance except the feed conversion ratio, while significant effects of interaction were found in drumstick, Back, gizzard, liver and heart of broilers.

Results indicated that feed pellets might enhance broilers performance support the hypothesis that the poultry feed should be formulated according to the recommended requirements of each hybrid, and birds response to the feed form are differ may be due to the inappropriate nutrient supplementation of one diet to other hybrid.

KEY WORDS: Feed form, Broiler Hybrid, Interaction, Performance, chicken carcass characteristics

INTRODUCTION

The economic importance of poultry feeding becomes apparent when it is realized that 60-70% of the total production cost of poultry is feed cost, therefore the efficient use of feed is important in broiler production (Zakaria *et al.*, 2013). Modern broilers have genetically selected for improved feed conversion and rapid growth rate (Ahmed and abbas, 2013). Different types of feed forms have been evolved in broiler production at the present time (Zakaria *et al.*, 2013).

Mash is a form of a complete feed that is finely ground and mixed (Agah *et al.*, 2008). Pellet consists of mechanically pressing the mash into hard dry pellets and fed nearly exclusively to broilers (Behnke, 1998). It's well-known that dietary factors modulate the immune system and gut micro-flora, thus formulating diets and managing feeding practices should be considered (Choct, 2009). Amerah *et al.* (2007) reported that broiler performance was superior ($P < 0.05$) in birds fed pelleted diets compared with those on mash diets. Enhancement of performance might be due to the improvement in nutrient metabolism and digestive tract development (Zang *et al.*,

2009). While, Bölükbasi *et al.* (2005) and Ahmed and Abbas (2013) found that performance parameters of broilers were not affected significantly by the feed form even the pellet group exceeded the mash group in growth parameters.

The benefits of pelleting include enhanced handling characteristics of feeds and improved bird performance (zakaria *et al.*, 2013). Pelleting increases bulk density and flow ability and decreases spillage and wind loss. Improved weight gain: feed ratios from feeding pellets as compared with mash have been documented (Calet, 1965; Choi *et al.*, 1986; Nir *et al.*, 1994). Reasons for the enhanced performance may be due to increased digestibility, decreased ingredient segregation, reduction of energy during prehension and increased palatability (Behnke, 1998).

Feeding each form of feed has its advantages and disadvantages. The effectiveness, digestibility and conversion efficiency of different feed forms are also different. For feeding broilers, poultry producers in Kurdistan region-Iraq mostly depend on local commercial manufactured feeds to feed their chickens in which the feed formula not formulated due recommendations of nutrient

requirements of each hybrid and limited research work has been performed to investigate the effect of feeding different forms of feed (mash and pellets) under local condition on the productive performance of broilers in Kurdistan. In this situation the present study has been undertaken to investigate the effect of feeding mash and pellet feeds and response of two hybrids (Ross and Cobb) to specific broiler rations (prepared for Ross broiler requirements) on growth rate, feed efficiency and carcass characteristics of broiler chickens.

MATERIALS AND METHODS

This experiment was conducted in Poultry Research Hall/College of Agriculture/Salahaddin University-Erbil, to investigate the response of modern broilers hybrids (Ross 308 and Cobb 500) to different physical shapes of the diet and specific feed formula and feeding strategy. The response of both hybrids to mash or pellet form of commercially produced feed mixture (made according to Ross nutritional requirements) was investigated. A number of 640 one-day old (Ross 308 and Cobb) chicks were distributed randomly on four experimental groups with four replicates. All the birds were reared under the same condition and the same diet was applied in mash or pellet form. The diet was prepared in commercial animal feed factory in Erbil according to the nutritional requirements guide of Ross broiler. The feed formulations of each feeding phases are shown in table 1. The environmental requirements were followed on Ross broilers management guide. The

water and feed was offered *ad libitum*. The feeding strategy was applied for 42 days with three feeding phases, for starter (0 to 14) days old, for the grower (15 to 31) days old and finally (32 to 42) days old for the finisher phase. Chickens were reared on the floor and wood shaving bedding material was used in pens with 2 x 1.5m distance. Circular feeder and watering systems were used for feeding and watering respectively.

Data recording

The body weight (BW) and feed intake (FI) were recorded and weight gain (WG) and feed conversion ratio FCR calculated at the end of each feeding phase. The (FI) was calculated for each group by subtracting the leftover feed from the feed offered. The (FCR) for each replicate was calculated by dividing the mean total quantity of feed consumed by the mean total gain in body weight during each feeding face. Mortality rate was recorded daily. The dead birds were dissected to determine the causes of death. Also, effects of hybrid and feed form interaction on main body portions, edible giblets (Heart, gizzard and liver) and spleen, intestine and fat pad were studied.

Data analysis

The data were statistically analyzed with the standard procedures of Analysis of Variance (ANOVA), using Completely Randomized Design, as described by Steel and Torrie (1981). The means were compared for significance of difference with the Duncan's Multiple Range Test for variables (1955). The statistical package (SAS, 2005) was used to perform the above analysis.

Table (1):- The feed formula of starter, grower and finisher diets during experimental period

Ingredients (kg/ton)	Feeding phases		
	1-14 day	15-31 day	32-42 day
Wheat	175	215	265
Corn	200	200	200
Wheat Flour	250	250	250
Soy bean meal	290	240	180
Protein concentrate (fish meal concentrate)	50	50	50
Di-Calcium Phosphate	6	6	5.5
Methionine	0.9	0.9	0.9
Lysine	0.5	0.5	0.5
Choline chloride	0.5	0.6	0.5
Salt	0.85	0.75	0.35
Oil (Soy bean oil)	13	24	33
Feed toxic	1	1	1
Limestone	10	9	11
Vitamins premix	0.5	0.5	0.5
Antioxidant	0.25	0.25	0.25
Feed sterilizer	1	1	1
Anticoccidia	0.5	0.5	0.5
Total	1000	1000	1000
Calculated feed composition			
CP %	22-23	20-21	18-19
ME (kcal/kg)	2900-2950	3030-3050	3100

RESULTS AND DISCUSSIONS

The result of the performance during starter period (0-14 d) showed significant differences ($p<0.05$) between the two hybrids and feed forms (table 2). Significant ($p<0.05$) differences were observed in body weight (BW), weight gain (WG) and daily weight gain (DWG). While, the daily feed intake, cumulate feed intake (CFI) and FCR were differed insignificantly ($p>0.05$). The insignificant difference in FCR attributed to the significant higher WG of Ross broilers compared to Cobb broilers during this period. This is indicating that the feed should be fitted to the requirements of each hybrid that this feed was prepared according to the requirements of Ross broilers. The feed form affected significantly all performance parameters, in which higher value were found in BW, WG, FI, DWG and DFI in chicks fed the pellet diet compared to the mash, while the FCR was improved significantly in the mash group, this is may be to the more surface area exposition of feed particles to intestinal secretions, thus higher utilisation from nutrients included in the feed.

During the grower phase for the effect of hybrid showed same pattern as the starter phase in general, except for the DFI (table 3). Also, effect of feed form was significant, and showed the same pattern as observed during the starter phase.

At 42 day old (table 4) significant difference between the two hybrids in BW was found, this is reasonable, in which the diet formulated according to Ross 308 nutritional requirements, and the DFI was higher in Ross group comparing to Cobb group, while the WG, DWG were higher in Ross group insignificantly than Cobb group and FCR showed insignificant better value in Cobb group. Feed form affected significantly on the BW and BWG only, while other parameters were not affected. All performance parameters improved in groups fed the pellet diet, only the DFI was lower

slightly in pellet group compared to the group which fed the diet in mash form. This is accordance with Leeson *et al.* (1999) results which they found the growth rate was reduced by about 300 g in groups fed mash diet compared to that in pellet form.

As in overall (table 5) the Ross group showed better performance compared to the Cobb group and this could be attributed to that the feed was formulated according to nutritional requirements of Ross broilers. The performance was influenced significantly by the feed form, chickens fed the pellet diet recorded higher value in TWG and TFI and significant improvement in TFCR. Zang *et al.* (2009) attributed the enhancement of performance might be due the improvement of nutrient metabolism and digestive tract development. These results are accordance with those obtained by zakaria *et al.* (2013) and Amerah *et al.* (2007), while disagreed with Bölükbaşı *et al.* (2005) and Ahmed and Abbas (2013). The total mortality was lower significantly ($p<0.05$) in the mash group. Also Leeson *et al.* (1999) observed that feeding high nutrient dense mash vs. pelleted diets reduced the mortality rate from 20% to 4%. The increased mortality in pellet group could be attributed to the high feed intake in this group compared to the mash group, the high feed intake and feed form are known to influence the occurrence of ascites in broilers, high basal metabolic rate and high energy rations (Dale, 1990; Odom, 1992; Bölükbaşı *et al.*, 2004). In addition to the advantages of less feed wastage birds spending less time when eating resulting in a reduction in maintenance energy requirements by the bird, also pelleted diets are more efficiently utilized due to chemical changes brought by heat, moisture and pressure. On other hand, the high temperature pelleting (80°C) can inactivate pathogens (Leeson and Summers, 2008).

Table (2):- the effect of broiler hybrid and feed form on performance parameters from 0 – 14 days old

Attributes	IW* (g)	BW (g)	WG (g)	FI (g)	DWG (g)	DFI (g)	FCR
Hybrid							
Ross	44.96±0.35 a	454.3±14.9 a	409.3±15.1 a	553.7±12.9 a	29.2±1.1a	39.6±0.9 a	1.359±0.03 a
Cobb	45.73±0.19 a	437.9±9.7 b	392.2±3.7 b	549.9±13.63 a	28.0±0.70 b	39.3±1.0 a	1.404±0.03 a
Feed form							
Mash	45.68±0.34 a	415.6±5.1 b	369.9±5.0 b	525.0±6.8b	26.4±0.4 b	37.5±0.5 b	1.420±0.01 a
Pellet	45.01±0.3 a	476.6±6.7 a	431.6±6.8 a	578.7±10.1 a	30.8±0.5a	41.3±0.7 a	1.343±0.03 b

*IW= Initial weigh

Means ±SE with different superscripts within columns are differ significantly ($p<0.05$)

Table (3):- the effect of broiler hybrid and feed form on broiler performance from 15-31 days old

Attributs	BW (g)	WG (g)	DWG (g)	FI (g)	DFI (g)	FCR
Hybrids						
Ross	1802.7±46.8 a	1348.4±35.0 a	79.3±2.1 a	2184.3±60.6 a	125.6±2.6 a	1.585±0.01 a
Cobb	1600.1±51.8 b	1162.2±43.7 b	68.37±2.6 b	2107.0±106.6 a	112.8±2.8 b	1.663±0.06 a
Feed form						
Mash	1590.9±47.1 b	1175.4±44.5 b	69.1±2.6 b	2005.2±38.2 b	116.1±2.5 a	1.689±0.05 a
Pellet	1811.8±45.9 a	1335.2±42.6 a	78.5±2.5 a	2286.1±91.4 a	122.3±4.1 a	1.560±0.04 b

Means ±SE with different superscripts within columns are differ significantly (p<0.05)

BW=Body weight, WG=Weight gain, DWG=Daily weight gain, DFI=daily feed intake, FCR=Feed conversion ratio.

Table (4): -the effect of broiler hybrid and feed form on broiler performance from 32-42 days old

Attributes	BW (g)	WG (g)	DWG (g)	DFI (g)	FCR (g)
Hybrid					
Ross	2697.6±69.6 a	895.0±56.0 a	81.4±5.1 a	163.4±3.6 a	2.090±0.20 a
Cobb	2446.9±72.6 b	846.83±28.7 a	76.98±2.6 a	143.6±1.7 b	1.880±0.07 a
Feed form					
Mash	2403.6±62.3 b	812.6±44.8 b	73.9±4.1 a	155.1±4.7 a	2.152±0.17 a
Pellet	2741.0±50.8 a	929.2±33.8 a	84.5±3.1 a	151.8±4.5 a	1.818±0.10 a

Means ±SE with different superscripts within columns are differ significantly (p<0.05)

BW=Body weight, WG=Weight gain, DWG=Daily weight gain, DFI=daily feed intake, FCR=Feed conversion ratio.

Table (5): -Effect of hybrid and feed form on overall broiler performance (0-42 days)

	TWG	TFI	TFCR	TM%
Hybrid				
Ross	2652.7±69.9 a	4535.0±93.40 a	1.718±0.06 a	8.30±3.0 a
Cobb	2401.2±72.6 b	4236.3±109.3 b	1.771± 0.05 a	14.6±5.1 a
Feed form				
Mash	2357.9±62.5 b	4236.5±83.50 b	1.803±0.05 a	4.60±2.1 b
Pellet	2696.0±50.8 a	4534.9±117.2 a	1.686±0.05 b	18.3±4.5 a

Means ±SE with different superscripts within columns are differ significantly (p<0.05)

BW=Body weight, WG=Weight gain, DWG=Daily weight gain, DFI=daily feed intake, FCR=Feed conversion ratio.

Significant interactions between hybrid and feed form were found in BW, FI and TM, while was insignificant in FCR (table 6). Highest value of BW, WG, FI were recorded in the (Ross x Pellet) group compared to others, and showed slight improvement in FCR compared to others. The highest rate of mortality was registered in (Cobb x pellet) group followed by (Ross x pellet), (Cobb x mash) and the lowest rate was observed in group (Ross x mash). The pellet form resulted in a reduction of livability states of the birds in both hybrids, this could be attributed to the over loaded nutrient intake which resulted in increase of feed intake as affected by alteration the feed physical form to pellet form.

The interaction between hybrid and feed form was not significant in the main chicken portions, but carcass percentage and edible parts influenced significantly. The highest value of carcass percentage was found in group (Ross x pellet)

followed by groups (Cobb x pellet), (Ross x mash), (Cobb x mash). The mash form of the diet resulted in bigger gizzard than pellet form in both hybrids and the Cobb group showed slight increase compared to the Ross group. Higher liver percentage found in group (Ross x pellet) and the difference was significant with group (Cobb x pellet). The pellet form in both hybrids resulted in bigger heart. The increase in liver and heart could be due to that the higher FI and rapped growth resulted by the increase of nutrient utilisation by pelleting require bigger organs to support those actions in birds consumed the pellet diet. Other portions (fat pad, spleen and intestine) were not differed significantly (p>0.05), higher portions of fat pad found in Cobb hybrid with both forms of the feed compared to the Ross hybrid. This is may be due to that the feed energy is higher the requirements of Cobb hybrids in which the feed formula was prepared according to Ross hybrid.

Results of this experiment indicating the hypothesis that the poultry feed should be formulated according to the recommended requirements of each commercial hybrid, and

birds response to the feed form are differ may be due to the inappropriate nutrient supplementation of ones diet to other commercial hybrid.

Table (6): -The effect of interactions between hybrid and feed form on the production performance and body portions of broiler chickens (0-42 days).

Interactions	Cobb x mash	Cobb x pellet	Ross x mash	Ross x pellet
Performance				
Body weight (g)	2270.4±41.8 c	2623.4±45.2 b	2536.7±67.4 b	2858.6±28.1 a
Weight gain (g)	2224.6±41.9 c	2577.8±45.1 b	2491.1±68.1 b	2814.2±27.9 a
Feed intake (g)	4042.9±35.1 b	4429.8±102.3 ab	4430.1±79.3 ab	4640.0±164.4 a
FCR	1.820±0.05 a	1.721±0.08 a	1.785±0.1 a	1.651±0.07 a
Mortality %	8.3±3.2 ab	20.8±9.3 a	0.83±0.8 b	15.8±2.1 ab
Main chicken portions %				
Carcass	65.80±0.75 b	66.92±0.95 ab	66.03±0.61 b	69.00±0.87 a
Breast	26.66±0.87 a	27.78±0.78 a	26.06±0.62 a	27.40±0.75 a
Legs	18.72±0.38 a	18.49±0.54 a	19.41±0.40 a	18.88±0.49 a
Thigh	10.64±0.30 a	10.38±0.34 a	10.64±0.21 a	9.74±0.41 a
Drumstick	8.07±0.31 c	8.34±0.24 bc	8.82±0.26 ab	9.17±0.27 a
Edible portions %				
Back	11.98±0.42 b	11.83±0.28 b	11.53±0.28 b	13.99±0.33 a
Wings	7.11±0.2 a	6.91±0.09 a	6.94±0.21 a	6.80±0.12 a
Neck	1.78±0.09 a	1.84±0.04 a	1.91±0.08 a	1.93±0.13 a
Gizzard	0.97±0.05 a	0.76±0.03 b	0.90±0.07 ab	0.76±0.06 b
Liver	2.29±0.08 ab	2.12±0.07 b	2.32±0.14 ab	2.66±0.22 a
Heart	0.422±0.02 ab	0.483±0.02 a	0.416±0.02 b	0.449±0.02 ab
Organs and fat pad %				
Spleen	0.11±0.01a	0.13±0.01 a	0.13±0.01 a	0.14±0.02 a
Fat pad	3.22±0.28 a	3.20±0.28 a	3.03±0.13 a	3.05±0.24 a
Intestine	2.84±0.12 a	2.69±0.15 a	2.77±0.15 a	2.95±0.10 a

Means ±SE with different superscripts within rows are differ significantly (p<0.05)

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ESTIMATION OF SOME GENETIC PARAMETERS FOR EGG QUALITY TRAITS IN JAPANESE QUAIL (*COTURNIX COTU JAPONICA*)

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ABSTRACT

A total of 608 eggs from 304 dams (100 F1, 54 selected dams and 150 F2, with 2 replicates for each dam), were tested to estimate the selection differential, response to selection, phenotypic correlation coefficients heritability and genetic correlation between egg traits including external and internal egg qualities. Results showed that there were a highly significant differences ($P < 0.01$) among F1, selected parent (SP) and F2 generation for egg weight (EW), shell weight (ShW), shell thickness (ShT), albumen weight (AW), albumen height (AH), albumen diameter (AD), Haugh unit (HU), yolk weight (YW), yolk height (YH) and yolk diameter (YD). The highest heritability estimation recorded for Haugh unit (0.49), while the lowest one was recorded for AW (0.12). The highest genetic correlation coefficient recorded between EW and AW (0.56), while the lowest one was found between EW and AH (-0.02).

KEY WORDS: Japanese quail, selection response, heritability, genetic correlation.

INTRODUCTION

Quail eggs have an expanded market over the world, so any improvement in egg quality beside its production will increase the number of consumers for such product. External eggshell quality is significance in acceptability by the consumers (Song, et al. 2000, Adeogun and Amole, 2004 and Dudusola, 2010), while internal egg quality is important in industry (Scott and Silversides, 2001). Egg weight is considered the most essential character of quality for consumers, and this character is related to genetic structure of the quail's flock (Rajkumar, et al. 2009).

The genetic improvement for egg quality traits by direct and indirect selection depends on genetic variances of quality characteristics, which resulted in improvement the egg composition (Minvielle and Oguz, 2002). Heritability estimates of some egg quality traits such as egg weight (EW), egg long diameter (LD), egg short diameter (ShD), shell thickness (ShT) and shell weight (ShW) were 0.83, 0.68, 0.72, 0.53 and 0.08, respectively (Sezer, 2007). The same author indicated that the genetic correlation between shape index (SI) and EW was positive and significant ($P < 0.05$). Egg weight had correlated positively with both ShT and ShW (Stadelman, 1986), and shell thickness had an effect on the egg stiffens (Thompson et al. 1981 and Buss, 1982). High

estimation for heritability of some egg quality traits such as egg weight (EW), albumen weight (AW), yolk weight (YW), ShW, albumen high (AH) and ShTh were ranged between 0.62-0.84 (Sato et al. 1989). Schuler et al. (1998) was recorded high heritability estimation (0.46) for YW. High but insignificant values for heritability of EW, ShW and YW were reported by (Minvielle et al., 1997). The last author indicated that the estimation of genetic correlation coefficients between ShW and YW in two lines of selected quail were (0.54 and 0.53). Sezer (2007) concluded that egg size was limited by the width of egg (long diameter) rather than high of egg (short diameter), because the presence of positive correlation between shape index (SI) and EW which was significant and higher than the negative correlation coefficient between shape index and high of egg (short diameter). Hrncar et al. (2014), reported that egg quality of two genotypes (laying type & meat type) of J. quail was significantly differed for SI and ShW (76.70 and 1.02 g. vs. 78.18 and 1.16 g., respectively). They mentioned that there was no significant ($P > 0.05$) difference determined between the laying and meat type for the Haugh Unit (87.28 and 87.56, respectively).

Haugh unit (HU) and yolk index are generally considered as good indicators to

evaluate egg quality (Chang and Chen, 2000). The overall least-squares means for EW, egg length, egg width, ShW, ShTh, albumen length, albumen width, AH, albumen weight (AW), yolk diameter (YD), yolk height (YH), YW, yolk color, SI, albumen index (AI), yolk index (YI) and HU score were 13.71 g, 34.12 mm, 26.98 mm, 1.17 g, 0.21 mm, 43.14 mm, 33.81 mm, 4.88 mm, 7.80 g, 25.19 mm, 11.29 mm, 4.74 g, 5.37, 79.23, 0.13, 0.45 and 58.27, respectively (Kumari, 2008).

Therefore, this research aimed to investigate the genetic gain and parameters of some egg quality traits in J. quail exposed to selection for feed conversion ratio.

MATERIAL AND METHODS

This study was conducted at poultry laboratory of the Department of Animal Production at the College of Agriculture, University of Duhok, Kurdistan region, Iraq. A total of 608 eggs from 304 dams (100 F1, 54 selected dams and 150 F2, with 2 replicates for each dam) were used to study the internal and external characteristics of egg quality at 12 weeks of age within 24 hours of collection. The dams of two generations were kept in a similar conditions and housed in cages of 40 X 30 cm² area. During the experimental period, the layer ration (Table 1) was offered *ad libitum*, and the feed was mixed according to Lesson and Summers (2005). The light during experimental period was 15 h/d, and ventilation was done by water coolers and fans for both generations.

The eggs were collected daily and the following procedures (measurements) were applied in the laboratory; the eggs were weighed individually using a laboratory digital balance with accuracy of 0.01gm.; long and short diameters of egg before breaking, yolk and albumen diameters, yolk and albumen high and eggshell thickness with membranes were measured using digital micrometer caliper with accuracy of 0.01mm. Shape index of the eggs were computed as the ratio of short diameters to long diameters (%); the weight of eggshell and yolk were measured with the same previous digital balance, while albumen weight was calculated as the difference between egg weight and (yolk and shell) weights. The percentages (%) of all studied characters were calculated as the proportion of each one on the

egg weight. Indices (%) of both yolk and albumen were computed separately as the ratio of the diameter on the highest of each. Haugh units were computed according to Haugh equation (Haugh, 1937) as following:

$$HU = 100 \log (AH + 7.57 - 1.7 \times EW^{0.37})$$

Genetic gain of the egg quality characters was calculated as the difference between the value of each character in the progeny and value of the same character in the first generation, while selection differential was computed as the difference between the value of each character in the selected dam and the value of the same character in the first generation. Realized heritability of egg quality characteristics was estimated as the ratio of genetic gain (response to selection) to selection differential for each character according to Falconer and Mackay (1995); the genetic correlation between characters was estimated according to the following geometric equation:

$$r_g = (\text{cov } Z_2X_1 * \text{cov } Z_1X_2) / (\text{cov } Z_1X_1 * \text{cov } Z_2X_2)$$

Where: Z represents the observations of selected dam and X represents the observations of the progeny); 1 represents the first character and 2 represent the second character.

Statistical analysis:

Statistical analysis was performed using SAS software (SAS institute, 2010) by GLM procedure and according to the following one-way model:

$$Y_{ij} = \mu + G_i + e_{ij}$$

Where: Y_{ij} = the observations of the studied character; μ = overall mean; G_i = the effect of generation (dams); e_{ij} = experimental error.

Phenotypic correlation between egg quality characters within each generation was performed using the same software, by correlation procedure. Duncan's multiple range test, was used to compare means (Duncan, 1955).

Table (1): Layer ration which submitted to the hens during the experiment.

<u>Ingredients</u>	<u>%</u>
Wheat	60
Barley	9
Soybean meal	18
vegetable oil	2.7
Limestone	7.7
Dicalcium phosphate	1
DL methionine	0.2
L- lysine	0.2
Phytase	0.4
Salt	0.3
Vit. Premix	0.5
Total	100
<u>Calculated Chemical composition</u>	
ME (Kcal/kg)	2838.42
Crude protein (%)	17.83
Fat (%)	3.85
Crude fiber (%)	2.84
Methionine (%)	0.50
Lysine (%)	1.12
Ca (%)	3.33
Avail. P (%)	0.45

RESULTS AND DISCUSSION

1- External egg quality and eggshell quality:

All external egg quality and eggshell quality traits are differed significantly among first generation (*F1*), selected parents (*SP*) and second generation (*F2*), with respect to EW, LD and ShD, the *SP* eggs surpassed significantly ($P<0.01$) both *F1* and *F2* dam's eggs (Table 2), and the eggs laid by *F2* hens are significantly ($P<0.01$) higher than *F1* eggs. The shape index (SI) of *SP* eggs averaged 80.6 which was significantly ($P<0.05$) higher than both of *F1* and *F2* eggs and ranged from 78.71 to 79.02.

Also, a similar trend was noticed for eggshell weight (1.55 gm.). Eggshell thickness did not differ significantly between *F1* and *F2* eggs, but both of them was significantly ($P<0.05$) lower

than *SP* eggs. These results may reflect the effect of selection for FCR on the egg quality traits. On the contrary, eggshell percentage of *SP* eggs was significantly ($P<0.05$) lower proportion as compared with *F1* and *F2* eggs (Table 2). The present results disagree with the finding of Song et. al. (2000) who reported higher eggshell weight (22.2 gm.). All selection differential (SD) values are positive except that noticed for eggshell percentage (Table 2) which have a negative value (-0.68 %). This finding may be due to the higher egg mass which resulted from selection for FCR, because higher egg mass (higher egg number and egg weight) affected negatively the weight of eggshell. A similar trend was recorded for the response to selection (R), because eggshell trait in the offspring was affected directly by *SP*.

Table (2): External egg quality traits and eggshell characters.

	<i>F1</i>	<i>SP</i>	<i>SD</i>	<i>F2</i>	<i>R</i>	<i>Sig.</i>
EW (gm.)	11.61 ± 0.05 ^c	12.83 ± 0.06 ^a	1.22	11.87 ± 0.09 ^b	0.26	**
LD (mm)	31.23 ± 0.11 ^c	33.6 ± 0.06 ^a	2.37	31.65 ± 0.13 ^b	0.42	**
ShD (mm)	25.05 ± 0.18 ^c	26.43 ± 0.04 ^a	1.38	25.65 ± 0.18 ^b	0.6	**
SI	78.71 ± 0.76 ^b	80.60 ± 0.74 ^a	1.89	79.02 ± 0.76 ^b	0.31	*
ShW (gm.)	1.48 ± 0.007 ^b	1.55 ± 0.01 ^a	0.07	1.51 ± 0.02 ^b	0.03	**
ShTh (mm)	0.31 ± 0.002 ^b	0.3 ± 0.003 ^a	0.05	0.3 ± 0.005 ^b	0.0	*
ShP (%)	12.75 ± 0.09 ^a	12.07 ± 0.14 ^b	-0.	12.72 ± 0.13 ^a	- .03	*

Means with common letter are not different significantly.

* Significant (*P* 0.05); ** highly Significant (*P* 0.01).

SD = Selection differential; R= Response to selection; EW= Egg weight; LD = Egg Long diameter; ShD= Egg Short diameter; SI= Shape index. ShW= Eggshell weight; ShTh = Eggshell thickness; ShP= Eggshell percentage

2- Internal egg quality traits:

Internal egg quality characteristics was affected significantly by the generation except AP and AI (Table 3). AW and YI in *SP* are significantly surpassed *F1* and *F2*. Also, AH, AD, HU, YW, YH and YD are superior in *SP* over *F2*. YP (%) didn't differ significantly between *SP* and *F2* (32.86-32.87 %), but they surpassed significantly *F1* eggs (32.04 %). However, selection for FCR improved to some extend quality characteristics of the eggs. Similar results were found by Hrnar *et. al.*, (2014). As it shown

from the Table (3), that SD value for AP is negative (-0.15 %), which mean that selection for FCR in quail may affect negatively the percentage of albumen. With respect to R, also AP resulted in a negative value (-0.53) which mean that the progeny eggs was affected by *SP*. Also, YI recorded a negative response (-0.05 %) which reflect the smaller yolk height and higher yolk diameter in the offspring. This finding may resulted from the effect of selection for FCR on quality characteristics of egg in quail.

Table (3): Internal egg quality traits (albumen and yolk characters).

	<i>F1</i>	<i>SP</i>	<i>SD</i>	<i>F2</i>	<i>R</i>	<i>Sig.</i>
AW (gm.)	6.41 ± 0.1 ^b	7.07 ± 0.05 ^a	0.66	6.49 ± 0.05 ^b	0.08	**
AP (%)	55.21 ± 0.2 ^a	55.06 ± 0.25 ^a	-0.15	54.68 ± 0.3 ^a	-0.53	ns
AH (mm)	4.1 ± 0.6 ^c	4.93 ± 0.03 ^a	0.83	4.49 ± 0.07 ^b	0.39	**
AD (mm)	37.12 ± 0.4 ^c	43.45 ± 0.14 ^a	6.33	39.6 ± 0.5 ^b	2.48	**
HU	87.0 ± 0.36 ^c	90.84 ± 0.18 ^a	3.84	88.87 ± 0.47 ^b	1.87	**
AI	11.05 ± 0.16 ^a	11.35 ± 0.09 ^a	0.30	11.34 ± 0.24 ^a	0.29	ns
YW (gm.)	3.72 ± 0.03 ^c	4.22 ± 0.02 ^a	0.5	3.87 ± 0.04 ^b	0.15	**
YP (%)	32.04 ± 0.25 ^b	32.87 ± 0.21 ^a	0.83	32.86 ± 0.24 ^a	0.82	**
YH (mm)	10.9 ± 0.08 ^c	12.44 ± 0.05 ^a	1.54	11.25 ± 0.11 ^b	0.33	**
YD (mm)	23.13 ± 0.11 ^c	25.63 ± 0.07 ^a	1.87	23.86 ± 0.13 ^b	0.73	**
YI	47.19 ± 0.31 ^b	48.7 ± 0.21 ^a	1.51	47.14 ± 0.39 ^b	-0.05	*

Means with common letter are not different significantly.

* Significant (*P* 0.05); ** highly Significant (*P* 0.01); ns = non-significant.

SD = Selection differential; R= Response to selection; AW= Albumen weight; AP= Albumen percentage; AH= Albumen height; AD=Albumen diameter; HU = Haugh units; AI = albumen Index. YW= Yolk weight; YP= Yolk percentage; YH= Yolk height; YD= Yolk diameter; YI = Yolk Index.

1- Heritability, genetic correlation and phenotypic correlation:

Heritability estimates for studied egg quality characters ranged between 0.12 to 0.49 (Table 4). The highest estimate was recorded for HU, while

the lowest one was for AW. Moreover, the realized heritability estimates for both YD and AD was recorded the same magnitude value (0.39). Also, heritability estimates were high for AH (0.47), ShW (0.43) and ShTh (0.40). The

heritability estimates for other remaining traits were low. These results indicate that it may be possible to improve the egg quality characteristics genetically by selection Japanese quail birds through their eggs with higher AH and ShTh measurements.

With regarding to the estimation of genetic correlation coefficients, most values were low and insignificant (Table 4). However, the highest coefficient was estimated between EW and AW (0.56), while the lowest was recorded between EW and AH (-0.02). Furthermore, a significant genetic correlation coefficients were estimated between (HU and AH), (ShW and EW), (EW and YW), (AD and EW), (AD and AW), (AD and YW) and (YW and YD). These findings suggest that any increasing in egg weight is result from the increasing in albumen weight, and the increasing in YW lead to longer AD.

With respect to phenotypic correlation, the egg weight trait is correlated positively and significantly with YH, YD, AD, YW, ShW and AW (Table 4). The highest phenotypic correlation coefficient was recorded between AH and HU (0.89), which may due to the relationship between them. Also, a significant phenotypic correlation coefficients were shown between (YD and YW), (YD and ShW), (AW and YD), (AD and YW) and (ShW and AW). However, the highest insignificant correlation coefficient was recorded between YH and AH (0.29). However, other

correlation coefficients are within the normal ranges as expected. These results indicate that longer YD affect positively AW, ShW and YW. Sezer (2007) found similar result in respect to the positive phenotypic correlation coefficient between EW and ShW, which revealed that heavier egg is expected to have heavier eggshell. He added that the indirect selection could be more effective than direct selection based on shell thickness in improving the shell ratio, and the selection for increasing EW will result in decreasing eggshell quality. Narushin and Romanov (2002) concluded that the eggshell character is one of the most significance exterior characteristics of the egg. It was proved that there is a significant positive correlation between EW and ShW (Stadelman, 1986); the author added that the ShP is related to the total EW, the larger egg having proportionately less eggshells. Significant high genetic correlation coefficient between ShW and YW (0.54) in J. quail was found by (Minvielle et. al., 1997). The egg quality characteristics was affected positively by indirect selection in quail, and there are a significant genetic correlation coefficients between EW and its components (Minvielle and Oguz, 2002). The last authors concluded that heritability estimation values for egg quality traits in J. quail are moderate to high. However, heritability estimation values of EW, ShT and ShW were 0.83, 0.53 and 0.08, respectively (Sezer, 2007).

Table (4): Genetic parameters for egg quality characteristics of Japanese quail hens

	<u>EW</u>	<u>YH</u>	<u>AH</u>	<u>YD</u>	<u>AD</u>	<u>YW</u>	<u>ShW</u>	<u>ShTh</u>	<u>AW</u>	<u>HU</u>
	0.21	0.32*	0.05	0.68**	0.42**	0.78**	0.56**	0.28	0.87**	-0.12
Egg weight	0.26	0.23	0.29	0.16	0.15	0.19	0.38*	-0.03	0.26	0.26
Yolk height	-0.02	0.23	0.47*	-0.07	-0.06	-0.1	0.08	0.21	0.14	0.89**
Albumen height	0.31	0.11	-0.09	0.39*	0.30*	0.77**	0.40**	0.37*	0.41**	-0.18
Yolk diameter	0.36*	0.09	-0.13	0.27	0.39*	0.25	0.27	0.18	0.39**	-0.13
Albumen diameter	0.39*	0.21	0.08	0.52*	0.22	0.30	0.41**	0.17	0.41**	-0.23
Yolk weight	0.44*	0.29	0.10	0.22	0.13	0.27	0.43*	0.26	0.36*	-0.01
Shell weight	0.28	0.19	0.20	0.24	0.08	0.12	0.28	0. *	0.25	0.16
Shell thickness	0.56**	0.11	0.18	0.07	0.31*	0.33*	0.27	0.16	0.12	-0.01
	-0.17	0.15	0.37**	0.19	-0.21	-0.14	0.12	0.20	0.14	0.49*

Heritability on diagonal, phenotypic correlation coefficients above and genetic correlation coefficients below the diagonal

CONCLUSION

It could be concluded from this investigation that it may improve quality characteristics of J. quail eggs by either direct selection (via selected dams that have higher AH or ShTh) or indirect selection (selection for FCR).

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THE IMPACT OF PACKAGING EGGS WITH SOME NATURAL OILS TO PROLONG ITS POWERS UNDER DIFFERENT STORAGE METHODS

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ABSTRACT

The aim of this study was to evaluate the effect of storage methods and packaging eggs with some natural oils on egg quality parameters. A total of 500 eggs were obtained from the Somel Poultry project farm / Duhok (Ross 308). 250 eggs were stored in refrigerator at 5°C and 250 eggs were stored in room temperature at 18-25°C for 1-12 weeks. Each group was divided into five treatments (50 eggs) as follows: Control treatment eggs without treatment, packaging eggs with Corn oil at 18-25°C for 15 minutes, packaging eggs with Olive oil at 18-25°C for 15 minutes, packaging eggs with Almond oil at 18-25°C for 15 minutes and packaging eggs with Nigella oil at 18-25°C for 15 minutes. Egg quality traits were monitored including egg weight before sampling and after sampling weighed, egg loss weight, loss percentage, (yolk and albumen) high, diameter, index, shell thickness, shell weight, air cell and HU (Haugh units). The results revealed that stored eggs in refrigerator improved losses moisture from eggs kept diameter, index for eggs yolk, albumin and improved HU. In general the natural oil improved all egg quality traits internal and external parameters. The interaction between refrigerator storage methods and coating lead to improved eggs quality for the 12 weeks. The investigate conclusion that storage methods with coating eggs by natural oil improved eggs quality.

KEYWORDS: storage methods, natural oil, egg quality, storage periods.

INTRODUCTION

The poultry industry is an important segment of the world's, providing eggs and meat to a large populace. Egg is one of the most nutritious foods available to man. It provides a balanced protein which contains all the amino acids considered essential in sufficient amounts and proportion to maintain life and support growth when used as a sole source of protein food (Raji *et al.* 2009). Since the beginnings of the last century has been working to devise methods of keeping and storage of eggs to increase the duration of preservation and storage, while keeping it from deterioration or damage and within the thirty last year popularized the use method of spraying oil on the eggs with a save in the stores refrigerated and that will prolong remember eggs without deterioration of the quality (Stadelman and Cotterill, 1995; Hank *et al.* 2001 and USDA, 2007; Othman, 2014), to pasteurize eggs with shell using low temperature (55°C) for a period of 180 minutes working to save the refrigerator for up to seven weeks without the appearance of a reduction in the content of protein dissolved or influence in the level of free amino acids (Free

amino acids). The Haugh unit, which an index based on the thickness, is adopted by the European community to select eggs Tayeb (2012). Proper storage of eggs is essential to preserve quality and cooking characteristics. Poor storage conditions can reduce eggs grade eggs within a few days. The principle degrading factors are high storage temperature and dehydration (Akyurek and Aylin 2009). Al Obaidi *et al.* (2011; Hermiz *et al.* 2012) found the treated of fresh eggs to water evaporation does not effect eggs quality after refrigerator storage for two weeks. Wilburn, (2006) recommended the pasteurize eggs with shell using temperature 57°C for 20 minutes to eliminate microorganism that may be present on the surface of the cortex or in the contents of Interior for whites. With the modern researches about the seeds of locally plants such as Nigella Sativa, olive and Almond used oils and high efficiency in reducing the damage vegetable crops and fruit during storage radiator for a long time as well as the role of the oils of these seeds in reducing the growth of microorganisms and causing damage (Al-Shadidy, 2010; Menezes, 2012 and Kadri *et al.* 2014). The aim of this study to show the effect of packaging eggs of

some species of natural oils fit for consumption when the conditions of storage room and a refrigerator.

MATERIAL AND METHODS

This study was conducted in Department of Animal resources laboratory Amedi technical Institute- Duhok polytechnic University, 500 laying hen (38 weeks age) strain (Ross 308) eggs were used. The eggs were obtained from the Somel Poultry project/ Duhok. The eggs were divided in to two groups: A-Storage 250 eggs in room temperature at 18-25°C for 1-12 weeks periods. B-Storage 250 eggs in refrigerator at 5°C for 1-12 weeks.

Each group was divided in to five treatments as follow:

1-Control treatment eggs (without packaging oil).

2-Packaging eggs with Corn oil at 18-25°C for 15 minutes (50) eggs.

3-Packaging eggs with Olive oil at 18-25°C for 15 minutes (50) eggs.

4- Packaging eggs with Almond oil at 18-25°C for 15 minutes (50) eggs.

5- Packaging eggs with Nigella oil at 18-25°C for 15 minutes (50) eggs.

Every days the temperature in all groups were keep the optimum range of temperature for storage. For sampling, each eggs were weighed and broken and the height of the albumen and egg yolk height thick were measured within a tripod micrometer. Haugh units were calculated by using HU formula [$HU=100 \log (H+7.57-1.7W^{0.37})$]. Egg albumin and yolk width were measured by using a compass. The albumin and yolk indices, then calculated as follows: yolk index= yolk height/yolk width. Air cell (distance between eggshell and membrane, mm) and eggshell weighed. Data for fresh and stored eggs together were subjected to Duncan's multiple range test. The data without fresh eggs were analyzed using the SPSS statistical package. An ANOVA using a general linear model included

the main effects of storage time and storage temperature of eggs and the two-way interactions between these factors. Although all interactions were significant a further ANOVA used only main effects.

RESULT AND DISCUSSION

The effect of storage method and packaging eggs with oil on the external and internal egg quality traits were showed a significant ($P<0.05$) for all traits, the results of eggs weighed before and after storage, egg losses, and egg percentage losses are presented in Table (1). The results of statistical analysis reveals that room storage significantly increased egg loss weight and egg loss percentage compare with refrigerator storage, this results are in agreements with finding (Siyar *et al.* 2007; Dudusola, 2009; Hasan and Aylin 2009; Raji *et al.* 2009; Tabidi, 2011; Jin *et al.* 2011; Tayeb, 2012; Hagan *et al.* 2013; and Dorji, 2014), home observed a decrease in weight within 10 days of storage at 29°C. Refrigerated eggs had lower ($P<0.05$) egg weight loss, may be due to less moisture loss from the eggs. The loss in weight is attributed to loss of humidity from inside the egg due to evaporation effects. About the treatments of packaging oil were significantly decreased the losses weight and percentage losses in eggs compare to control groups, this results are in agreement with finding (Raji *et al.* 2009; Al-Shadeedi and Al-Fayadh 2010; Al-Shadeedi, 2010 and Kadri *et al.* 2014), who reported that coating eggs with natural oils prevented losses weight and evaporation moisture from eggs. Interaction between all treatment results revealed that refrigerator storage with natural oils significantly decreases the humidity losses compare with control groups, the results are in agreement with finding (Dudusola, 2009; Hasan and Aylin 2009; Raji *et al.* 2009; Al-Shadeedi and Al-Fayadh 2010; Al-Shadeedi *et al.* 2010; Tabidi, 2011; Jin *et al.* 2011; Tayeb, 2012; Hagan *et al.* 2013; and Dorji, 2014).

Table (1):- Effect of packaging with some natural oil under different storage methods on egg weight and losses at 12 weeks of storage.

Treatment	Egg weight		Egg Weight Loss (g)	Egg Loss %	
	Before Treatment	After Treatment			
Effect of storage methods					
Cool Storage	64.49±0.38 ^a	62.54±0.42 ^a	1.95±0.20 ^b	3.02±0.31 ^b	
Room Storage	65.13±0.41 ^a	62.80±0.49 ^a	2.32±0.29 ^a	3.58±0.44 ^a	
Effect of Treatment					
Control	65.13±0.78 ^{ab}	58.54±0.81 ^c	6.60±0.35 ^a	10.15±0.53 ^a	
Corn oil	63.82±0.52 ^b	62.71±0.53 ^b	1.11±0.10 ^b	1.75±0.15 ^b	
Olive oil	64.55±0.61 ^b	63.61±0.64 ^{ab}	0.94±0.11 ^b	1.47±0.18 ^b	
Almond oil	64.45±0.60 ^b	63.46±0.70 ^{ab}	0.99±0.09 ^b	1.55±0.15 ^b	
Nigella oil	66.49±0.66 ^a	65.19±0.68 ^a	1.29±0.15 ^b	1.96±0.22 ^b	
Interaction					
Cool Temperature	Control	65.00±1.01 ^{abcd}	59.63±1.06 ^{cd}	5.37±0.33 ^b	8.30±0.53 ^b
	Corn oil	63.90±0.73 ^{bcd}	62.71±0.75 ^b	1.20±0.16 ^a	1.88±0.26 ^c
	Olive oil	64.70±0.91 ^{abcd}	63.91±0.96 ^{ab}	0.80±0.16 ^a	1.25±0.25 ^c
	Almond oil	62.95±0.57 ^d	61.97±0.59 ^{bc}	0.99±0.13 ^a	1.57±0.21 ^c
	Nigella oil	66.00±0.95 ^{abc}	64.45±1.00 ^{ab}	1.55±0.28 ^a	2.36±0.41 ^c
Room Temperature	Control	65.26±1.23 ^{abcd}	57.44±1.19 ^d	7.82±0.46 ^b	11.99±0.70 ^a
	Corn oil	63.74±0.75 ^{cd}	62.71±0.78 ^b	1.03±0.10 ^a	1.62±0.16 ^c
	Olive oil	64.40±0.83 ^{abcd}	63.32±0.88 ^{ab}	1.08±0.15 ^a	1.70±0.25 ^c
	Almond oil	66.77±0.97 ^{ab}	65.77±1.01 ^a	1.00±0.14 ^a	1.51±0.22 ^c
	Nigella oil	66.95±0.93 ^a	65.90±0.92 ^a	1.06±0.09 ^a	1.57±0.13 ^c

a, b, c and d: means within each column had the different subscript were differ significantly (P<0.05).

Table (2) show effect of storage methods and packaging eggs with oil on the internal characteristics of eggs, the results reveal significant deference in all yolk and albumin parameter for storage methods except yolk height and albumen index. This results are corroborated with the finding (Silversides and Scott 2001; Siyar *et al.* 2007 and Dudusola, 2009) who reported albumen weight decreased and yolk weight increased with storage temperature. The longer periods of storage resulted in greater percentages of yolk and a lesser percentage of albumen. The difference between the various methods to maintain egg quality could be due to their varying ability to retard carbon dioxide loss and breakdown of carbonic acid to carbon dioxide. This is because these losses cause Mucin fiber which gives the albumen and yolks their gel-like texture to loss their structure and so the albumen and yolk becomes watery(Raji *et al.* (2009). The natural oils covered lead to improved eggs compounds (yolk and albumin) significantly compare to

control groups. The almond and nigella sativa oil are batter to control the evaporation moisture and kept the internal eggs. This result are in agreements with the finding (Raji *et al.* 2009; Al-Shadeedi Al-Fayadh 2010 and Al-Shadeedi, 2010). In interaction table (2) show significant deference in characteristic of yolk and albumin with the interaction storage methods and packaging eggs of oil, this may due to that cooling eggs with packaging oil lead to keep evaporation water from eggs and improved the characteristics of yolk and albumin, the results are in agreement with the founding (Siyar *et al.* 2007; Raji *et al.* 2009; Al-Shadeedi and Al-Fayadh 2010; Al-Shadeedi 2010; Al-Obaidi *et al.* 2011; Abiona *et al.* 2013; Hagan *et al.* 2013; Alade, *et al.* 2013 and Dorji, 2014). The treatment eggs of oils generally works to add a new layer on the surface of the egg shell and thereby increase the thickness of bridging the gaps open in the shell, as the treatment of thermal oil thermostabilization at temperature 56.6°m for a period of 16 minutes working on

the clotting of the outer albumin of egg white light contact with the shell and their membranes lead to prevent the loss of moisture and gas Co2 from inside the egg through the stomata to a minimum during storage. Hank *et al.* (2001) show that pasteurization eggs with shell using

low heat (55°m) for a period of 180 minutes has lead to increase the storage duration and this is why the decline in the amount of deterioration in the eggs quality trait, oils egg weight and the proportion of weight lost.

Table (2):- Effect of packaging with some natural oil under different storage methods on egg yolk and albumen at 12 weeks of storage.

Treatment	Yolk			Albumen			
	High	Diameter	Index	High	Diameter	Index	
Effect of storage methods							
Cool Storage	3.19±0.11 ^a	44.25±0.54 ^a	7.18±0.25 ^a	0.49±0.01 ^a	89.65±1.78 ^a	0.55±0.15 ^a	
Room Storage	2.16±0.12 ^a	39.33±1.82 ^b	4.58±0.27 ^b	0.36±0.02 ^b	57.78±4.67 ^b	0.32±0.03 ^a	
Effect of Treatment							
Control	1.25±0.22 ^b	23.76±3.86 ^b	2.61±0.48 ^b	0.17±0.03 ^b	48.75±9.04 ^b	0.16±0.03 ^c	
Corn oil	2.81±0.17 ^a	46.30±0.50 ^a	6.12±0.38 ^a	0.46±0.01 ^a	83.34±5.99 ^a	0.43±0.03 ^b	
Olive oil	2.91±0.14 ^a	46.30±0.41 ^a	6.34±0.32 ^a	0.47±0.01 ^a	81.84±4.29 ^a	0.51±0.03 ^{ab}	
Almond oil	3.12±0.17 ^a	45.68±0.53 ^a	6.89±0.41 ^a	0.49±0.02 ^a	73.66±5.31 ^a	0.54±0.04 ^a	
Nigella oil	3.20±0.14 ^a	45.73±0.54 ^a	7.10±0.35 ^a	0.49±0.01 ^a	75.25±5.01 ^a	0.51±0.03 ^{ab}	
Interaction							
Cool Temperature	Control	2.29±0.24 ^c	43.28±2.59 ^a	4.92±0.54 ^c	0.37±0.01 ^d	100.21±7.2 ^a	0.33±0.03 ^b
	Corn oil	3.25±0.22 ^{ab}	44.73±0.72 ^a	7.26±0.46 ^b	0.47±0.01 ^b	89.92±3.42 ^{ab}	0.54±0.02 ^a
	Olive oil	3.23±0.21 ^{ab}	44.92±0.58 ^a	7.19±0.48 ^b	0.52±0.01 ^a	86.80±2.36 ^{ab}	0.61±0.02 ^a
	Almond oil	3.47±0.24 ^a	44.54±0.50 ^a	7.78±0.52 ^{ab}	0.55±0.01 ^a	85.67±2.31 ^{ab}	0.64±0.02 ^a
	Nigella oil	3.73±0.17 ^a	43.69±0.76 ^a	8.58±0.42 ^a	0.54±0.01 ^a	86.58±2.44 ^{ab}	0.63±0.02 ^a
Room Temperature	Control	0.21±0.14 ^d	5.27±3.62 ^a	0.41±0.28 ^d	0.00±0.00 ^e	0.00±0.00 ^e	0.00±0.00 ^c
	Corn oil	2.35±0.23 ^c	47.87±0.48 ^a	4.92±0.49 ^c	0.44±0.01 ^c	76.43±11.7 ^{bc}	0.33±0.05 ^b
	Olive oil	2.60±0.15 ^c	47.68±0.38 ^a	5.49±0.34 ^c	0.43±0.01 ^c	76.88±8.20 ^{bc}	0.42±0.05 ^b
	Almond oil	2.59±0.19 ^c	47.43±0.93 ^a	5.51±0.47 ^c	0.41±0.01 ^c	55.18±11.4 ^d	0.37±0.08 ^b
	Nigella oil	2.70±0.15 ^{bc}	47.68±0.47 ^a	5.69±0.34 ^c	0.44±0.01 ^c	64.48±8.94 ^{cd}	0.39±0.05 ^b

a, b, c and d: means within each column had the different subscript were differ significantly (P<0.05).

Table (3) revealed the effect of storage methods on shell thickness, shell weight, air cell and HU. There are significant differences between refrigerator storage and room temperature in HU parameter this may due to the refrigerator storage kept the internal quality of eggs and prevented the evaporation of moisture from eggs. The results are in agreements with the founding (Dudusola, 2009; Al-Obaidi *et al.* 2011; Alsobayel and Albadry 2011; Tayeb, 2012; Menezes, 2012 and Dorji, 2014), home reported that the storage eggs at temperature 20-25°C effected significantly compared with the eggs storage at 5°C, this due to the high temperature effected on the albumin quality and this lead to influence the HU. Shell thickness,

shell weight, air cell and HU effected by packaging eggs with natural oils, there are significantly decreases in shell thickness, shell weight and Air Cell this may lead to the oil decreased the shell thickness shell weight and decreased evaporation of moisture while in control groups increased evaporation of moisture that lead to increase air cell, also the HU improved by oil packaging. In interaction combination storage methods with oil packaging the shell thickness, shell weight, air cell and HU effected with treatment and storage methods that there are significant differences between treatment groups compared with the control group this due to the storage methods with oil packaging improved the quality of eggs.

Table (3):- Effect of packaging with some natural oil under different storage methods on egg shell, air cell and HU at 12 weeks of storage.

Treatment		Shell Thickness	Shell weight	Air Cell	HU
Effect of storage methods					
Cool Storage		0.41±0.23 ^a	8.02±0.12 ^a	9.01±0.33 ^a	38.59±0.25 ^a
Room Storage		0.40±0.16 ^a	8.32±0.15 ^a	11.02±0.57 ^a	36.05±0.34 ^b
Effect of Treatment					
Control		0.52±0.02 ^a	8.82±0.22 ^a	17.85±0.82 ^a	35.18±0.68 ^b
Corn oil		0.40±0.02 ^b	7.62±0.27 ^b	7.43±0.34 ^c	37.78±0.36 ^a
Olive oil		0.40±0.02 ^b	7.88±0.18 ^b	7.88±0.34 ^c	37.74±0.410 ^a
Almond oil		0.38±0.03 ^b	8.18±0.19 ^b	8.13±0.31 ^{bc}	38.15±0.55 ^a
Nigella oil		0.36±0.02 ^b	8.18±0.19 ^b	9.38±0.38 ^b	37.04±0.46 ^a
Interaction					
Cool Temperature	Control	0.55±0.03 ^a	8.16±0.30 ^b	13.57±0.47 ^b	37.72±0.67 ^b
	Corn oil	0.45±0.02 ^{bc}	7.65±0.26 ^b	6.93±0.37 ^d	38.31±0.51 ^{ab}
	Olive oil	0.41±0.02 ^{bcd}	8.05±0.26 ^b	7.46±0.60 ^d	38.41±0.53 ^{ab}
	Almond oil	0.34±0.02 ^d	8.15±0.26 ^b	7.97±0.40 ^{cd}	39.99±0.47 ^a
	Nigella oil	0.33±0.03 ^d	8.11±0.25 ^b	9.59±0.71 ^c	38.47±0.55 ^{ab}
Room Temperature	Control	0.49±0.02 ^{ab}	9.47±0.27 ^a	21.91±0.72 ^a	32.64±0.86 ^d
	Corn oil	0.36±0.03 ^{cd}	7.58±0.49 ^b	7.97±0.60 ^{cd}	37.60±0.51 ^b
	Olive oil	0.38±0.04 ^{cd}	7.70±0.24 ^b	8.30±0.33 ^{cd}	37.06±0.60 ^{bc}
	Almond oil	0.44±0.06 ^{bc}	8.23±0.28 ^b	8.39±0.49 ^{cd}	35.31±0.64 ^c
	Nigella oil	0.39±0.04 ^a	8.25±0.28 ^b	9.18±0.30 ^c	35.69±0.59 ^b

a, b, c and d: means within each column had the different subscript were differ significantly (P<0.05).

CONCLUSION

The results recorded from this experiment suggest that the ageing of eggs and storage methods had a significant effect on exterior and interior egg quality. However, all quality traits expressed inconsistent direction changes. The covered eggs with natural oil significantly improved egg quality. From our results, it is suggested that eggs may not be stored for more than one month at home and refrigerator.

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PERFORMANCE, REPRODUCTIVE AND PHYSIOLOGICAL TRAITS OF THREE DIFFERENT LINES OF LOCAL QUAIL - A COMPARISON

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ABSTRACT

An experiment was conducted to compare among three lines of local quails. This study included 300 one day old quail chicks were randomly distributed to three treatments (T1: Black, T2: white and T3: Brown) lines local quail and five replicates.

The brown line quails had significantly higher ($p < 0.05$) in body weight, body weight gain and feed conversion ratio (FCR) at week 5th. Body weight, egg production percentage (H.D%), egg mass, FCR, oviduct relative weight, sexual maturity age, economic profit, egg weight, Haugh unit, eggshell thickness and yolk index were higher ($p < 0.05$) in brown than other lines at 15 week of age. Testes relative weight, ejaculate volume, sperms concentration, live normal morphology sperm and sperm quality factor in male brown line were higher ($p < 0.05$) from other experiment groups. The brown line quails had higher ($p < 0.05$) percentages of; fertility, hatching of fertile and total eggs, chicks weight. However the percentage of non-fertile eggs, early, late and total dead embryos and disabled chicks percentage were lower in white quails than others. Among the measured hematic-biochemical parameters; total RBC account, hemoglobin (Hb) concentration, packed cell volume (PCV) percentage, total protein, Growth hormone, insulin-like growth factor (IGF-1) concentrations, immunological ELISA titer against Newcastle disease (ND) and Gamboro disease (IBD) were higher in brown than black and white lines, thus improved in H/L ratio in brown quails.

The results demonstrated that the brown quail line had productive and physiological achievements.

KEYWORD: body performance, egg production, physiological traits, three lines local quail

INTRODUCTION

Japanese quail originally domesticated around the 11th century as a pet song bird (Howes, 1964), and has gained in value for human nutrition (Kayang *et al.*, 2004). Recently quail industry has been developed in many countries for both meat and egg production (Risse, 1980). Also, quail is considered a good economical source for producing animal protein (Singh *et al.*, 1981). Japanese quail is intensively used as a laboratory animal, because of its small body size, little consumption and rapid maturation (Mizutani *et al.*, 1992). In addition to its early sexual maturity and short generation interval making it possible to have many generations in a year (Anon, 1991). Quail meat and egg are renowned for their high quality protein, high biological value and low caloric content (Agiang *et al.*, 2011). Experimental researches established that the body weight of Japanese quail responded quickly to selection (Marks, 1993). At the same time, Japanese quail farming for meat production expanded all over the world (Vali, 2008).

MATERIALS AND METHODS

The experimental work was carried out at the Poultry Farm, Department of Animal Resources/College of Agriculture/University of Salahaddin-Erbil. A total of 300 day old unsexed Japanese quails were reared in cages for 16 weeks. Chicks were randomly distributed into 3 treatments, each treatment with 5 replicates: 20 chicks (15 females and 5 males) per each replicate, (T1: Black, T2: White and T3: Brown) quails. Feed and water were supplied *ad libitum*, the feed content (3200, 3100, 3050 kcal/kg) metabolized energy, (23.2, 22.4, 21.8%) crude protein in (starter, grower and layer) diet respectively.

The body weight, body gain, feed intake, feed conversion ratio, mortality and economic profit were measured at weeks 5th and 15th, also at week 15th egg production (H.D%), egg mass, oviduct relative weights %, Sexual maturity age in female, thus egg quality measured (egg weight, Haugh unit, shell thickness, shell weight, eggshell strength, yolk index and total egg cholesterol). In males taken the parameters (body weight, body weight gain, FCR, mortality,

feed and water were withheld from the males at least 6hr prior to semen collection, in order to minimize contamination of the semen with faeces and urine then semen samples were collected according to (Bakst and Cecil, 1997). The female birds were bringing to the male in the same cage, each male was gently restrained on the palm of the left hand and foam was squeezed out before semen collection. The lumber region towards tail was massaged 3-4 times smoothly and applied gentle pressure on either side of the vent by using thumb and fore finger. The semen was collected by accurate pipette after cloaca gland was cleaned gently with tissue paper. Semen characteristics were estimated immediately after collection in each ejaculate such as; Testes relative weight, semen ejaculates volume, sperm concentration, Live & normal morphology sperm, Semen quality factor, dead sperm percentage.

At the beginning of 15th wk for 7 days a total of 1500 fertile eggs, 500 eggs for each treatment incubated and hatched during 17days. At hatching all live and dead chicks were counted and the percentages of (fertility, non-fertile eggs, hatching of fertile and total eggs, (early 1-7 d, late 8-17 d and total 1-17 d) dead embryos, livability, disabled chicks and chicks weight were recorded.

Blood samples from the brachial vein of 15 birds were collected in EDTA tubes to measure hematological indexes. The number of total RBC ($10^6/\text{mm}^3$) and total WBC ($10^3/\text{mm}^3$) were determined using Natt & Herrick staining solution (Natt and Herrick, 1952) in a haemocytometer chamber. Differential leukocyte count (heterophil and lymphocyte) made on slides stained with Wright-Giemsa and observed in an optical microscope (100x) to determined H/L ratio. Hemoglobin level (g/100 ml) was measured by the cyanmethemoglobin method and hematocrit (PCV) (%) was determined using a micro-hematocrit capillary, serum was harvested after blood centrifuged to measure the total cholesterol (mg/l), glucose (mg/l), protein (g/l) concentration using commercial kits and the growth hormone concentration (ng/ml) were measured by Radio immunoassay (RIA) using

kits purchased from Biochem Immuno Systems, antibody titer of Newcastle Disease (HI), Infectious Bursa Disease (IBD) or Gumboro and Infectious Bronchitis Viral (IBV) were measured by ELISA.

All data were analyzed by using CRD (Complete Randomize Design) by SAS (Statistical Analysis System, 2005), as per variance, significant differences among treatment means were determined by Duncan's multiple range tests (Duncan, 1955).

RESULTS AND DISCUSSION

Body performance at the end of 5th week is summarized in Table 1. Brown line local quail had significantly higher ($p < 0.05$) in body weight, body weight gain and feed conversion ratio (FCR) compared with black and white lines, while no significant differences among three lines birds in initial body weight, feed intake, mortality and economic profit. Table 2. Shows significantly higher ($p < 0.05$) in body weight, egg production percentage (H.D%), egg mass, oviduct relative weight, sexual maturity age, economic profit and better results in FCR at 15th week in brown line females of quail than black and white lines quail. However, non-significant differences among the three lines in feed intake and mortality. These results indicated high metabolic rate represented by improvement in feed conversion ratio in brown line quail led to heavy body at 6-15 weeks of age matured earlier and high relative weight of oviduct produced heavier egg than the white and black lines that matured later because of the low body weight (Anthony et. al., 1990 and Meky, 2007). Generally, genetic factors which increase in body weight were associated with increase egg weight and mass (Nestor *et al.*, 1996). Mady (1990) explained the decrease in serum cholesterol (Table 6.) due decreased egg yolk cholesterol (Table 3.) which led to increasing egg production percentage, may be cholesterol due shift from blood to the ovarian tissue for egg yolk formation which due increasing of egg production as found in brown line.

Table (1):- Performance parameters of three lines of local quail at 5th week

Traits	T1= Black	T2= White	T3= Brown	L.S.
Initial body weight (g)	8.5±0.12	8.4±0.0	8.7±0.10	N.S
Body weight (g)	194.2±11 ^b	207.0±12 ^{ab}	223.8±11 ^a	*
Body weight gain (g)	185.7±11.6 ^b	198.6±10.3 ^{ab}	215.1±8.4 ^a	*
Feed intake (g)	553.68±54 ^a	514.12±41 ^a	511.94±76 ^a	N.S
FCR (g/d/bird)	2.98±0.25 ^a	2.59±0.17 ^{ab}	2.38±0.13 ^b	*
Mortality %	1.33±0.15 ^a	0.00±0.0 ^a	1.33±0.0 ^b	N.S
Economic profit (IQD/quail)	1265±50 ^a	1250±50 ^a	1280±35 ^a	N.S

^{a-b} Means within rows with different superscripts differ significantly at (P 0.05). N.S. non-significant

Table (2):- Reproductive related parameters of three lines of local female quail (6-15th) week

Traits	T1= Black	T2= White	T3= Brown	L.S.
Body weight (g)	241.6±19 ^b	248.1±17 ^b	277.3±12 ^a	*
Egg production (H.D%)	82.95±2.8 ^b	84.05±3.1 ^b	89.75±2.1 ^a	*
Egg mass (g/d/bird)	815.8±35.2 ^b	840.2±31.5 ^b	967.5±27.9 ^a	*
Feed intake (g)	1933.4±52 ^a	1840.0±36 ^a	1886.6±41 ^a	N.S
FCR (g feed/g egg)	2.37±0.11 ^a	2.19±0.14 ^{ab}	1.95±0.09 ^b	*
Mortality %	1.33±0.0 ^a	0.0±0.0 ^a	0.0±0.0 ^a	N.S
Oviduct relative weight %	10.35±0.89 ^b	10.67±1.1 ^b	11.55±0.61 ^a	*
Sexual maturity age (day)	37±0.80 ^b	37±0.70 ^b	35±0.50 ^a	*
Economic profit (IQD/quail)	3150±130 ^b	3485±105 ^b	4280±95 ^a	*

^{a-b} Means within rows with different superscripts differ significantly at (P 0.05). N.S. non-significant

Egg quality performance results are listed in Table 3. egg weight, Haugh unit, eggshell thickness and yolk index were higher (p<0.05) in brown line quails than the white and black lines.

However; eggshell weight, eggshell strength and total egg cholesterol were almost same for all experimental groups.

Table (3):- Egg quality traits of three lines of local quail at 15th week

Traits	T1= Black	T2= White	T3= Brown	S.L.
Egg weight (g)	14.05±1.7 ^b	14.28±1.1 ^b	15.40±1.5 ^a	*
Haugh unit %	85.10±3.5 ^b	85.93±2.8 ^b	92.17±2.0 ^a	*
Shell thickness (mm)	0.264±0.02 ^b	0.277±0.04 ^b	0.341±0.02 ^a	*
Shell weight (g)	1.76±0.25 ^a	1.81±0.23 ^a	1.86±0.11 ^a	N.S
Eggshell strength (kg/cm ²)	1.138±0.04 ^a	1.055±0.09 ^a	1.167±0.05 ^a	N.S
Yolk index	0.39±0.03 ^b	0.42±0.02 ^b	0.49±0.02 ^a	*
Total egg cholesterol (mg/egg)	81.98±3.0 ^a	82.30±3.1 ^a	82.75±2.5 ^a	N.S

^{a-b} Means within rows with different superscripts differ significantly at (P 0.05). N.S. non-significant

FCR was improved and the testes relative weight, ejaculate volume, sperms concentration, livenormal morphology sperm and sperm quality factor were significantly higher (p<0.05) in brown line quails, whereas; significantly lower (p<0.05) in mortality in brown and white lines and abnormal morphology sperm in brown line. While non- significant differences were found among the three lines in body weight, body

weight gain, feed intake and dead sperms in Table 4.

Tables 2 & 4 showed that females were heavier in body weight than males. Caron *et al.*(1990) indicated that quail females grow faster and yielded larger muscles and more abdominal fat than males at the same age, also the results shown the oviduct in females heavier than the testes of males. The differences between

semen quality of three lines quail could be explained by the genetic material that was different (Kirby and Froman 2000).

Table (4):- Body performance and insemination of three lines of local male quail at 15th week

Treatments	T1= Black	T2= White	T3= Brown	L.S.
Body weight (g)	218.9±10.3 ^a	223.2±9.1 ^a	241.0±9.6 ^a	N.S
Body weight gain (g)	209.6±9.1 ^b	214.7±8.3 ^{ab}	232.3±8.8 ^a	N.S
Feed intake (g)	777.62±38 ^a	721.39±33 ^a	715.48±29 ^a	N.S
FCR (g/d/bird)	3.71±0.31 ^a	3.36±0.22 ^a	3.08±0.20 ^b	*
Mortality %	4.0±1.00 ^a	0.0±0.0 ^b	0.0±0.0 ^b	*
Testes relative weight %	2.46±0.25 ^b	2.67±0.28 ^b	3.17±0.23 ^a	*
Ejaculate volume(µL)	22.13±1.35 ^b	21.86±1.33 ^b	23.79±1.04 ^a	*
Sperms concentration (×10 ⁶ /ml)	613.9±25.9 ^b	668.5±32.0 ^{ab}	723.8±21.3 ^a	*
Live normal morphology sperm %	78.15±2.53 ^b	78.59±2.36 ^b	82.95±2.19 ^a	*
Abnormal morphology sperm %	15.41±0.85 ^a	14.58±1.15 ^a	11.29±0.53 ^b	*
Dead sperms %	6.44±0.25 ^a	6.83±0.25 ^a	5.76±0.25 ^a	N.S
Semen quality factor	10.62±0.38 ^b	11.48±0.31 ^b	14.28±0.21 ^a	*

^{a-b} Means within rows with different superscripts differ significantly at (P 0.05). N.S. non-significant

Table 5. shows the brown line quails had significantly higher (p<0.05) percentages of; fertility, hatching of fertile and total eggs and chicks weight (g), but significantly lower (p<0.05) non-fertile eggs, (early, late and total dead embryos) and disabled chicks percentages in brown line quails than white and black lines. Lake (1983) referred that egg production is an indicator of fertility rate in the layer birds, which is characterized by high production as usually

put high percentage of fertile eggs because it has qualified and intact reproductive system able to place high number of eggs due high fertility and then high hatching rate, where there is a positive relationship between production and fertility and hatching ratios. Thus; noticeable improvement in semen quality especially of brown males in table 4. due improve in fertility, embryo development, hatchability and chicks weight compared with white and black lines.

Table(5):- Hatchability traits of three lines of local quails

Traits	T1= Black	T2= White	T3= Brown	L.S.
Fertility %	86.90±2.5 ^b	89.82±2.9 ^b	93.30±1.8 ^a	*
Non-fertile eggs %	13.10±0.84 ^a	10.18±0.71 ^b	6.70±0.45 ^c	**
Hatching of fertile eggs %	75.71±3.4 ^b	79.63±2.8 ^b	88.45±2.5 ^a	*
Hatching of total eggs %	73.19±2.13 ^b	74.52±2.2 ^b	82.12±1.19 ^a	*
Early dead embryos (1-7) d %	12.95±0.51 ^a	13.10±0.43 ^a	9.88±0.26 ^b	*
Late dead embryos (8-17) d %	10.78±0.75 ^a	9.83±0.63 ^a	6.96±0.34 ^b	*
Total dead embryos %	23.73±1.26 ^a	22.93±1.06 ^a	16.84±0.60 ^b	*
Disabled chicks %	3.08±0.12 ^a	2.55±0.13 ^a	1.04±0.05 ^b	*
Chicks weight (g)	8.65±0.38 ^b	8.77±0.35 ^b	9.28±0.29 ^a	*

^{a-c} Means within rows with different superscripts differ significantly at (P 0.05). N.S. non-significant

The total RBC (10⁶cells/mm³) numbers, hemoglobin (Hb) concentration, packed cell volume (PCV) percentage, total protein, growth hormone and insulin-like growth factor (IGF-1) concentrations were significantly higher (p<0.05), but H/L ratio was lower in brown line quails than white and black lines quail. While no significant differences were found among the three lines in total WBC (10³cells/mm³) numbers, total cholesterol and glucose concentrations in Table 6. This improvement in growth hormone secretion in brown line has

been attributed to the suppression of endogenous somatostatin secretion (Alba-Roth *et al.*, 1988). Darras *et al.* (1990; 1992) indicated that during embryonic growth, liver cells are capable of responding to the growth hormone by converting Thyroxin (T4) to Triiodo thyronin (T3) and decreasing type III iodothyronine deiodinase. Moreover, hepatocytes derived from chick embryos respond to growth hormone with an increased insulin-like growth factor in brown line had significant beneficial effects on growth and carcass composition (Burke *et al.*, 1987;

Cravener *et al.*, 1989). The growth hormone exerts a broad spectrum of effect that results in somatic growth and maintenance of fuel homeostasis. These effects include reduction in lipid synthesis, enhanced growth and protein

synthesis, alterations metabolism of carbohydrate, protein and glucose in blood stimulated erythrocyte synthesis and cellular differentiations (Harvey and Etches, 1997).

Table(6):- Whole blood and serum characteristics of hatched three lines of local quails

Traits	T1= Black	T2= White	T3= Brown	S.L
Total RBC (10 ⁶ cells/mm ³)	3.32±0.30 ^b	3.45±0.26 ^b	3.95±0.21 ^a	*
Hb (g/dl)	13.22±1.07 ^b	13.98±0.85 ^b	15.05±0.67 ^a	*
PCV %	34.30±1.85 ^b	33.70±1.59 ^b	36.95±1.45 ^a	*
Total WBC (10 ³ cells/mm ³)	18.57±1.23 ^a	18.85±1.15 ^a	19.05±1.08 ^a	N.S
H/L ratio	0.67±0.06 ^a	0.64±0.06 ^a	0.52±0.05 ^b	*
Total cholesterol (mg/dl)	155.4±11.3 ^a	158.1±9.0 ^a	152.9±7.1 ^b	*
Glucose (mg/dl)	188.0±15 ^a	185.5±13 ^a	180.7±11 ^a	N.S
Total protein (g/dl)	3.64±0.28 ^a	3.83±0.15 ^a	4.07±0.20 ^a	N.S
Growth hormone (ng/dl)	153.8±11.0 ^b	156.2±9.5 ^b	167.3±10.2 ^a	*
insulin-like growth factor (IGF-1) (ng/dl)	17.91±1.7 ^b	18.08±1.8 ^b	20.89±1.4 ^a	*

^{a-b} within rows with different superscripts differ significantly at (P 0.05). N.S. non-significant

The immunological ELISA titer against Newcastle disease (ND) and Gamboro disease (IBD) were significantly higher (p<0.05) in brown line quails than white and black lines. While, no significant differences were found among the three lines in infectious bronchitis viral disease (IBV) in Table 7. The decreases of heterophil to lymphocyte ratio (H/L) in brown line quails at hatching day in table 6. Is due to that chicks make a special mechanical to

produce natural immunity to infections that occur in the body and when the development of lymph nodes produced lymphocytes type T and B to increase the number of total lymphocytes when progressed in age that lead to a decrease in heterophil (Abdullah, 1978), later led to increases in body immunity against Newcastle and Gumboro (IB) diseases especially in brown line quails.

Table(7):- Immunological ELISA titer against some diseases of hatched three lines of local quails

Traits	T1= Black	T2= White	T3= Brown	S.L
ND (µg/ml)	5825±128 ^b	6009±112 ^b	6567 ±103 ^a	*
IBD (µg/ml)	3082±98 ^b	3267±92 ^b	4009 ±75 ^a	*
IBV (µg/ml)	2038±22 ^a	2009±28 ^a	2056±25 ^a	N.S

^{a-b} Means within rows with different superscripts differ significantly (P 0.05). N.S. non-significant

CONCLUSION

It can be concluded that the brown line of local quails have higher productive performance, egg production and quality in female, so males gain high semen quality. High hatchability rate and chicks quality, certain blood serum characteristics and improved in chicks immunity than white and black lines of local quails. Therefore, advised to interest rearing brown line for its economic profit.

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ISOLATION OF GRAMNEGATIVE BACTERIA FROM ULCERATED SKIN LESIONS AND OTHER PARANCHYMATORY ORGANS OF CARP FISH PONDS AT SULUMANIA PROVINCE

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ABSTRACT

This study was conducted for isolation of the gram negative bacterial causative agents of skin ulceration in ponds carp fish in Sulaimani province. Samples were taken from 5 ponds of common carp fish (*Cyprinus Carpio*L.) from different regions in the Sulaimani province , which have an ulcerated skin lesions, available in Kfry, Kanarwe, Chwarta and 2 ponds in Dukan.The total number of fish were 17700 ,morbidity rate was (67.7%), and mortality rate was(20.7) .The result of the study revealed that there were 8 species of gram negative bacteria isolated from skin lesion, liver and kidney, which were the following bacteria (*Pseudomonas spp*, *Citrobacter freundii*, *Citrobacter amalonaticus*, *Enterobacter aerogenes*, *Serratia odorifera*, *Escherichia coli*, *Proteus Volgaris*,and *Edwardsiella tarda*). All 8 species of bacteria were isolated from skin lesions and seven species of bacteria were isolated from liver, while only 5 species of bacteria were isolated from the kidney that were (*Pseudomonas sp*, *Citrobacter freundii*, *Citrobacter amalonaticus*, *Enterobacter aerogenes*, *Edwardsiella tarda*). The high isolated bacterial prevalence in this study were *Pseudomonas sps* (19.35%) and *Citrobacter freundii* (19.35%) which have been isolated from 2 ponds, from the skin lesion in (6.45%), from the liver (6.45%) and the kidney (6.45%) of the infected fish. The rate of isolated *Edwardsiella tarda* was (12.90 %), from the skin lesion of 2 ponds in a ratio of (6.45%) while (3.22 %) from the liver and the kidney (3.22 %) in only one pond.

KEY WORDS : ulceration ,skin , carp fish.

INTRODUCTION

Production of fish, gradually developed in the world as well as in Iraq, the history of fish farming in Iraq can be drawn back to the mid of last century (Al-Hamed, 1960), while in Kurdistan region, the culture industry developed only during the last twenty years or so, and now spread to many farms in the region (Shamall and Kamaran, 2013).

Fish diseases are one of the major problems in a fish farm (Idowu *et al.*, 2013), fish farms are affected by many pathogenic microorganisms including bacteria, virus, parasite and protozoa (Roberts, 2010) and these farms could also be affected by noninfectious diseases (Mhaisen, 1993).

Skin disorders in fish are especially harmful and any surface injury to the skin makes fluid balance more difficult and may lead to circulatory malfunctions the skin layers are extremely important protective barriers for fish, and the mucus allows fish to slip through the water more

easily, so less energy is used while swimming, also there are several protective compounds in the mucus that protect the fish from bacteria and other organisms in the water (Noga, 2000).

Skin ulcers in fish can have many different etiologies, including infectious agents, toxins, physical causes, immunologic causes, nutritional and metabolic disturbances (Law, 2001).

The most common group of bacterial pathogens that affect fish include bacteria in the genera *Aeromonas*, *Vibrio*, *Edwardsiella*, *Pseudomonas*, *Flavobacterium*, also several members of family *Enterobacteriaceae* have been identified from fish samples as *Proteus vulgaris*, and *Escherichia coli*, these bacteria are potentially present in water and are not known as classical fish pathogens (Al-Imarah 2008) .

The most important fish pathogens are *Pseudomonas* and *Aeromonas*, both of them are gram-negative bacteria, these microorganisms are responsible for skin ulcer type diseases, including ulcerative syndrome, hemorrhagic septicemia, tail

and fin rot, bacterial gill rot and dropsy (Shayo *et al.*, 2012).

Vibrio spp. caused a disease which is very similar to motile aeromonad septicemia and results in hemorrhagic septicemia with cutaneous hemorrhages, and ulcers and as with other bacterial infections, underlying environmental stresses are often present (Roberts *et al.*, 2009).

Also a clinical illness of Cyprinids that indicated typical acute bacterial septicemia caused by Gram-negative bacteria *Citrobacter freundii*, this disease of Cyprinids was characterized by typical hemorrhagic septicemia on the skin and internal organs, (Svetlana *et al.*, 2003).

Edwardsiella tarda, a Gram-negative bacterium belonging to the family Enterobacteriaceae, is the causative agent of Edwardsiellosis which is a septicemic disease characterized by extensive lesions in the skin, muscle and internal organs and infected commercially important fish including eels, channel catfish, mullet, Chinook salmon, flounder, carp, tilapia and striped bass (El-Sayyadet *et al.*, 2010) and *Edwardsiella tarda* was isolated from common carp (Sae-Qui *et al.*, 1984). This microorganism is present in the aquatic environment and infection by this organism can lead to mass mortality (Mohanty and Sahoo, 2007).

The aim of this study was isolation of bacterial causes of skin ulceration in pondsof carp fish at Sulumania Province .

MATERIAL AND METHODS

1- Clinical Examination

The fish have been examined clinically according to the methods described by (Noga 2010). Attention to fish behavior in eating, swimming ,changes in color, respiratory manifestations and external lesions must be taken in consideration.

2- Materials

2-1: Collection of Samples and Preparation

A collection of different cases from 5 pond carp fish that have ulcerated skin lesions from different regions of Sulaimani province. Total fish were collected from ponds during the period from October 2014 till May 2015. Fish specimens were collected by nets that were used to capture these fish. Then each fish was rinsed with de-ionized water and the surface of the fish was decontaminated by dipping it in ethyl alcohol.

Then necropsy was done for liver and kidney samples

2-2: Using some of the different isolated media as shown in table 1.

3. Using some of the biochemical tests as shown in table 2.

4. Use of the Rapid Biochemical kits test (Remel one system) for bacterial diagnosis, which contains 20 rapid biochemical tests

5. Use of some laboratory chemical and stain reagent as shown in table 3.

Table (1):Shows some of the different isolated media

No	Items	Note
1	Nutrient Broth	LAB M. LAB014
2	Nutrient Agar	LAB M. LAB008
3	MacConkey Agar	LAB M. LAB045
4	Blood Agar Base	LAB M. LAB015

Table (2):Shows some of the biochemical tests.

No	Items	Note
1	Kliglar Iron Agar	LAB M. LAB059
2	Urea test	-
3	Simmons Citrate Agar	Accumix™ .BCM

Table (3):Shows laboratory chemical and stain reagent.

No	Items	Note
1	Crystal violet	-
2	Iodine	-
3	Safranin	0.25%

3- Methods:

Microbiological Examination

Swabs and a small piece of the ulcerated lesion, liver and kidney of infected fishes have been taken. Preserve immediately and disinfected in nutrient broth, the samples have been preserved in a cool box till brought to the laboratory for bacterial isolation, then incubated at 25°C for 24hrs.

Bacterial isolation and identification

A loop full from each broth tube was streaked onto the following media: Nutrient agar, MacConkey's agar and blood agar. Purified isolates were used as stocks for further morphological and biochemical identifications.

Morphological characterization of bacteria

Bacterial film was prepared from each suspected purified isolate and stained with Gram's stain (Cruickshank *et al.* ,1979) then examined under the bright field microscope with the oil immersion lens.

Biochemical characterization

Traditional methods

The separate colonies were subjected to biochemical identification by the following tests: triple sugar iron agar, urea utilization, and Simmon`s citrate agar, according to the biochemical identification keys of Practical Medical Microbiology, 14th ed., edited by (Collee et al.,1996).

Rapid biochemical kits (Remel one system)

Biochemical profiling test was performed according to manufacturer's instructions. Finally isolates were stabbed into tubes containing semi-solid nutrient agar medium and then incubated at 37°C for 18- 24 hrs. This test contains 20 biochemical tests as the following table (4).

Table (4): Remel one system contains 20 rapid biochemical tests.

reagent	NON																			
Positive	Red Or Violet	Bright purple or blue																		
Cavity# ,no	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	18	
Test code		A D H	O D C	L D C	T E T	L I P	K F S	S B L	G U R	ONP G	B G L	B X Y	NA G	MAL	G G T	PYR	SBL	ADON	IND	O X L
Value	1	2	4	1	2	4	1	2	4	1	2	4	1	2	4	1	2	4	1	2
result																				
Value total																				

Remel
 Refrence #, NO.
 Date.
 Tech. Source
 Identification
 Microcode /
 REMEL Inc

rapid™ one

report form

800-255-6730

printed in USA 04/12

Procedure of Remel one system.

1-test organisms must be grown in pure culture and examined by Gram stain before use in the system.

2- test organisms may be removed from a variety of selective and nonselective agar growth media.

The following types of media are recommended:

Nonselective media: Tryptic Soya Agar with or without 5% sheep blood; Nutrient Agr.

Differential or Selective Media: MacConkey Agar; Salmonella –Shigella Agar.

Plates used for inoculums preparation should by preference be 18-24 hours old. Slow growing isolates may be tested using 48-hour plates .

3- using a cotton swab or inoculating loop and Culture in RapidTM inoculation fluid (2ml) to achieve a visual turbidity equal to at #2 McFarland turbidity standard or equivalent.

Suspension is less turbid than #2 McFarland standards will result in aberrant reaction.

Bacterial suspensions that are slightly more turbid than a #2 McFarland standard

Suspensions should be mixed thoroughly and vortexes if required.

Suspensions should be used within 15 minutes.

4-an agar plate may be inoculated for purity and any additional testing that may be required to use a loopful of the test suspension from inoculation fluid tube incubate the plate for at least 18-24 hours at 35 - 37°C.

Inoculation of RapidTM one Panels:

1- Peel back the lid of the panel over the inoculation port by pulling the tab market (peel to inoculate)up and to the left.

2- using a pipette, gently transfer the entire contents of the fluid inoculation tube into the upper right –hand corner of the panel. Reseal the inoculation port on the panel by pressing the peel-back tab back in place.

3- after adding the test suspension, and while keeping the panel on a level surface. Tilt the panel back away from the reaction cavities at 45-degree angle.

4-While tilted back, gently rock the panel from side to side to evenly distribute the inoculums along the rear baffles.

5- While maintaining a level, horizontal position, slowly tilt the panel forward toward the reaction cavities until the inoculam flows along the baffles into the reaction cavities.

6- Return the panel to a level position. If necessary, gently tap the panel of the bench top to remove any air trapped in the cavities.

Incubation of RapidTM one Panels:

Incubate inoculate panels at 35 - 37°C in a non-CO₂ incubator for 4 hours.

Scoring of RapidTM one Panels:

RapidTM one Panels contain 18 reaction cavities that provide 19 test scores. Test cavity 18 is bifunctional, containing to separate tests the same cavities bifunctional tests are first scored before the addition of reagent to provide the first test result and the same cavity is scored again after the addition of reagent to provide the second test result. Test cavities 15 through 17 require RapidTM one reagent and are designated with a box drawn around them. Bifunctional test 18 which use RapidTM Spot Indole Reagent with a box drawn around the reagent-requiring test.

1-While firmly holding the RapidTM one Panel on the bench top , peel off the label, lid over the reaction cavities by pulling the lower right-hand tab up and to the left.

2- We added 2 drops of RapidTM one reagent to the cavities 15 (PRO) through 17 (PYR).

3- Wered and score cavities one (URE) through 18 (ADON) from left to right using the interpretation to guide presented in Table 6. Record test scores in the appropriate box on the report form using the test code above the box for the bifunctional test.

4-We added 2 drops of RapidTM Spot Indole Reagent to the cavities 18 (ADON /IND)

5- We allowed at least 10 seconds but no more than 2 minutes for color development.

6- We readas score test cavity 18 (IND). Record the score in the appropriate Box on the report form.

7- Reference the microcode obtained on the report form in the RapidTM ONE Code Compendium or ERIC (Electronic RapidTM Compendium) for the identification.

RESULTS & DISCUSSION

This study detects that the main causative agents of skin ulceration in fishes are bacteria which was identified as (*Pseudomonas spp*, *Citrobacter freundii*, *Citrobacter amalonaticus*, *Enterobacter aerogenes*, *Serratia odorifera*, *E.coli*, *Proteus vulgaris*, *Edwardsiella tarda*).

A pure culture of isolated bacteria was successfully done from skin, liver, and kidney of naturally infected common carp fish. All bacterial growth were gram negative and motile.

The biochemical patterns of representative of the recovered isolate are summarized in Table (4), the isolated bacteria from skin, liver, and kidneys of naturally diseased (*Cyprinus carpio L*) were *Pseudomonas spp* (5500410), *Citrobacter freundii* (0031430), *Citrobacter amalonaticus* (4235131), *Enterobacter aerogenes* (0337330), *Serratia odorifera* (413143), *Escherichia coli* (4161002), *Proteus vulgaris* (0602001), *Edwardsiella tarda* (0602001). All of them are under the Family of Enterobacteriaceae-Facultatively Anaerobic Gram-Negative Rods.

According to the data shown in table 8, the origin of gram negative bacterial isolates tested were: *Pseudomonas spp* was isolated from 2 ponds (Kfry and Dukan1) in different site of the fish samples: skin lesion, liver and kidney from Kfry's pond, also *Pseudomonas spp* was isolated from Dukan pond 1 from 3 sites of infected fish: skin lesion, liver and kidney. The species of *Proteus vulgaris* were isolated from 2 ponds Kfry and Kanarwe, *Proteus vulgaris* was isolated only from skin lesion in Kfry pond and from (skin lesion and liver) in Kanarwe's pond.

Citrobacter freundii had isolated from skin lesion, liver and kidney, from samples of both ponds Kfry and Dukan pond 2, while *Citrobacter amalonaticus* was isolated from the skin lesion and kidney of Dukan pond 2. Whereas the species *Edwardsiella tarda* was isolated from two pond Chwarta and Dukan pond 2, in Dukan pond 2 from three organs of fish skin, liver and kidney, also in Chwarta pond only from the skin lesion.

Yarsina krestensia have been isolated only from skin, liver and kidney samples from Kanarwe pond. Also species *Serratia odorifera* were isolated only from skin lesion and liver samples from Dukan pond1, also *Enterobacter aerogenes* isolated from tow organs only of fish, skin lesion and kidney at Dukan pond 2. The species *Escherichia coli* was isolated from two

ponds Dukan pond1 and Kanarwe, from Dukan pond1 *E.coli* have been isolated from skin lesion and the liver, where as from Kanarwe pond it was isolated only from the skin lesion.

Table 8 shows the number and percentage of the bacteria isolates from the skin lesions and some of the internal organs of fish at different region of Sulaimani province. Totally 9 species of bacteria were isolated from skin lesion, liver and kidney of 5 cases which had skin ulceration. Total isolated bacteria from skin lesion was 14 (45.16 %) isolates, from liver was (1032.22%) isolates and from kidney was 7(22.56%) isolates.

The *pseudomonas spp* (19.35%) and *Citrobacter freundii* (19.35%) has been a high bacterial prevalence of this study, each of them was isolated from 2 ponds, which have skin ulceration, also the ratio of the isolation of *pseudomonas spp* and *Citrobacter freundii* were present in the same percentage from (skin lesion 6.45%, liver 6.45% and kidney 6.45%) of the infected fish. After that frequently rate of isolated *Edwardsiella tarda* was (12.90 %) during this study, skin lesion of 2 ponds has been *Edwardsiella tarda* at the ratio of (6.45%) while *Edwardsiella tarda* was isolated from liver (3.22 %) and kidney (3.22 %) from only one case.

Proteus vulgaris, *E.coli* and *Yarsina Kerstenia* were isolated separately with the same ratio (9.67%) of different organs. *Proteus vulgaris* and *E.coli* were isolated from the skin lesion of 2 cases with a ratio of 6.45 % and from liver of one case with a ratio of (3.22%). Also, *Yarsina Kerstenia* was isolated from one case with the same ratio from the skin (3.22%), liver (3.22%) and kidney (3.22%).

Citrobacter amalonaticus, *Enterobacter aerogenes* and *Serratia odorifera* were isolated with the same ratio (6.45%) from only one pond that had skin ulceration. However *Enterobacter aerogenes* and *Serratia odorifera* were isolated from skin lesion (3.22%) and liver (3.22%) while *Citrobacter amalonaticus* was isolated from skin lesion (3.22 %) and kidney (3.22 %)

Table (8):- number and percentage of bacterial isolates from different organs of fish at different region of Sulaimani province.

Name of isolated bacteria	Number & Percentages of isolated bacteria from Organs.			Total
	Skin	Liver	Kidney	
<i>Pseudomonas spp</i>	(2) 6.45 %	(2) 6.45 %	(2) 6.45 %	(6) 19.35%
<i>Citrobacter freundii</i>	(2) 6.45 %	(2) 6.45%	(2) 6.45 %	(6) 19.35%
<i>Edwardsiella tarda</i>	(2) 6.45 %	(1) 3.22%	(1) 3.22 %	(4) 12.90%
<i>Proteus volgaris</i>	(2) 6.45 %	(1) 3.22%	-	(3) 9.67%
<i>E.coli</i>	(2) 6.45 %	(1) 3.22%	-	(3) 9.67%
<i>Yarsina krestensia</i>	(1) 3.22 %	(1) 3.22%	(1) 3.22 %	(3) 9.67%
<i>Serrasia odenifera</i>	(1) 3.22 %	(1) 3.22%	-	(2) 6.45%
<i>Citrobacter amalonaticus</i>	(1) 3.22 %	-	(1) 3.22 %	(2) 6.45%
<i>Enterobacter aerogenes</i>	(1) 3.22 %	(1) 3.22%	-	(2) 6.45%
	(14) 45.16%	(10) 32.22	(7) 22.56%	(31) 99.9%

A major biological interface between a fish and its aqueous environment effect the epidermis because its overlying mucous layer forms over the fish and playing a great role in protecting against injury, friction reduction and ion regulation (Handy *et al.*, 1989, Fouz *et al.*, 2000). The epidermis has a number of chemical defenses and mucous, such as complement, natural antibiotics, immunoglobulin, lysozyme and agglutinins, may support in the protection (Ellis, 2001).

McGarey *et al.*, (1991) state that a common fish disease is an epizootic ulcerative symptom characterized by the presence of severe, open dermal ulcers on the head, on the middle of the body, and on the dorsal regions of the fish. Ulcerative syndrome disease is still unknown; however, organisms belonging to the potentially fish-pathogenic genera *Pseudomonas*, *Vibrio*, *Aeromonas* and *Plesiomonas* were often isolated from the lesions (Rahman *et al.*, 2002).

In general clinical examination of the bacterial infection of common carp fish in this study showed are similar to the results which were reported by (El-Sayyad., *et al* 2010) and (Sujatha *et la.*,2013)

The result of this study indicates isolation of the many species of gram-negative bacteria from

the affected fish are most frequently species of bacteria that are evreywhere in the aquatic

environment acting as opportunistic pathogens and most of these bacterial infections of fish are caused by gram negative organisms and include the genera *Citrobacter*, *Pseudomonas*, *Edwardsiella*, *Aeromonas*, *Flavobacterium*, and *Vibrio*, which caused skin lesion in different species of fish (Roberts *et al.*,2009).

Several members of family *Enterobacteriaceae* infected fish in this study and caused external lesions,*Pseudomonas sps* was one of them which is encountered in cases of spottiness of the skin and hemorrhagic septicemia (Toranzo*et al.*, 2005, Mastan, 2013 andHanna *et al.*, 2014). Also*Pseudomonas sps* were isolated from skin lesion, liver, and kidney of diseased fish, and this agrees with the results of (Khatun *et al.*, 2011and Mastan, 2013). Mesalhy *et al.*, (2013) isolated *Pseudomonas species* from naturally infected and experimentally infected skin of Nile tilapia and African catfish (*Clarias gariepinus*), silver carp (*Hypophthalmichthys molitrix*) and gray mullet (*Mugil cephalus*), while Eissa *et al.*, (2010) isolated *Pseudomonas sp* mainly from liver followed by the kidneys.

In this study, *Citrobacter freundii* was isolated from the infected fish, this result are similar with the results of (Svetlana *et al.*, 2003 and Karunasager *et al.* 1992).*Citrobacter freundii* was isolated from the liver and the kidney of diseased fish, which were characterized by presence of hemorrhagic spots on the surface of the liver and kidney, which had given abnormal color to them, this result agrees with (Svetlana *et al.*, 2003).

The isolation of *Citrobacter freundii* from skin, liver and kidney, in this study is due to that this bacteria isan opportunistic pathogen of wide spectrum in susceptible hosts (Pádua *et al.*, 2014) . In this study, a common carp infected with *Edwardsiella tarda*, which was isolated from the skin ,liver and kidney of the diseased fish this result agrees with the ones by (El-Sayyad *et al.*,2010) who detected Edwardsiellosis as a septicemic disease characterized by extensive lesions in the skin of commercially important fish including eels, channel catfish, mullet, Chinook salmon, flounder, carp, tilapia and striped bass.Also (Eshetu Yimer, 2000) isolated *Edwardsiella tarda*, from the liver of one *Oreochromis niloticus* and kidney of another carp species which is known to be pathogenic to fish. During this study, bacterial infections of *Pseudomonas sps Citrobacter frunidii*, and *Edwardsiella tarda* were found as mixed infections. This could be attributed to the suppressed immunity of the cultured fish (El-Sayyad *et al.*, 2010).

Citrobacter amalonaticus and *Serratia odorifera* were also isolated from the infected fish and caused skin lesion and same results had been seen by (El-Sayyad *et al.*,2010), who showed that *Citrobacter amalonaticus* and *Serratia odorifera* were isolated from skin lesion of diseased sharp tooth catfish (*Clarias gariepinus*

In this study, *Enterobacter aerogenes* was isolated from the skin and liver of diseased fish, this bacteria has been reported to cause diseases in fish (Jakhar *et al.*, 2010). Also Salah *et al.* (2012) isolated *Enterobacteriaceae* including *Escherichia coli*, *Proteus spp.* and *Enterobacter aerogenes* respectively from the infected Nile Tilapia,

The infected fish had *Yarsinia kristensenii*, which was isolated from the skin,kidney and liver lesion.*Yarsinia kristensenii* previously was described as *Yarsinia enterocolitica*-like organisms, isolated mainly from various environmental sources (water and fish) (Goull and

Picard ,1988). Also Eshetu (2000) who showed *Escherichia coli*, *Citrobacter*, *Shigella species*, and *Yersinia enterocolitica* were the major bacteria identified from the apparently healthy fish.

Enterobacteriaceae is a common water-borne bacterium that may be present in the tissues of apparently normal fish (Newaj *et al.*, 2008) whenever fish are revealed to environmental stress, or injury, it causes serious outbreaks of disease with mortalities (Sekar *et al.*, 2008).

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EFFECTS OF SUPPLEMENTED DEFFERENT LEVELS OF LOCAL VETCH SEEDS (*Common Vicia sativa*) SOAKED IN DIFFERENT SOLUTIONS ON BROILERS PERFORMANCE

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ABSTRACT

This study was conducted to improve nutritive value and investigate the possibility of using two levels (15,30%) of raw or soaked *common Vicia sativa* seed (cvs) in water or in acetic acid, in the broiler diet and their effects on the production performance and some biochemical blood parameters of broiler. The treatments were include : 1) control diet, 2) 15% raw cvs seeds, 3) 15% water soaked cvs seeds, 4) 15% acetic acid 1% soaked cvs seeds, 5) 30% raw cvs seeds, 6) 30% water soaked cvs seeds, 7) 30% acetic acid 1% soaked cvs seeds. The results showed that birds fed diets contained treated cvs had significantly higher body weight compared to those received raw cvs seeds in their diets. However, the birds fed control diet had higher ($P < 0.05$) body weight over all treatments. Feed intake was significantly lower in birds fed raw or treated cvs seeds relative to control group. Feed Conversion ratio (FCR) was significantly poorer in birds fed 30% raw cvs seeds compared to other experimental groups. The mortality percentage was higher ($P < 0.05$) in birds fed raw cvs seeds compared to control birds. Statistical analysis showed that birds received 15 or 30% cvs seeds soaked in water or acetic acid had significantly higher performance index than those received 15% or 30% raw cvs seeds. However, birds in control group had higher production performance index relative to other experimental groups. Furthermore, the relative weights of liver, pancreas and heart were significantly higher ($p < 0.05$) in birds received 30% raw cvs seeds than control group. Blood serum biochemical parameters results of the current study showed that bird groups fed diets contained raw cvs seeds had significantly lower total protein, albumin and glucose concentrations, while triglycerides and cholesterol concentrations in birds fed on either 15% or 30% raw cvs seeds were higher in compared to the other groups. With regard to the economic evaluation of experimental parameters, the results showed that there was no significant differences in the third treatment (15% water soaked cvs seeds) in compare with control of both the value of the net profit and the net profit ratio contribution, recorded the lowest value of the net profit and the share of net profit in birds group fed diets contained 15% or 30% raw cvs seed.

KEY WORDS: vetch seeds, broiler chicks, water soaked, acetic acid soaked

INTRODUCTION

Increasing the costs of conventional feedstuffs like corn, soybean meal and fish meal for poultry diets is pushing the need to find less expensive alternatives source. (Sadeghi et al., 2009), and this protein untapped sources are common *Vicia sativa* seed (cvs), which is one Family plants leguminosae and a good source of protein and energy, containing crude protein about 24-32% and metabolizable energy about 2880 – 3100 Kcal/Kg (Francis et al., 1999), and that the amino acid chain which is similar to a large extent for the soybean

meal (Yalcin and Onol, 1994) and (Farran et al., 2001). However, its importance is limited to animals with a stomach simple inability to resist the toxins inhibitory factors that affect the process Metabolism (Farran et al., 2001). The presence of some anti-nutritional factors (ANF) and toxins in the crude seeds limits their use in poultry diets. The main ANF in vetch cvs are -cyano-L-alanine (BCA), protease (trypsin and chymotrypsin) inhibitors, vicine, convicine, and tannins. Which have negative effects on the production performance and health status of birds (Abdullah et al., 2010). Can be seen from the foregoing that (cvs) of great

importance in poultry feed because of its cheap in cost and rich in protein content and energy and amino acids.

The aim of this study was to try to improve the nutritional value of the (cvs) by using two methods of treatment soaking in water or soaking in acetic acid 1% in diets of broiler chicks and its effects on the production performance and some biochemical characteristics of blood serum.

MATERIALS AND METHODS

This study was conducted in the poultry field of the animal resources department at the college of Agriculture and Forestry - University of Mosul for the period from 10/10/2013 until 11/1/2015. A total of 420 unsexed one day old of hybrid broiler chicks strain (Ross 308), average of weight(40g) were used. Chicks were reared together as one group during the 1st week of age then the chicks were randomly distributed into seven treatments groups. Each group were divided into two replicates with 30 birds per pens. The treatments were as follows: 1) control diet (0%) cvs seeds T1, 2) 15% raw cvs seeds T2, 3) 15% water soaked cvs seeds T3, 4) 15% acetic acid 1% soaked cvs seeds T4, 5) 30% raw cvs seeds T5, 6) 30% water soaked cvs seeds T6, 7) 30% acetic acid 1% soaked cvs seeds T7. *Common Vicia sativa* seeds were obtained from local market in Mosul. The seeds were either grinded and soaked in water (10 water:1 seed) for 72 h with changing the water every 12 h or soaked in acetic acid (1%) at room temperature (5 acid:1 seeds) for 24 h and sun dried. The birds were reared on the floor in a house (wire mesh partitioned at 1 × 2.5 m²). During the trial period, experimental diets were fed starter diets (Table 1) during first three weeks and finisher diets (Table 2) between 4-7 weeks. Then evaluate some traits such as: live body weight, feed intake, feed conversion ratio, production index and mortality rate. In the investigation, quantitative traits such as carcass weight, dressing percentage and the percentage of some carcass cuts (thigh, breast, back, wing, neck) adipose tissue, liver weight, heart weight and gizzard weight were measured, in addition the biochemical characteristics of blood serum and economic evaluation of the study were also calculated. The chemical analysis of raw and treated vetch seeds were conducted in laboratory as

shown in (Table 7). The work of the experimental diets to the stage (Starter and Finisher) identical in their content of crude protein and energy represented by the bird needs for each phase depending on the recommendations adopted by The NRC National Research Council (1994), as shown in the Table 1 and 2.

STATISTICAL ANALYSIS

Data were analyzed using complete random design (CRD), to study the effect of treatments on performance, carcass and blood characters in the traits, as a significant test for differences between the averages using multi-range test Duncan (Duncan, 1955) at the level of probability ($p < 0.05$) using the statistical program SAS 2003.

Table(1):- Ration formulation and feed ingredients for chicken in 1-21days old (Starter).

Ingredient%	Treatments*						
	T1	T2	T3	T4	T5	T6	T7
Yellow corn	56	48	48	48	41	41	41
Soybean meal	35	28	28	28	20	20	20
Vetch seeds	0	15	15	15	30	30	30
**Protein concentrate	5	5	5	5	5	5	5
Vegetable oil	3	3	3	3	3	3	3
Salt	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Limestone	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Premix	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total	100	100	100	100	100	100	100
Calculated composition (NRC,1994)							
Crude Protein	23.4	23.6	23.5	23.6	23.6	23.4	23.5
ME(kcal/kg)	3034	3060	3063	3064	3068	3067	3068
Methionine	0.58	0.54	0.52	0.55	0.60	0.56	0.58
Lysine	1.16	1.14	1.18	1.12	1.18	1.21	1.16
Methionine + Cysteine	0.95	0.93	0.91	0.94	0.96	0.94	0.97
Crude Fiber	3.19	3.16	3.13	3.15	3.14	2.98	3.13
Ether Extract	2.71	2.29	2.53	2.55	2.36	2.39	2.42
Calculated analysis in laboratory							
Crude Protein	22.6	22.4	22.5	22.3	22.4	22.5	22.4
Ether Extract	2.81	2.34	2.57	2.75	2.46	2.49	2.46
Crude Fiber	3.35	3.26	3.22	3.27	3.22	2.78	3.73

*T1 is control group (free of seeds cvs), T2, 15% raw seeds cvs, the T3 15% cvs(soaked in water), T4 15% cvs (soaked in acetic acid 1%),T5 30% raw seeds cvs, T6 30% cvs (soaked in water), T7 30% cvs (soaked in acetic acid1%).

** Provided % of diet (WAFI), 40% crude protein, 5% Ether Extract, 2% crude fiber, 3.85% lysine, 3.7% Methionine, 4% Methionine + Cysteine, ME2100(kcal/kg).

Table (2):- Ration formulation and feed ingredients for chicken in 22-49 days old (Finisher).

Ingredient%	Treatments*						
	T1	T2	T3	T4	T5	T6	T7
Yellow corn	63	53	53	53	46	46	46
Soybean meal	28	23	23	23	15	15	15
Vetch seeds	0	15	15	15	30	30	30
**Protein concentrate	5	5	5	5	5	5	5
Vegetable oil	3	3	3	3	3	3	3
Salt	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Limestone	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Premix	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total	100	100	100	100	100	100	100
Calculated composition estimated (NRC,1994)							
Crude Protein	20.8	21.5	21.3	21.4	21.5	21.3	21.4
ME(kcal/kg)	3144	3141	3144	3145	3149	3155	3157
Methionine	0.47	0.44	0.41	0.46	0.42	0.40	0.44
Lysine	0.95	0.94	0.92	0.96	0.94	0.98	0.95
Methionine +Cysteine	0.72	0.74	0.72	0.75	0.76	0.72	0.77
Crude Fiber	3.10	2.83	2.76	2.29	2.85	2.63	2.83
Ether Extract	3.11	2.79	2.81	2.82	2.60	2.63	2.65
chemical composition actually (laboratory)							
Crude Protein	21.3	21.8	21.7	21.8	21.9	21.6	21.7
Ether Extract	3.51	2.88	2.91	2.97	2.90	2.93	2.98
Crude Fiber	3.4	2.73	2.72	2.39	2.92	2.89	2.88

*T1 is control group (free of seeds cvs), T2, 15% raw seeds cvs, the T3 15% cvs(soaked in water), T4 15% cvs (soaked in acetic acid 1%),T5 30% raw seeds cvs, T6 30% cvs (soaked in water), T7 30% cvs (soaked in acetic acid1%).

** Provided % of diet (WAFI), 40% crude protein, 5% Ether Extract, 2% crude fiber, 3.85%lysine, 3.7% Methionine, 4% Methionine + Cysteine, ME2100(kcal/kg).

RESULTS AND DISCUSSION

The results showed(Table 3) that the birds fed diets treated CVS seeds had significantly higher body weight and weight gain compared to those received raw CVS seeds in their diets. However, the birds in control diet had higher ($P < 0.05$) body weight and weight gain over all treatments. Feed intake was significantly lower in birds fed raw or treated CVS seeds compared to control group . Feed Conversion Ratio (FCR) was significantly poorer in birds fed 30% raw cvs

seeds compared to other experimental groups. The mortality percentage was higher ($P < 0.05$) in birds fed raw cvs seeds compare to control birds. The highest mortality percentage was recoded for birds fed 30% and followed by 15% raw cvs seeds .These findings are consistent with Sadeghi et al(2004), which stated that treatment of 15% seeds raw Vetch soaked in the water led to an improvement in the rate of live body weight of the broiler are significant compared to the transactions containing seeds Vetch raw form, but it was less weight to those in the control

group .While the rate of deterioration of body weight with an increased level of seeds Vetch from 30 to 45%. It also agreed with Farran et al(2001) results , who asserted that the process of soaking the vetch seeds in water had improves the performance of the birds, but the improvement did not reach the level of those in t h e c o n t r o l g r o u p .

Generally, the results obtained from this study that average of birds weight has significantly improved were fed diets contend vetch seeds 15% treated by soaking in water ,compare with birds group were fed diets contained different level(15-30%) of raw vetch seeds or vetch seeds soaking in acetic acid 1%, but this average of live body weight did not reach average in birds in control group -free seeds Vetch, demonstrating the effectiveness of the treatment method of soaking water in relieving toxins and anti-nutritional factors ANF. It was reported in some studies that the seeds of raw Vetch when they are used to high levels, which contain high levels of ANF such as tannins, vicine and lectins, which have the ability to discourage Activity digestive enzymes of protein , carbohydrates and fat, and is characterized by these compounds in its ability to blood Haemagglutinins that have assembly serious repercussions on growth and public health for the birds, as these compounds cause damaging to the mucous membranes of the digestive tract and the erosion of the cells lining the wall of the small intestine, leading to bleeding topical infections, intestinal and thus to a lack of absorption of nutrients, leading to rapid weight loss and death (Al-Mendalawi ,2009 , Sadeghi et al.,2009, Al-qhomssani, 2012 and Yusuf and Altarqi,2012).

It was noted from the table (3) That significant decrease of feed consumption in birds of all groups fed feed treated with Vetch seeds compared to control. While no significant differences in feed consumption between birds that fed with the diet containing a low level of the seeds raw Vetch (15%) in the second group T2 and other groups (T3, T4, T6 and T7) containing Vetch seeds by (15 and 30%) which have been improved nutritional value soaked in water or in acetic acid 1%), while happened deterioration in the feed consumption in birds fed

on (30%) raw Vetch seeds which recorded the lowest rate in feed consumption. The reason may be due to the low palatability of feed with raising level of raw Vetch seeds because they contain increasing amounts of toxins and anti-trypsin (Sadeghi et al., 2009). These results agreed those reported by Castanon and Perez-Lanzac (1990), Majeed(2009)and Sadeghi et al(2011) who found that raising the proportion of raw vetch in broiler diet from 10% and up to 45% led to a significant decrease in the amount of feed intake. Also It is clear from the (Table3) significant improvement in feed conversion ratio (FCR)of the birds in control group compared to all experimental treatments. Also that the treatment of vetch seeds (soaking in water or in acetic acid 1%) positive effects on food conversion ratio for the birds, the proportion (15 and 30%) treated vetch Seeds compared to (T2 and T5) containers on the same proportion of the seeds raw Vetch and degraded the value of FCR of the two, may be attributed the cause of the deterioration of the (FCR) in treatments to increase the level of anti-nutritional factors property the (BCA), which was observed from the chemical analysis it contains 36.0% of the dry matter (Farran et al., 2001) and the toxic effects of this compound through overlaps in sulfur transsulfuration process of amino acids sulfur (eg: oxidized parts of cysteine to consist bond sulfur bilateral between them to produce Cysteine this interaction plays a role in maintaining the structural composition of proteins) (EPA, 2009). As well as on the lower crude vetch seeds to sulfur amino acids compared to soybean leads to an imbalance of these acids in dietary protein and thus the decrease of feed conversion ratio, where the ratio of methionine 0.75% in the raw vetch seeds versus 1.3 % in the soybean meal (Farran et al., 2001). However ,the mortality rate has been found to increase significantly in T2 and T5 compared to other treatments ,also there are no significant found in treatments soaked in water or in acetic acid 1% (T3, T4, T6 and T7) compared to control. These results agreed with that found by Majeed (2009), who noted that the mortality percentage increase directly proportional to increase the proportion of Vetch seeds in broiler diet. Figure(1) indicate that there

are significant differences between the production index value in experimental treatments used in the current study . Our data showed that the production index were significantly different between treatments. The highest production index were verified for control birds group (350.3) and followed by T3 (309.4). Conversely, the lowest production index was documented for T5 (155.2) and T2 (200.7).The decrease in production index value in T5 group reflect the lower economic value, because it is known that the high production

index value opposed high productivity and good profit. Despite that, the production index values in all treatments took place within the economic range, as indicated by(Fayad and Saad, 1999) ,high production index of the 150 values is a good indicator to breeding broiler chicks.These results are agree with the obtained by Majeed(2009) and Kloor(2011), high value of production index in the first treatment free of vetch seeds and lower in the experiment treatment ,which contain the highest rate of raw vetch seeds .

Table (3):- Effects supplemented deferent Proportion of raw or treated Vetch seeds (soaked on water or acetic acid 1%) to broiler diet on production performance at 49 days old (averages \pm standard error).

Traits	Treatments						
	T1	T2	T3	T4	T5	T6	T7
Live body weight	2946.6 \pm 6.0 a	2252.6 \pm 52.3 d	2722.7 \pm 53.6 b	2513.2 \pm 69.1 c	1837.9 \pm 25.3 e	2302.8 \pm 2.6 d	2355.6 \pm 53.7 d
Feed intake	4961.9 \pm 14.7 a	4466.6 \pm 73.8 b	4550.2 \pm 61.6 b	4475.7 \pm 24.1 b	3907.2 \pm 52.7 c	4334.8 \pm 32.9 b	4409.1 \pm 42.3 b
Feed conversion ratio	1.71 \pm 0.02 c	2.00 \pm 0.08 ab	1.70 \pm 0.01 c	1.85 \pm 0.02 bc	2.15 \pm 0.09 a	1.90 \pm 0.02 b	1.90 \pm 0.05 b
Mortality rate %	3.34 \pm 0.01 c	6.68 \pm 0.02 b	3.34 \pm 0.01 c	3.34 \pm 0.01 c	11.69 \pm 0.03 a	3.34 \pm 0.01 c	3.34 \pm 0.01 c

Different letters within the same column indicate significant differences at the level of probability ($p < 0.05$).

T1 control, T2 15% raw vetch seeds, T3 15% vetch seeds (soak in water), T4 15% vetch seeds (soak in acetic acid 1%), T5 30% raw vetch seeds, T6 30% vetch seeds (soak in water), T7 of 30% vetch seeds (soak in acetic acid 1%).

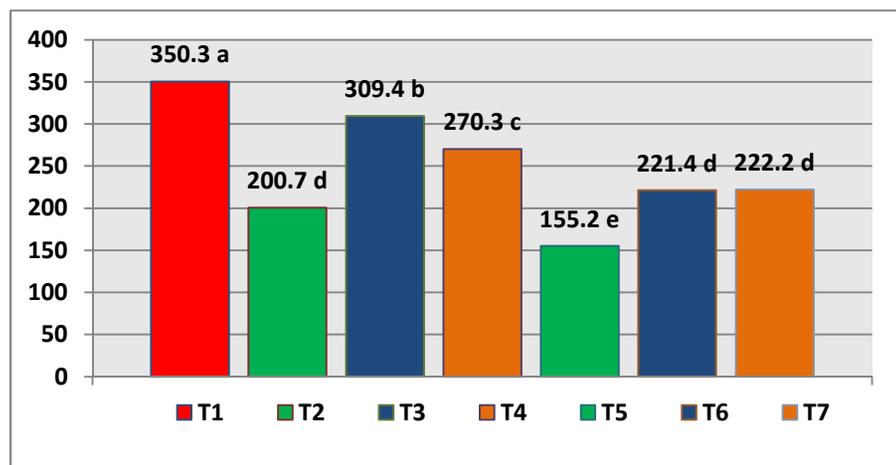


Fig.(1):- Effects supplemented deferent Proportion of raw or treated Vetch seeds (soaked on water or acetic acid 1%) to broiler diet on production index at 49 days old broiler.

Various characters within the same row indicate significant differences at the level of probability ($p < 0.05$)

T1 control, T2 15% raw vetch seeds, T3 15% vetch seeds (soak in water), T4 15% vetch seeds (soak in acetic acid 1%), T5 30% raw vetch seeds, T6 30% vetch seeds (soak in water), T7 of 30% vetch seeds (soak in acetic acid 1%).

The results also shown in (Table 4) significant differences between treatments in the proportion of dressing ,carcasses,breast,thighs,gizzard and abdominal fat for broiler chicks (49) days old. These results are agree with the obtained by both Saki, et al(2008) and Sadeghi et al(2011), who did not find significant differences in dressing percentage ,breast and thighs when fed raw or treated vetch seeds with different levels ranged from 10-30% of the diet compared with control free of vetch seeds. Also (Table 4) shown significantly increase in the percentage of the weight of the liver for all experimental treatments contain the seeds of vetch compared to the control,T5 record highest relative weight of the liver compared to all treatments contain on Vetch seeds , which were not significantly different between them (p 0.05). The reason may be due to that the use of vetch seeds especially high levels led to the instability of enzymes for the representation of the protein in the liver and thus to the high proportion of inhibitors nutrition which leads to liver stress and amplified in order to get rid of toxins (Majeed,2009 and Sadeghi et al., 2011). Table (4) also showed that there were no significant differences in the percentage of heart and pancreas between all experimental treatments containing raw Vetch seeds or treated (soaked in water or in acetic acid 1%) compared to the control, except for the T5 (30% raw vetch seeds) which gets the highest increase in the relative weight of the heart and pancreas compared to all experimental treatments. It has attributed the cause of inflation each of the pancreas and heart to the presence of anti-nutrition factors in the crude vetch seeds , since these inhibitors is working to swell the size of the pancreas (to increase his activity) as a result of compounds excreted from the bowel wall and lead to stimulate the pancreas and increase the size and increase the secretions of trypsin formation (Ahmed Abdo, 2009) . These results agreed with both of Sadeghi et al(2004), Farran et al(2005) and Majeed (2009). While these results varied with the results Farran et al(2001), which noted that there was no significant difference in the proportion of the pancreas weight and liver between the first treatment free of vetch seeds compared to that treatments contains a high level of raw vetch seeds and treated (soaked in water 40 ° C for 72 hours). It proved the results in the (Table 5) obtain a

significant decrease of the concentration of each of the total protein, albumin and glucose in the blood of birds all experimental treatments which contained (15 and 30%) raw vetch seeds and treated compared with birds in control free of vetch seeds. While there were no significant differences in total protein concentration among all other experiments treatments on the container (15 and 30%) vetch seed treated (soaking in water or in acetic acid 1%).The reason of decrease level of total protein concentration of the birds blood of experience treatments, may be due to effects of -Cyanalanine in the liver, or maybe it's because this is that Hydrogen cyanide (HCN) can lead to bleeding in the trachea, lung, heart and intestines, which lead to increased protein loss as a result of loss of blood poisoning as a result of bleeding. The low glucose levels may be due to the toxic compounds found in the composition of the vetch seeds affect the level of glucose in the blood of these chicks as a result of a decrease in the amount of feed intake and thus lower energy, because cyanide, for example, lead to a drop feed consumption or decrease its percentage (Altamir et al., 2002, Kenneth et al., 2003 and Majeed,(2009) . These results agreed with what was found by both Sadeghi et al.(2007) and Majeed, (2009) where they found a decrease in the percentage of protein and the concentration of glucose in the blood serum of broiler with an increased proportion of vetch seeds in both treated or raw, compared with control a diet free of vetch seeds. Also found in the (Table 5) too high significant in the concentration of cholesterol and triglyceride of T2 birds blood serum and T5which containers on (15 and 30%) raw vetch seeds compared to the control. The reason for the high cholesterol concentration, and triglyceride may be the result of the case of thyroid deficiency associated with increased triglycerides and few of fat transfer the bile acids and thus increase the fat in the blood of the bird serum (Thrall et al., 2004).The results of statistical analysis Table(6),showed that the highest value of imports from the sale of the meat and the total costs show in control treatment free of vetch seeds andT3 treatment containing (15%) vetch seeds treated by socking in water compared to all the other experimental treatments containing raw and treated vetch seeds. Table(6) also, showed that net profit ratio and net profit

contribution , there were no significant differences ($p < 0.05$) in birds T3 treatment in compare to control , while the value of these two variables decreased in other experimental treatments (T2, T4, T5, T6 and T7) than controls, and recorded the lowest percentage of the net profit and net profit ratio contribute to the birds of the two treatments (T2 and T5). Inferred from these results in addition to the live body weight and the mortality rate that the cost of feed material effects directly on broiler chicks breeding economics, when the use of 15% vetch seeds treated with soaking in water in the third treatment T3 was not significantly different with the control treatment .From here it can be seen that the local vetch seeds worked to lower the cost of poultry ration due to lower its cost compared to traditional fodder imported materials such as SBM high price, which led to be a net profit does not differences significant with comparer to control treatment.

CONCLUSIONS

The use of raw vetch seeds by 15% in broiler diets led to a decrease in productive characteristics, when supplied higher ratio of crude vetch seeds to 30% led to increase deterioration dramatically. Although , the production index value in control is higher than all experimental treatments, but the results of economic evaluation proved that the percentage value of contribution to net profit in T3 treatment (15% vetch seeds soaking in water) was higher value than all experimental treatments ,and did not different significantly compared to control.

RECOMMENDATIONS

This study recommend that we can use 15% vetch seeds type *Common Vicia sativa* treated with soaking in water for 72 hours used in this study to feed broiler chicks.

Table (4);- Effects supplemented deferent Proportion of raw or treated Vetch seeds (soaked on water or acetic acid 1%) to broiler diet on Dressing, Carcass , Edible and Pancreas Percentage at 49 days old broiler (averages \pm standard error).

Traits%	Treatments						
	T1	T2	T3	T4	T5	T6	T7
Dressing	74.53 \pm 0.45 a	73.20 \pm 0.78 a	74.61 \pm 0.58 a	71.75 \pm 0.50 a	72.40 \pm 1.85 a	72.86 \pm 0.60 a	73.01 \pm 0.68 a
Breast	35.33 \pm 0.74 a	35.38 \pm 0.55 a	34.07 \pm 0.85 a	34.22 \pm 0.66 a	34.18 \pm 0.51 a	35.12 \pm 0.45 a	35.59 \pm 0.44 a
Thigh	28.00 \pm 0.44 a	27.53 \pm 0.29 a	28.47 \pm 0.49 a	28.11 \pm 0.40 a	27.91 \pm 0.86 a	28.26 \pm 0.35 a	28.05 \pm 0.32 a
Heart	0.45 \pm 0.02 b	0.54 \pm 0.03 b	0.50 \pm 0.03 b	0.50 \pm 0.03 b	0.69 \pm 0.05 a	0.49 \pm 0.02 b	0.50 \pm 0.03 b
Geezad	1.85 \pm 0.04 a	1.86 \pm 0.06 a	1.81 \pm 0.05 a	1.95 \pm 0.06 a	1.90 \pm 0.09 a	1.86 \pm 0.03 a	1.98 \pm 0.05 a
Abdomen	0.70 \pm 0.04 a	0.83 \pm 0.03 a	0.71 \pm 0.04 a	0.83 \pm 0.04 a	0.80 \pm 0.05 a	0.78 \pm 0.06 a	0.75 \pm 0.05 a
Pancreas	0.20 \pm 0.0 b	0.20 \pm 0.0 b	0.21 \pm 0.02 b	0.23 \pm 0.03 b	0.28 \pm 0.03 a	0.21 \pm 0.01 b	0.19 \pm 0.01 b
Live	1.63 \pm 0.03 c	1.99 \pm 0.11 b	1.99 \pm 0.04 b	2.00 \pm 0.06 b	2.41 \pm 0.14 a	2.07 \pm 0.05 b	2.05 \pm 0.06 b

Different letters within the same column indicate significant differences at the level of probability (p = 0.05).

T1 control, T2 15% raw vetch seeds , T3 15% vetch seeds (soak in water), T4 15% vetch seeds (soak in acetic acid 1%), T5 30% raw vetch seeds , T6 30% vetch seeds (soak in water), T7 of 30% vetch seeds (soak in acetic acid 1%).

Table (5) :- Effects supplemented deferent Proportion of raw or treated Vetch seeds (soaked on water or acetic acid 1%) to broiler diet on biochemical characteristics at 49 days old broiler (averages \pm standard error).

biochemical characteristics	Treatments						
	T1	T2	T3	T4	T5	T6	T7
Total Protein g/100ml	4.85 \pm 4.85 a	3.78 \pm 0.25 bc	3.38 \pm 0.30b	4.02 \pm 0.02b	3.13 \pm 0.02c	4.00 \pm 0.4b	3.92 \pm 0.14b
Albumin g/100ml	3.50 \pm 0.11 a	2.9 \pm 0.17b	2.83 \pm 0.02b	2.68 \pm 0.20 b	2.66 \pm 0.14b	2.85 \pm 0.10b	2.72 \pm 0.17b
Glucose mg/100ml	211.3 \pm 6.65 a	189.24 \pm 5.00b	183.14 \pm 3.68b	180.39 \pm 1.66b	182.01 \pm 2.49b	184.79 \pm 3.34b	180.66 \pm 3.60b
Cholesterol mg/100ml	134.48 \pm 1.53 b	162.39 \pm 1.8a	138.46 \pm 3.69 b	134.83 \pm 1.05 b	165.90 \pm 2.36 a	135.08 \pm 0.74 b	136.11 \pm 1.52 b
Triglyceride mg/100ml	87.38 \pm 2.01c	97.91 \pm 0.72b	89.06 \pm 2.28c	90.91 \pm 1.55c	105.91 \pm 0.92 a	89.86 \pm 2.27c	90.71 \pm 1.23 c

Different letters within the same column indicate significant differences at the level of probability (p = 0.05).

T1 control, T2 15% raw vetch seeds , T3 15% vetch seeds (soak in water), T4 15% vetch seeds (soak in acetic acid 1%), T5 30% raw vetch seeds

, T6 30% vetch seeds (soak in water), T7 of 30% vetch seeds (soak in acetic acid 1%).

Table (6):- Effects supplemented deferent Proportion of raw or treated Vetch seeds (soaked on water or acetic acid 1%) to broiler diet on economical evaluation at 49 days old broiler (averages \pm standard error).

Economic Value	Treatments						
	T1	T2	T3	T4	T5	T6	T7
Incoming /ID	209352 \pm 4029.5 a	154529 \pm 3585.1 e	193445 \pm 3812.9 b	178562 \pm 4906.1 c	119295 \pm 608.2 f	163610 \pm 183.3 de	167366 \pm 3816.8 d
Costs/ID	155757 \pm 311.4 a	134918 \pm 1387.2 c	139541 \pm 1198.4 b	138092 \pm 468.7 cd	113452 \pm 2019.6 e	126803 \pm 575.7 d	128098 \pm 1968.4 d
Net Profit/ID	53595 \pm 118.1 a	19611 \pm 4472.2 c	53904 \pm 2416.6 a	40470 \pm 4437.3 b	5844 \pm 1411.4 d	36807 \pm 392.4 b	39268 \pm 1852.5 b
share of net profit %	100.0 \pm 0.0 a	36.6 \pm 9.2 c	103.1 \pm 2.2 a	75.6 \pm 8.5 b	10.9 \pm 2.6 d	68.7 \pm 0.6 b	73.3 \pm 3.3 b

Different letters within the same column indicate significant differences at the level of probability ($P < 0.05$)

Fixed costs include the cost of buying (chicks, sawdust, fuel, electricity, labor, vaccines and veterinary medicines = 102000 dinars / treatments)

Variable costs include the purchase of feed stuff (vetch seeds 300, yellow corn 495, SBM 990, Centre protein 1860) dinars / kg.

Broilers sale price = 2450 dinars / kg (live).

Table(7):-The chemical composition of vetch seed

Chemical composition %	raw vetch seeds	vetch seeds soaked in water	vetch seeds soaked in acetic acid 1%
Moisture	8.95	9.64	8.86
Crude protein	28.86	27.25	27.74
Ether extract	1.23	1.36	1.41
Crude fiber	3.72	3.43	3.28
Ash	4.12	2.33	2.58
Nitrogen-free extract	53.12	55.99	56.13
ME (kcal/kg)	3002	3020	3027

ME (kcal/kg) = { (Crude protein% \times 0.153) + (Ether extract% \times 0.345) + (Nitrogen-free extract% \times 0.143) } \times 238.85 (Farran and others, b2001)

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FATTY ACID PROFILE OF *L.DORSI* MUSCLE OF AWASSI AND KARADI LAMBS INDUCED BY ZERANOL IMPLANTATION

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ABSTRACT

To evaluate the effect of breed and zeranol implantation on fatty acid composition of meat, ten intact weaned lambs from each Awassi and Karadi were divided equally into subgroups; the first as a control and the second was implanted with 12mg zeranol, fed a concentrate diet and slaughtered after 70 days of fattening. After chilling, homogenous samples of meat from *L.Dorsi* muscle were blended for analysis of fatty acid composition. Breed comparison indicated that C:18 is significantly higher and C16:1 is significantly lower in Karadi than Awassi lambs, Total fatty acid were higher ($p > 0.05$) in lambs implanted with zeranol as compared to intact lambs. Also, a decrease ($p < 0.05$) in α -linolenic acid was observed in zeranol implanted lambs compared to control lambs. Neither n-6: n-3 ratio nor PUFA to SFA was modified by implantation with zeranol.

KEY WORDS: fatty acids, lambs, zeranol

INTRODUCTION

Recently, as far as meat consumers are concerned, meat should contain only a small amount of fat, and particularly its content of saturated fatty acids which is considered a major risk factor for coronary heart disease (Department of Health, 1994). It is known that ruminant meat have a low ratio of polyunsaturated fatty acid to saturated fatty acid (P: S) because of the hydrogenating action of the rumen microorganisms on dietary fatty acids but n-6: n-3 ratio is beneficially low, particularly in grass diet (Enseret *et al.*, 1998). Furthermore, animals vary in composition of fat at various fat depots (Marchello and Cramer, 1963), and many factors such as sex, breed, live weight, feeding regimen, hormones, dietary fat and age has been related to fatty composition (Sanudo *et al.*, 2000).

Approximately two decades ago, the meat industry investigated new technologies derived from animal production that promote a decrease in the content of the fat and an increase in the intramuscular deposition of PUFA and MUFA (Troy and Kerry, 2010). Among these technologies, is hormonal implants which are used in animal production with the dual purpose of both increasing growth rate and feed efficiency and decreasing level of intramuscular fat (Monson *et al.*, 2007). The few reports on the effect of growth-promoting implants on the fatty acid profile of meat are largely inconclusive in beef. However,

Valenzuela- Grijalva *et al.* (2011) concluded that it is possible to induce favorable changes in the fatty acid profile and cholesterol content using a zeranol implantation of lambs. Therefore, this work aims to evaluate the influence of implantation with zeranol on fatty acid profile in the *longissimusdorsi* muscle of Awassi and karadi lambs.

MATERIALS AND METHODS

Ten entire weaned lambs (3-4 month old) from each of Awassi and Karadi with an average initial live weight of 27.7 ± 0.29 and 27.8 ± 0.16 kg, respectively maintained at Animal farm, Faculty of Agriculture, University of Duhok were divided equally into two sub groups, the first as a control, and the second was implanted with 12mg zeranol. Each group of lamb was kept in a separate pen, and fed concentrate diet contained 14.34 % crude protein and 2240kcal energy was offered *ad libitum*. After 70 days of fattening, all lambs were slaughtered according to Islamic way at the farm abattoir. Following chilling the carcass at 4°C for 24 hours, homogenous samples of meat from *L.Dorsi* muscle was blended using a food processor. Fatty acids were measured according to the method described by O'Fallon *et al.* (2007). Briefly, 500 mg of dry meat was placed into test tubes to which 1.0 mL of internal standard (0.5mg of C13:0/mL of methanol), 0.7 mL of 10 N KOH and 5.3 mL of methanol were added. The tubes

were incubated in water bath at 55°C for 90 min with vigorous hand-shaking for 5 second every 20 min and 580 µL of 24 N H₂SO₄ was added after cooling the tubes. The tubes were then incubated for further 90 min in 55°C water bath with shaken by hand for 5s every 20 minutes. The tubes were cooled and 3 ml of hexane were added and vortexed. After centrifugation, the hexane layer was placed into a GC vial. The fatty acid composition of the FAME was determined by capillary GC on a CP-SIL88, 100 m × 0.25 mm × 0.20 µm capillary column installed on a Hewlett Packard HP 6890 series gas chromatograph equipped, a flameionization detector, and split injection. The initial oven temperature was 70°C, held for 2 min, subsequently increased to 225°C at a rate of 4°C/ min, and then held for 15 min. hydrogen was used as the carrier gas at a flow rate of 2.1 mL/min, and the column head pressure was 29.59 psi. Both the injector and the detector were set at 250°C. The split ratio was 100:1. Fatty acids were identified by comparing their retention times with the fatty acid methyl standards described previously.

Statistical analyzed:

Data were analyzed statistically by General linear model within SAS (2002) to study the effect of breed and treatment with zeranol on fatty acid composition according to the following model:

$$Y_{ijk} = M + B_i + T_j + e_{ijk}$$

Y_{ijk} = observational value of kth animal.

M = overall mean

B_i = effect of ith breed (Awassi, Karadi)

T_j = effect of jth treatment (control, zeranol)

e_{ijk} = random error associated with each observation assumed to the NID with zero mean and σ^2 variance.

RESULTS AND DESCUSSION

Fatty acid profile has an important role to describe meat quality and is usually linked to meat aroma and nutritive value (Yaraliet *al.*, 2014). Mean values and standard errors for *L.dorsi* muscle fatty acid composition (g / kg dry basis muscle) are shown in Table 1. It appears from the table that the proportion of SFAs to total fatty acids was 44.8%. Moreover, the predominant SFAs types was palmitic acid (C16:0), followed by stearic acid (C18:0) and myristic acid (C14:0)

which represented approximately 95.8% of the total SFAs in the *Longissimusdorsi* muscle of lambs. Similarly, Gecgelet *al* (2015) found that about 90% of SFAs are (C16:0, C18:0 and C 14:0) in *Longissimusdorsi* intramuscular fat in Bandirma crossbreed, Karacabey Merino multiplier and Karacabey Merino Nucleus lambs..

Results presented in Table 1 revealed that stearic acid (C18:0) is significantly ($p < 0.05$) higher (23.24 g/kg) and palmitoleic (C16:1) is significantly ($p < 0.05$) lower in Karadi lambs than Awassi (3.10 and 3.39g/kg). Also, myristic acid (C14:0) and palmitic acid (C16:0) are insignificantly ($p > 0.05$) higher in Awassi as compared with Karadi lambs. Such results were resemble with those reported by other workers (Yakan and Unal, 2010; Yaraliet *al.*, 2014; and Gecgelet *al.*, 2015).

Total fatty acid were higher (139.0g/kg) in lambs planted with zeranol as compared to intact lambs (138.80 g/kg) ; but the difference between them was not significant ($p > 0.05$) (Table 1). Also, Valenzuela Grijalvaet *al* (2011) indicated that lambs implanted with 12mg zeranol caused a significant rise in TFA as compared with control. Furthermore, as shown in Table 1 that implanted lambs with zeranol compared with the control lambs resulted in a non- significant increase in each of C14(3.76 vs. 3.48g/kg), C16(34.2 vs. 32.45g/kg),C17(3.03 vs. 2.60 g/kg) C20 (0.45 vs 0.42 g/kg) and a decrease in C18(22.0 vs.22.14g/kg) and C22(0.10 vs. 0.18 g/kg). However, in contrast to these results, it was found that implanting beef steer with zeranol resulted in a significant decrease ($p < 0.05$) the concentration of SFA (C6:0, C10:0,C21:0 C22:0 and C23:0) in intramuscular fat. Such differences between the findings could be due to difference among species (Nurnberg et al.,1998).

It appears from the results given in Table (1) that C18:1 was the most represented fatty acids accounting for about 95% of MUSFAs in both Karadi and Awassi lambs. Moreover, it is known that C18:1 is the major fatty acid in intramuscular lipids of lambs (Tejeda *et al.*, 2002). The results were similar to those reported previously by Yakan and Unal, (2010),Yousefi et al.,(2012) and

Table (1): - Fatty acid profile of Awassi and Karadi lambs implanted by zeranol.

Trait	Mean	Breed		Treatment		Significance	
		Awassi	Karadi	Control	Zeranol	B	T
NO:		9	7	8	8	ns	ns
C14	3.62 ± 0.15	3.78± 0.24	3.41± 0.13	3.48± 0.2	3.76± 0.23	ns	ns
C16	33.33± 0.75	33.97±1.16	32.5 ±0.85	32.45±1.1	34.2± 1.0	ns	ns
C16-1	3.26 ± 0.78	3.39±0.09	3.1± 0.10	3.14± 0.1	3.38±0.1	*	ns
C17	2.82 ± 0.15	2.61±0.19	3.08 ±0.22	2.6 ± 0.23	3.03± 0.1	ns	ns
C18	22.77 ± 0.48	21.16±0.57	23.24 ±0.58	22.14±0.73	22.0±0.66	ns	ns
C18-1	60.5 ± 0.77	60.59±1.2	60.38 ±0.92	60.67±0.7	60.32±1.43	*	ns
C18-2	9.32 ± 0.56	9.31±0.88	9.33 ±0.69	10.08±0.74	8.56± 0.8	ns	ns
C18-3	0.46 ± 0.04	0.45±0.07	0.49± 0.04	0.57±0.03	0.36± 0.06	ns	*
C20	0.44 ± 0.41	0.43±0.06	0.45± 0.05	0.42±0.07	0.45± 0.04	ns	ns
C20-4	2.86 ± 0.20	2.92±0.3	2.78± 0.27	2.99±0.26	2.73± 0.31	ns	ns
C20-5	0.05 ± 0.038	0.09 ±0.06	0	0.06±0.06	0.04±0.04	ns	ns
C22	0.14 ± 0.02	0.18±0.03	0.08± 0.04	0.18±0.03	0.1± 0.04	ns	ns
TFA¹	138.9 ± 0.34	138.9±0.49	138.9± 0.5	138.8±0.44	139.0±0.55	ns	ns
SFA²	62.3 ± 0.62	61.97±0.85	62.71± 0.76	61.12±0.71	63.47±0.87	ns	ns
MUFA²	63.76 ± 0.8	63.98±1.27	63.48± 0.93	63.82±0.75	63.71±1.48	ns	ns
PUFA²	12.85 ± 0.79	12.98±1.23	12.7± 0.98	13.89±1.09	11.81±1.09	ns	ns
n-6	12.19 ± 0.75	12.24±1.17	12.12± 0.93	13.08±1.0	11.3± 1.09	ns	ns
n-3	0.66 ± 0.08	0.73±0.138	0.57± 0.06	0.81±0.11	0.51± 0.09	ns	ns
MUFA/SFA	1.02 ± 0.016	1.03±0.02	1.01± 0.02	1.04±0.01	1.0± 0.03	ns	ns
PUFA/SFA	0.20 ± 0.014	0.21±0.02	0.20± 0.01	0.22±0.02	0.18±0.018	ns	ns
n-6:n-3	22.22 ± 3.46	22.41±6.18	21.99± 1.68	16.72±1.05	27.72±6.45	ns	ns

1. TFA = Total fatty acid, breed (B), Treatment (T).

2. Sum of saturated fatty acids(SFA), monounsaturated fatty acid(MUFA), polyunsaturated fatty acids(PUFA)

Gegelet *et al.*,(2015).The minor fatty acid within PUSFAs is linolic acid (n-3, C18:3), which had its similar value in Awassi (0.45g/kg) and Karadi lambs (0.49g/kg). These lower values are attributed to the fact that animals are incapable of synthesizing them, and C18:2 and C18:3 fatty acids are introduced to the diet (Addis *et al.*, 2013).

A decrease ($p<0.05$) in the content of - Linolenic acid (C18:3) was noticed in zeranolimplanted lambs as compared to intact lambs (0.36 vs 0.57 g/kg). Similarly, a decrease ($p<0.05$) in the content of oleic acid was observed when the dose of zeranol was increased from 12 to 24 mg in hair lambs (Valenzuela – Grejalvaet *al.*, 2011). Also, Kennett and Siebert (1987), Duckett *et al.*(1999), and Ibrahim *et al* (2006) who found that implanting steers with zeranol reduce C18:1). However, it is important to note that the necessity of the presence of higher content of MUFA with cis configuration in the human diet because MUFA exhibit hypocholesterolemic effects and do not reduce the concentration of high-density lipoprotein (HDL) cholesterol in the blood, which

protect against heart disease (Simopoulos *et al.*,1999).

It is known that the ratio between PUFAs of the n-6 and n-3 series is an index commonly used to detect the nutritional value of fats (Santos-Silva *et al.*, 2002). In the current work, the n-6: n-3 ratio was 22.41 and 21.99 for Awassi and Karadi lambs, respectively ($p>0.05$). However, such ratio is higher than 4.0 value which recommended by the Department of Health Organization (Anonymous, 1994). Moreover, n-6: n-3 fatty acid may be variable depending on lambs diet (Gegelet *et al.*, 2015). Also, the relative proportion of n-6: n-3 fatty acid in the meat was not affected by treatment (16.72vs 27.72). This result is similar to that reported by Ibrahim *et al* (2006) and Valenzuela-Grijalvaet *al.*, (2011) who observed that steers and lambs implanted with zeranol exhibited increase in n-3 and n-6 fatty acid.

In the current work, the relative proportion of PUFA to SFA was not modified by implantation with zeranol ($p>0.05$) presenting percentage of 0.22 and 0.18 for intact and implanted lambs, respectively. Similarly, Valenzuela-Grijalvaet *al* (2011) indicated that the proportion of SFA to PUFA was not affected by treated hair lambs with zeranol. However, other worker (Ibrahim *et a l.*, 2006) observed an increase in the relative proportion of SFA in steers implanted with zeranol. It is known that PUFAs help to lesser

cholesterol and decrease platelet aggregation, thus decreasing the risk of heart disease (Reavley, 1998).The values of PUFA:SFA 0.21 and 0.20 obtained here in for Awassi and Karadi lambs, respectively is lower than the value (0.40-0.45) recommended in diet (Anonymous,1994).However, this PUFA:SFA ratio was higher than the value 0.03- 0.04 noticed by Landimet *al*(2011) in lambs *Longissimusdorsi* muscle from different breeds. Such difference may be a results of various factors affecting this ratio such as breed, sex, and feeding regimes (Yaraliet *al*, 2014).

CONCLUSION

The result obtained show that in general, no differences exist in fatty acid composition between Awassi and Karadilambs. Also, it seems that zeranol implant had no effect on fatty acid profile of both breeds.

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EFFECT OF OXYTOCIN AND PROSTAGLANDIN F2 INJECTION ON SEMEN TRAITS AND LIBIDO OF MERIZ BUCKS IN BREEDING SYSTEM

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ABSTRACT

Nine male Meriz bucks, aged 3-4 years, were randomly distributed equally into three groups to study the effect of injection (1ml) normal saline (control group), (10i.u.) oxytocin and (75µg) prostaglandin (P) F2 on semen characteristics and libido traits. Semen samples were collected at weekly intervals by Electro-ejaculator and evaluated for semen traits. Libido traits were measured at biweekly intervals for 20 minutes. Result revealed that injection of oxytocin significantly ($p < 0.05$) improved semen volume (0.77 ± 0.07 vs. 0.62 ± 0.04), color (3.40 ± 0.23 vs. 2.79 ± 0.16), individual motility (69.88 ± 4.09 vs. 53.33 ± 4.14), sperms' concentration/ml $\times 10^7$ (94.11 ± 11.76 vs. 64.11 ± 9.72) and live sperms' percent (64.96 ± 4.53 vs. 47.31 ± 4.09) compared to control bucks. Injection of PGF2 did not have a significant effect on semen characteristics. However, it improves mass and individual motility and decreases sperm abnormalities at a long term effect. Month of semen collection had a high significant effect ($P = 0.01$) on most of the semen characteristics, the maximum was recorded in September, while the minimum was recorded in June and July. Oxytocin had no significant effect on all examined traits of libido. Injection of PGF2 had a significant effect ($p < 0.05$) in reducing reaction time to 1st mount (21.20 ± 3.15 vs. 114.70 ± 28 sec.) and in an increasing the number of successful ejaculate (2.70 ± 0.37 vs. 1.58 ± 0.19) compared to control bucks. Month had a significant effect ($P = 0.05$) on the most libido traits, the minimum reaction time to 1st mount (47.55 ± 12.53 sec.), reaction time to 1st ejaculate (1.61 ± 0.48 min.) and the maximum number of successful ejaculate (3.22 ± 0.41) was recorded in September and July, while the maximum reaction time to 1st mount (170.55 ± 84.98 sec.), reaction time to 1st ejaculate (6.80 ± 1.45 min.) and minimum number of successful ejaculates (0.77 ± 0.22) was recorded in June.

KEY WORDS: Semen traits, Libido, Oxytocin, PGF2, Meriz.

INTRODUCTION

Goats are characterized by many unique biological features like high fertility, ability to produce multiple births, adaptability to different environmental conditions (Gall, 1981) and utilizing poor quality feed stuffs (Delgadillo and Malpeux, 1996). Moreover Meriz goats are found along the northern border of Kurdistan region of Iraq, they are smaller in size than the native black goats (Alkass and Merkhan, 2013). They are a seasonal breeder and have the adaptability to survive under adverse conditions of feed limitations (Alkass and Ahmad, 2011).

Animal production depends on the development and maintenance of population of animals that can be exploited to man's economic advantage. Therefore, reproductive traits have always been a major interest in any livestock production.

Moreover, fertility in sheep and goat is influenced by both females and males. The male has an effect on two ways. Firstly through the genes which he contributes, since any one male should leave many more progeny than any one female in the population. Secondly, a male has a direct effect through his own characters (libido and semen traits) (Alkass, 1979).

It was noticed that oxytocin have an effect on reproductive action of male as sexual behavior, sperm transmission and semen ejection (Melin and Kihlstrom, 1963). It has been indicated that oxytocin treatment prior to semen collection influence the quality and quantity of ram semen (Knight and Lindsay, 1970; Knight, 1974; Alkass et al., 1987; Nicholson et al., 1999; Bozkurt, et al., 2007 and Al-Hassan, et al., 2013), bulls (Berndtson and Igboeli, 1988; Ibrahim, 1988 and Palmer et al., 2004) dogs (Hess, 2002), and rabbits (Fjellstrom et

al., 1968). In addition to that, intravenous injection of oxytocin has a significant effect on reaction time of Awassi ram (Al-Hassan et al., 2013) and higher motivation for copulation in rabbit (Fjellstrom et al., 1968).

Also, PGF2 is known to increase smooth muscle contractility in the male and female genital tracts and may be involved in the ejaculation process (Bygdeman, 1981). Intramuscular injections of PGF2 was found to improve significantly some semen characteristics in Meriz bucks (Barwary et al., 2013), rams (Marai et al., 2003; Azawi, et al., 2011; Olfati et al., 2013), bulls (Ibrahim, 1988; Kreider et al., 1981; Capitan et al., 1990; Masoumi et al., 2011) and dogs (Hess, 2002). Additionally intramuscular injection of PGF2 improve libido of rams (Marai et al., 2003) bulls (Masoumi et al., 2011) Narasimha et al., 1986) and boars (Zamora, et al., 2010).

Thus improving the sexual behavior and semen traits will be a benefit for farm animal. Therefore the aim of this study is to investigate the effect of injection oxytocin and PGF2 on seminal traits and libido of Meriz goats.

MATERIALS AND METHODS

The current work was performed at the farm project, Department of Animal Production / College of Agriculture, University of Duhok, from 1st June, 2014 to 30th September, 2014. Nine Meriz bucks aged (3-4) years and (35-45 kg) in weight were randomly distributed into three groups and housed in individual pens.

Prior to the commencement of the experiment, all bucks were adapted for 14 days and clinically examined and in particular for genital organs. Each animal was fed daily (750 g) of concentrate diet "containing 14% crude protein and 2700 kcal/ kg" (Al-Khawaja, et al., 1978) and (750g) of hay and water was available ad libitum.

Semen was collected at weekly interval by the aid of an electro-ejaculator type (BAILY EJACULATOR-MOD 2). Semen was collected 10 minute following injection of oxytocin and 30 minutes following injection of PGF2 or normal saline; and immediately transferred to the laboratory and maintained in a water bath at (37C°) throughout the evaluation.

Semen Evaluation: Seminal volume was measured directly in milliliters after collection from graduated collection tube (0.1 to 10 ml). The semen color was assessed according to method described by Evan and Maxwell (1987). Measurement of hydrogen ion concentration (pH) was assessed by digital pH meter model (Microcomputer pH /mV/ Temp. Meter6171). Scores of mass motility and the percentage of progressive motility was assessed as described by Avdi et al. (2004). The method of Salisbury et al., (1943) was used to determine sperms' concentration; using a haemocytometer chamber. Total number of sperms per ejaculate was calculated by multiplying sperms' concentration and ejaculate volume. The method of Swanson and Beardon (1951) was used to determine the percentage of dead and live sperm. The method of Milovanov (1960) was used to determine the percentage of abnormal sperms.

Libido Evaluation: Libido was examined at biweekly intervals for each buck; about 10-30 minutes after bucks treated with hormones, bucks were individually introduced to five oestrogenized does and records the libido parameter for (20) minutes. The oestrogenized does was prepared by administration (1mg) Estradiol Benzoate to does for two days prior to exposing them to bucks (Price et al., 1988; Smith and Sherman, 2009). The reaction time to 1st mount was assessed by recording the time between the introducing bucks to does and the first mount by the aid of stop watch (expressed in seconds) (Chenoweth, 1981; Estienne and Harper, 2000; Hoflack, et al., 2006). Reaction time to 1st ejaculate was recorded according to how long the buck took time from entering the mating room to ejaculate (Estienne and Harper, 2000). Ejaculation was characterized by a thrust pelvic with the head thrown back, followed by slow dismounting and a short period during which the buck showed no interest in the does (Aller et al., 2012). The number of mounts was based on the number of times that the 2 front feet of the buck left the ground to mount the doe during entering the mating room and ejaculation (Fahey et al., 2012). Number of successful ejaculates was assessed by recording the number of copulations which each buck performed in a 20-min test period (Knight and Lindsay, 1970).

General Linear Model (GLM) within the statistical program SAS (2005) was used to analyze the factors

affecting semen characteristics and libido traits assuming the following model: $Y_{ij} = \mu + T_i + M_j + (TM)_{ij} + e_{ijk}$ Where: Y_{ij} = observational value. μ = effect of the overall mean. T_i = effect of the treatments (where i = is normal saline, oxytocin and PGF₂) on semen characteristics or libido traits. M_j = effect of month (where j = is June, July, August and September) on semen characteristics or libido traits. $(TM)_{ij}$ = interaction effect between treatment and month on semen characteristics or libido traits. e_{ijk} = effect of the random error assuming to be NID. Duncan Multiple Range Test (Duncan, 1955) was used to detect the significant differences between classes.

RESULTS AND DISCUSSION

Semen Characteristics: It appears from Table (1) that injection of 10i.u. oxytocin resulted in a significant increase ($p < 0.05$) in the volume of the ejaculate compared to control bucks (0.77 ± 0.07 vs. 0.62 ± 0.04). Oxytocin stimulates epididymal smooth muscle contraction (Hib, 1974, 1977; DaSilva E Souza et al., 1975), and increase spontaneous contractions (Bereznev, 1963, 1964). Expulsion of prostatic secretions at ejaculation is done by oxytocin effect via contraction of the prostate gland (Nicholson and Jenkin, 1995). In addition to that it stimulates either the formation or expulsion of seminal plasma from seminal vesicles (Knight, 1974). Moreover, it was observed in rams that oxytocin increase both fluid and spermatozoa output from the epididymis (Nicholson et al., 1999), and within testes (Voglmayer, 1975). This suggest that the effect recorded here was due to increase contraction of the upper genital tract and the accessory glands during emission (i.e. the transport of sperm from the epididymis into the pelvic urethra) as far back in the tract as the epididymis and testis (Knight and Lindsay, 1970). Such result is in accordance with those reported in bucks (Alkass et al., 1996), rams (Knight and Lindsey, 1970; Knight, 1974; Voglmayer, 1975; Alkass and Ibrahim, 1984; Alkass et al., 1987; Nicholson et al., 1999; Bozkurt et al., 2007 and Al-Hassan et al., 2013), buffalo (Ibrahim, 1988), and rabbits (Fijellstrom et al., 1968). It seems that the administration of (75 μ g) PGF₂ didn't significantly affect volume of ejaculate (0.68 ± 0.05) compared to

control group (0.62 ± 0.04) (Table 1). Similar result was found in Meriz bucks (Barwary et al., 2013), rams (Marai et al., 2003 and Azawi et al., 2011), buffalo (Narashimha et al., 1986; Capitan et al., 1990) bulls (Berndtson et al., 1979 and Palmer et al., 2004), and boars (Estienne and Harper, 2004), but disagree with other workers including rams (Olfati et al., 2013), buffalo (Ibrahim 1988), bulls (Masoumi et al., 2011), and stallion (Kreider et al., 1981) who found a significant increase in ejaculate volume. Also, the effect of month of collection on semen traits was significant ($p < 0.001$). The maximum volume was recorded during September (1.00 ± 0.06 ml) and the minimum value was during July (0.36 ± 0.03). Since Meriz buck is an autumnal seasonal breed (Alkass and Merkhan, 2013) and the maximum of each of the level of testosterone and scrotal circumference is attained during late summer and autumn (Zebari, 2011) therefore, such result is expected because of the positive relationship between ejaculate volume and testosterone level (Kishk, 2008) and scrotal circumference (Mukasamugerwa and Ezaz, 1992; Kridli et al., 2005). These results resemble those reported by other investigators (Ahmad and Noakes, 1996; Perez and Mateos, 1996; Barkawi et al., 2006; Al-Duhoky, 2006; Talebi et al., 2009 and Zebari, 2011).

Injection of oxytocin resulted in a significant increase ($p < 0.05$) in the color of the semen (3.40 ± 0.23) compared to control bucks (2.79 ± 0.16) (Table 1). This may be due to an increase in sperm cell concentration which, in turn, significantly increased by oxytocin. Hence, a positive correlation between sperms' concentration and semen color in Meriz bucks was observed (Zebari, 2011). Similar result was reported in rams (Al-Hassan et al., 2013). Administration of PGF₂ didn't significantly (2.98 ± 0.17) affect semen color when compared to control (2.79 ± 0.16) (Table 1). This result is in agreement to that noticed in Meriz bucks (Barwary et al., 2013). The month of collection had a significant ($p < 0.001$) effect on color. Yet, the highest (3.58 ± 0.16) and the lowest (2.22 ± 0.21) was recorded in September and June, respectively (Table 1). This improvement was expected because of the positive correlation between semen color and sperm cells' concentration (Kamal et al., 2005 and Zebari, 2011). Similar results were reported earlier by Ahmad and

Noakes (1996), Kamal et al., (2005) and Zebari (2011).

Result revealed that injection of oxytocin or PGF2 had no significant effect on pH (Table 1). The same result has been reported earlier in rams by Marai et al., (2003) and Azawi et al., (2011). Month of semen collection also didn't significantly affect pH value, the highest value was recorded in July (7.16 ± 0.18) and the lowest in September (7.06 ± 0.10) (Tables 1).

Statistical analysis revealed that mass motility was not affected by oxytocin treatment (3.19 ± 0.23) compared to control group (2.69 ± 0.21). Such result is in agreement with the finding obtained in rams by Nicholson *et al.*, (1999), while disagree with report of Bozkurt *et al.*, (2007) and Al-Hassan *et al.*, (2013) who found a significant effect on mass motility. It appears from Table (1) that PGF2 also had no significant effect on mass motility (2.90 ± 0.24) compared to control group (2.69 ± 0.21). A similar finding was reported in Meriz bucks (Barwary *et al.*, 2013), rams (Azawi *et al.*, 2011 and Olfati *et al.*, 2013), buffalo (Narasimha *et al.*, 1986) bulls (Masoumi *et al.*, 2011), and stallions (Kreider *et al.*, 1981); while disagree with those found a significant effect on mass motility in rams (Marai *et al.*, 2003) and buffalo (Capitan *et al.*, 1990). Month of collection was significantly ($p < 0.001$) affect mass motility. The highest mass score (3.51 ± 0.20) and the lowest (1.94 ± 0.30) were obtained in September and June, respectively. Hence, in the present study the highest percent of live sperms was observed in September and the lowest in June, and the highest abnormal percent was observed in June and the lowest in August and September. Such result is expected because of a significant positive correlation between live sperms' percent and mass motility, and a negative correlation between abnormal sperms' percent and mass motility in bucks exist (Kridli *et al.*, 2005 and Zebari, 2011). This result is in accordance with the findings of other workers (Perez and Mateos, 1996; Ahmad and Noakes, 1996; Karatzas *et al.*, 1997; Karagiannidis *et al.*, 1999, Al-Duhoky, 2006 and Zebari, 2011) but disagree with those by Ahmad *et al.*, (1997) and Kamal *et al.*, (2005).

Administration of oxytocin increased significantly ($p < 0.05$) percentage of individual motility (69.88 ± 4.09) compared to control group

(53.33 ± 4.14) (Table 1). Since a significant positive correlation between live sperms' percent and individual motility, and a negative correlation between abnormal sperms' percent and individual motility in bucks was observed (Kridli *et al.*, 2005 and Zebari, 2011), and the highest live sperms' percent and the lowest sperm abnormality was recorded in bucks treated with oxytocin therefore such result is expected. A similar result was reported in buffalo (Ibrahim, 1988). PGF2 injection didn't significantly affect individual motility (58.21 ± 4.58) compared to control group (53.33 ± 4.14). Such result resemble those found in rams (Azawi *et al.*, 2011 and Olfati *et al.*, 2013), bulls (Berndtson *et al.*, 1979) and boars (Estienne and Harper, 2004). Month of collection affect individual motility significantly ($p < 0.001$). The highest percent ($75.44 \pm 2.87\%$) and the lowest ($38.88 \pm 6.83\%$) was obtained in September and June, respectively. Since, a significant positive correlation between live sperms' percent and individual motility, and a negative correlation between abnormal sperms' percent and individual motility in bucks was observed (Kridli *et al.*, 2005 and Zebari, 2011), and the highest percent of live sperm was recorded in September and the lowest in June, and the highest abnormal percent was observed in June and the lowest in August and September so this result is expected. This result is in agreement with the findings of other workers (Perez and Mateos, 1996; Ahmad and Noakes, 1996; Karatzas *et al.*, 1997; Karagiannidis *et al.*, 1999, Al-Duhoky, 2006 and Zebari, 2011).

In the current work, injecting bucks with oxytocin yielded significantly ($p < 0.05$) higher sperm cells count ($94.11 \pm 11.76 * 10^7$) compared to control bucks ($64.11 \pm 9.72 * 10^7$) (Table 1). The increase of sperms' concentration may be explained by the acceleration of the sperm movement by oxytocin, which stimulates the smooth muscle cells, during its transport from testes (ductuli efferentes) and epididymis (Voglmayer, 1975 and Nicholson *et al.*, 1999), which has oxytocin receptors (Whittington *et al.*, 2001). Similar result was reported earlier in bucks (Alkass *et al.*, 1996), rams (Knight, 1974; Voglmayer, 1975; Alkass and Ibrahim, 1984; Alkass *et al.*, 1987; Nicholson *et al.*, 1999; Bozkurt *et al.*, 2007 and Al-Hassan *et al.*, 2013), and rabbits (Fijellstrom *et al.*, 1968). As it

appears from Table (1) that administration of PGF2 didn't alter ($64.33 \pm 9.10 * 10^7$) sperms' concentration compared to control bucks ($64.11 \pm 9.72 * 10^7$). Such result resemble those of earlier investigators who work on Meriz bucks (Barwary *et al.*, 2013), bulls (Berndtson *et al.*, 1979 and Palmer *et al.*, 2004), buffalo (Narasimha *et al.*, 1986; Capitan *et al.*, 1990 and), and boars (Estienne and Harper, 2004). It is seems from Table (1) that month of collection had a significant ($p < 0.001$) effect on sperms' concentration, the highest value was recorded in September ($107.80 \pm 10.26 * 10^7$) and the lowest was recorded in June ($38.88 \pm 9.55 * 10^7$). The maximum level of testosterone was attained during late summer and autumn (Zebari, 2011), also, a positive correlation between testosterone level and sperm concentration was observed in rams (Kishk, 2008) so such reasons may explain this result. This result resembles those of earlier investigators (Perez and Mateos, 1996; and Karatzas *et al.*, 1997; Barkawi *et al.*, 2006; Al- Duhoky, 2006 and Zebari, 2011).

Although oxytocin had no significant effect on total number of sperm per ejaculate ($79.94 \pm 15.78 * 10^7$) compared to control bucks ($51.61 \pm 11.84 * 10^7$) however, total sperms per ejaculate of treated bucks increased by about 54.8% compared to untreated bucks due to increasing both sperm concentration and ejaculate volume. Similar result have been reported in bucks (Alkass *et al.*, 1996) and rams (Alkass and Ibrahim, 1984 and Alkass *et al.*, 1987). It is evident from Table (1) that PGF2 injection has no significant effect on total sperms per ejaculate ($58.51 \pm 10.77 * 10^7$) compared to control bucks ($51.61 \pm 11.84 * 10^7$). Similar result have been reported in Meriz bucks (Barwary *et al.*, 2013), rams (Azawi *et al.*, 2011), bulls (Berndtson *et al.*, 1979), stallion (Kreider *et al.*, 1981), buffalo (Narasimha *et al.*, 1986 and Capitan *et al.*, 1990), and boars (Estienne and Harper, 2004), however Olfati *et al.*, (2013) found a significant increase in total sperm per ejaculate in rams treated with PGF2. The effect of month on this trait was highly significant ($p < 0.001$). Yet, the highest total number of sperm per ejaculate was noticed in September ($116.16 \pm 15.87 * 10^7$) and the lowest number was observed in June and July ($18.40 \pm 4.28 * 10^7$ and $17.24 \pm 4.96 * 10^7$) respectively. Total number of sperms per ejaculate is a product of semen volume x

sperm concentration. Therefore, changes in one or both traits will lead to increase or decrease this trait, which both of them also increased in September compared to other months. Such results resemble those of earlier investigators including Karagiannidis *et al.*, (1999), Shamsuddin *et al.* (2000), Zamiri and Heidari (2006), and Zebari (2011).

It appears from Table (1) that injection of oxytocin resulted in a significant increase ($p < 0.001$) (Appendix Table 2) in the live sperms' percent ($64.96 \pm 4.53 \%$) compared to control bucks ($47.31 \pm 4.09 \%$). This result is in agreement to those found in rams (Al-Hassan *et al.*, 2013). Table (1) also shows that injection of PGF2 does not significantly affect live sperms' percent ($48.16 \pm 4.31 \%$) compared to control bucks ($47.31 \pm 4.09 \%$). Such result resembles those reported in Meriz bucks (Barwary *et al.*, 2013), rams (Azawi *et al.*, 2011 and Olfati *et al.*, 2013), and bulls (Masoumi *et al.*, 2011). Monthly differences in this trait were highly significant ($p < 0.01$); the highest percent of the live sperms was attained in September ($61.53 \pm 3.41 \%$), while the lowest value was recorded during June ($36.99 \pm 7.34 \%$). Similarly, Delgadillo *et al.* (1999), Barkawi *et al.* (2006), Al-Duhoky, (2006), Talebi *et al.* (2009) and Zebari (2011) found that the percent of live sperms was at its highest during autumn.

Analysis of variance revealed that injection of oxytocin had no significant effect on abnormal sperms ($11.50 \pm 1.89 \%$) compared to controlled bucks ($15.47 \pm 2.26 \%$) (Table 16). Similar result have been reported earlier in rams by Nicholson *et al.*, (1999), Bozkurt *et al.*, (2007) and Al-Hassan *et al.*, (2013) and disagree with result of Knight and Lindsey, (1970) who found an adverse effect on sperm abnormality. It seems from Table (1) that injection of PGF2 had no significant effect on sperm abnormalities ($11.62 \pm 1.96 \%$) compared to control bucks ($15.47 \pm 2.26 \%$). This result is in accordance to those noticed in rams (Azawi *et al.*, 2011 and Olfati *et al.*, 2013), bulls (Masoumi *et al.*, 2011), and stallion (Kreider *et al.*, 1981). The highest sperms abnormality was recorded in June ($18.01 \pm 3.47 \%$) and the lowest was recorded in August ($10.56 \pm 2.03 \%$) (Table 1); however, the difference was not significant. This finding disagrees with other workers (Al-Duhoky, 2006;

Talebi et al., 2009 and Zebari, 2011) who observed a significant effect of month on abnormal sperm.

Libido Traits: It is evident from Table (2) that injection of oxytocin didn't significantly affect reaction time to 1st mount (71.54 ± 29.11 sec.) compared to control bucks (114.70 ± 28 sec.). Similarly, Al-Hassan et al., (2013), noticed similar finding. While, injecting bucks with PGF2 significantly ($p < 0.01$) decreased reaction time to 1st mount (21.20 ± 3.15 sec.) compared to control bucks (114.70 ± 28 sec.) (Table 17). It was unknown how PGF2 improve libido but it has been proposed that the PGF2 stimulates testicular steroid release (Kozink, et al., 2002), and a significant increase in testosterone after PGF2 was observed in bulls (Haynes, et al., 1975 and Masoumi et al., 2011) and boars (Estienne, et al., 2004). It was also believed that this may be due to a direct action of the PGF2 at the level of the hypothalamus, preoptic area, or hippocampus (Burne, et al., 2002 and Walton, et al., 2002). Such finding was observed in rams (Marai et al., 2003), buffalo (Narasimha et al., 1986), bulls (Masoumi et al., 2011), and boars (Zamora et al., 2010). The lowest reaction time to 1st mount was recorded in September (47.55 ± 12.53 sec.) and the highest value was recorded in June (170.55 ± 84.98 sec.), and the difference between them was significant ($p < 0.05$). Since Meriz buck is a seasonal breed (Alkass and Merkhan, 2013) and the maximum level of testosterone and scrotal circumference is attained during late summer and autumn (Zebari, 2011), therefore, such result in this study is expected. Similar finding was observed by Ahmad and Noakes, (1995).

Injection of oxytocin did not alter significantly reaction time to 1st ejaculate (2.97 ± 0.67 min.) compared to control bucks (3.71 ± 0.62 min.) (Table 2). Such result disagree to those found in rams (Al-Hassan et al., 2013) and rabbits (Fjellstrom et al., 1968) who observed a reduction in reaction time to 1st ejaculate, following injection of oxytocin. Result presented in Table (2) showed that PGF2 didn't significantly affect reaction time to 1st ejaculate (2.43 ± 0.48 min.) compared to control bucks (3.71 ± 0.62 min.). Similar finding was observed in bulls (Berndtson et al., 1979) and buffalo (Capitan et al., 1990). Month of test significantly ($p < 0.001$) affect reaction time to 1st ejaculate, the minimum time

was recorded in July (1.61 ± 0.48 min.) and the maximum time was recorded in June (6.80 ± 1.45 min.). This result is due to attaining breeding season which demonstrated by an increase of testosterone blood concentration (Zebari, 2011) intensity of sexual odor and decrease of the ingested quantity of food (Hammoudi et al., 2010). It is also affected by social environment such as the presence of other animals and experience (Fabre, 2000). So, bucks exhibited a seasonal cycle of sexual interest and libido in association with perception of doe estrous status; this was underlined by shorter reaction time to 1st ejaculate to-ward sexually active female goat (Delgadillo et al., 1999; Soury and Mirmahmoudi, 2014). Similarly, Ahmad and Noakes (1995), Zarazaga et al., (2009) and Soury and Mirmahmoudi (2014) found a significant decrease in reaction time to 1st ejaculate during breeding season.

Administration of oxytocin did not significantly affect the number of mounts per 1st ejaculate (3.20 ± 0.40) compared to control bucks (3.33 ± 0.26) (Table 2). Such result disagrees with those found in rams (Al-Hassan et al., 2013). Also, it appears from Table (2) that administration of PGF2 did not affect the number of mounts per 1st ejaculate (3.70 ± 0.34) compared to controlled bucks (3.33 ± 0.26). Such result has been reported earlier in bulls (Berndtson et al., 1979). The highest number mount per 1st ejaculate was recorded in June (4.22 ± 0.52) and the lowest was recorded in July (2.94 ± 0.28) the difference between them was not significant. This result disagree to those found by Soury and Mirmahmoudi (2014) who noticed a significant decline in the number of mounts per ejaculate during breeding season (months of late summer and autumn) of Merkhos bucks.

Results revealed that injection of oxytocin did not significantly alter number of successful ejaculates (2.04 ± 0.24) compared to control bucks (1.58 ± 0.19) in 20 minutes (Table 2). Similar result was reported in rams (Knight and Lindsey, 1970 and Al-Hassan et al., 2013). Injecting bucks with PGF2 significantly increased ($p < 0.05$) number of successful ejaculates (2.70 ± 0.37) compared to control group (1.58 ± 0.19) in 20 minutes (Table 2). This increase may be attributed to the stimulates testicular steroid release (Kozink, et al., 2002), or it may be suggested that PGF2 may have an independent effect on sexual behavior through a

direct action of the PGF2 at the level of the hypothalamus, preoptic area, or hippocampus (Burne, et al., 2002 and Walton, et al., 2002). This result agrees to that found in boars (Zamora et al., 2010). Month of libido test significantly ($p < 0.001$) affect the number of successful ejaculates, the highest number was recorded in July (3.22 ± 0.41) and the lowest was recorded in June (0.77 ± 0.22) (Table 17 and Figure 17). Since social environment such as sexual experience affect this traits (Fabre, 2000) and breeding season which maximize each of the level of testosterone and scrotal circumference (Zebari, 2011) and high intensity of sexual odor, decrease of the ingested quantity of food, frequency rates of sniffing, overlapping, and vocalizing toward sexually active female was observed (Hammoudi et al., 2010), therefore such result was expected. This result is in agreement with the finding of other investigators (Tilbrook et al., 1988; Ahmad and Noakes, 1995; Hammoudi et al., 2010).

In conclusions: oxytocin has an immediate effect in increasing seminal output and improving some semen quality. At long term effect of PGF2 improve some seminal quality by increasing individual and mass motility and decreasing abnormal sperm percent. Late summer is more preferred to collect the best quality and quantity of semen for artificial insemination. PGF2 is an active hormone to improve animal with low libido.

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Table (1): Mean semen characteristics of Meriz bucks in response of treatments and months (mean ± SE)

Factors		Semen characteristics									
		No. of Obs	Volume (ml)	Color (score)	pH	Mass motility (score)	Individual motility %	Concentration X 10 ⁷ /ml	No. of sperm per ejaculate X 10 ⁷	Live sperm %	Abnormal sperm %
Overall mean		126	0.69 ± 0.03	3.06 ± 0.11	7.11 ± 0.06	2.92 ± 0.13	60.47 ± 2.52	74.19 ± 6.01	63.35 ± 7.51	53.48 ± 2.57	12.85 ± 1.18
Treat.	Saline	42	0.62 ± 0.04 b	2.79 ± 0.16 b	7.14 ± 0.11 a	2.69 ± 0.21 a	53.33 ± 4.14 b	64.11 ± 9.72 b	51.61 ± 11.84 a	47.31 ± 4.09 b	15.47 ± 2.26 a
	Oxy	42	0.77 ± 0.07 a	3.40 ± 0.23 a	7.20 ± 0.13 a	3.19 ± 0.23 a	69.88 ± 4.09 a	94.11 ± 11.76 a	79.94 ± 15.78 a	64.96 ± 4.53 a	11.50 ± 1.89 a
	PGF2	42	0.68 ± 0.05 ab	2.98 ± 0.17 ab	7.00 ± 0.11 a	2.90 ± 0.24 a	58.21 ± 4.58 b	64.33 ± 9.10 b	58.51 ± 10.77 a	48.16 ± 4.31 b	11.62 ± 1.96 a
Months	June	18	0.46 ± 0.05 c	2.22 ± 0.21 c	7.12 ± 0.27 a	1.94 ± 0.30 c	38.88 ± 6.83 c	38.88 ± 9.55 b	18.40 ± 4.28 b	36.99 ± 7.34 c	18.01 ± 3.47 a
	July	27	0.36 ± 0.03 c	3.00 ± 0.25 ab	7.16 ± 0.18 a	2.51 ± 0.27 bc	47.22 ± 5.39 c	45.44 ± 10.27 b	17.24 ± 4.96 b	46.73 ± 6.09 bc	15.63 ± 2.91 a
	August	36	0.67 ± 0.03 b	2.87 ± 0.22 b	7.15 ± 0.06 a	3.00 ± 0.24 ab	62.50 ± 4.57 b	71.38 ± 11.35 b	54.42 ± 10.71 b	56.72 ± 4.85 ab	10.56 ± 2.03 a
	Sep.	45	1.00 ± 0.06 a	3.58 ± 0.16 a	7.06 ± 0.10 a	3.51 ± 0.20 a	75.44 ± 2.87 a	107.80 ± 10.26 a	116.16 ± 15.87 a	61.53 ± 3.41 a	11.37 ± 1.83 a
Significance	Treatment		*	*	n.s.	n.s.	*	*	n.s.	***	n.s.
	Months		***	***	n.s.	***	***	***	***	**	n.s.
	Treat. * Months		n.s.	n.s.	n.s.	*	n.s.	n.s.	n.s.	n.s.	n.s.

Means with different letters within groupings differ significantly n.s. (p>0.05); * (p<0.05); ** (p<0.01); *** (p<0.001).

Table (2):- Effect of treatments and months on libido traits (mean \pm SE).

Factors		Libido traits				
		No. of Obs.	Reaction time to 1 st mount (seconds)	Reaction time to 1 st ejaculate (minutes)	No of mounts per 1 st ejaculate	No of Successful ejaculates
Overall mean		72	69.15 \pm 14.25	3.04 \pm 0.34	3.41 \pm 0.19	2.11 \pm 0.16
Treatment	Saline	24	114.70 \pm 28 a	3.71 \pm 0.62 a	3.33 \pm 0.26 a	1.58 \pm 0.19 b
	Oxytocin	24	71.54 \pm 29.11 ab	2.97 \pm 0.67 a	3.20 \pm 0.40 a	2.04 \pm 0.24 ab
	PGF2	24	21.20 \pm 3.15 b	2.43 \pm 0.48 a	3.70 \pm 0.34 a	2.70 \pm 0.37 a
Months	June	9	170.55 \pm 84.98 a	6.80 \pm 1.45 a	4.22 \pm 0.52 a	0.77 \pm 0.22 c
	July	18	54.88 \pm 21.65 b	1.61 \pm 0.48 b	2.94 \pm 0.28 a	3.22 \pm 0.41 a
	August	27	59.25 \pm 17.70 b	2.54 \pm 0.51 b	3.37 \pm 0.41 a	1.81 \pm 0.23 b
	September	18	47.55 \pm 12.53 b	3.33 \pm 0.33 b	3.55 \pm 0.27 a	2.11 \pm 0.17 b
Significance	Treatment		**	n.s.	n.s.	*
	Months		*	***	n.s.	***
	Treat.*Months		n.s.	n.s.	n.s.	n.s.

Means with different letters within groupings differ significantly n.s. ($p > 0.05$); * ($p < 0.05$); ** ($p < 0.01$); *** ($p < 0.001$).

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THE EFFECT OF PROPOLIS ADMINISTRATION ON HEMATOLOGICAL AND BIOCHEMICAL PARAMETERS OF KARADI EWES

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ABSTRACT

This study was conducted to investigate the effect of propolis extract on haemato-biochemical parameters of Karadi ewes. Four different doses (0, 1, 2, and 3 ml) of propolis were orally given to the animals on a weekly base throughout the 8 weeks experimental period. Karadi ewes that received Propolis extract had a significantly ($P<0.05$) higher packed cell volume, hemoglobin and lower neutrophil/lymphocyte ratio than control. Furthermore, the serum total protein and globulin contents were higher in propolis treated ewe groups. However, the concentration of glucose, Aspartate-aminotransferase (AST) and cholesterol were almost same in all experimental groups.

KEY WORDS: Haematological; Biochemical; Propolis; Karadi ewes.

INTRODUCTION

There is a growing interest of using natural feed additives as riggers of rumen fermentation and to improve feed efficiency, growth performance and immune response of animals (Selem, 2012). Propolis is a mixture of substance produced by the honey bees that collected from plants such as pollen and sugar, the chemical composition of the propolis is highly depends on the source of plant, location and time of collection (Morsey *et al* 2013). Propolis contain adversity chemical compounds such as polyphenol (flavonoid aglycones, phenolic acid and their esters, phenolic aldehydes, alcohols and ketones); sesquiterpenequinones, coumarins, steroids, amino acids, and inorganic compounds (Bankova *et al.* 2000). Propolis has been intensively used in medicine as on antimicrobial, immunomodulatory, antiinflammatory, and antioxidant due to its biological action contains (Shawky, 1996; Amal, 1997; Abd El-Fattah *et al.*, 1999; Nakamura *et al.*, 2010; Vatansever *et al.*, 2010., Albokhadaim 2015). Several studies indicated that the supplementation of propolis in the animal diet caused an improvement in growth performance, digestibility, carcass yield, and meat tenderness in bull (Guo *et al.* 2011). Moreover research on ewes which was carried out by Selem, (2012), showed that supplemented propolis caused increase of progesterone, total leucocyte, total protein, globulin; and decreased cortisol concentration, T4 thyroxin, red blood cell,

Aspartate-aminotransferase (AST) and Alanine-aminotransferase (ALT), while T3 (triiodothyronine), packed cell volume, hemoglobin, glucose, albumin, total cholesterol, urea, creatinine were not affected significantly. Also, (Mahmood, 2011) reported that supplementing Turkish Awassi lambs with the Propolis extracts (5, 10 & 15 ml) caused an increase the level of T3, T4 and TSH hormones which reflect an increase in the metabolic rate, feed conversion and daily gain. Hussien, (2011) mentioned that the addition of Propolis caused an increase in level of LH, FSH and Testosterone concentration of Turkish Awassi lambs. However, Lana *et al.* (2005) reported that addition of propolis in dairy goat did not influence feed intake rumen fermentation, digestibility or milk production and composition.

Since there were limited data on the effect of propolis on hematological and biochemical parameter in ruminants, therefore the objective of this study is to determine the effect of propolis administration on some hematological and biochemical parameter of Karadi ewes.

MATERIALS AND METHODS

Animal's husbandry and experimental design

This study was conducted at the Animal Production Project, College of Agriculture, University of Duhok, during (1/6/2015 to 1/8/2015). Twenty Karadi ewes 3 to 4 years old were randomly divided into four equal groups and

received orally 0, 1, 2, 3, ml/propolis respectively at weekly intervals. All animals were grazed on pasture and the concentration feed and water where provide at libitum. All animals were free from disease and health control was performed according to the animal production project program.

Preparation of propolis extracts:

Thirty grams of propolis was dissolved in 100 mL of 70% ethanol solution, protected from light and moderately shaken for one day at room temperature. After that the propolis extract was filtered and then evaporated a vacuum evaporator, the propolis was collected into capsules and kept away from light and stored at 4°C (Mani *et al.* 2006).

Blood collection and analyses:

Ten ml of blood samples was collected from jugular vein of ewes at 7 am before feeding at biweekly intervals throughout the experimental periods. 3 ml of blood was emptied into an anticoagulant test tube for determination packed cell volume, hemoglobin concentration, N/L ratio and 7 ml was placed into test tubes without anticoagulant and prepare serum for biochemical analyses (total protein, albumin, globulin, cholesterol, glucose, Aspartate aminotransferase, Alanine-aminotransferase

Data of this study was analyzed using the GLM (General Linear Model) of SAS (2002). Different between means values were determined by using Duncan multiple range tests (1955).

RESULTS AND DISCUSSION

1. Hematological parameters:

The overall means of hematocrit (PCV) and hemoglobin are (24.48±0.342, 8.15±0.113,) respectively (Table 1). These values are within the range (22-38 %) of hematocrit and (8-12 g/dl) of hemoglobin concentration reported by Kahn, (2005). PCV and Hb values attained by T2 had significantly higher values compared to other treatment. This result agrees with the finding of Abdel-Rahman and Mosaad, (2013) but disagree with the result of (selem, 2012, Mangilli *et al.* 2015) in ewes and (Sarker and yang, 2010) in calves. Such increase in Hb and PCV could be attributed to the improves of the digestive utilization of iron and the regeneration efficiency of hemoglobin and it has a prophylactic immune stimulating effect following propolis administration (Bratter *et al.*, 1999; Haro *et al.*, 2000; Omar *et al.*, 2003). Also; no significant

effect was noticed among the periods of blood collection throughout the experiment in both Hb and PCV.

The N/L ratio has significantly ($p < 0.01$) declined with the increase propolis concentration in T4 (0.93±0.139) compared with T3, T2&T1 (0.99±0.116, 1.31±0.083 and 1.58± 0.109) respectively (Table1). Result revealed that N/L ratio decline significantly from the 1st period (1.63±0.118) toward the lowest values (0.88±0.118) at the final period of collection. This result is in accordance with the result of Sulaiman, (2013) in quail, Galalet *al.* (2008) in laying hens and Ziaran *et al.* (2005) in broiler. Decrease in N/L ratio observed in this study is due to the active compound flavonoids in the propolis which stimulates the immune system by increasing the lymphocyte number (Haveesten, 2002).

Serum biochemical parameters

The effect of propolis on serum biochemical parameters are shown in (Table 2). The result indicated that propolis administration caused significantly ($p < 0.05$) increase total protein and globulin. However, glucose, cholesterol and albumin was not significantly differ. This finding agreed with the result of selem, (2012), who reported that the total protein and globulin were significantly ($p < 0.01$) increase in propolis treated ewes. However, (Kashkooliet *al.* 2011) found that propolis have no significant effect on serum total protein, albumin and globulin. The increase of serum total protein by propolis could be due to that propolis modulate protein metabolism (Selem, 2012). Increase of globulin concentration may be attributed to stimulation of immune system by propolis flavonoid (havsteen, 2002). A higher value of glucose was recorded at the 3 and 4 period of blood collection (Table 4). This suggests that propolis modulate the glucose metabolism (Fuliang *et al.* 2005). Higher value of cholesterol was recorded in the first period (52.31 ± 4.309) then gradually decreases at the final period of collection (37.53 ± 2.425) Table (4). This may be attributed to lipase stimulation, through direct relation of propolis to lipid metabolism (Albokhadaim, 2015). Total protein and globulin gradually increase to reach the highest value at the end period (Table 4).

2. liver enzymes activity: Aspartate-aminotransferase (AST) and Alanine-aminotransferase (ALT):

The analysis of variance indicates that treatment had a significant ($p < 0.05$) effect on ALT

value only (Table 3). Propolis decreased the activity of ALT especially in T4 compared to other treatments. A decrease at the end period of blood collection was noticed in AST (Table 4). Similarly, it has been reported that administration of propolis caused a decrease in AST and ALT in

ewe (Selem, 2012), a decrease of ALT in rats (Sanzet *et al.* 1994; Chopra *et al.* 1995; Sugimoto *et al.* 1999; Albokhadaim, 2015). This may be due to the hepatoprotective effect of propolis which could have a role in the protection of liver from damage (Denliet *et al.* 2005).

Table (1):- Effect of propolis administration on some hematological parameters of Karadi ewes (Means± S.E)

Effect	N	PCV %	Hbg/dl	N/L %
overall mean	80	24.48±0.342	8.15±0.113	1.20± 0.063
T1 Control	20	23.15± 0.529 b	7.71±0.175 b	1.58± 0.109 a
T2(1ml propolis)	20	25.50±0.856 a	8.49± 0.284 a	1.31±0.083 b
T3(2ml propolis)	20	24.40±0.634 ab	8.12±0.210 ab	0.99±0.116 c
T4(3ml propolis)	20	24.90±0.610 ab	8.29± 0.202 ab	0.93±0.139 c

Means with in each column bearing different letters denote a significant difference; otherwise there is no significant difference

Table(2):- Effect of propolis administration on some biochemical attributes in blood Karadi ewes (Means± S.E)

Effect	N	Glucose mg/dl	Cholesterol mg/d	Total protein g/d	albumin g/d	Globulin g/d
overall mean	80	67.77±1.867	44.75±1.450	6.64±0.091	2.68±0.056	3.95±0.108
T1 Control	20	70.06±3.037a	41.61±2.360a	6.01±0.093c	2.79±0.093a	3.22±0.126 c
T2(1ml propolis)	20	69.47±3.514a	48.09±2.980a	6.52± 0.143b	2.57±0.091a	3.95±0.183 b
T3(2ml propolis)	20	65.68±4.580a	40.83±2.612a	6.92±0.192a	2.61±0.123a	4.32±0.196 a
T4(3ml propolis)	20	65.87±3.820a	48.48± 3.324a	7.10±0.190a	2.76±0.138a	4.33±0.251a

Means with in each column bearing different letters denote a significant difference; otherwise there is no significant difference

Table(3):- Effect of propolis administration on AST&ALT enzymes of Karadi ewes (Means± S.E)

Effect	N	AST IU/L	ALT IU/L
overall mean	80	201.27±2.876	135.36± 2.682
T1 Control	20	194.12± 4.250a	143.87±4.877a
T2(1ml propolis)	20	206.02±7.312a	142.00±5.755ab
T3(2ml propolis)	20	199.41±3.977a	128.62±4.432ab
T4(3ml propolis)	20	205.55±6.721a	126.95±5.553b

Means with in each column bearing different letters denote a significant difference; otherwise there is no significant difference

Table(4):- Effect of period of blood collection on hemo-biochemical parameters of Karadi ewes

Variable	N	1	2	3	4	5
PCV %	16	25.87±0.576 a	24.37±1.024 a	23.81±0.627a	24.56±0.701 a	23.81± 0.791a
Hbg/dl	16	8.60±0.188 a	8.12± 0.341 a	7.93±0.209 a	8.18±0.233 a	7.92±0.262 a
N/L %	16	1.63±0.118 a	1.31±0.092 b	1.195±0.143 bc	0.99±0.158 dc	0.88±0.118 d
Glucose mg/dl	16	65.03±5.24 ab	69.87±2.316 ab	72.75±2.70 a	71.30±4.825 ab	59.91±4.575 b
Cholesterol mg/dl	16	52.31±4.309 a	46.16±3.209 ab	46.68±2.47 ab	41.08±2.431 b	37.53±2.425 b
Total protein g/dl	16	5.81±0.092 d	6.18±0.093 c	6.70±0.131 b	7.16±0.167 a	7.32±0.222 a
Albumin g/dl	16	2.46±0.118 b	2.78±0.086 ab	2.88±0.122 a	2.64±0.117 ab	2.66±0.166 ab
Globulin g/dl	16	3.35±0.126 c	3.40± 0.13 c	3.81±0.14 b	4.52±0.193 a	4.68±0.336 a
AST IU/L	16	208.54±7.935 a	208.00±8.774 a	204.34±4.877 ab	198.56±3.542 ab	186.93±4.489 b
ALT IU/L	16	136.12±5.699 a	142.06±6.773 a	129.03±4.387 a	133.65±5.65 a	135.93±7.340 a

CONCLUSION

It could be concluded from the present investigation that the propolis has positive effect on animal hygiene by increasing the immunity and decreasing the stress via increase the globulin level in the blood, which may affect positively on the productive performances and reproductive.

Recommendation:

The present research recommended to apply propolis with different another levels at earlier ages.

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A COMPARATIVE STUDY ON MILK YIELD AND ITS COMPOSITION BETWEEN BLACK MOUNTAIN AND DAMASCUS (SHAMI) GOATS RAISED AT COMMERCIAL FARMS

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ABSTRACT

This study was conducted on 25 Black mountain does and 28 Damascus does raised at two commercial flocks at Qultapa village at Qushtapa settlement in Erbil plain during December, 2010 to July, 2011. Milk traits consist of 290 monthly records of test day milk yield. All the studied milk traits and milk samples to determined milk compositions were recorded at monthly interval starting one month post kidding till the does were dried off. Overall mean \pm S.E. of test day milk yield (TDMY), Daily milk yield (DMY), total milk yield (TMY), pre-weaning milk yield (PrWMY), post-weaning milk yield (PWMY) and peak mild yield (PMY) were 0.829 ± 0.03 , 1.66 ± 0.12 , 136.04 ± 9.97 , 78.88 ± 6.55 , 57.16 ± 6.09 and 2.65 ± 0.18 kg, respectively. Breed had a significant ($P < 0.01$) effect on TDMY, DMY, TMY, PrWMY, and the effects were significant ($P < 0.05$) on PWMY and PMY. Also the effect of age of doe was significant ($P < 0.01$) only on TDMY. Moreover the month of kidding and stage of lactation had a highly significant effect on PWMY and TDMY, respectively. Overall mean \pm S.E. of fat (F%), protein (P%), lactose (L%), total solid (TS%) and solid non fat (SNF%) were 3.80 ± 0.09 , 5.13 ± 0.06 , 4.49 ± 0.01 , 14.24 ± 0.14 and $10.44 \pm 0.07\%$, respectively. Effect of breed was significant ($P < 0.01$) only on F%. Effects of month of kidding was significant on F% and TS% ($P < 0.01$), P%, and SNF% ($P < 0.05$). The effect of stage of lactation on milk compositions except SNF% were significant ($P < 0.01$). Correlation coefficients were negative, but no significant among TDMY and milk components, whereas there were highly significant correlations among milk compositions. Repeatability estimates by REML method for TDMY was 0.254.

KEY WORD: Black Mountain, Damascus goat, fixed factors, milk yield, milk composition, Repeatability.

INTRODUCTION

Goats with a world population of about 868 million heads (FAO, 2011) have played a significant socio-economic role in the evolvement of human civilization around the world. They are an important component of domestic animal genetic resources in many parts of the world including Kurdistan region of Iraq, because of their adaptability to different environmental condition (Gall, 1981). Their good adaptation to specific environments allows for the exploitation of low-potential rural areas and wastelands providing rural societies with typical products of animal origin (Boyazoglu and Morand-fehr, 2001; Haenlein, 2001). Also, it was reported that local goat genotypes which are suited to environmental conditions produce satisfactory milk and support kid growth without supplementary feeding (Cabiddu et al., 1999; Sangare and Pandey, 2000). Moreover, the native goats are important livestock

species in Iraq and particularly in Kurdistan region they can play an important role for the provision of meat and milk, particularly under the agriculture system prevailing in the country (Alkass and Juma, 2005). The Damascus goats, also known as the Shami in Arabic, is a native breed of Syria and are considered the most important breed of goats in some near east countries due to their highly milk yield and prolificacy (Constantinou, 1981; Constantinou *et al.*, 1981 and Mavrogenis *et al.*, 2006). This work aimed to study the effects of breed and some non-genetic factors like age, type of birth, month of kidding and stage of lactation on milk yield and its compositions of Black mountain and Damascus goats.

MATERIALS AND METHODS

This study was conducted on 25 Black mountain does and 28 Damascus does raised at

two commercial flocks at Qultapa village at Qushtapa settlement in Erbil plain during December, 2010 to July, 2011. The flocks were managed semi-intensively; the animals were allowed to graze natural pasture and cereal stubbles for five hours in the morning and three hours in the afternoon. Does were offered a daily allowance of 1kg/head/day of barley and wheat bran with straw during kidding season and suckling period. In addition, mineral blocks and clean water were available all the time. Ages of does were determined by dentation. Kids were left with their does till weaning (3 months). All the animals were protected against common diseases through regular vaccination and were drenched against internal parasites and dipped twice a year by insecticide to control the external parasites.

Milk yield was recorded at monthly intervals starting one month post kidding till the does were dried off (less than 100 gm) (ICAR, 2007). Kids were separated from their does overnight (at 8:00 pm – 8:00 am) prior to milking. Does were milked by hand and the quantity of milk was recorded and then multiplied by 2 to calculate the test-day milk yield. A total of 288 milk samples were taken separately at monthly intervals and analyzed by EKO TOTAL MILK* in order to determine the chemical composition of the milk.

General Linear Model (GLM) within the statistical program SAS (2005) was used to analyze the collected data to estimate the effect of breed, age of doe, type of birth, month of kidding and month of lactation on the studied traits, assuming to the following model:

$$Y_{ijklmn} = \mu + B_i + A_j + T_k + K_l + S_m +$$

e_{ijklmn}

Where:

Y_{ijklmn} = Observational value of animal.

μ = Overall mean.

B_i = Effect of i^{th} breed (i = Black mountain goat or Damascus goat).

A_j = Effect of j^{th} age of doe (j = 2, 3, 4, 5).

T_k = Effect of k^{th} type of birth (k = single or twin).

K_l = Effect of l^{th} month of kidding (l = December, January, February, March).

S_m = Effect of m^{th} stage of lactation (m = 1, 2, 3, 4, 5, 6, 7).

e_{ijklmn} = Experimental error assumed to be NID with (0, $\sigma^2 e$).

Also Scheffe's test was used to found the significant differences between means, the repeatability of TDMY were estimated by REML method; also the Pearson correlation test was used

to assess the significance of correlation among test day milk yield and milk compositions.

RESULTS AND DISCUSSION

Milk Traits

The overall mean \pm S. E. of TDMY, DMY, TMY, PrWMY, PWMY and PMY were 0.829 ± 0.03 , 1.66 ± 0.12 , 136.04 ± 9.97 , 78.88 ± 6.55 , 57.16 ± 6.09 and 2.65 ± 0.18 kg (Tables 1 and 2).

Factors affecting Milk Traits

Breed

Breed effects were significant for all studied milk yield traits, Damascus does had the highest all milk yield traits as compared with the black mountain does (Tables 1 and 2). Such result could be due to differences in the genetic makeup of does. This result are in accordance with findings of previous results (Alkass and Merkhan, 2011 and Silva et al., 2013). But the result was contradictory to the earlier finding reported by Hermiz et al. (2004) in Local does with their crosses.

Age of doe

It appears from the results given in Table (1) and (2) that age of doe had no significant effect on all milk traits except a highly significant effect on TDMY which showed that the highest TDMY was found in does aged 3 years and was significantly higher than those 2 years old. This might be due to an increase in their body weight which is associated with the increase in udder and digestive system (Rathore, 1970), both of which are related with increases in feed intake (Randy et al., 1988). Although the effect of age of doe was no significant on the DMY, TMY and PrWMY but there were significant differences between different ages of does. The significant effect of age of doe on TDMY was in accordance with those reported earlier in Damascus and Black and Maraz goat breeds (Jawasreh, 2003 and Alkass and Merkhan, 2011). Similar results of non-significant effect of age of doe have been noticed on DMY (Mohammed et al., 2007), TMY and PWMY (Hermiz et al., 2004).

Type of birth

Results showed that the type of birth did not significantly affect all the studied milk traits, however does with single kid produced more milk yield when compared to does kidded twin in all the studied milk traits (Tables 1 and 2). Similar results of non significant effect of type of birth on milk yield traits in different goat breeds were

observed in other studies (Akpa et al., 2001; Jawasreh, 2003; Hermiz et al. 2004; Alkass and Merkhan, 2011 and Marete et al., 2014). Also our results were in accordance with the findings of Mohammed et al. (2007) who observed that type of birth had no significant effect on DMY and PMY, but contradictory effects on TMY.

Month of kidding

In the current study, the effect of month of kidding on all milk yield traits was no significant except PWMY. It appears from Table (1) and (2) that does kidded during December and January produced a highly significant more PWMY than those kidded during February and March. Such effect of month of kidding reflects the environmental variation and particularly the availability of feed. Similarly, Salih and Maarof (2004) found that the month of kidding also had a non-significant effect on the TMY, PrWMY, PWMY and PMY. The non significant difference

found in this study of month of kidding on TDMY was in agreement with the result reported by Hermiz et al. (2004).

Stage of lactation

The effect of stage of lactation on TDMY of in this study was highly significant (Table 1). The highest test-day milk (0.990 kg) yielded by does at the first month of lactation and the lowest test was reported at the seven month of lactation. This effect of stage of lactation on milk yield might be to physiological changes in the number and activity of secretory cells in mammary gland. Earlier studies conducted by Alkass and Merkhan (2011), Klir et al. (2015) and Pleguezuelos et al. (2015) reported that stage of lactation affect TDMY significantly in different breeds of goats. Also some authors were found a significant effect of stage of lactation on DMY in different breed of goats (Ciappesoni et al., 2004; Guler et al., 2007 and Mioc et al., 2008).

Table(1):- Least square means \pm standard errors for the effects on milk traits (Kg) in Black Mountain and Damascus does.

Factors	No	TDMY (Kg)		DMY(Kg)		TMY(Kg)	
		Means \pm S.E.	No	Means \pm S.E.	Means \pm S.E.		
Overall mean	290	0.829 \pm 0.03	53	1.66 \pm 0.12	136.04 \pm 9.97		
Breed		**		**	**		
Black Mountain	139	0.47 \pm 0.05b	25	1.04 \pm 0.14b	85.81 \pm 11.30 b		
Damascus	151	1.11 \pm 0.05a	28	2.38 \pm 0.14a	185.13 \pm 5.08 a		
Age of doe (years):		**					
2	102	1.23 \pm 0.10b	21	1.36 \pm 0.15b	108.71 \pm 12.31b		
3	68	1.81 \pm 0.18a	12	1.94 \pm 0.18a	158.52 \pm 14.89a		
4	59	1.69 \pm 0.13a	10	1.84 \pm 0.20ab	147.58 \pm 16.62ab		
5	61	1.63 \pm 0.14a	10	1.70 \pm 0.22ab	127.07 \pm 18.01ab		
Type of birth :							
Single	167	0.82 \pm 0.05a	30	1.78 \pm 0.14a	143.06 \pm 11.37a		
Twin	123	0.77 \pm 0.05a	23	1.64 \pm 0.14a	127.87 \pm 11.58a		
Month of Kidding:							
December	125	0.78 \pm 0.04a	19	1.55 \pm 0.15a	157.62 \pm 11.93a		
January	47	0.80 \pm 0.07a	8	1.76 \pm 0.22a	150.32 \pm 17.73ab		
February	75	0.74 \pm 0.06a	15	1.64 \pm 0.17a	121.31 \pm 13.60ab		
March	43	0.85 \pm 0.08a	11	1.88 \pm 0.21a	112.63 \pm 17.38b		
Stage of Lactation:		**					
1	53	0.99 \pm 0.06a					
2	53	0.85 \pm 0.06a					
3	52	0.87 \pm 0.06a					
4	51	0.88 \pm 0.06a					
5	40	0.82 \pm 0.07a					
6	23	0.79 \pm 0.10a					
7	18	0.35 \pm 0.11b					

** P<0.01

Means having different letters within each factor/column differ significantly (P<0.05) according to Scheffe's test.

Table(2);- Least square means \pm standard errors for the effects on milk traits (Kg) in Black Mountain and Damascus does.

Factors	No	PrWMY(Kg)		PWMY(Kg)		PMY(Kg)	
		Means \pm S.E.	S.E.	Means \pm S.E.	S.E.	Means \pm S.E.	S.E.
Overall mean	53	78.88 \pm 6.55	**	57.16 \pm 6.09	*	2.65 \pm 0.18	*
Breed							
Black Mountain	25	43.92 \pm 6.99 b		41.89 \pm 7.20 b		1.74 \pm 0.22b	
Damascus	28	118.77 \pm 6.95 a		66.36 \pm 7.15 a		3.63 \pm 0.21a	
Age of doe (years):							
2	21	67.22 \pm 7.62b		41.49 \pm 7.84a		2.28 \pm 0.24a	
3	12	95.49 \pm 9.22a		63.03 \pm 9.49a		2.82 \pm 0.29a	
4	10	84.21 \pm 10.30ab		63.37 \pm 10.59a		3.04 \pm 0.32a	
5	10	78.47 \pm 11.16ab		48.60 \pm 11.48a		2.60 \pm 0.34a	
Type of birth :							
Single	30	82.48 \pm 7.04a		60.58 \pm 7.25a		2.73 \pm 0.22a	
Twin	23	80.22 \pm 7.17a		47.66 \pm 7.38a		2.63 \pm 0.22a	
Month of Kidding:			**				
December	19	67.43 \pm 7.39a		90.19 \pm 7.60a		2.73 \pm 0.23a	
January	8	84.82 \pm 10.98a		65.50 \pm 11.30a		2.75 \pm 0.34a	
February	15	80.78 \pm 8.42a		40.53 \pm 8.67b		2.51 \pm 0.26a	
March	11	92.36 \pm 10.76a		20.26 \pm 11.07b		2.74 \pm 0.33a	

** P<0.01

* P<0.05

Means having different letters within each factor/column differ significantly (P<0.05) according to Scheffe's test.

Milk Composition

The overall mean \pm S. E. of fat, protein, lactose, total solid and solid non fat averaged 3.80 \pm 0.09, 5.13 \pm 0.06, 4.49 \pm 0.01, 14.24 \pm 0.14 and 10.44 \pm 0.07 %, respectively (Tables 3 and 4).

Factors affecting Milk Composition

Breed

Milk of Damascus goat had significantly (P<0.05) higher content of fat (4.36 vs. 3.96%) than those of Black mountain goat. This difference between the two breeds might be attributed to difference in the genetic makeup of does. While milk of Black mountain goat had numerically higher content of protein (5.41 vs. 5.25%), lactose (4.51 vs. 4.48%), solid non fat (10.77 vs. 10.57%) than those of Damascus goat (Table 1 and 2); which could be due to the lower milk yielded of Black mountain as compared to Damascus goat. Similarly, the significant effect of breed on F% is in accordance with the findings of Mioc et al. (2008); Merkhan and Alkass (2012); Sanogo et al. (2013) and Silva et al. (2013) in different breed of goats. Conversely, the non significant effect of breed on milk constituent is in agreement with the findings of Merkhan and Alkass (2012) for L%, Mioc et al. (2008) and Silva et al. (2013) for P% and L%. These results of milk components of Black mountain goats were higher than those reported earlier for F% and P% by Salih and Maarof (2004) and Merkhan and Alkass (2012) and for all milk constituents by Zarkawi et al.

(2013). On the other hand, our results of Damascus goat were higher than those recorded previously for Damascus and German Fawn X Hair goat in Turkey by Keskin et al. (2004), for F% and TS% of Damascus goat by Guler et al. (2007) and for all milk composition of Barky breed and only F% of Damascus goat by Salem et al. (2000) and for all components of crossbred 1 and 2 with the exception of F% by Salem et al. (2004).

Age of doe

The results given in Table (3) and (4) showed that the effect of the age of does on all milk compositions was not significant. However, does aged 4 years produced milk richer in F%, P%, L%, TS% and SNF% compared to other ages of does. The non-significant effect of age and parity of does on milk constituents were in agreement with those reported earlier by Merkhan and Alkass (2012) and Kaskous et al. (2015). Also these results were in accordance with those reported by Mioc et al. (2008) who showed that parity had a non significant effect on fat and lactose percentages. Moreover, no significant effects of parity on milk constituents were found by other authors (Zeng and Escobar, 1995; and Pal et al., 1996; Zahraddeen et al., 2007 and Merkhan and Alkass 2012).

Type of birth

Although, all milk contents given in Tables 3 and 4 produced from does rearing twin kids were

higher than those in milk produced from does rearing singles, but the differences were not significant. Earlier studies claimed that the effect of type of birth on F% and P% was not significant (Salih and Maarof, 2004 and Zumbo et al., 2004). Also Merkhan and Alkass (2012) reported no significant difference of type of birth on P%, L% and SNF% in Black and Maraz goats. In addition, Sanogo et al. (2013) indicated that F%, P% and TS% were not affected by type of birth. Moreover, Kaskous et al. (2015) showed non significant effects of type of birth on F%, L% and SNF% in Syrian Mountain goats.

Month of kidding

It appears from Table (3) that does kidded in March produced significantly more F% and P% than those kidding in other months, and those kidded in February yielded significantly more TS% and SNF%. Similarly, the effect of month and season of kidding was found to be significant on TS% and SNF% (Midau et al., 2010), on F% and P% (Ciappesoni et al., 2004 and Pleguezuelos et al., 2015), on F%, P% and TS% (Sanogo et al., 2013) and on F%, P% and L% (Silva et al., 2013 and Klir et al., 2015). While the month of kidding was no significant on L%. This result is in agreement with the findings of Salih and Maarof (2004) and Mioc et al. (2008).

Stage of lactation

The effect of stage of lactation on all milk constituents was highly significant with the exception of SNF%. It appears from Tables (3) and (4) that all milk constituents showed the lowest value during early lactation followed by a significant rise toward the maximum values during the six and seven month of lactation. This effect might be due to the highest TDMY obtained during early stage of lactation then followed the mid lactation and the lowest TDMY attained during the late stage of lactation.

This finding is in accordance with those noticed by Ciappesoni et al. (2004); Mioc et al. (2008); Merkhan and Alkass (2012); Klir et al. (2015) and Pleguezuelos et al. (2015).

Repeatability Estimates of TDMY

Repeatability estimates of TDMY obtained from this study (0.254) was lower than several estimated values reported earlier of milk traits using different breeds of goat (Bagnicka et al., 2004; Hermiz et al., 2004; Shaat et al., 2007; Faruque et al., 2010; Brito et al., 2011 and Bagnicka et al., 2015).

Correlations between TDMY and its Compositions

Phenotypic correlations between TDMY with milk constituents including P%, L% and SNF% were all negative and not significant, while the estimates with F% and TS% was positive and also non significant (Table 5). On the other hand, all correlations among milk compositions were positive and highly significant except between F% and L%. Also, Breznik et al. (2000) claimed that the correlation between DMY and fat and protein contents were negative, but with lactose content was positive. Also they noticed positive phenotypic correlations among milk contents. While Kuchtik et al. (2008) found negative and significant phenotypic correlations between milk yield and all milk composition except lactose contents, whereas the correlation among all milk constituents except lactose content were positive and highly significant in their study on East Friesian ewes. Moreover, Silva et al. (2013) reported that there were negative correlations between TDMY with milk fat and protein contents, except for lactose content which had a positive correlation with TDMY also they were showed that a positive correlation between fat and each of protein and lactose contents in their study on Alpine and Saanen goats. While, Mioc et al. (2008) reported that the correlations between DMY with milk constituents (F% and P%) was negative and significant, but with L% was positive and significant, while correlation between F% and P% was highly significant and positive.

CONCLUSIONS

It was concluded that Damascus goat surpassed significantly Black mountain breed in all milk yield traits. Also age of doe and stage of lactation had highly significant influence on TDMY, Also month of kidding had highly significant on PWMY, respectively. Also breed had significant effect only on F%, while month of kidding was effected significantly all milk compositions except L%. Also stage of lactation had highly significant influence on F%, P% and L%. Estimate of repeatability for TDMY obtained from this study was moderate to high and this is indicate that selecting does according to their records at early age of does will improve their later performance. Phenotypic correlations between TDMY and all milk constituents were not significant. While all correlations among milk compositions were

positive and highly significant except between F% and L%.

Table (3):- Least square means \pm standard errors for the effects on Fat, Protein and Lactose in milk of Black Mountain and Damascus does (%).

Factors	No	Means \pm S.E.		
		F%	P%	L %
Overall mean	288	3.80 \pm 0.09	5.13 \pm 0.06	4.49 \pm 0.01
Breed		*		
Black Mountain	137	3.96 \pm 0.13b	5.41 \pm 0.10a	4.51 \pm 0.01a
Damascus	151	4.36 \pm 0.13a	5.25 \pm 0.10a	4.48 \pm 0.01a
Age of doe (years):				
2	102	4.16 \pm 0.14a	5.44 \pm 0.12a	4.50 \pm 0.01ab
3	68	2.25 \pm 0.16a	5.37 \pm 0.13a	4.50 \pm 0.01ab
4	59	4.17 \pm 0.17a	5.44 \pm 0.14a	4.51 \pm 0.01a
5	59	4.06 \pm 0.19a	5.06 \pm 0.15a	4.47 \pm 0.01b
Type of birth :				
Single	166	4.13 \pm 0.13a	5.28 \pm 0.10a	4.49 \pm 0.01a
Twin	122	4.19 \pm 0.13a	5.38 \pm 0.11a	4.50 \pm 0.01a
Month of Kidding:		**	*	
December	124	3.90 \pm 0.11b	5.07 \pm 0.09c	4.48 \pm 0.01b
January	46	3.72 \pm 0.18b	5.17 \pm 0.15bc	4.49 \pm 0.01ab
February	75	3.90 \pm 0.16b	5.43 \pm 0.13ab	4.51 \pm 0.01a
March	43	5.16 \pm 0.22a	5.65 \pm 0.18a	4.51 \pm 0.02ab
Stage of Lactation:		**	**	**
1	52	2.94 \pm 0.17d	4.84 \pm 0.14e	4.48 \pm 0.01b
2	53	3.52 \pm 0.17c	5.04 \pm 0.14cde	4.48 \pm 0.01b
3	51	3.09 \pm 0.17c	4.80 \pm 0.14e	4.47 \pm 0.01b
		d		
4	51	4.10 \pm 0.17b	5.31 \pm 0.14bd	4.49 \pm 0.01b
5	40	5.12 \pm 0.20a	5.37 \pm 0.16bc	4.48 \pm 0.01b
6	23	4.88 \pm 0.27a	6.21 \pm 0.22a	4.56 \pm 0.02a
7	18	5.46 \pm 0.31a	5.73 \pm 0.25ab	4.50 \pm 0.02b

** P<0.01

* P<0.05

Means having different letters within each factor/column differ significantly (P<0.05) according to Scheffe's test.

Table (4):- Least square means \pm standard errors for the effects on Total solid and Solid non fat in milk of Black Mountain and Damascus does.

Factors	No	Means \pm S.E.	
		TS%	SNF%
Overall mean	288	14.24 \pm 0.14	10.44 \pm 0.07
Breed			
Black Mountain	137	14.72 \pm 0.20a	10.77 \pm 0.12a
Damascus	151	14.93 \pm 0.21a	10.57 \pm 0.12a
Age of doe (years):			
2	102	14.95 \pm 0.23a	10.80 \pm 0.14a
3	68	14.97 \pm 0.26a	10.72 \pm 0.16a
4	59	14.98 \pm 0.28a	10.82 \pm 0.17a
5	59	14.41 \pm 0.31a	10.35 \pm 0.18a
Type of birth :			
Single	166	14.73 \pm 0.21a	10.61 \pm 0.12a
Twin	122	14.93 \pm 0.21a	10.74 \pm 0.13a
Month of Kidding:		**	*
December	124	14.21 \pm 0.30b	10.49 \pm 0.18bc
January	46	14.70 \pm 0.26b	10.79 \pm 0.16ab
February	75	16.14 \pm 0.35a	11.04 \pm 0.21a
March	43	14.26 \pm 0.19b	10.36 \pm 0.11c

Stage of Lactation:		**	
1	52	13.06±0.28d	10.12±0.17d
2	53	13.87±0.28c	10.34±0.17cd
3	51	13.16±0.28cd	10.07±0.17d
4	51	14.73±0.28b	10.64±0.17bc
5	40	15.81±0.32a	10.69±0.19bc
6	23	16.60±0.43a	11.72±0.26a
7	18	16.57±0.50a	11.11±0.30ab

** P<0.01

* P<0.05

Means having different letters within each factor/column differ significantly (P<0.05) according to Scheffe's test.

Table (5): Correlations between test day milk yield and milk compositions in milk of Black Mountain and Damascus does.

Traits	F%	P%	L%	TS%	SNF%
TDMY	0.027	-0.025	-0.025	0.006	-0.024
F%		0.446 **	0.103	0.872 **	0.423 **
P%			0.929**	0.827 **	0.999 **
L%				0.572 **	0.938 **
TS%					0.812 **

** P<0.01,
lk yield,

TDMY=Test day m

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EFFECT OF OAK ACORN (*Quercus aegilops*) SUPPLEMENTATION ON MILK YIELD, COMPOSITION AND SOME BLOOD BIOCHEMICAL TRAITS OF BLACK GOATS RAISED UNDER FARM CONDITION

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ABSTRACT

This study aimed to investigate the influence of oak acorn supplementation on milk yield and its composition as well as some blood biochemical in goats maintained on pasture. After kidding within a week, 44 lactating adult Black does at mid lactation were milked and accordingly were divided into two groups. The first group was fed on pasture plus 0.5 kg barley/head/daily and considered as a control (CON). The second group was fed on pasture plus 0.5 kg barley/head/daily and supplemented with 14% (70gm) of ground oak acorn (QAA). In achievements, daily and total milk yield as well as milk yield components were highly significantly affected by ground oak acorn treatment. In the exception of lactose percentage and triglyceride concentration in the milk composition and blood, respectively were not affected by both treatments. Moreover, relative economical efficiency of the ground oak acorn group was 21.87% higher than control group. It could be concluded that ground oak acorn treatment showed an improvement in milk production, milk yield components and better economical efficiency compared to the animals fed the control diet.

KEYWORDS: Oak acorn, tannins, milk yield, milk component, blood biochemicals, goat.

INTRODUCTION

Oak acorn is a woody plant, cheap and widely available in many parts of the globe (FROUTAN et al., 2015). It contains starch amounting to over 550 g/kg of the kernel (SAFFARZADEH et al., 1999), variable amount of lipids (15-60 g/kg DM) and low level of crude protein (30-40 g/kg DM) (LOPES and BERNARDO-GIL, 2005). It has been reported that oak acorn have an impact on animal performance because it contains some anti-nutritional factors like tannins and phenolic compounds (SILANIKOVE and PEREVOLOTSKY, 1994). The total phenol and total tannins in the oak is about 232.58 mg/g and 158.129 mg/g, respectively (AZIZ, 2006). Tannins are polyphenolic compounds of plant-origin feedstuffs (FROUTAN et al., 2015), with the capacity to form reversible and irreversible complex mainly with proteins (SCHOFIELD et al., 2001). Traditionally, it has been divided into two types, including condensed tannins (CT) and hydrolysable tannins (HT) (FROUTAN et al., 2015). Peas and beans mainly legume forage are the rich sources of CT, however, fruit pods, tree leaves and woods mainly chestnut and oak are the rich

sources of HT (MIN et al., 2003). Additionally, Gallic and/or hexahydroxydiphenic acid are the building blocks of the HT which is important for esterification by binding with hexo-sugars (WAGHORN, 2008; PATRA and SEXENA, 2010). It has been indicated that a high concentration of tannin (> 50 g Kg⁻¹ of dry matter, DM) resulted in reducing the voluntary feed intake and the digestibility of nutrient, while the digestive utilization of feed is improved with low to moderate concentrations (<50 g Kg⁻¹ DM) and this could be attributed to a slight increase in the flow of amino acids to the small intestine and to reduce in protein degradation in the rumen (FRUTOS et al., 2004).

The leaves and acorn of many oak species are avidly eaten by cattle, sheep and goat. Studies on the impact of oak acorn supplementation on milk yield and composition in goat is rare, therefore, such research would be useful in the mountainous areas of Kurdistan region/Iraq because of the use of acorn in the goat smallholder farming and their availability in bulk (November- March) during the shortage of shrub vegetation nutritive value. Thus this study aimed to investigate the influence of

oak acorn supplementation on milk yield and its composition as well as some blood biochemical in goats maintained on pasture.

MATERIAL AND METHODS

This study was conducted in a Black goat commercial flock at Akri. After kidding within a week, 44 lactating adult Black does at mid lactation were milked and accordingly were divided into two groups (each 22 goats). The first group was fed on pasture plus 0.5 kg barley/head/day and considered as a control (CON). The second group was fed on pasture plus 0.5 kg barley/head/day and supplemented with 14% (70 g) of ground oak acorn (QAA). Milk yield was measured at biweekly interval for three months. As well as, milk samples were collected for determination its composition. Prior to the measurements, the kids were separated from the does at 8:00 p.m. and on the following day (8.00 a.m.), does were milked manually. Daily Milk yield was obtained by multiplying Test-day milk yield (TDMY) by two.

During the trial period, blood samples were obtained at monthly intervals. 10 ml of blood from jugular vein of each doe was collected and stored in vacuum glass tubes containing no anticoagulant. Then, the samples were left for 20 minutes at room temperature. Next, the serum was kept at -25°C after the samples were been centrifuged for 10 minutes at 3,000 rpm. The commercial kits (BIOLAPO SA, France) was used to measure the serum total protein, glucose, cholesterol, albumen, urea and triglycerides contents and these parameters were finally measured using the UV Spectrophotometer. Immediate composition (fat, solid non fat, lactose, protein and total solid) of milk samples (50 ml) was taken by EKO MILK TOTAL (Eon Trading LLC, USA). General Linear Model was used to determine the effect of treatments on studied traits by using SAS, (2002).

RESULTS AND DISCUSSION

In the current work, the initial milk yield was similar ($P > 0.05$) for the experimental groups (0.871 vs. 0.999 Lt) (Table 1). Moreover, does fed supplemented diet (QAA) yielded significantly ($P < 0.01$) higher daily milk yield (1.092 Lt/ day) and total milk yield (95.26 Lt) during the experimental period as compared with control

does (0.799 Lt/day and 68.06 Lt, respectively) (Table 1). Some researches indicated that HT is degraded by rumen microbes (Makkar, 2003). According to Alonzo-Diaz et al., (2009) and Lamy et al., (2011), concluded that tannins react with the specific types of protein in the saliva called prolin. Furthermore, the concentration of this protein is varying depending on species, physiological state and geographical region. For instance, this protein is more active and concentrated in the animal that found in the tropical region such as goat and deer compared to cattle and sheep (Mueller-Harvey, 2006). Another reason is that tannins may enhance to make a complex between proteins and polysaccharide (cellulose, hemicelluloses, pectin, etc.) (Schofield et al., 2001). For this reason, Barry and McNabb, (1999) and Min et al., (2003) concluded that the concentration between the range of 10-40 g kg⁻¹ DM, improve the feed utilization and this may lead to greater absorption of available amino acids in the small intestine. Similarly, Ayadi et al. (2012) reported that moderate incorporation of CT (8%) from Carob pulp (*Ceratonia siliqua*) was associated with an increase in milk production of Morocco goats. Also, Decandia et al. (2000) and Pintus, (2000) found that goats browsing ashtruble comprising lentisk (*Pistacio lentiscus*) and *Quesrcus spp.*, increased milk yield. In ewes, Wang et al. (1996) found that CT from *L. corniculatus* increased milk yield.

Does fed supplemented diet (QAA) yielded significantly ($P < 0.01$) higher milk yield components; fat, protein, solid non fat, lactose and total solid (3.23, 3.72, 8.91, 4.50 and 12.14 Kg, respectively) as compared with control does (2.48, 2.68, 6.19, 3.02 and 8.67 Kg, respectively) during the experimental period. This increase in milk yield components may be due to the increase in milk yield in the treated group while, milk components in percentage remained similar between both experimental groups (Table 1).

Although the higher ($P < 0.001$) content of lactose percentage found in milk of goats that fed oak acorn, the percentage of other milk components (fat, protein, solid non fat and total solid) were not significantly affected by treatment. The increase of lactose concentration may be related to the greater glucose supply and this may be due to that in the mammary gland the lactose synthesis depends directly on the blood glucose, and in the ruminants the propionic acid and amino acids are the main involvements of the

gluconeogenesis. As a result of this, a greater glucose synthesis would contribute by a greater availability of amino acids (Wang et al., 1996). These authors showed that due to the action of tannins the increase in the concentration of lactose occurred without modification of the molar proportions of volatile fatty acids. Such results are

consistent with the finding of Pintus (2000) who found that no difference in milk fat and protein percentage of goats browsing CT from different plant species. Also, in ewes, Wang et al. (1996) found that CT from *L. corniculatus* (44.5 g CT Kg⁻¹ DM) increased protein and lactose yield, and decrease milk fat content.

Table (1): -The effect of oak acorn supplementation on milk yield and compositions.

Traits	Treatment		S.E.	Probability
	CON	QAA		
Milk yield (Lt)				
Initial daily milk yield	0.871	0.999	0.04	0.
Daily milk yield	0.799	1.092	0.040	<.0001
Total milk yield/90d	68.069	95.265	3.637	<.0001
Milk composition				
Fat %	3.671	3.372	0.097	0.128
Fat yield (kg)	2.48	3.23	0.14	0.007
Protein %	3.913	3.906	0.058	0.955
Protein yield (kg)	2.68	3.72	0.15	0.0002
Solid non fat %	9.070	9.335	0.083	0.111
Solid non fat yield (kg)	6.19	8.91	0.36	<.0001
Lactose %	4.429	4.713	0.037	<.0001
Lactose yield (kg)	3.02	4.50	0.19	<.0001
Total solid %	12.741	12.708	0.136	0.905
Total solid yield (kg)	8.67	12.14	0.48	<.0001

Biochemicals of blood serum are given in Table (2). It appears that does fed supplemented diet with oak acorn (QAA) resulted in a significant higher concentration of triglyceride (59.174 mg/dL) as compared with the control group (37.595 mg/dL). This may be due to the presence of different phenolic compounds including gallic, tannins and ellagic acids as well as various galloyl and hexahydroxydiphenoyl derivatives are contained in the oak acorns. These biological active compounds have an important role in regulating the concentrations of blood lipid

(Rakic *et al.* 2006). While, the concentrations of cholesterol, glucose, total protein, albumin and globulin in blood serum were not significantly influenced by the treatment. To the author knowledge, no information was available in the literatures for blood biochemical in lactating does consuming diets containing oak acorn. However, Froutan *et al.* (2015) noticed that glucose, protein and cholesterol concentrations were not significantly influenced by the different concentration of ground oak acorn in the kid's diets.

Table (2): The effect of oak acorn supplementation on blood biochemical.

Traits	Treatment		S.E	Probability
	CON	QAA		
Triglyceride (mg/dL)	37.595	59.174	4.840	0.025
Cholesterol (mg/dL)	107.961	113.434	2.262	0.228
Glucose (mg/dL)	30.440	27.646	1.519	0.360
Total protein (g/dL)	4.349	4.419	0.045	0.438
Albumin (g/dL)	3.118	3.261	0.053	0.183
Globulin (g/dL)	1.231	1.157	0.067	0.590

The economical efficiency (EE) of this study is demonstrated in Table 3. According to the present results, the supplementation of oak acorn group gave the highest revenue compared to that of the control group. Also, the economic efficiency of the studied treatments resulted in 202 % and 314 % for the QAA and CON, respectively. This

means that CON (the highest EE) could cover 314% of the total cost, while QAA (the lowest EE), just can cover 202% of the total costs in the same period. If CON is considered as the standard treatment (100%), then the relative economical efficiency of QAA was 121.87%.

Table (3): The economic efficiency of supplementation oak acorn in the goat diets.

Contributors	Treatments	
	CON	QAA
Feed cost/ton (\$)	316.66	529.06
Consumed feed /trial period (ton)	0.99	1.123
Total feed cost/ trial period (\$)	313.33	594.13
Milk price/ Litter (\$)	0.83	0.83
Total milk produced /trial period (Lt)	1564.2	2162.16
Total revenue (\$)	1298.29	1794.59
Net revenue (\$)	984.96	1200.46
Economic efficiency (EE)	3.14	2.02
Relative economic efficiency (R %)	100	121.87

- Barley price /kg (0.315 \$)
- Oak acorn price / kg (2.08 \$)

CONCLUSIONS

It could be concluded that lactating goat's rations (barley and pasture) and supplemented with oak acorn showed an improvement in milk production, milk yield components and better economical efficiency compared to the animals fed the control diet. Additionally, no changes in milk compositions percentage (except lactose) and blood biochemical's (except triglyceride) were observed between both groups during experimental period. Further studies are needed to determine the exact ratio of the oak acorn supplementation and respective mechanisms that elicit these positive effects on milk production.

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DEVELOPMENT OF PREDICTION EQUATION FOR TOTAL MILK YIELD FROM PARTIAL MONTHLY YIELD IN KARADI AND AWASSI EWES

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ABSTRACT

Data of Test-Day milk yield (TDMY) was collected on 30 Awassi and 32 Karadi ewes maintained on commercial farm to develop a prediction equation for total milk yield (TMY) from part lactation records. Results revealed that correlation coefficients between TMY and each of TDMY were all positive and highly significant ($P < 0.01$) being 0.767-0.902 for Karadi and 0.731-0.938 for Awassi. Based on multiple regression equation by using maximum R-square improvement between TMY and TDMY it appears that the best equations for prediction are:

For Karadi ewes:

$$TMY = 44763 + 79.7 \text{ TDMY}_3$$

And for Awassi ewes:

$$TMY = 26603.7 + 91.5 \text{ TDMY}_4$$

KEY WORDS: Prediction, Milk yield, Awassi, Karadi ewes.

INTRODUCTION

Although sheep in Iraq are raised primarily for lamb and mutton production, however, ewes are milked partially during suckling period and after weaning the lambs to be sold by the farmers to maximize their profit from such enterprise.

It is well known that genetic evaluation of dairy animals at an early age on the basis of part yields is beneficial to the dairy farmer as it cuts down the cost of rearing the animals and also helps in progeny testing (Ranjan et al., 2005). Moreover, part yield (monthly milk yield) or cumulative monthly yield have been reported to have a very genetic and phenotypic relationship with full records (Koul, 1973). Therefore, it seems essential to predict lifetime performance of an animal at the earliest possible stage on the basis of allied characters for judicious culling of inferior stock so as to result in a profitable animal farming and improvement of animal genetically (Alkass et al., 2000). The present work was, therefore, carried out to develop a prediction equation for total milk yield from partial records for Karadi and Awassi ewes.

MATERIALS AND METHODS

Data for the current investigation was collected on 30 Awassi and 32 Karadi ewes, 2-5 years old and over maintained on a commercial farm during the lambing season 2014. In addition to ewes were

allowed to graze on natural pasture, 500 gm of barley were also given for each ewe with free access of wheat straw and water. New born lambs were kept with their dams till weaning (5 months) except for the time when milk yield was recorded.

Milk was recorded at monthly intervals starting one month post-lambing till the ewes were dried off (<100 ml milk) according to ICAR, (2007). On the day of test, the lambs were separated from their mothers at 8.00 p.m. on the following morning, ewes were hand milked at 8.00 a.m., and the quantity of milk was recorded using a graduated cylinder. Daily milk yield were obtained by multiplying test day milk yield by 2.

The Multiple regression analysis models were obtained using the stepwise method of MINITAB (Minitab Inc., 2007). Variables were added or removed with a significance level of $P < 0.01$. All coefficients of determination (R^2) were adjusted to the number of variables included in the model (Chatterjee et al., 2000) to avoid artifact improvement in R^2 associated with variable addition (Weiss, 1993). Models were selected based on the highest adjusted R^2 with the least number of variables. Model selection was also based on visual appraisal of residual plots. The correlation coefficients between total milk yield (TMY) and each of monthly milk yields were also calculated.

RESULTS AND DISCUSSION

Overall means of total milk yield (TMY), test-day milk yield 1 (TDMY1), test-day milk yield 2 (TDMY2), test-day milk yield 3 (TDMY3), test-day milk yield 4 (TDMY4), test-day milk yield 5 (TDMY5) and test-day milk yield 6 (TDMY6) for Karadi and Awassi ewes are given in Table 1. Results indicated that total milk yield attained in the current study for Karadi ewes is higher than

those recorded previously for the same breed in the region (Alkass and Gardi, 2010), as well as for Awassi ewes (Karam et al., 1971; Alkass et al., 2009). However, such differences could be attributed to the genetic make-up of the animals, as well as to the condition of ewes and feeding and management practices followed in each farm.

Table (1): Total and test-day milk yield (TDMY) at different intervals for Karadi and Awassi ewes (Litter).

Milk yield	Karadi	Awassi
Total milk yield (TMY)	135.360 ± 7.209	122.945 ± 6.594
1st month (TDMY1)	0.681 ± 0.043	0.770 ± 0.051
2nd month (TDMY2)	0.787 ± 0.040	0.859 ± 0.052
3rd month (TDMY3)	1.136 ± 0.081	1.112 ± 0.076
4th month (TDMY4)	1.033 ± 0.057	1.052 ± 0.067
5th month (TDMY5)	0.840 ± 0.054	0.817 ± 0.047
6th month (TDMY6)	0.430 ± 0.029	0.483 ± 0.034

TMY= Total Milk Yield, TDMY1, TDMY 2, TDMY 3, TDMY 4, TDMY 5 and TDMY 6 = Milk Yield at 1st, 2nd, 3rd, 4th, 5th and 6th months;

It seems from Figure 1 that milk yield was increased gradually at TDMY1 to reach the peak at TDMY3, and falls gradually till weaning (5

month) followed by a sharp decline towards the dried off the ewes.

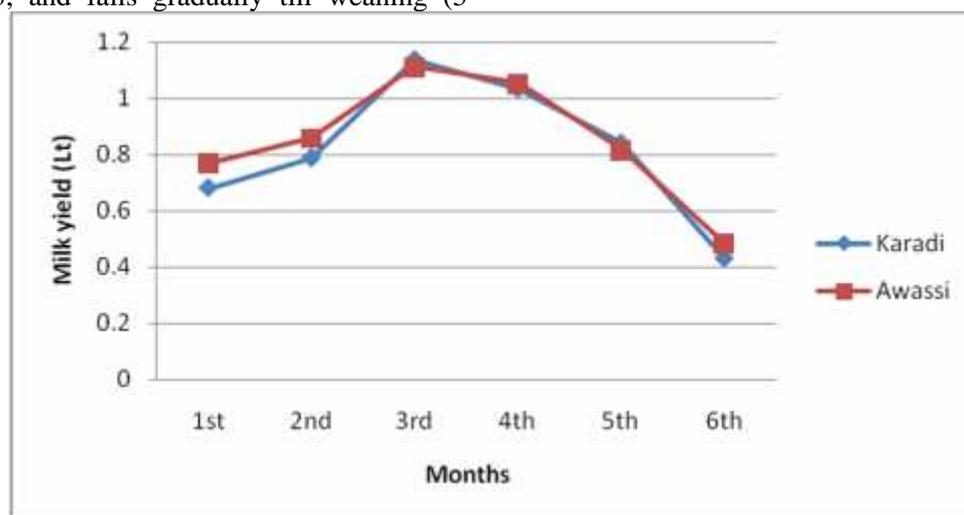


Fig. (1) Lactation curve of Karadi and Awassi ewes.

In order to estimate the relationship between each of six partial milk yields and total milk yield, the simple moment correlation between the have been calculated. It seems that there was a significant ($P < 0.01$) positive correlation between each part and total milk yield ranged between 0.731-0.938 for Awassi ewes (Table 2) and 0.767-0.902 for Karadi ewes (Table 3). Therefore, the critical appraisal could be drawn that partial milk yield could be used as useful indicator for total milk yield. Similarly, a significant positive correlation between different parts of lactations

and total milk yield were noticed in cattle (Roy and Katpatal, 1989; Alkass et al., 2000; Ranjan et al., 2005) and in goat (Alkass et al., 2009; Alkass and Merkhan, 2012).

Tables (2 and 3) revealed the leaders in the ordering within each set of monthly test-day milk yield combination according to the R^2 values. In view of the results demonstrated in Tables (2 and 3) entering new additional trait improved the predicted total milk yield according to the importance and correlated response of the monthly test-day milk yield with total milk yield, although

R-square values increased from 80.71 to 99.56 in Karadi and from 87.53-99.70 in Awassi ewes, its gain decreased after introducing two variables. Thus, to select the simplest equation, it can be suggested that step 1 would be more reliable than

others. Therefore, the best equations will be for Karadi ewes:

$$TMY = 44763 + 79.7 \text{ TDMY}_3$$

And for Awassi ewes:

$$TMY = 26603.7 + 91.5 \text{ TDMY}_4$$

Table (2): Multiple regression equations using maximum R-square improvement between total and monthly milk yield of Karadi ewes

Step	Intercep t	TDMY 1	TDMY 2	TDMY3	TDMY4	TDMY5	TDMY6	-seq
1	44763			79.7**				80.71
2	15380			53.8**	56.9**			93.19
3	10656			48.8**	42.7**	30.0**		95.95
4	3039	35.3**		36.7**	38.3**	32.1**		98.26
5	1175	37.2**		30.4**	32.3**	29.4**	37.6**	99.38
6	-1382	26.4**	18.5**	28.3**	31.1**	29.5**	35.2**	99.56
Correlation coefficient		0.767*	0.852*	0.902**	0.847**	0.771**	0.799**	

TMY= Total Milk Yield, TDMY1, TDMY 2, TDMY 3, TDMY 4, TDMY 5 and TDMY 6 = Milk Yield at 1st, 2nd, 3rd, 4th, 5th and 6th months; **P<0.01

Table (3): Multiple regression equations using maximum R-square improvement between total and monthly milk yield of Awassi ewes

Step	Intercep t	TDMY1	TDMY2	TDMY3	TDMY4	TDMY5	TDMY6
1	26603.7				91.5**		87.53
2	12287.4	41.6**			74.7**		95.23
3	4313.6	43.7**			57.4**	30.0**	97.15
4	3060.0	37.6**		16.0**	46.2**	29.9**	98.60
5	1913.2	38.1**		14.7**	38.9**	29.3**	21.7** 99.11
6	-341.0	29.8**	15.1**	14.7**	33.1**	28.1**	27.4** 99.70
Correlation coefficient		0.731**	0.764**	0.839**	0.938**	0.794**	0.793**

TMY= Total Milk Yield, TDMY1, TDMY 2, TDMY 3, TDMY 4, TDMY 5 and TDMY 6 = Milk Yield at 1st, 2nd, 3rd, 4th, 5th and 6th months; **P<0.01

CONCLUSION

From the results obtained in this study it can be concluded that 3rd and 4th month was the best for the prediction total milk yield for Karadi and Awassi ewes, respectively.

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HISTOPATHOLOGICAL CHANGES IN THE INTESTINE OF TWO PERCIFORM FISHES DUE TO THEIR INFECTION WITH *Hysterothylacium* spp. LARVAE (NEMATODA, ANISAKIDAE) FROM THE IRAQI MARINE WATERS

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ABSTRACT

Histopathological changes in the intestines of two perciform marine fishes viz. *Argyrops spinifer* (Forsskål, 1775) of the family Sparidae and *Sphyaena obtusata* Cuvier, 1829 of the family Sphyraenidae due to their infection with the anisakid nematodes *Hysterothylacium* sp. type BA and *Hysterothylacium* sp. type BC respectively were studied. Cross sections of both parasites revealed different aspects of tissue defensive reactions due to the free movement of these nematodes among in the intestinal tissues. The pathological changes included spaces of oedematous fluid in the muscle layers, necrosis in the epithelial tissue, separation in muscle layers and hyper pigmentation.

KEYWORDS: Histopathology, *Hysterothylacium*, anisakid nematode, perciform marine fishes, Iraq.

INTRODUCTION

Parasites infections of fishes are caused clinical or subclinical diseases and pathology that might led to economic losses which reduced the production and increased cost of treatment (Aloo, 2002). Some of the parasites which have been reported to cause mild to severe pathological effects in fish belong to the groups (Rodriguez *et al.*, 2005)

Parasitic infestations are a common problem in commercially cultured yellow perch, *Perca flavescens*. Nematodes may have harmful health consequences when fish are severely parasitized or heavily infested (Mumford *et al.*, 2007).

For instance, governed intestinal epithelial turnover and normal mucosal integrity are essential in maintaining the overall absorption efficiency of the intestine, and consequently the fish's growth (Yuen *et al.*, 2007). Since tissues respond to pathological stimuli, histopathology provides a rapid method to detect the effects of irritants (Mumford *et al.*, 2007). The aim of the study including the histopathological effects of *Hysterothylacium* spp. larvae in intestine of perciform marine fishes *A. spinifer* and *S. obtusata*.

MATERIALS AND METHODS

A total of 41 fish specimens were collected by fishermen using trawl net monthly, during the period from October 2013 until the end of July 2014, which belong to two species of Perciform fishes, *A. spinifer* (Forsskål, 1775) and *S. obtusata* (Cuvier, 1829), they were taken from Iraqi marine water, North west Arab Gulf (47° 30' to 48° 15' E; 30° 50' to 30° 00' N). Fishes were identified according to Carpenter *et al.* (1997) and updated according to (Froese and Pauly, 2015).

For histological study, pieces of intestine tissue up to 10 × 15 mm were excised from the infected fish. The samples were then transferred to 10% formalin, dehydrated through a graded series of ethanol, cleared in xylene and prepared for paraffin embedding. Sections with 5 µm thickness were then stained with hematoxylin and eosin. The slides were examined under light microscope and take a picture by digital camera (Canon model DSC-W120).

RESULTS

During the period from October 2013 till the end of July 2014, a total of 41 fish was collected from the Iraqi marine waters. These fishes belonged to two species of the order Perciformes, *A. spinifer* and *S. obtusata*. A total of 41 fish

specimens consist of 19 *A. spinifer* (Sparidae), 19.1-26.7 cm in total length and 22 *S. obtusata* (Sphyraernidae), 22.8-56.7 cm in total length.

Pathological changes taken place in the intestine of fishes as a result of infection with nematode, *Hysterothylacium* sp. BA and *Hysterothylacium* sp. BC (Nematoda:

Anisakidae) (Table 1) and their effects. Observed tissue damage included space of edematous fluid in muscle layers, hyperplastic submucosal tissue, necrosis in epithelial tissue, separation in muscle layers, hemorrhage of tissue; degeneration, hyperpigmentation (Plates 1-6).

Table (1):- Parasite-host list, prevalence and mean of intensity.

Parasite	Fish species			Number of parasites	Prevalence of infection	Mean intensity
	Host	examined	infected			
<i>Hysterothylacium</i> sp. BA	<i>A. spinifer</i>	20	3	14	15%	4.7
<i>Hysterothylacium</i> sp. BC	<i>S. obtusata</i>	21	2	38	9.5%	19

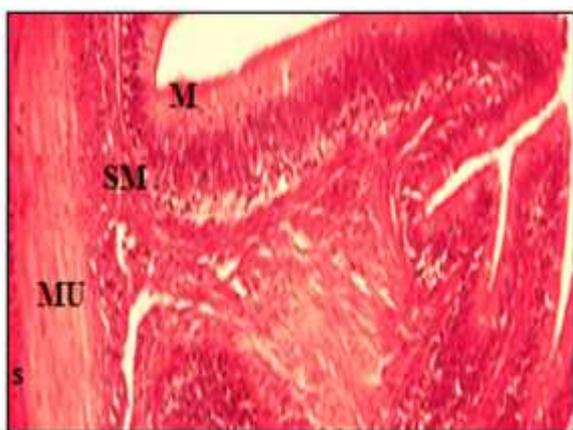


Plate (1): Normal intestine of *A. spinifer* (H & E, 100X), M- mucosa, SM- submucosa, Mu- muscularis, S- Serosa.

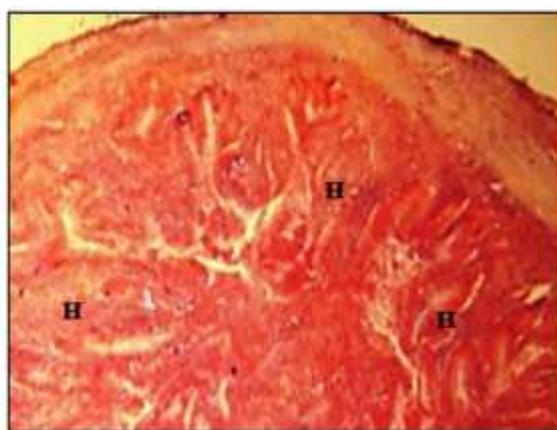


Plate (2): Intestine of *A. spinifer* infection with *Hysterothylacium* sp. BA (H & E, 100X), H- hyperplasia.

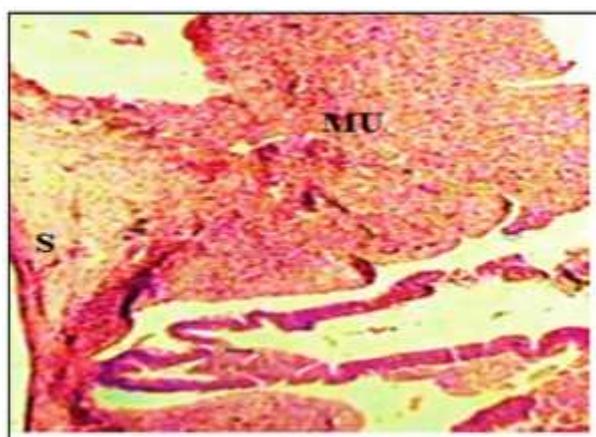


Plate (3): Intestine of *A. spinifer* infection with *Hysterothylacium* sp. BA (H & E, 100X), hyperplastic submucosal tissue.

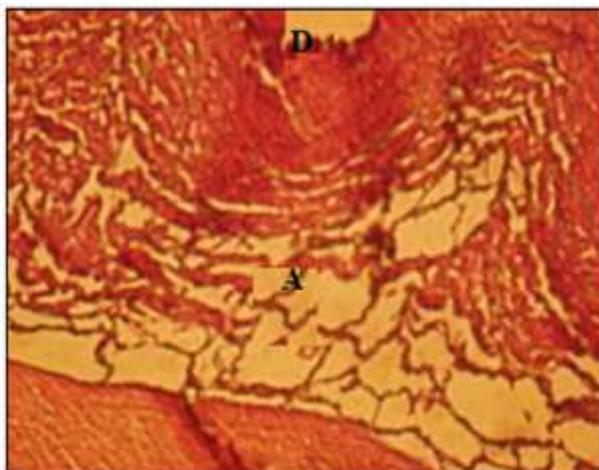


Plate (4): Intestine of *S. obtusata* infection with *Hysterothylacium* sp. BC (H & E, 100X), A- Space of odematus fluid in muscle layers, D- Necrosis in epithelial tissue.

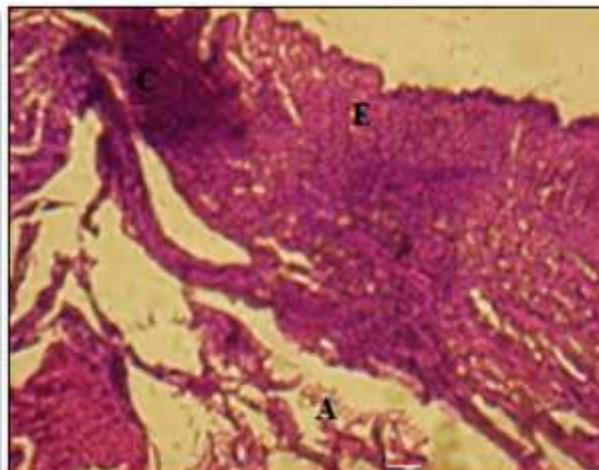


Plate (5): Intestine *S. obtusata* infection *Hysterothylacium* sp. BC (H & E, 100X), A- Space of odematus fluid in muscle layers; C- Hemorrhage of tissue; E- Degeneration.

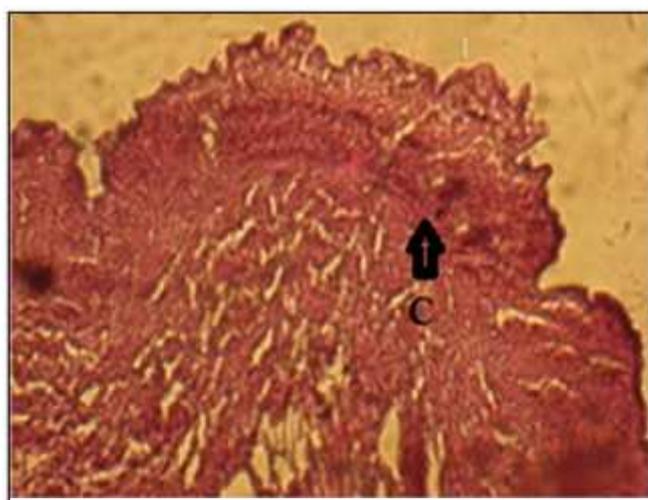


Plate (6): Intestine of *S. obtusata* infection with *Hysterothylacium* sp. BC (H & E, 100X); C- hyperpigmentation.

DISCUSSION

Histopathological studies are recommended for the evaluation of fish health, such studies allowed reliable assessments of biochemical responses in animals exposed to a variety of environmental stressors (Deborah, 2014).

This study shows erosion in muscle layers, necrosis in epithelial tissue, separation in muscle layers in the intestine of fishes, which were infected with nematode larvae. This is due to adhesion of these larvae in the epithelial layer and mucosal destruction and hyperplastic changes of the epithelial cells as well as histopathological changes of the submucosa may modify the normal

functional appearance of the intestine. This result is similar to the result of Samaneh *et al.* (2013) and Khalil *et al.* (2014) who observed destruction of the intestinal villi and necrotic changes in the mucosal epithelium which may adversely affect the absorptive efficiency of the fish's intestine.

The internal parasites can cause physiological damage (cell proliferation, immunomodulation, detrimental behavioral responses and altered growth) and reproductive damage (Deborah, 2014; Shanchita and Hossain, 2015).

Nahal *et al.* (2012) studied the pathology of internal parasites in Arabian Mallas (*Thalassoma klunzengri*), they described the pathological

lesions of parasitic manifestation of infected Arabian Mallas, as chronic gastroenteritis with diffuse and granulomatous lesions in the sub mucosa, cross section of the flukes and nematode were observed in the lesions of intestine.

The histopathological changes can be assessed when the biochemical estimations were made on the infected fish, parasites not only bring change in the morphology of the organ but also interfere with the nutrition, metabolism, movements and secretory efficiency of associated glands of alimentary canal which adversely influence the host (Laxma and Benarjee, 2014). Finally The effect of parasites on the host causes series of interactions which ultimately reduces the absorption and other metabolic process.

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CAVES ECOTOURISM IN FOREST AREA AS A GREEN PRACTICES TOWARD THE REALIZATION OF A SUSTAINABLE FUTURE ZAWITA RESORT, DUHOK GOVERNORATE KURDISTAN REGION OF IRAQ CASE STUDY

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ABSTRACT

The potential tourism resource that exists in Iraqi Kurdistan region, in particular in Duhok Governorate and the applicability of adopting this new green practise approach in tourism in the region practising in Zawita and its approaches, this paper mention the concept of cave tourism as one of the sustainable categories, and forms of tourism, highlighting the external factors which affect the planning and development of the such tourism sector in Iraqi Kurdistan region, as well as internal factors that affect the trends of the tourist market, and the tourism impacts in social, economical and environmental aspects in the frame of sustainability.

Sustainability development issues and their dimensions have been taken in consideration through components of tourism planning.

The strengths, weaknesses, opportunities and the threats (SWOT) that challenge this type of tourism development in the site have been applied as a scenario which based on technological, economical and environmental aspects these conclusions will guide the future development and considered as strong factors toward the realization of a sustainable future of cave tourism in Iraqi Kurdistan region for future strategic planning taking sustainability as a core factor.

Key Words *Iraqi Kurdistan, Cave tourism, Zawita, Green practise, Sustainability*

Introduction

Zawita has been mentioned in many tourist guides that have been published since the sixties of the last century as one of the tourist places in Iraq and Kurdistan region of Iraq, it about 20 km to north of Duhok city, and can be accessed via two lane paved road. It has been chosen as resort for former Iraqi king Faisal the 2nd. This resort is particularly beautiful for its magnificent natural sceneries, fruitful trees, and Zawita-pine trees which are unique in the area. Some archaeologists believe that this resort was a tourist place for Assyrian King Sennacherib at that time (Sefer & et al 1966), Map (1) shows the location of Zawita sub-district in Kurdistan Region.



Map (1): Location of Zawita sub-district in Kurdistan Region

For more than a century, countries throughout the world have been setting aside areas for special

protection because of their natural beauty and their repository status for important biodiversity. The aim of this paper is to show how protected area can conserve its natural biological, physical and cultural features, promote sustainable and environmentally friendly economic activities such as ecotourism, figure (1) shows the a part of green cover in Zawita region, thus the control and mitigate impacts of ongoing adverse activities such as hunting and grazing, encourage scientific research in areas related to life sciences, especially from biodiversity and conservation point of view; and how to contribute as a regional attraction and a focal point for ecologically sensitive tourism and environmental education for the benefit of the present and future generations, (Ali, 2009).



Fig. (1): Green cover in Zawita

Sustainable Ecotourism for Zawita Resort

Zawita resort has been identified by Iraq and Kurdistan region of Iraq at the national level as a key growth area for tourism, and also for a number of specific ecotourism products. As well, it has a new tourism development plan such as digging caves as a new ecotourism in forest area as a green practices toward the realization of a

sustainable future for the region, which identifies key assets and provides a framework for future development. Significant growth is anticipated, linked to the establishment of a new and extensive “sketch plan” to be designed for defining the future of the new emerged ecotourism development in the Kurdistan region of Iraq. Ecotourism is a very important source of green growth for KRI which significant natural endowments and is a sound base for creating many export opportunities in remote locations in other parts of Kurdistan region. Ecotourism is often built on community-led tourism activities and operations that preserve natural ecosystems, while generating employment for the unskilled workforce in rural communities. These activities do not normally require vast capital outlays and investment. Thus, ecotourism is an ideal industry for the fostering of economic growth in developing countries such KRI which have abundance natural resource and capital scarcity, (UNEP, 2013), fig (2) shows the basic pivotal point of the balancing of the dimensions of sustainable development, (Jelena et al, 2008).



Fig. (2): Balancing the dimensions of sustainable development, after (Jelena et al, 2008)

Zawita is one of the main places in which thousands of people from Duhok Governorate and all around Iraq gather there in occasions like Newroze, the (Kurdish New Year), Weekends and summer evenings. In general there is a shortage of facilities and services in the area except some benches on roadside and small kiosks with some takeaway kiosks and restaurants in Gali Zawita, (Hajani, 2009), figure (3) shows the current situation of the road, small kiosks and restaurants in Gali Zawita.

But new tourism facilities and services are under rapid development all across the Kurdistan Region of Iraq (KRI). At Zawita just outside Duhok a major tourism complex is nearing

completion with a teleferic (cable car) to the top of a Zawita mountain with scenic views on both sides, three lakes and an aqua park, sports grounds and facilities, vacation accommodations including houses, apartments, a motel and hotel; million-dollar residential villas, some for rent; restaurants and snack bars, picnic facilities, waterfalls and hiking trails, <http://www.tolerancy.org/> figure (4) shows the cross section of Gali-Zawita. Kurdistan has been known since ancient times for its wealth of fruitful trees and luxurious flowers which is reflected in the naming of Kurdish girls such the wild Narjes *Narcissus* which one million flower of this wild Narjes *Narcissus* among 10 million flowers have to be planted and native wild animals will add to the sights to be viewed over the area.

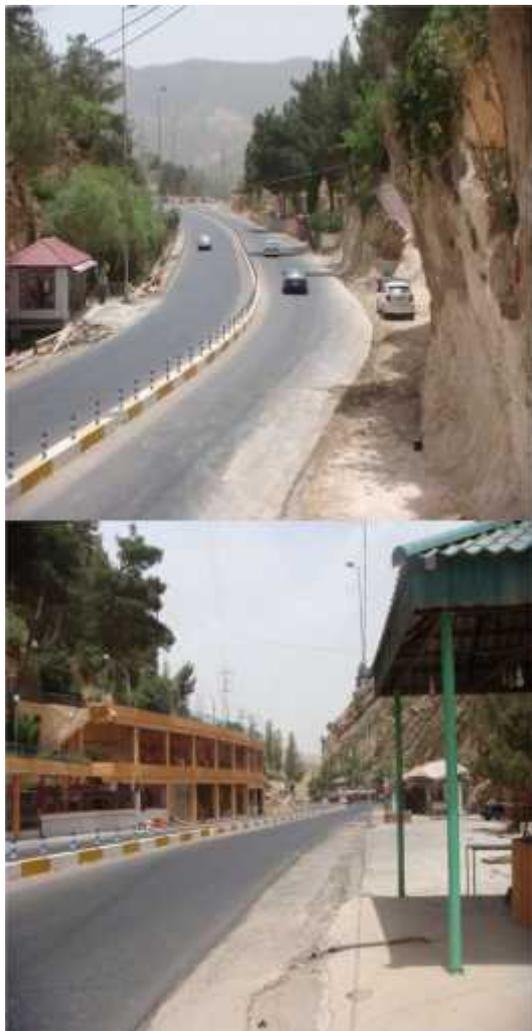


Fig. (3): shows current situation of the road, small kiosks and restaurants in Gali Zawita

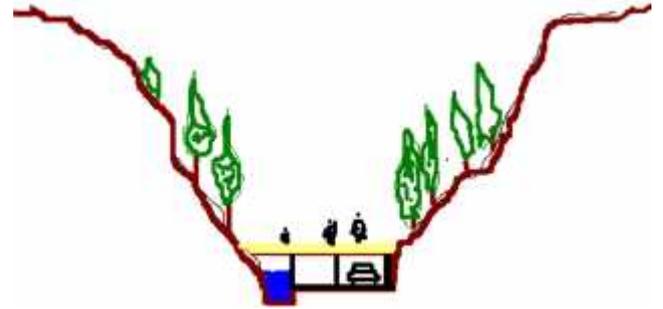


Fig.(4): shows cross section of Gali-Zawita

Ecotourism as a Key of Transition to a Green Economy

The Rio+20 Outcome Document “The Future We Want” (UN 2012) highlights the role of sustainable tourism in the transition to a green economy in the context of sustainable development and poverty eradication. Tourism is considered as one of the best green options for addressing poverty, employment and economic diversification initiatives in developing countries. Sustainable tourism, in particular, has the potential to create new jobs, reduce poverty and increase export revenues, (UNEP, 2013).

Green Jobs = Decent Work + Environmental Sustainability

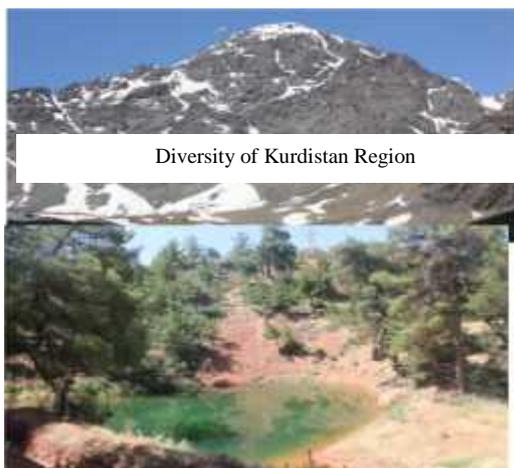
1. Biodiversity in Kurdistan Region of Iraq

Biodiversity analyses up to now have revealed a set of 34 Hotspot (*biogeographic areas that contain high levels of species diversity but are threatened with extinction*) among them Kurdistan Region of Iraq (KRI) which is a part of Irano-Anatolian Hotspot which harbour around 6,000 plant species approximately 2,500 of them are endemic designing it as a territory of high biological diversity values and particular natural ecosystem. It is an intersection between Mediterranean, temperate, semi-arid and continental biogeographical zones, therefore favouring the hybridization, colonization and speciation process of species from varying origins. In addition, the wide range of bioclimate (from hot semi-arid to cold alpine bioclimatic zone) and the landscape features' diversity, (from Mesopotamia's plains to high mountains about 3600 m a.s.l.) gave rise to high richness value for biological diversity including an important numbers of rare, endemic, threatened and remarkable plant and wild animal species from divers biogeographic origine e.g. Irano-Turanian, Mediterranean basin, Arabic desert, Siberia and

many other places, (Duhok-Eco, 2015), figure (5) show the diversity of Kurdistan Region.



Fertile Plain of Mesopotamian Region



Diversity of Kurdistan Region

Pine Forest of Zawita & Atrush



Open Oak Forest of Zawita – Atrush area

Fig.(5): Diversity of Kurdistan Region

1.1. Biodiversity in Zawita Area

The vast configuration of the Zawita mountain series has traditionally supported a rich variety of plant and animal life. The vegetation community structure is Pine Forest *Pinus brutia's* forest occurs in a restricted locality between Zawita and Atrush towns Duhok governorate; this forest covers about 100 km² at an altitude of 700-1200 meter, figure (6) show the general view of diversity of Zawita Region.

Zawita Pine is the dominant species associated with *Q. aegilops* and *Juniperus oxycedrus*.

Great number of low cover of annuals from Poaceae, Fabaceae, Asteraceae, and Umbeliferae inhabit these mild, vast aspects of relatively higher soil moisture content and lesser light intensity to constitute more or less homogeneous steppe verge, the vegetation is quite healthy with numerous species of biennials and perennials. Famous Pine (*Pinus brutia*), Shrubs mostly of Oak coppices (*Quercus aegilops* and *Q. infectoria*) with dispersed individuals or groups of *Anagyris foetida*, *Prunus microcarpa*, *Populus euphratica*, *Wenlandia* sp. *Scropholaria* sp. and *Salix* spp. higher elevations are of relatively denser vegetation cover, gradually decreasing northwards towards Sindy plain near Zakho. It is a typical representative of the woodland area.



Fig. (6): General view of diversity of Zawita Region

1.2. Landscape Diversity

Zawita area is characterized by high landscape diversity including high foothills at different levels, cultivated plains, deep valleys and mountain chains running generally in a north-west to south-east direction. In fact, it is a geographic transition from the foothills and steppes of the Mesopotamian to southern of Gara Mountain. General elevation is ranging from 500 to more than 2000 m a.s.l. at the summit of Gara Mountain. This mountainous region is extremely crumpled and traversed by many deep valleys where streams have cut down sharply into the limestone rock. The general vegetation structure is an open Oak and Pine forests occupying the mountain slopes while on the summit of the mountains are generally rather barren and rocky where the passes often blocked by snow during the winter season, knowing that many wet valleys are found within the mountain chains sometimes opening out into high fertile plains.

Kurdish people are well exploit this cultivate plains via growing essential crops (cereals, orchards), but the forests and

rangelands still occupying the greater part of this mountain.

1.3. Bird Diversity

Kurdistan region is in general a hotspot for biodiversity and especially for birds. This particular richness may be due to its situation on migration road of birds from Europe and Russian to Africa and Gulf countries, (Korsh, 2008), figure (7) show the bird species in Zawita Region. Beside of this migration road, the high diversity of landscape and topographic features with intermediate climate (between Mediterranean, continental and saharian) give a rise for high diversity of birds (breeders, migrants, visitors) and advantage to attract more and more the breeders birds to install in this region. Whoever, anthropogenic activities -increasing numbers of hunters and destruction of natural habitat by land use change and deforestation- presents major threats to birdlife diversity. According to Nature Iraq- Key Biodiversity Area, (KBA report, 2009), 13 threatened and near threatened bird species occur have been recorded in Kurdistan as breeders, migrants or winter visitors.



Fig. (7): bird species in Zawita Region

1.4. Wild Animal Diversity

Wildlife diversity in Zawita by some direct observation and principally scientific knowledge of wild life it needs to consider the area as spot light, and there is a real need to carry out deep phylo-taxono-ecological studies on Kurdistan region in term of biodiversity conservation and ecosystem management. Knowing that several animal population like e.g. wild goat (*Capra aegagrus*), and Rock Partridge (*Alectoris*) are endangered species because of overhunting, land mines and diseases, figure (8) show the wild animals in Zawita Region.



Fig. (8): Wild animals in Zawita Region

2. Human Activities and Ecosystem Services

Interaction between human beings and environment certainly engender the improvement in the well-being of humanity via exploitation of natural resources. In Kurdistan region of Iraq as a part of Mesopotamian "land of ancient civilization", one so extensively cultivated and grazed for millennia, the natural vegetation of the territory has been greatly changed as the result of anthropogenic, fertile plains and wet valleys changed in favour of agriculture; many low and middle forest zone destroyed in favour of agro forestry; natural vegetation largely destroyed to cultivation activities, in this circumstance, the biodiversity conservation strategies will play a spectacular role to find a suitable balance by conserving the high richness biological diversity and decreasing the high influence of anthropogenic agent. Cave tourism in this case will be a promising source of conservation strategies because it provides effective outcomes for new ecotourism typology and help to transfer of income from developed to developing green economies. According to the UNWTO, 2010 in recent years, developing country destinations have grown faster than destinations in developed countries. This trend is set to continue, figure (9) show the caves in Zawita-Atrush Area and figure (10) show the rock-cut tombs in Zawita -Atrush Area.



Fig. (9): Caves in Zawita-Atrush Area



Fig. (10): Rock-Cut Tombs in Zawita –Atrush Area

2.1. Agro Forestry Activities and Irrigation Systems

The greatest threat to the Kurdistan region of Iraq biodiversity heritage's is the permanent ancient-new pressure of human activities in this region that have significantly influenced the structure and composition of the biodiversity during thousand years ago, our ancestors hunter-gatherers in Kurdistan region, as a part of Mesopotamian region, have well exploited natural resources which in turn influenced the forms of actual agriculture, cultivable land, urban civilization and ethno-culture, figure (11) show Alexander the Great and the location of the battle in Kurdistan region of Iraq. On the other hand, the greatest threat nowadays to biodiversity in this region is the development of irrigation systems associated with infrastructure such as dams and reservoir. For example, the excessive use of water for cereal agriculture has led to the loss of certain natural steppe areas and fertile plains.

The importance of the stream system in the economy of Kurdistan region is important. On Zawita area, the cultivated plains rainfall is generally sufficient for winter crops, but summer crops cannot be grown without irrigation, which is also necessary for the maintenance of orchards. Even in the mountains the inhabitants are obliged to resort to irrigation during the summer months, figure (12) show the agro forestry activities in Zawita - Atrush Area.

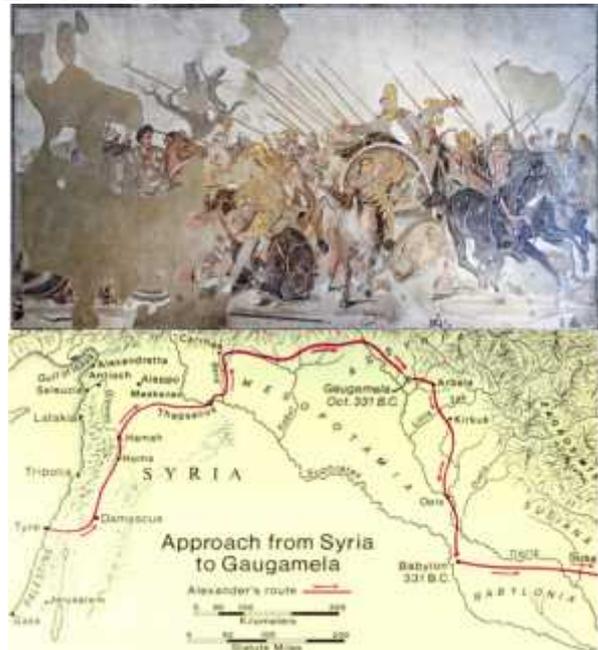


Fig. (11): Alexander the Great and the location of the battle in Kurdistan region of Iraq



Fig.(12): Agro forestry Activities in Zawita

2.2. Ethnobotany and Pastoralism Activities

Kurdistan region is considered as one of the richest irreplaceable sources for natural resources of economical importance as crops, medicinal, aromatic and edible plants. Researching and using the wild edible plants according to Kurdish folks is an important link to our past. In this context, the ethnobotanical study focusing on how plants are used managed, perceived across human societies. However, the actual progressive over-harvesting and increasing demands on edible wild plants by local people threat some native plant species. Furthermore, the impacts of human population growth induce an obvious decline in many species of wild edible plants. For example, many bulbs and wild edible plants from genera such as *Gundelia*, *Allium*, *Malva*, *Arum*, *Anchusa*, *Echium*, *Adiantum*, *Rheum*... etc, have declined dramatically as a globally result of overexploitation and more less of land use changes (agricultural expansion, crop-improvement projects), overgrazing and habitat destruction for urbanization purposes. Therefore, necessary changes of traditional cultural practices should be introduced that allows local people to understand the important of the protection of these edible plants from extinction and in this context the ecotourism will help as new the local peoples will have contact with many other different cultures and will get more knowledge and be more aware of the nature biodiversity conservation.

Pastoralism (extensive livestock production in the rangelands) plays a major role in Pasture and grazing may drive either positive or negative ecological effects on natural ecosystems: Primary role of grazing livestock (stimulate the essential role of wild grazing animals), is maintenance the biodiversity and enhancement of structural e.g. Euro mediterranean region such as south of France, appropriate levels of grazing applied to restore and maintain the high biodiversity in mountain region disturbed before by overgrazing

or lack of grazing. Negative effects of grazing “over-grazing” include increased soil erosion, change water quality and loss of biodiversity. In Kurdistan region, the pastoralism activities globally represented by overgrazing due to the ongoing grazing expansion (driven by increasing more the number of livestock of semi-aride plains of surrounded region such as Ninwa plain) in this region threatens the remaining biological diversity of Kurdistan Region Mountain, figure (13) in (a & b) show the pastoralism activities in the region while (c) show the ethnobotany activities “collectors of wild edible plants”.



Fig. (13) a & b) Pastoralism activities in the region; c) Ethnobotany Activities “Collectors of wild edible plants”

The Problem

Climate change, ecosystem fragmentation, population growth are intensify putting the pressures on the biodiversity, making the future increasingly uncertain. At the same time, the introduction of new technologies, greater access to information, communication, and consolidation may open new opportunities which could make it easier to respond to the challenges of climate change.

Kurdistan region natural environment is a core part of its overall tourism attraction. However, from the environmental point of view, the condition is far from ideal. Over-exploitation of Kurdistan region’s rich and diverse ecosystems is widely recognized in documents.

The Need to Develop a Diversified Regional Ecotourism for Zawita Area

For development of the cave ecotourism in Zawita area it is need to a varied and diverse destination, and chose the excellent opportunities to develop a varied diversity, the current infrastructure is not limiting factor for greater tourism development, and by near future direct flights to Duhok Governorate will be available from all around the world via Duhok International Airport 'DIA'.

There may be opportunities for innovative packaging to foreign investor based on diversity of Kurdistan region of Iraq nature.

SWOT analysis

Strengths, Weaknesses, Opportunities, and Threats, also called SWOT. The SWOT analysis is one of the strategic planning tools through which planners can articulate the socioeconomic priorities and determine the interest in tourism. It involves specifying the objectives of the tourism organization or project and identifying the internal and external factors that are favourable and unfavourable in the context of achieving that objective. SWOT analysis can be useful to show opportunities that the tourism organization or project is well placed to use. By understanding the weaknesses, SWOT also helps to manage and eliminate possible threats

➤ Strengths

1. Zawita has been identified by the Iraq and Iraqi Kurdistan region at the national level as a key growth area for tourism
2. The vast configuration of the Zawita mountain series has traditionally supported a rich variety of fauna and flora life.
3. Zawita area is characterized by high landscape diversity including high foothills at different levels, cultivated plains, deep valleys and mountain chains.
4. Zawita area can be considered as unique place for national park.
5. Zawita area can be considered virgin area in spite of indiscriminate selection of buildings and roads that were constructed during last year's.
6. Zawita area can be reached via Duhok International Airport 'DIA' it is 20 km drive from Duhok city center which as a nearest resort to Duhok city.
7. Zawita area is characterized with vegetation community structure of Pine forest *Pinus brutia's* forest, Zawita Pine is the dominant species and

internationally recognized as Zawita Pine; Zawita forest covers about 100 km² at an altitude of 700-1200 meter.

➤ Weaknesses

The weaknesses that affect developing process of Zawita area:

1. Shortage of surface and groundwater resources in Zawita area unless the annual average of rain precipitation is more than 600mm/year.
2. Zawita area infrastructure has been partially distorted due to the wrong environmental practicing in particular in Gali-Zawita and its approaches.
3. The lack of high desire of investors to work in the field of tourism due to unstable political and economic situation of the country and especially because of the fluctuation of oil prices which is adopted as the main state budget.
5. No Strategic Plan for regional development in particular for developing tourism industry.

➤ Opportunities

The opportunities that offer a chance to the developing process are:

1. Kurdistan Region of Iraq has a stable security situation compared with rest of Iraq which is a motive element for attracting tourists' attention from southern and central parts of Iraq and from outside Iraq.
2. Tourism has become an industry overall the world and it is one of the main economic resources of the national income in particular the new emerging ecotourism.
3. Operation of Duhok International Airport 'DIA' in the near future will encourage international and local investors to invest in tourism sector in Kurdistan Region.

➤ Threats

Threats that challenge developing process are:

1. Corruption and bureaucracy in the body of government.
2. Lack of official and public awareness and environmental impacts assessment.
4. Lack of master plan and other related developing plans for mid and long terms.
5. Incapability of tourism staff in Kurdistan Region and related institutions to draw a certain plan, and non-existence of clear vision for developing the area.

Scenario for Integrated Development Plan for Zawita Area Ecotourism

- 1- Design new pedestrian roads across the area and Rehabilitation the existing ones.

2- Design new highway through the beautiful mountain scene with environmental development in the area for all season, which will help in attracting tourist around the year and not only in certain season.

3- The lack of water resource in Zawita area can be solved by constructing small to mid size earth and concert dams, and start by water harvesting technique.

4- Continue work in the major tourism complex with a teleferic (cable car) line across the mountains in Zawita-Atrush area with scenic views on all sides, lakes and an aqua park, sports grounds and facilities, vacation accommodations including houses, apartments, a motel and hotel; villas, restaurants and snack bars, picnic facilities, waterfalls and hiking trails,

Advantages:

1. The scenario gives enough facilities required by ecotourism and to have enough space for future extension.

2. Improving the natural view of the region as whole.

3. The area can provide more tourist capacity by adopting the new cave ecotourism and provide more beautiful scene for more attraction.

Disadvantages:

1. Shortage of water resources.

2. Loss of natural cover of soil, and increased pressure on water resources.

3. Loss of some unknown historical and archaeological evidence.

4. Displacement of existing land use activities.

Recommendations

In order to activate and organize the role of ecotourism in the region's economy and maximize the incoming tourist movement to Zawita and upgrading of tourism services, taking into account the aspects of sustainability, we propose the following:

1. More researches for the development of ecotourism in Kurdistan region of Iraq considering ecotourism as one of the main tributaries of the country's green economy as well as one of the contemporary activities.

2. To promote private sector's investments by furnishing laws and regulation that can facilitate the investor works.

3. Preparing of comprehensive master plans and related documents to adopt them in establishing, allocating and developing of ecotourism.

4. To improve the level and means of administration and quality of the tourism service.

Abbreviations

DIA	Duhok International Airport
KBA	Key Biodiversity Areas
KRI	Kurdistan Region of Center
SWOT	Strengths, Weaknesses, Opportunities, Threats
UNWTO	United Nations World Tourism Organization

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السياحة البيئية في الكهوف ضمن منطقة الغابات بإعتبارها إحدى الممارسات الخضراء كتوجه نحو مستقبل
مستدام لمنتجع زاويته، محافظة دهوك إقليم كردستان العراق دراسة حالة

الخلاصة

يزخر إقليم كردستان العراق بالعديد من الموارد السياحية، ولا سيما في محافظة دهوك وبالإمكان تطبيق وإعتماد نهج الممارسة الخضراء كتوجه جديد في قطاع السياحة في المنطقة وتطبيقها في منطقة زاويته وضواحيها، هذا البحث يتطرق الى مفهوم السياحة في الكهوف كأحد الأشكال والتطبيقات السياحية المستدامة بتسليط الضوء على العوامل الخارجية التي تؤثر على تخطيط وتطوير قطاع السياحة لهذا النوع من السياحة في منطقة إقليم كردستان العراق، فضلا عن العوامل الداخلية التي تؤثر على اتجاهات سوق السياحة، وتأثير السياحة على التنمية الإجتماعية، الإقتصادية والجوانب البيئية في إطار الاستدامة. وقد أخذت مسائل التنمية والاستدامة، وأبعادها في الاعتبار من خلال دراسة مكونات التخطيط السياحي. تم تحليل مواضع القوة ومواضع الضعف والفرص والتهديدات (SWOT) حيث يعتبر هذا النظام من النظم الجيدة لبناء إستراتيجيات وخطط الأعمال للوصول الى الأهداف المرجوة لنجاح المشروع وذلك بتحليل الوضع الداخلي والخارجي من خلال البنود الأربعة التالية: نقاط القوة، الضعف، الفرص والتهديدات من خلال وضع سيناريو يستند على الجوانب التكنولوجية والاقتصادية والبيئية وهذه الإستنتاجات تستخدم لتوجيه التنمية المستقبلية وإعتبارها عوامل قوية نحو تحقيق مستقبل مستدام للسياحة في مناطق الكهوف في كردستان العراق ضمن التخطيط الاستراتيجي في المستقبل مع الأخذ بالاستدامة كعامل أساسي.

EFFECT OF PLANT DENSITIES AND METHODS OF WEED CONTROL ON POPULATION, TYPES AND GROWTH OF ACCOMPANIED WEEDS WITH CHICKPEA (*Cicer arietinum* L.) UNDER RAINFED CONDITIONS AT DUHOK

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ABSTRACT

A field trial was carried out during the growing season, 2015, at the research farm of Field Crops, College of Agriculture, University of Duhok, Kurdistan Region at Sumail county. A randomized complete block design (RCBD) was applied with two factors plant densities at three levels (100, 80 and 60 plants/plot of 3m² which corresponded to 33.33, 26.6 and 20 plants.m²) and four methods of weed control (check, hand hoeing, Propyzamide herbicide 50% WP, at 1.5kg a.i.ha⁻¹ and Haloxyfop 10.8% EC at 0.108 kg a.i.ha⁻¹; with three blocks. The results revealed that the Haloxyfop was the most effective method for controlling narrow leaf weeds, which recorded 1.88 weeds per 3m² plot, and the only significant differences was noticed between Haloxyfop and Propyzamide herbicides. However Propyzamide resemble control and hand hoeing treatments. The interaction of chickpea densities with weed control methods was also significant; the most effective combination was recorded for the herbicide Haloxyfop at 33.33 chickpea plants.m². It gave the lowest number of narrow weed leaf (0.33), while the highest number of narrow leaf weeds (25) was recorded for Propyzamide herbicide at 26.6 chickpea plants.m². With respect to the number of broad leaf weeds, there was no significant differences between chickpea plant densities on this trait, while weed control methods was significantly varied, hand hoeing was the most effective method in diminishing this trait followed by Haloxyfop. Also no significant differences were noticed for chickpea densities on broad leaf dry weight per plot, however hand hoeing was the most effective method in reducing dry weight of broad leaf weeds at all densities of chickpea plants, but the inferior was at 20 chickpea plants.m² (90.5 g); meanwhile the highest number was recorded for the combination of Propyzamide at 20 chickpea plants.m² (529.0 g). Total dry weight of weeds per 3m² plot, was significantly influenced by chickpea densities, the highest the density of chickpea (33.33) plants per m² the lowest the total dry weight per plot of 3m² (259.5g).

The combination of hand hoeing at 20 chickpea plants.m² was most effective methods in reducing total number of weeds (23.0) followed by Haloxyfop at the same density of chickpea plants.

KEY WORDS: *Cicer arietinum* L., Propyzamide, Haloxyfop, narrow and broad leaf weeds.

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is the largest produced legume food in South Asia and the third largest produced legume food globally, after common bean (*Phaseolus vulgaris* L.) and field pea (*Pisum sativum* L.). Chickpea is grown in more than 50 countries (89.7% area in Asia, 4.3% in Africa, 2.6% in Oceania, 2.9% in Americas and 0.4% in Europe; (FAO, 2012). In Iraq, it ranks as a second grain legume after faba bean. Its cultivation is concentrated mostly in the northern governorates including Sulaymania, Duhok, Erbil and Ninevah (Abbas, 1990). According to the Central Statistical Organization

of Iraq (2011) the total cultivated area of chickpea in Iraq was 956 hectare and the total production totaled 780 tons with an productivity average 815kg/ha. It is mainly grown at rain fed zone, but the possibility of growing it with supplemental irrigation is being explored.

Chickpea is a weak competitor with weeds; yield reductions of 23-87% due to competition of weeds have been reported by Bhan and Kukula (1987). Additional losses are due to weeds were often seen with reduced harvest efficiency and reduced crop quality (McKay, et al., 2002). Gan., et al. (2003) attributed the weak competition capacity to its slow growth during early growth stages, short plant stature (<60cm in height) and

open canopy; while, Solh and Pala (1990) attributed that to slow growth rate and limited leaf area development at early stages of crop growth and establishment.

In the Mediterranean region, however, chickpea is grown commonly as a spring crop and thus does not face a serious weed problem because of pre-sowing cultivation to control winter weeds.

The problem of weeds in winter sown chickpea is serious that lack of suitable weed control measure is hindering the transfer of winter sowing technology to many farmers in West Asia and North Africa (WANA) is to exploit fully the potential of winter sowing, the crop should be planted at high population density (Saxena, 1987) which makes inter-row cultivation impossible, except at very early stage of crop growth. To prevent crop losses, chickpea needs to be kept free of weeds until the canopy begins to cover the soil surface. Blessdal (1960) reported that increasing crop densities effectively reduces weeds, their growth and dry matter. Light is another environmental resource, which influences chickpea growth. Chickpea, being a dwarf stature crop and many time weeds smother its growth and yield reduces severely (Donald, 1963). Accompanied weeds may reduce light supply to crop. Plants with large leaf area indices (LAIs) have a competitive advantage and normally competed plants with smaller leaf area. Because of the sensitivity of chickpea to herbicides, there is a need to identify more effective herbicides with broader spectrum of weed control and wide adaptability.

Integrated weed management program for chickpea such as crop rotation and other cultural practices and herbicide applications all need to be integrated to develop an effective weed control strategy. Generally, cool season broadleaf weeds are the most difficult to control in chickpea and the problematic annual broadleaf species in chickpea include *Brassicaceae*, *Asteraceae*, *Chenopodiaceae*, *Fabaceae*, *Polygonaceae* (Bhan and Kukula, 1987). Moreover, perennial weeds can be a problem in chickpea production. Although many annual grass species can be selectively and effectively controlled with herbicides, there are some grasses (*Poaceae*) species commonly reported in chickpea that are resistant, e.g., *Phalaris sp.* and *Avena sp.* among others.

Accordingly, the objective of this study is to determine the effect of plant densities and

methods of weed control on accompanied weeds population, their growth and types as they reduce the yield ultimately.

MATERIALS AND METHODS

A field trial was carried out during the growing season of 2015, at the research farm of Field Crops, College of Agriculture, University of Duhok, Kurdistan Region at Sumail county. It located 15 km west of Duhok city (longitudes 42° 52 E, latitudes 36° 51 38 N and altitude 473 m above sea level).

The experiment was established in a secured rain zone with semi arid climatic condition. It is characterized by cold winter with possible temperature below zero and hot summer with temperature elevating up to 40°C. The climatic information of growing season from September 2014 to June 2015 was given in table (1), While soil conditions were classified as vertisol, silty clay in texture, with pH 7.8 (Table 2).

The field was plowed with a standard disk plow two weeks prior to planting, then pulverized by rotovator and leveled manually before implementation of the experiment. Experimental plots were prepared with an area of 3m length x 1m width comprised of four lines 25cm apart); with 0.5m space between plots, 2m space between blocks.

A randomized complete block design (RCBD) was applied with two factors plant densities at three levels (100, 80 and 60 plants/plot of 3m² which corresponded to 33.33, 26.6 and 20 plants/m²) and methods of weed control at four methods (check, hand hoeing, Propyzamide herbicide 50% WP at 1.5 kg a.i. ha⁻¹; Haloxypop 10.8% EC at 0.108 kg a.i. ha⁻¹; with three blocks. The number of treatments combinations was 12 with three blocks; therefore, total number of experimental units was 36. Seeds of local variety of chickpea (*Cicer arietinum* L.) were sown at 16th February 2015; after seedlings establishment, plant densities were kept at 33.33, 26.6 and 20 plants.m². Neither irrigation nor fertilization was applied.

Weed control methods were terminated at 65 days post sowing, and were applied according to herbicide application recommendations. All weeds were cut above soil surface as much as possible within the whole plots (3m²); then sorted to broad and narrow leaf, and classified to the type of growth habit; whether winter or summer, annual

or perennial; and their numbers and dry weight at 70°C for 48 hours were recorded.

The recorded data was statistically analyzed according to RCBD design using SAS (2001) and

Duncan's multiple range test (DMRT, 1955) was used for means verification at 0.05 level.

Table (1): Monthly average temperature, atmospheric relative humidity and rainfall during growing season (2014-2015).

Months	Temperature °C	Relative Humidity %	Rainfall mm
September.2014	27.31	25	0
October.	18.25	42	88
November	12.4	69.17	105.4
December	9.77	82.7	71.2
January.2015	7.29	76.8	47.2
February	9.03	73.2	49.8
March	12.18	70.2	47.8
April	16.26	59	22.2
May	23.98	37.3	11.4
June	28.63	26.4	1.8
Total			444.8

Source: College of Agriculture, Metrological Station (2014- 2015).

Table (2): Soil characteristics of the experiment site.

Trait	pH	N %	P %	K (ppm)	Ec (ds ⁻¹)	OM %	Sand %	Silt %	Clay %	Texture
Measuring Units	7.86	28.89	0.0294	1.59	1.02	2.56	1.5	39.66	58.83	Clay

Source: Laboratory of Soil and Water Sciences Department, College of Agriculture, University of Duhok.

RESULTS AND DISCUSION

The results revealed to occurrence of thirteen different accompanied weed species of chickpea, comprised nine families, seven winter annual weeds, six summer annual weeds, four summer perennials weeds, three narrow leaf and ten broad leaf (Table 3). Among 13 weed species ten are broadleaf, which makes chemical control more complicated.

The occurrence of similar annual broadleaf species in chickpea has been reported by (Bhan and Kukula, 1987) who referred to *Brassicaceae*, *Asteraceae*, *Chenopodiaceae*, *Fabaceae*, *Polygonaceae*.

While Yadav et al. (1983) denoted to *Asphodelus tenuifolius* Cav., *Chenopodium album* L., *Fumaria parviflora* Lam. and *Convolvulus arvensis* L. as the dominant weeds and hand hoeing was the most effective in controlling weeds.

The impact of plant densities on narrow leaf weeds population indicated to ambiguities results (Table 4). Although it was significantly different, as the lowest number of narrow leaf weeds was recorded for the density 20 chickpea plants m⁻². whereas, the highest was for 26.6 plants m⁻².

Generally the results were coincide with those of Stanojevic et al., (1996) whom deduced that the number of species and specific biomass of weeds decreased with increasing maize density. Tollenaar et al., (1994) mentioned that increasing maize density can enhanced relative competitive ability and they noticed negative correlation between maize population density and weed dry matter, they attributed to higher quantity and also the quality of light interception by the crop. Ball et al., (1997) found that the total weed density and total weed dry weight were declined to a greater extent by increasing seeding rate of lentil. Increasing crop seeding rate would maximize the light interception by the crop (Radford et al.,

1980). Wheat density can significantly affect formation of crop-weed association (Buhler and Oplinger, 1990; Kasperbauer and Karlen 1994). Barbour and Bridge (1995) who studied the model of competition for light between peanut and broadleaf weeds and suggested that such model should be capable of simulating competitive differences between morphological and phenological different population of the weeds. However, Aldrich (1987) suggested that all of the factors for which competition occurs (light, water or nutrients) will be reflected in the canopy growth.

Plant competition occurs among individuals, and its intensity depends on spatial relations between a plant and its neighbors and on their effect on resource availability. It was reported by Wilson et al. (1995) that the higher wheat density will limit the competitive effects of associated weeds, illustrating that increasing wheat density accompanied with reduction in growth, biomass and seed production of *Viola arvensis* Murray. and *Papaver rhoeas* L.

Regarding weed control methods; Haloxyfop was the most effective method for controlling narrow leaf weeds, which recorded 1.88 weeds per 3m² plot, and the only significant differences was noticed between Haloxyfop and Propyzamide herbicides, however Propyzamide resemble control and hand hoeing treatments.

Similar results was reported by Plew et al., 1994 who reported that chickpea response to post emergence herbicides and tolerate to the narrow leaf herbicides haloxyfop and clethodim. Furthermore, they claimed that total dry weight g/m² after 90 days from sowing was 85.2g per m², was close to that applied by haloxyfop which was 88.3 g m⁻². However, it was contradict to the results of Kantar, et al. 1999, as they have applied Propyzamide in mixtures with Terbutryne and Methabenzthiazuron or Linuron with Propyzamide.

The interaction of chickpea densities with weed control methods was also significant; the most effective combination was recorded for the herbicide Haloxyfop at 33.33 chickpea plants.m², it gave the lowest number of narrow weed leaf (0.33) , while the highest number of narrow leaf weeds (25 narrow leaf weeds) was recorded for Propyzamide herbicide at 26.6 chickpea plants m⁻².

The dry weight of narrow leaf weeds was not affected significantly by chickpea plant densities

(Table 4), meanwhile significant variation was noticed between methods of weed control in respect to dry weight of narrow leaf weeds/ plot. The impact of weed control methods behaved similar trend of the number of narrow leaf weeds; Haloxyfop was most effective and recorded the lowest weight (7.56 g/ 3 m² plot). But Propyzamide gave the highest weight (98.58 g/ 3m² plot). The interaction of chickpea densities with weed control methods was significantly influenced on number of narrow leaf weeds per plot of 3m², the most effective combination was for Haloxyfop at chickpea density 33.33 plants/3m² plot, which recorded the lowest weight 0.12 g/plot, whereas the highest value was for the combination of Propyzamide at 26.6 chickpea m² (164.43 g). With respect to the number of broad leaf weeds, the data in table (5) refers to no significant differences between chickpea plant densities on this trait, while weed control methods was significantly varied, hand hoeing was the most effective method in diminishing this trait followed by Haloxyfop. Treatment combination has significant influence on number of broad leaf weeds per plot; hand hoeing at 20 chickpea plant per m² fulfilled the lowest number of broad leaf weeds per plot (17.67); whereas Propyzamide with 20 chickpea per m² corresponded to the control treatment.

No significant differences were noticed for chickpea densities on broad leaf weeds dry weight per plot; while significant differences were evident between methods of weed control, hand hoeing the only methods that reduced significantly broad leaf weeds weight in comparison to control treatment.

Treatment combinations were significantly varied, although inconsistency was obvious, however hand hoeing was the most effective method in reducing broad leaf weeds at all densities of chickpea plants, but the inferior was at 20 chickpea plants.m² (90.5 g); meanwhile the highest number was recorded for the combination of Propyzamide at 20 chickpea plants.m² (529.0 g).

Table (6) refers to no significant effects of chickpea densities on total number of weeds, while methods of weed control were significantly different, hand hoeing which resemble Haloxyfop acquired the lowest number of total weeds per plot (39.11 and 54.22, respectively), in comparison with Propyzamide and control treatment (82.44 and 78.56, respectively). The combination of hand

hoeing at 20 chickpea plants.m² was most effective methods in reducing total number of weeds (23.0) followed by Haloxyfop at the same density of chickpea plants.

Methods of weed control was also significantly affected total dry weight of weeds, the results was as expected that hand hoeing was most effective methods as it reduced total dry weight per plot of 3m² (128.21g) followed by Haloxyfop (308.57). Whereas the highest dry weight was recorded for control and Propyzamide treatments. Treatment combination was significantly varied, hand hoeing at all densities was most effective method in reducing total dry weight, followed by Haloxyfop and Propyzamide at the density 33.33 chickpea plants.m² other combinations are statistically similar.

Total dry weight of weeds per 3m² plot, was significantly influenced by chickpea densities, the highest the density of chickpea (33.33) plants per m² the lowest the total dry weight per plot of 3m² (259.5g). These results were in harmony with the those of Sarparast and Sheikh, 2010, whom reported to no significant effects of Propyzamide admixture with Terbutyn (0.5 kg a.i. ha⁻¹) on total number of weeds per m². in comparison with the control. However, no significant affects in weeds dry weight per m², was noticed for admixture of Propyzamide with Terbutyn (0.5 kg a.i. ha⁻¹), was reported by Sarparast and Sheikh, 2010, but our finding was attributed to possibility that Propyzamide was applied individually or to low dose.

Table (3): Common weeds accompanied with chickpea field during the growing season 2015.

	Scientific name	Family name	Growth habit	Types
1	<i>Phalaris minor</i> Retz.	Poaceae	Winter annual	Narrow leaves
2	<i>Hordeum glaucum</i> Steud.	Poaceae	Winter annual	Narrow leaves
3	<i>Cyperus rotundus</i> L.	Cyperaceae	Summer perennials	Narrow leaves
4	<i>Carthamus oxycantha</i> Bieb.	Asteraceae	Winter annual	Broad leaves
5	<i>Xanthium strumarium</i> L.	Asteraceae	Summer annual	Broad leaves
6	<i>Cichorium intybus</i> L.	Asteraceae	Summer perennials	Broad leaves
7	<i>Centaurea iberica</i> Trevir. Spreng.	Asteraceae	Summer annual	Broad leaves
8	<i>Hypericum perforatum</i> L.	Hypericaceae	Summer perennials	Broad leaves
9	<i>Sinapis arvensis</i> L.	Brassicaceae	Winter annual	Broad leaves
10	<i>Convolvulus arvensis</i> L.	Convolvulaceae	Summer perennial	Broad leaves
11	<i>Trifolium campestre</i> Scherb.	Fabaceae	Winter annual	Broad leaves
12	<i>Vaccaria pyramidata</i> Medik.	Caryophyllaceae	Winter annual	Broad leaves
13	<i>Euphorbia helioscopia</i> L.	Euphorbiaceae	Winter annual	Broad leaves

Table (4): Effect of plant densities, methods of weed control and their interaction on narrow leaf weeds population and dry weight.

	Number of narrow leaf weeds / plot of 3m ²				Dry weight narrow leaf weeds(g) /plot of 3m ²			
	33.33 plants/m ²	26.6 plants/m ²	20 plants/m ²	Means of weed control methods	33.33 plants/m ²	26.6plants/m ²	20plants/m ²	Means of weed control methods
Control	6.00 ab	22.00 ab	5.00 ab	11.00 ab	15.20 b	61.67 ab	30.67 b	35.84 b
Propyzamide	15.00ab	25.00 a	12.00ab	17.33 a	74.67 ab	164.43 a	56.63 ab	98.58 a
Haloxypop	0.33 b	4.00 ab	1.33 ab	1.88 b	0.12 b	15.17 b	7.40 b	7.56 b
Hand hoeing	16.66ab	16.66ab	5.33ab	12.88ab	46.10 b	16.00 b	21.37 b	27.82 b
Mean of densities	9.50 ab	16.91 a	5.91 b		34.02	64.32	29.02	

Within each character mean of factor and their interaction followed by similar letters are not significantly different at 5% level according DMRT, 1955.

Table (5): Effect of plant densities, methods of weed control and their interaction on broad leaf weeds population, and dry weight.

	number of broad leaf weeds/ plot of 3m ²				dry weight of broad leaf weeds(g) /plot of 3m ²			
	33.33 plants/m ²	26.6 plants/m ²	20 plants/m ²	Means of weed control methods	33.33 plants/m ²	26.6 plants/m ²	20 plants/m ²	Means of weed control methods
Control	45.67 ab	74.33 ab	82.67 ab	67.56 a	354.3 abc	483.3 ab	480.0 ab	439.22 a
Propyzamide	50.67 ab	55.33 ab	89.33 a	65.11 a	212.5 bc	375.7 abc	529.0 a	372.39 a
Haloxypop	42.33 ab	79.00 ab	35.67 ab	52.33 ab	226.0 bc	343.7 abc	333.3 abc	300.98 a
Hand hoeing	29.33ab	31.67ab	17.67 b	26.22 b	109.1 c	101.6 c	90.5 c	100.39 b
Mean of densities	42.00	60.08	56.33		225.48	326.07	358.19	

Within each character mean of factor and their interaction followed by similar letters are not significantly different at 5% level according to DMRT, 1955.

Table (6): Effect of plant densities, methods of weed control and their interaction on total weeds population and total dry weight of weeds.

	Total number of weeds / plot of 3m ²			Means of weed control methods	Total dry weight (g) / plot of 3m ²			Means of weed control methods
	33.33 plants/m ²	26.6 plants/m ²	20 plants/m ²		33.33 plants/m ²	26.6 plants/m ²	20 plants/m ²	
Control	51.67 abc	96.33 ab	71.33 abc	78.56 a	369.5 abc	545.0 ab	510.7 ab	475.07 a
Propyzamide	65.67 abc	80.33 abc	101.33 a	82.44 a	287.1 bc	554.1 ab	585.6 a	475.63 a
Haloxypop	42.67 bc	83.00 ab	37.00 bc	54.22 ab	226.1 c	358.8 abc	340.8 abc	308.57 b
Hand hoeing	46.00 abc	48.33 abc	23.00 c	39.11 b	155.2 c	117.6 c	111.9 c	128.21 c
Mean of densities	51.50	77.00	62.25		259.5 b	393.88 a	387.23 ab	

Within each character mean of factor and their interaction followed by similar letters are not significantly different at 5% level according to DMRT, 1955.

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LEAVES EPIDERMIS ANATOMY OF 16 DROUGHTED AND IRRIGATED BARLEY (*Hordeum vulgare*) GENOTYPES

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ABSTRACT

16 Barley (*Hordeum vulgare*) genotypes, namely G30, G54, G65, G74, G77, G83, G94, G98, G116, G119, G126, G127, G142, G144, G154 and G169, were subjected to adequate irrigation during their growing season and to drought only during spike development stage. The obtained results revealed that the best performance of epidermal dimension traits under irrigation were confined to G30, G116 and G169 followed by G65, G83, G94, G127, G142, G144 and G154, then came next G54 and G126. The lowest responses were detected in G74, G77, G98, and G119. On the other hand under drought conditions the superiority was concomitant to G126 and G116, followed by G54, G65, G74, G83, G127, G144 and G169 then came next G30, G77, G94, G98 and G142, the worst was G119 and G154. values of individual genotype between irrigation and drought revealed that drought tended to improve 5 detected traits in G126, 4 traits in G74, G98, 3 traits in G127 and 2 traits in G30, G83, G119 and 1 trait in G142 and G169.

KEYWORDS: Barley, *Hordeum vulgare*, Genotypes, Irrigation, Water Stress, Drought, moveable greenhouse

INTRODUCTION

On the basis of the anatomical features of the leaves, discrimination between barley species was fulfilled, where, two species, *H. vulgare* and *H. spontaneum*, were found to share the same clade with the highest similarity level (0.78) within the studied taxa. Because they are in the same cluster of the phonograms, results support the close relationship between *H. bulbosum* and the *H. vulgare*-*H. spontaneum* clade. In the phonograms, *H. distichon* and *H. bulbosum* are both close neighbors of the *H. vulgare*-*H. spontaneum* clade with similarity levels of 0.71 and 0.65 respectively and *H. murinum* subsp. *glaucum* is a sister taxon of these species, where the first major cluster includes the members of the subgenus *Hordeum* (Blattner, 2009). Within this subgenus, there are 2 sections, namely *Hordeum* and *Trichostachys* Dum. *H. murinum* subsp. *glaucum* is included in the latter. These 2 sections can be distinguished by indumentum properties, marginal sclerenchymatic line numbers, and the maximum number of long cell lines between the rows of intercostal stomata. *H. murinum* subsp. *glaucum* has adaxially located short hairs, 1 or 2 lines of marginal sclerenchymatic cells and a maximum of 6 cell

lines between the stomatal rows. While the species within the section *Hordeum* do not contain macro hairs either on the adaxial or abaxial surfaces of their leaves, they have 3 or 4 layers of marginal sclerenchyma and a maximum of 9 cell lines between stomatal rows (Mavi *et al.*, 2011).

The leaves epidermis characteristics play important roles in distinguishing the taxa of Poaceae (Metcalf, 1960). Epidermal cells in transverse sections of the taxa have regular or irregular shapes with either uniform or varying sizes. *H. violaceum*, *H. bulbosum*, *H. geniculatum*, *H. distichon*, and *H. vulgare* have regularly arranged uniformly sized epidermal cells. However, both the shape and the arrangement of the epidermal cells of *H. murinum*, *H. murinum* subsp. *glaucum*, and *H. spontaneum* are irregular. Adaxially, epidermis is differentiated into long cells, stomata, hairs, and short cells such as silica bodies. On the adaxial surfaces of the leaves, in addition to these types of cells, epidermis also has bulliform cells. The type and the arrangement of bulliform cells are determined easily from transverse sections of leaves (Mavi *et al.*, 2011). For the blade epidermis there was generally a stomatal row on both sides of each vein. The stomatal rows (sr) consisted of the stomata (s, i.e. guard cells and lateral subsidiary cells) and inter

stomatal cells (is), and had a single file of lateral epidermal cells (lc) on either side. These lateral epidermal cells had previously been part of the subsidiary mother cell which divided to produce the lateral subsidiary cell (Stebbins and Jain, 1960; Tomlinson, 1974. Zeiger (1971) called the lateral subsidiary mother cell a 'lateral cell'. However here we define a lateral cell as one of the two progeny of the lateral subsidiary mother cell]. On the abaxial surface one or both stomatal rows were occasionally absent from over the outermost veins. In this case the distinction between edge cells and those lying over the veins was arbitrary. Infrequently there were intervals of about five to ten cells within a sr with no stomata, or two sr were separated by a single common lc file (Winzel *et al.*, 1997). The objective of this study was to evaluate the performance of 16 barley genotype for adequate irrigation and drought.

MATERIALS AND METHODS

This experiment was conducted at Institute Fur Gartenbauliche Produktions Systeme, Biologie, Leibniz Universitat, Hannover, Germany. 16 Barley (*Hordeum vulgare*) genotypes, namely G30, G54, G65, G74, G77, G83, G94, G98, G116, G119, G126, G127, G142, G144, G154 and G169, to adequate irrigation and to drought during flowering and seed development stage. The objective of this study was to evaluate the genotypes performance under both adequate watering and the impacts of drought upon flowering and seed development stage.

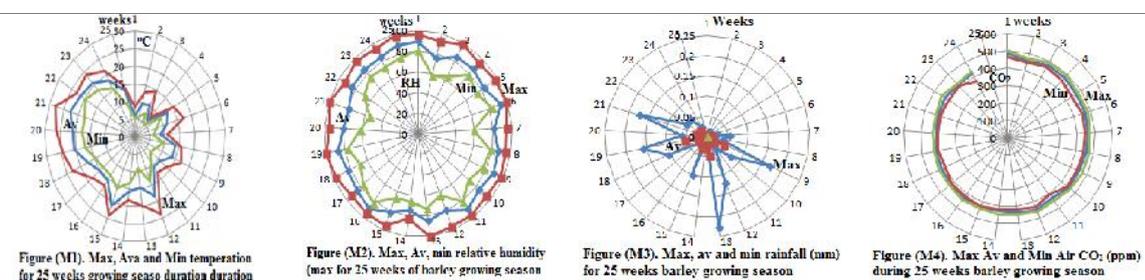
Experimental design

Split plot within Randomized Complete Block Design was selected for this investigation; the main plot represents irrigation (A), where

adequate during whole growing season (a1) and droughted plots during flowering and seed development stage (a2). The sub plot (B) represented by 16 barley genotypes G30 (b1), G54 (b2), G65 (b3), G74 (b4), G77 (b5), G83 (b6), G94 (b7), G98 (b8), G116 (b9), G119 (b10), G126 (b11), G127 (b12), G142 (b13), G144 (b14), G154 (b15) and G169 (b16). Therefore, the experiment contained 32 treatments each was repeated four times and each replicate was grown in 7m² at seeding rate of 300seeds.m⁻².

Cultural practices

Two lines driving greenhouses motivated by electrical motors were used one for adequate irrigation plots and the other one for droughted plots. Barley was covered with greenhouse whenever rainfall should be avoided during the growing season. Greenhouse land was ploughed, dissected to cope with the experimental design and then was sown with the above mentioned barley genotypes. Field meteorological data was obtained from the same institute environment control cabinet (figure, M1-8). Seeds were sown on 6th April 2014 according to the selected experimental design, seeding was fulfilled in rows with intra spaces of 15 cm and finally plants were harvested on 15th August 2014. Soil moisture content during the growing season for both irrigated and droughted greenhouses was monitored TIME DOMAIN REFLECTOMETRY (TDR). Irrigation frequencies, quantity and dates are illustrated in figure (M9). Finally, Barley leaf was sliced mounted on glass slides and they were examined under light microscope using graded slides and lenses, and then photographed.



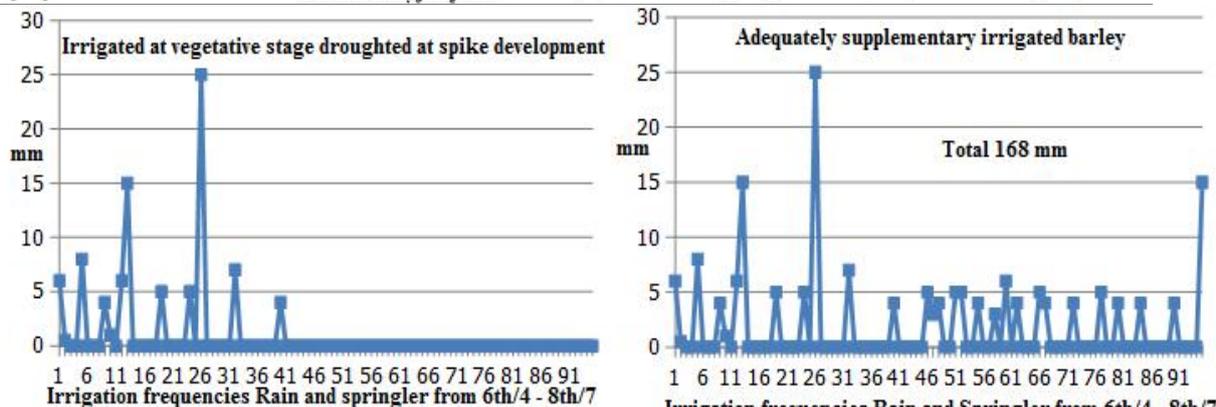
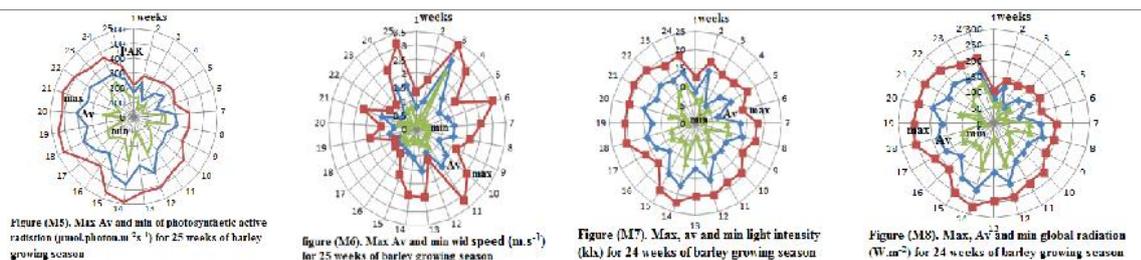


Figure (M9). Number, quantities of applied water and date of supplementary irrigation of 16 barley genotypes for irrigated and droughted treatments

RESULTS AND DISCUSSION

A. Effects of irrigation

The obtained results (table, R1) revealed that adequately irrigated barley substantially exceeded that of droughted in terms of Ep L St (22.44%), EpW St (20.88%), Ep L out 55.81%), EpW St (32.35%) at the upper leaf surface. Epidermal dimensions at of lower leaf surface of irrigated barley also manifested significant differences as compared to droughted in EpW St (32.35%), Ep L out (56 %), Ep W St (27.65%). It can be inferred from these results that the epidermal dimensions of droughted leaves were more adversely affected that of well irrigated. In addition to that lower surface epidermis dimensions were less affected than that of upper surface owing to the direct contact with environment demand of water and to the higher air humidity at the lower surface than that of air humidity at upper surface, since air fluency was more reliable Oasis phenomenon.

These results can be attributed to the water stress adversity on epidermal cell growth, it was reported that under environmental stress conditions such as drought, high activities of antioxidant enzymes and high levels of no enzymatic antioxidant compounds are important for plants to tolerate stresses (Gong *et al.* 2005). However, response of antioxidative enzymes to water deficiency is variable and depends on the intensity of the imposed water stress (Habibi and Hajiboland 2011). Antioxidative enzymes such as superoxide dismutase (SOD), ascorbate peroxidase (APX) and catalase (CAT) play an important role against oxidative stress (Apel and Hirt 2004). Plants containing high activities of antioxidant enzymes has shown considerable resistance to oxidative damage caused by ROS (Khan *et al.* 2007; Gapinska *et al.* 2008; Frary *et al.* 2010).

Table (R1): Epidermis cell dimensions (μm) of irrigated and droughted of 16 barley genotypes* **

Treatments	Upper leaf Surface					Lower leaf Surface				
	Ep L St	Ep W St	Ep L out	Ep W out	L no St up	Ep L St	Ep W St	Ep L out	Ep W out	L noSt L
Irrigation	A82.135	A21.5625	A434.64	A21.7448	A 5.250	A 66.302	A23.8542	A 558.39	A26.6927	A 6.1458
Drought	B67.083	B17.8385	B278.96	B17.6823	A 4.8750	A 65.417	B18.0208	B 358.02	B20.9115	A 5.8750

* Ep L st = Length of Epidermal intra stomata line cell; Ep W St = Width of Epidermal intra stomata line cell; Ep L out= Length of epidermal cell out of stomata lines; Ep W out= width of epidermal cell out of stomata line; L no. St L= Number of epidermal lines between two stomata lines.

** Figures of unshared characters are significantly differs at 0.05 levels, Duncan.

B. Responses of genotypes

The highest length of epidermis within intra stomata lines at leaf upper surface (table, R2) was confined to G169 (144.6 μm) which substantially exceeded G126 (35.42 μm). Insignificant differences were detected among G169, G30, G54 and G116 and also among G126, G144, G127, G98 and G74. Consequently, the investigated genotypes can be categorized in to highest Ep L St G169, G30, G54 and G116 to medium Ep L St G65, G77, G98, G116, G119, G142 and G154 and the lowest G 126, G144, G127, G98 and G74. However, the highest length of epidermis within intra stomata lines at leaf lower surface was confined to G116 (100.42 μm) and the lowest with G94 (45.83 μm) which showed insignificant differences with G30, G74, G98, G119, G142, and G144. The moderate values were detected in G54, G77, G83, G126, G127, G154, and G169 which showed insignificant differences with both highest and lowest values. These results suggested that differences in epidermis length among genotypes were more obvious at the upper leaf surface, as compared to that of lower leaf surface. The best performed Ep L St at both upper and lower leaf surfaces were G 54, G116 and G169 and the worst were G74, G98 and G144. The highest epidermal width within stomata lines at upper leaf surface were detected in G126 and G94, on the lower leaf surface, however, the highest width of intra stomata lines epidermis (Ep W St) was confined to G30, G74, G119, G144, G154 and G169. On the other hand the lowest upper leaf surface Ep W St was accompanied G77, G83, G98, G116, G142, G144 and G169. Whereas the lowest Ep W St at lower leaf surface was found in G65, G77, G83, G94, G98, G116, G126, G127, G142. The lowest Ep W St at both upper and lower surfaces was detected in G77, G83, G98, G116 and G142. These results revealed higher differences between genotypes at upper leaf surface than that observed at lower leaf surface. The highest Ep L out at upper leaf surface was detected in G30, G83, G116, G119, G126, G127, G142 and G169,

however, insignificant differences were detected I Ep L out at leaf lower surface. On the other hand the lowest Ep L out at upper leaf surface was confined to G54, G65, G74, G77, G94, G98, G144 and G154. Significant differences were not observed in Ep L out at leaf lower surface. These results revealed that upper leaf surface was more vulnerable to drought. The highest epidermis width of inter stomata lines was observed in G54 and G116 at upper leaf surface and in G116 at lower leaf surface. Thus, G116 showed superiority at both upper and lower leaf surface. On the other hand the lowest width of inter stomata lines was detected in G30, G77, G83, G126 and G127 at upper leaf surface, however, at lower leaf surface the lowest Ep W out was coincided to G77, G83, G98, G119, G126, G127, G142 and G144. Moreover, G77, G83, G126 and G127 showed the lowest Ep W out at both upper and lower leaf surface. These results suggested that leaf upper surface epidermis dimension was highly influenced as compared to lower leaf surface and G116 was the best. Substantial differences among investigated barley genotypes was detected in term of number of epidermal lines between two stomata tapes in both upper and lower leaf surface (table, R2). The highest line numbers were confined to G30, G54, G77, G83, G126 and G169 at the upper leaf surface. At lower leaf surface G30, G54, G65, G77, G83, G94, and G98 gave the highest line numbers. On both upper and lower leaf surfaces the highest L no. St was detected in G30, G54 and G83. The lowest L no St at upper leaf surfaces was found in G74, G94, G116, G119, G142, G144 and G154. At lower leaf surface, the lowest line numbers were observed in G116, G154 and G119. The lowest inter stomata line number of epidermal cells (L no. St) at both upper and lower leaf surfaces was found in G116, G154 and G119. Lengths of some cell types varied with position along the blade or sheath. For example, the bv cells on the abaxial surface of the blade were shorter near the tip than at the ligule, whereas the bulliform cells on the adaxial surface

were the same length at all positions. All cell types of the adaxial surface of the sheath tended to increase in length from 0% to 100% sheath length. Although some cell types did vary in length at different positions along the leaf, average cell lengths taken at 33% and 66% blade or sheath length still provided a statistically valid measure for comparison between cell types. Differences between barley genotypes in term of epidermis dimensions were obvious. This difference made it easy to distinguish between the two surfaces of the blade. Also, the ovS and ovL cells were generally longer on the adaxial than on the abaxial surface. The bvn cells on the abaxial surface varied in length from about 200µm to over 3 mm because the cells in these files were shorter prior to the formation of lc associated with occasional changes of stomatal rows from one file to another. In contrast, the bv cells on the abaxial surface were never shorter than 1 mm. Hence on the abaxial surface the bv cells were on average longer than the bvn cells. There was no obvious corresponding difference between bv and bvn cells on the adaxial surface since they were already about the same length (200µm) as the lc (Winzel *et al.*, 1997). Varying responses among cultivars are usually

attributed to the differences in genome diversities and their capabilities to express their genes. Lately, drought resistance genotypes were found to possess diverse types of late embryo abundant genes (LEA). These genes are randomly coiled moieties of some LEA proteins are consistent with a role in binding water. Total desiccation is probably lethal, and therefore such proteins could help maintain the minimum cellular water requirement. A general structural feature of the LEA proteins is their biased amino acid composition, which results in highly hydrophilic polypeptides, with just a few residues providing 20-30% of their total complement. For example, a deduced D19 protein from cotton contains 13% glycine and 11% glutamic acid. Furthermore, most LEA proteins lack cysteine and tryptophan residues. LEA proteins can protect specific cellular structures or ameliorate the effects of drought stress. Because they are highly hydrophilic, it appears unlikely that they occur in specific cellular structures. Also, their high concentrations in the cell and biased amino acid compositions suggest that they do not function as enzymes (Baker *et al.*, 1988).

Table (R2): Epidermis cell dimensions (µm) of irrigated and droughted of 16 barley genotypes * **

Genotype	Upper leaf Surface					Lower leaf Surface				
	Ep L St	Ep W St	Ep L out	Ep W out	L no. St up	Ep L St	Ep W St	Ep L out	Ep W out	L no. St L
Geno. 30	89.17A-D	22.917BC	659.6A	15.83F-H	6.3333A	57.5 B	25.417AB	360A	25B-E	7AB
Geno 54	100.4A-C	22.5BC	308.3B-D	29.167AB	5.333A-C	75.42AB	20.42C-E	695.4A	25.42B-D	6.1667A-C
Geno. 65	75B-E	20.42B-E	312.5B-D	18.96D-G	4.833B-D	72.08AB	16.25E	653.3A	26.667BC	6.8333AB
Geno 74	60.42D-F	22.08B-D	289.2B-D	20.42D-F	3.8333D	60.83 B	23.75A-C	467.5A	26.25BC	5.5A-D
Geno 77	69.58C-E	14.583F	199.2CD	16.25F-H	6AB	64.17AB	16.667E	290A	20.42B-F	7.3333A
Geno 83	72.08B-E	18.75C-F	400A-D	15.83F-H	5.333A-C	65.83AB	18.333DE	408.3A	20C-F	5.6667A-D
Geno 94	72.08B-E	27.083A	292.9B-D	18.33D-F	4.1667CD	64.583 B	20.83B-E	633.3A	26.667BC	7AB
Geno 98	60.42D-F	16.667EF	234.6B-D	13.125H	4.833B-D	48.33 B	18.75DE	320.8A	17.5F	5.8333A-C
Geno 116	101.7AB	16.25EF	511.7A-C	30.833A	4.5CD	100.42A	20.42C-E	654.2A	33.333A	5B-D
Geno 119	79.58B-E	19.17C-E	352.1A-D	15GH	4.833B-D	51.25 B	27.083A	264.6A	19.58D-F	3.8333D
Geno 126	35.42F	23.75AB	414.6A-D	15.42F-H	5.333A-C	72.92AB	18.333DE	408.3A	18.75EF	6.6667A-C
Geno 127	56.67EF	17.083EF	353.3A-D	16.88E-H	6AB	66.25AB	20.42C-E	419.6A	20.83B-F	5.5A-D
Geno 142	82.08B-E	17.92D-F	377.1A-D	21.67C-E	5B-D	60 B	17.5E	480.4A	24.17B-E	5.5A-D
Geno 144	50.83EF	17.92D-F	306.3B-D	20D-G	4.833B-D	55.42 B	23.75A-C	635.4A	23.33B-F	7AB
Geno 154	73.75B-E	20.21B-E	157.9D	22.5CD	4.3333CD	80AB	22.92A-D	258.8A	26.875B	4.6667CD
Geno 169	114.6A	17.92D-F	539.6AB	25.208BC	5.5A-C	77.5AB	24.17A-C	381.3A	26.04B-D	6.6667A-C

* Ep L st = Length of Epidermal intra stomata line cell; Ep W St = Width of Epidermal intra stomata line cell; Ep L out= Length of epidermal cell out of stomata lines; Ep W out= width of epidermal cell out of stomata line; L no. St L= Number of epidermal lines between two stomata lines.

** Figures of unshared characters are significantly differ at 0.05 level, Duncan.

C. Cultivar responses to irrigation The highest Ep L St at upper leaf surface (table, R3) was confined to G169 adequately irrigated (161.67 μ m) and at lower leaf surface highest Ep L St was observed in irrigated G116 (105 μ m) and in irrigated G154 (102.5 μ m). On the other hand the lowest Ep L St at upper leaf surface was coincided to droughted G126 (15.83 μ m) and at lower leaf surface in G94 (30 μ m). Drought substantially reduced the Ep L St at upper leaf surface in G30, G65, G83, G94, G98, G119, G142, G144, G154, G169, particularly in G126. Drought substantially reduced the Ep L St at lower leaf surface in G65, G94, G127, G154, G169, particularly in G30. Ep L St at upper leaf surface was improved under drought than that under irrigation in G54, G74, G77, G116 and G127. Resemble results were also observed at lower leaf surface where drought positively influenced Ep L St in G54, G74, G77, G83, G98, G119, G126, G142, G144 (table, R4 and Figure, R1-2). The highest epidermal width of intra stomata line (Ep W St) at upper leaf surface (table, R3) was concomitant to irrigated G94 (32.5 μ m) and at lower leaf surface was confined to irrigated G119 (33.33 μ m). In contrast the lowest Ep W St at upper leaf surface was found in Droughted G77 (11.66 μ m) and droughted G116 (10.83 μ m). At lower leaf surface, the lowest Ep W St was observed in droughted G127. These results manifested the adverse effects of drought on epidermal cell developments. The obtained results (table, R4 and Figure, R3-4) manifested that drought tended to reduce the Ep W St at upper leaf surface for G30, G74, G94, G98, G116, G119, G127, G142, G 144, G154 and G169. Moreover, drought also reduced the Ep W St at lower leaf surface in G30, G54, G74, G83, G98, G116, G119, G127, G142, G 144, G154 and G169. On the other hand drought increased Ep W St at upper leaf surface in G54, G65 and G126 and at lower leaf surface resemble increases were found in G65, G94 and G126. Therefore, G65 and G126 showed increases at both leaf surfaces in Ep W St under drought. These results suggested that these genotypes were either, susceptible to heavy irrigation and high humidity that were prevailed at the failed which highly reduced epidermal growth rates or they were drought resistant genotypes. Both G65 and G126 gave significantly lower Ep W St (18.33 and 20.83 μ m, respectively) under watering as compared to that obtained from G119 at lower leaf surface (33.33 μ m) and under drought G65 and G126 gave Ep W St (22.5 and 26.66 μ m,

respectively), where G126 gave the highest Ep w St under drought. The highest Ep L out at upper leaf surface (table, R3) was found in droughted G30 (895.8 μ m) and in irrigated G169 (845.8 μ m), at lower surface, however, the highest Ep L out was confined to irrigated G54 (882.5 μ m). The lowest Ep L out at upper and lower leaf surface were accompanied to droughted G98 (105.8 μ m) and droughted G119 (129.2 μ m), respectively. Drought highly reduced Ep L out at both upper and lower leaf surface in all genotypes except G30 and G126, respectively, as these two genotypes manifested Ep L out improvements under drought (table, R4 and Figure, R5-6). Long epidermal are elongated horizontally, parallel with the long axis of the leaf. The length of these cells shows variation within each taxon. However, the thickness as well as the structure of the walls is usually uniform within all leaf samples. The lower surface of the leaves of *H. violaceum* has epidermal long cells with pitted walls, whereas all the other taxa have both adaxial and abaxial epidermal long cells with straight walls. In leaves of all taxa, the long cells in the intercostal zones are arranged between the stomatal rows. The taxa can be classified according to the maximum number of these long cell lines, having 3, 6, or 9 lines between the stomatal rows (Mavi *et al.*, 2011). The highest epidermal cell width in inter stomata lines Ep W out at upper and lower leaf surfaces (table, R3) were found in irrigated G116 (41.667 and 44.167 μ m, respectively), the lowest Ep W out at upper and lower leaf surfaces were confined to droughted G119 (11.66 μ m) and droughted G54 (15 μ m), respectively, ((table, R4 and Figure, R7-8). Drought profoundly reduced the Ep W out at upper leaf surface in all investigated genotypes except G30, G74, G74, G98 and G169 which showed apparent improvement under drought conditions. Resembled results were detected at lower leaf surface where drought significantly reduced Ep W out in all genotypes except in G54 and G126 showed apparent improvement under drought. The highest numbers of epidermal cells tapes inter stomata lines (L no. St) at upper and lower leaf surfaces (table, 3) were concomitant to irrigated G30 (8 μ m) and irrigated G77 (7.667 μ m), respectively. Adequately irrigated barley genotypes substantially increased L no. St at upper leaf surfaces except in G74, G83, G94, G119 and G127, where drought revealed positive increases in L no St. Moreover, similar results were

observed at lower leaf surface in (L no. St), of all genotypes except in G65, G83, G127 and G169 which showed increases in (L no. St) grown under drought conditions. Differences were observed in the performance investigated genotypes under adequate irrigation and drought. Subsequently, best performance under irrigation were confined to G30, G116 and G169 followed by G65, G83, G94, G127, G142, G144 and G154, then came next G54 and G126, the worst genotypes were G74, G77, G98 and G119. On the other hand under drought conditions the superiority was concomitant to G126 and G116, followed by G54, G65, G74, G83, G127, G144 and G169 then came next G30, G77, G94, G98 and G142, the worst was G119 and G154. values of individual genotype between irrigation and drought revealed that drought tended to improve 5 detected traits in G126, 4 traits in G74, G98, 3 traits in G127 and 2 traits in G30, G83 and G119 and 1 trait in G142 and G169 (table, 4). These results revealed that these genotypes possess high drought resistance capabilities but differing in their growth potencies under adequate irrigation and drought, they can be used for breeding for more efficient drought tolerance. These differences in barley genotype responses in the performance of epidermal dimensions can be attributed to the adverse effects of water stress and the mean by which each individual genotype react with in order to avoid the stress adversities. Metcalfe (1960) studied the anatomy of the family. Poaceae (Gramineae) and determined the diagnostic anatomical characteristics as epidermal cell type, stoma type, and the arrangement of the sclerenchymatic cells

around the vascular bundles of the leaves. Also, some studies included the anatomy of some species of the family from Turkey. In these studies, taxonomic significance of some anatomical features, such as glumes, awns, and caryopsis cross sections, were examined (Dogan, 1999; Dogan and Tosunoglu, 1992). Wenzel *et al.* (1997) studied the mutations of barley (*H. vulgare*) and found variations in leaf length associated with cell number, cell length, and cell type depending on leaf blade. In a more recent study, Islam *et al.* (2009) investigated the epidermal features of a rice cultivar leaf and described the leaf surfaces of the taxa of the family using commonly used anatomical diagnostic characteristics, such as stomatal aperture type and number, hair type and size, prickle density and size, long and short cell properties, and silica body density. Under drought conditions, the improvement of photosynthesis of barley plants treated with SA was associated with an increase in *gs*, whereas the maximal quantum yield of PSII (Fv/Fm) did not change with SA treatment. Malondialdehyde (MDA) content remained unchanged in DSA plants because of an efficient scavenging of reactive oxygen species (ROS) following a significant enhancement of some antioxidative enzyme activities. Previous work suggested that the improvement of SA on drought tolerance of barley plants was associated with the increase of antioxidant defense abilities and maintenance of photosynthesis under drought, which may elucidate the physiological mechanism of SA in improvement of drought tolerance of barley plants (Habibi, 2012).

Table (R3): Epidermis cell dimensions (µm) of irrigated and droughted of 16 barley genotypes * **

G:lr	Upper leaf Surface					Lower leaf Surface				
	Ep L St	Ep W St	Ep L out	Ep W out	L no.St up	Ep L St	Ep W St	Ep L out	EpW out	Lno.StL
30 W	110.83BC	24.17B-D	423.3B-D	12.5KL	8A	80.83A-E	30.833AB	533.3A-D	31.667B	7AB
54 W	97.5B-E	21.67B-G	416.7B-D	35B	5.333C-E	50.83A-E	23.33C-F	882.5A	24.167B-I	6.333A-D
65 W	82.5B-G	18.333D-I	454.2A-D	21.67C-H	5C-F	92.5A-C	15.833HI	783.3AB	27.5B-F	6.333A-D
74 W	48.33F-H	25BC	349.2CD	20C-J	3.6667EF	47.5B-E	30A-C	604.2A-D	31.667B	5.667A-E
77 W	53.33E-H	17.5E-J	244.2CD	16.67E-L	6BC	41.67C-E	16.667G-I	435A-D	20.833C-I	7.667A
83 W	85B-G	21.67B-G	550A-D	18.33E-L	4.667C-F	63.33A-E	21.67D-G	487.5A-D	20.833C-I	5A-E
94 W	82.5B-G	32.5A	375B-D	21.67C-H	4D-F	61.67A-E	20F-I	787.5AB	27.5B-F	7.333AB
98 W	81.67B-G	15.83G-J	363.3CD	12.083KL	5.667B-D	32.5DE	21.67D-G	291.7A-D	20D-I	6.333A-D
116 W	85.83B-G	21.67B-G	631.7A-C	41.667A	5.667B-D	105A	24.17B-F	775A-C	44.167A	6A-E
119 W	91.67B-F	24.17B-D	370.8B-D	18.33E-L	4.333C-F	45C-E	33.333A	400A-D	22.5B-I	4C-E
126 W	55E-H	20.83B-G	420.8B-D	15.83G-L	6BC	51.67A-E	16.667G-I	245.8A-D	15.833I	7.333AB
127 W	49.17F-H	17.5E-J	440A-D	18.75D-L	4.667C-F	85A-D	27.5A-E	480.8A-D	24.167B-I	4.333B-E
142 W	91.67C-F	19.17C-H	445.8A-D	22.5C-G	5.333C-E	55A-E	20F-I	748.3A-D	29.17B-D	5.667A-E

144 W	59.17D-H	23.33B-E	452.5A-D	25.833CD	5C-F	45.83B-E	27.5A-E	691.7A-D	28.33B-E	7.333AB
154 W	78.33B-G	23.33B-E	170.8CD	23.33C-F	4.667C-F	102.5A	28.33A-D	379.2A-D	30BC	6A-E
169 W	161.67A	18.333E-I	845.8AB	23.75C-E	6BC	100AB	24.17B-F	408.3A-D	28.75B-E	6A-E
30 D	67.5E-G	21.67B-G	895.8A	19.17D-K	4.667C-F	34.17DE	20F-I	186.7B-D	18.333F-I	7AB
54 D	103.3B-D	23.33B-E	200CD	23.33C-E	5.333C-E	100AB	17.5F-I	508.3A-D	26.67B-G	6A-E
65 D	67.5C-G	22.5B-F	170.8CD	16.25G-L	4.667C-F	51.67A-E	16.667G-I	523.3A-D	25.83B-H	7.333AB
74 D	72.5B-G	19.17C-H	229.2CD	20.833E-I	4D-F	74.17A-E	17.5F-I	330.8A-D	20.833C-I	5.333A-E
77 D	85.83B-G	11.667K	154.2CD	15.83G-L	6BC	86.67A-D	16.667G-I	145CD	20D-I	7AB
83 D	59.17D-H	15.83G-K	250CD	13.333J-L	6BC	68.33A-E	15HI	329.2A-D	19.167E-I	6.333A-D
94 D	61.67D-G	21.67B-G	210.8CD	15H-L	4.333C-F	30E	21.67D-H	479.2A-D	25.83B-H	6.667A-C
98 D	39.17GH	17.5F-J	105.8D	14.167I-L	4D-F	64.17A-E	15.833HI	350A-D	15I	5.333A-E
116 D	117.5B	10.833K	391.7B-D	20C-J	3.3333F	95.83A-C	16.667G-I	533.3A-D	22.5B-I	4C-E
119 D	67.5C-G	14.17H-K	333.3CD	11.667L	5.333C-E	57.5A-E	20.83E-H	129.2D	16.667HI	3.667DE
126 D	15.83H	26.667B	408.3B-D	15H-L	4.667C-F	94.17A-C	20F-I	570.8A-D	21.667C-I	6A-E
127 D	64.17C-G	16.67F-K	266.7CD	15H-L	7.3333AB	47.5B-E	13.333I	358.3A-D	17.5G-I	6.667A-C
142 D	72.5C-G	16.67F-K	308.3CD	20.83C-H	4.667C-F	65A-E	15HI	212.5B-D	19.167E-I	5.333A-E
144 D	42.5GH	12.5I-K	160CD	14.167I-L	4.667C-F	65A-E	20F-I	579.2A-D	18.333F-I	6.667A-C
154 D	69.17C-G	17.083E-J	145CD	21.67C-H	4D-F	57.5A-E	17.5F-I	138.3CD	23.75B-I	3.333E
169 D	67.5C-G	17.5E-J	233.3CD	26.667 C	5C-F	55A-E	24.17B-E	354.2A-D	23.333B-I	7.333AB

* Ep L st = Length of Epidermal intra stomata line cell; Ep W St = Width of Epidermal intra stomata line cell; Ep L out= Length of epidermal cell out of stomata lines; Ep W out= width of epidermal cell out of stomata line; L no. St L= Number of epidermal lines between two stomata lines.

** Figures of unshared characters are significantly differ at 0.05 level, Duncan.

Table (R4): Percentage differences between irrigated and droughted 16 barley genotypes [Wet-Dry/Dry*100] (*)

Genotypes	Upper leaf Surface					Lower leaf Surface				
	Ep L St	Ep W St	Ep L out	EpWout	Lno.St L	Ep L St	Ep W St	EpLout	EpW out	L no. St L
Geno. 30	64.19	11.54	-52.75	-34.78	71.43	136.55	54.17	185.65	72.73	0
Geno 54	-5.64	-7.14	108.35	50	0	-49.17	33.33	73.62	-9.37	5.55
Geno. 65	22.22	-18.52	165.93	33.34	7.14	79.02	-5	49.68	6.45	-13.64
Geno 74	-33.34	30.43	52.36	-4	-8.3325	-35.96	71.43	82.65	52	6.26
Geno 77	-37.87	50	58.37	5.27	0	-51.92	0	200	4.17	9.53
Geno 83	43.65	36.85	120	37.5	-22.22	-7.32	44.45	48.09	8.69	-21.05
Geno 94	33.78	50	77.89	44.45	-7.69	105.57	-7.69	64.34	6.45	9.99
Geno 98	108.5	-9.53	243.38	-14.71	41.6675	-49.35	36.85	-16.66	33.33	18.75
Geno 116	-26.95	100.01	61.27	108.34	70	9.57	45	45.32	96.3	50
Geno 119	35.81	70.59	11.25	57.14	-18.75	-21.74	60	209.6	35	9.08
Geno 126	247.44	-21.88	3.06	5.55	28.57	-45.13	-16.67	-56.94	-26.93	22.22
Geno 127	-23.38	5	64.98	25	-36.36	78.95	106.26	34.19	38.1	-35.01
Geno 142	26.44	15	44.6	8	14.28	-15.38	33.33	252.14	52.17	6.26
Geno 144	39.22	86.66	182.81	82.35	7.14	-29.49	37.5	19.42	54.55	9.99
Geno 154	13.24	36.59	17.79	7.69	16.6675	78.26	61.9	174.19	26.32	80.02
Geno 169	139.51	4.76	262.54	-10.94	20	81.82	0	15.27	23.22	-18.18

* Ep Lst = Length of Epidermal intra stomata line cell; Ep W St = Width of Epidermal intra stomata line cell; Ep L out= Length of epidermal cell out of stomata lines; Ep W out= width of epidermal cell out of stomata line; L no. St L= Number of epidermal lines between two stomata lines.

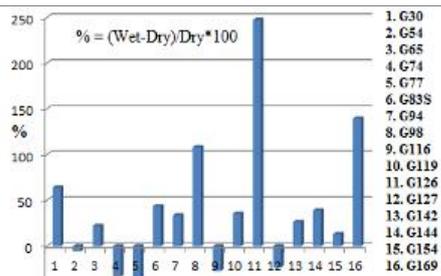


Figure (R1). Percentages of Δ wet-dry intra stomata epidermis cell length (micron) at upper leaf surface of 16 barley genotypes

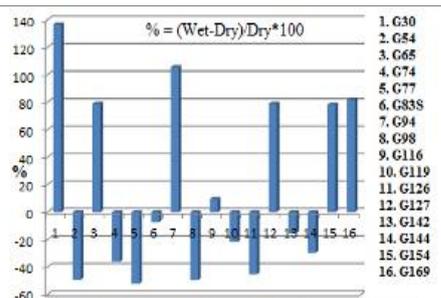


Figure (R2). Percentages of Δ wet-dry intra stomata epidermis cell length (micron) at lower leaf surface of 16 barley genotypes

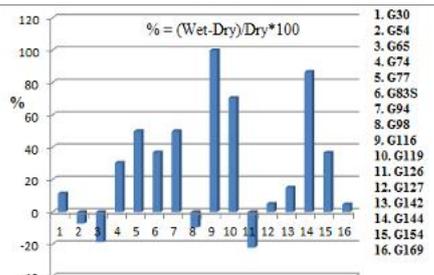


Figure (R3). Percentages of Δ wet-dry intra stomata epidermis cell width (micron) at upper leaf surface of 16 barley genotypes

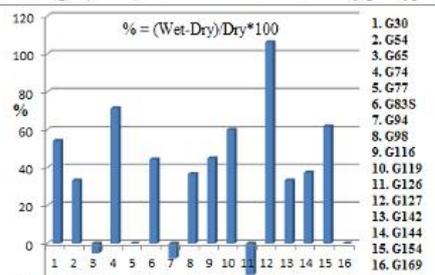


Figure (R4). Percentages of Δ wet-dry intra stomata epidermis cell width (micron) at lower leaf surface of 16 barley genotypes

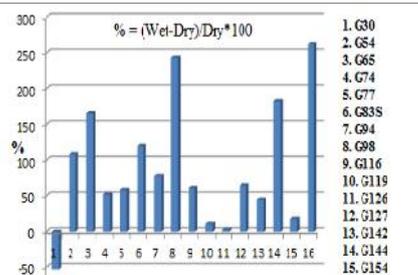


Figure (R5). Percentages of Δ wet-dry inter stomata line epidermis cell length (micron) at upper leaf surface of 16 barley genotypes

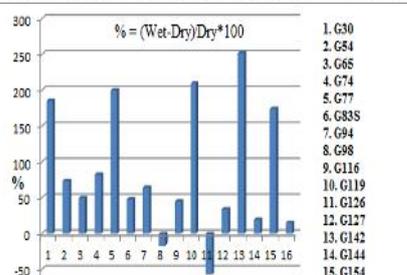


Figure (R6). Percentages of Δ wet-dry inter stomata line epidermis cell length (micron) at lower leaf surface of 16 barley genotypes

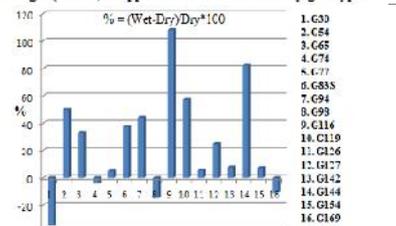


Figure (R7). Percentages of Δ wet-dry inter stomata line epidermis cell width (micron) at upper leaf surface of 16 barley genotypes

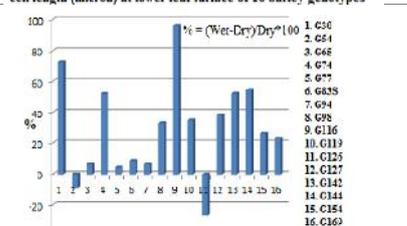


Figure (R8). Percentages of Δ wet-dry inter stomata line epidermis cell width (micron) at lower leaf surface of 16 barley genotypes

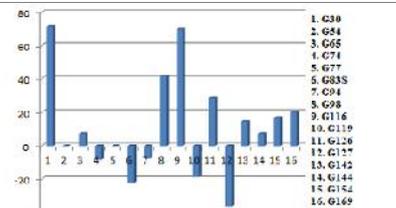


Figure (R9). Percentages of Δ wet-dry inter stomata number of epidermis line at upper leaf surface of 16 barley genotypes

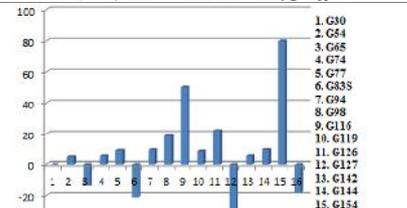
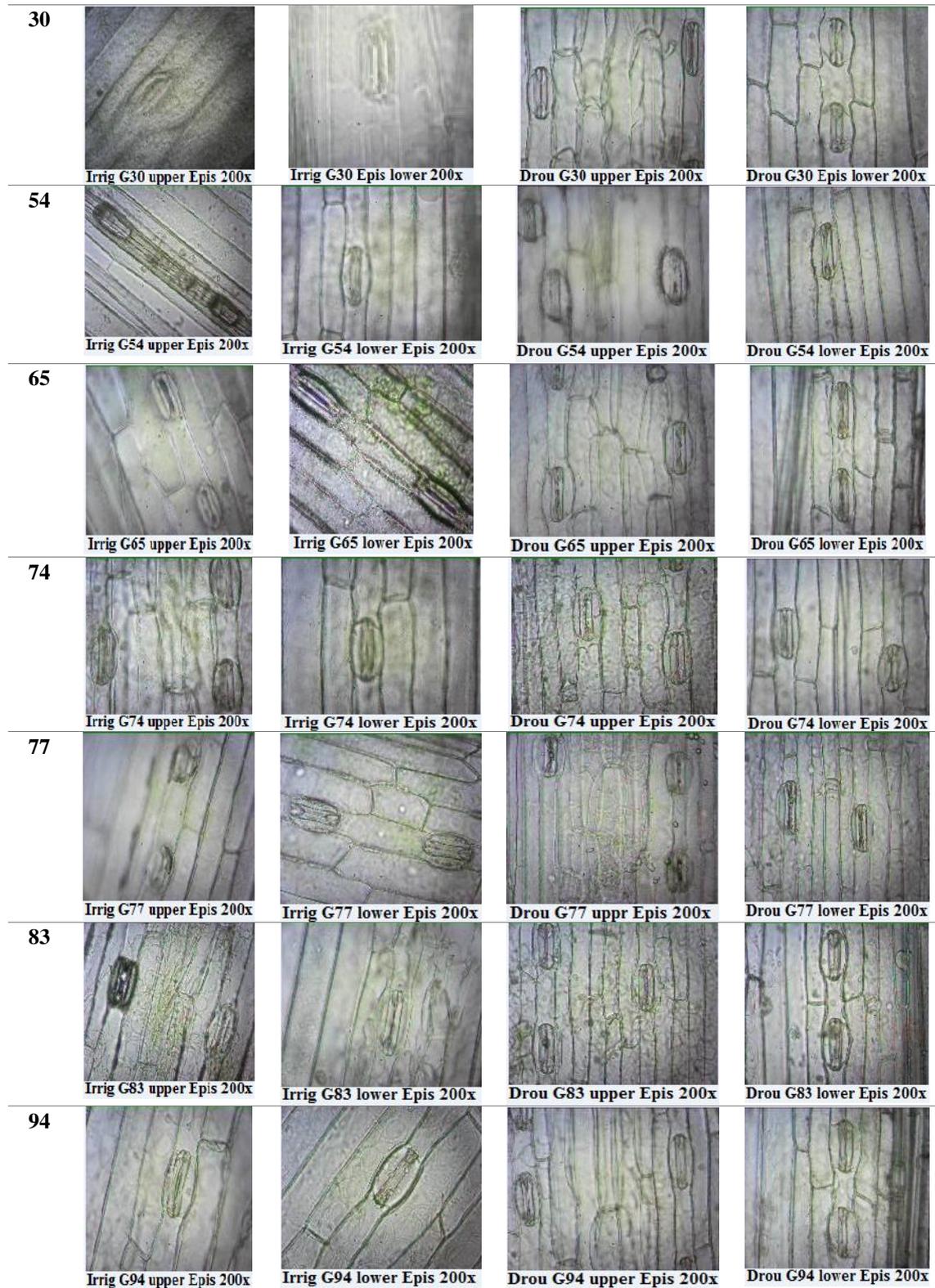
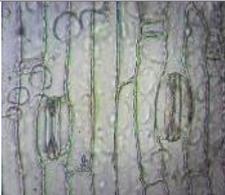
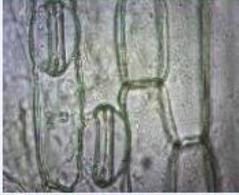


Figure (R10). Percentages of Δ wet-dry inter stomata number of epidermis line at lower leaf surface of 16 barley genotypes

Photograph (R1). Epidermis cells of 16 irrigated and droughted barley genotypes

G	Irrigated		Droughted	
	Upper leaf surface	Lower leaf surface	Upper leaf surface	Lower leaf surface



98	 Irrig G98 upper Epis 200x	 Irrig G98 lower Epis 200x	 Drou G98 upper Epis 200x	 Drou G98 lower Epis 200x
116	 Irrig G116 upper Epis 200x	 Irrig G116 lower Epis 200x	 Drou G116 upper Epis 200x	 Drou G116 lower Epis 200x
119	 Irrig G119 upper Epis 200x	 Irrig G119 lower Epis 200x	 Drou G119 upper Epis 200x	 Drou G119 lower Epis 200x
126	 Irrig G126 upper Epis 200x	 Irrig G126 Lower Epis 200x	 Drou G126 upper Epis 200x	 Drou G126 lower Epis 200x
127	 Irrig G127 upper Epis 200x	 Irrig G127 lower Epis 200x	 Drou G127 upper Epis 200x	 Drou G127 lower Epis 200x
142	 Irrig G142 upper Epis 200x	 Irrig G142 lower Epis 200x	 Drou G142 upper Epis 200x	 Drou G142 lower Epis 200x
144	 Irrig G144 upper Epis 200x	 Irrig G144 lower Epis 200x	 Drou G144 upper epis 200x	 Drou G144 lower Epis 200x
154	 Irrig G154 upper Epis 200x	 Irrig G154 lower Epis 200x	 Drou G154 upper Epis 200x	 Drou G154 Lower Epis 200x

169



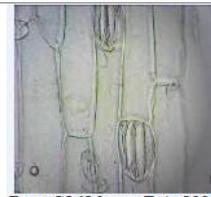
Irrig G169 upper Epis 200x



Irrig G169 lower Epis 200x



Drou G169 upper Epis 200x



Drou G169 lower Epis 200x

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STOMATA ANATOMY OF 16 DROUGHTED AND IRRIGATED BARLEY (*Hordeum vulgare*) GENOTYPES

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ABSTRACT

16 Barley (*Hordeum vulgare*) genotypes, namely G30, G54, G65, G74, G77, G83, G94, G98, G116, G119, G126, G127, G142, G144, G154 and G169, were subjected to adequate irrigation during their growing season and to drought only during spike development stage. The results manifested that the best performance of barley genotypes can be categorized according to their superiorities G94, G116 and G169 > G54, G83, G142, and G144 > G30 > G65, G126, G127 and G154 > G119 > G77 and G98. The performance potencies of barley genotypes under drought can be ordered as below G127 > G54 and G142 > G116 > G30 and G119 > G65, G83, G94, G83, G94, G119, G144, G154 and G169 > G77 and G98. Therefore, the best genotype performance under both irrigation and drought G54, G142, and G127.

KEYWORDS: Barley, Drought, Irrigation, Anatomy, Stomata

INTRODUCTION

The anatomical structure of the second leaf blade of barley (*Hordeum vulgare* L. cv. Koral) was studied in plants exposed to a photosynthetic photon flux density {PPFD} of 200 $\mu\text{mol m}^{-2} \text{s}^{-1}$ compared with those grown under 25 $\mu\text{mol m}^{-2} \text{s}^{-1}$. Design based stereological methods were used for the estimation of various leaf anatomical characteristics such as mesophyll volume, proportion of intercellular spaces, number of mesophyll cells, mean mesophyll cell volume, and internal leaf surface area. The structure of the mesophyll was more affected by different levels of PPFD than were the stomatal characteristics. Increased PPFD produced thicker leaves with a larger mesophyll volume having a higher number of less elongated mesophyll cells and a larger internal leaf surface area (Kubinova, 1991).

It is noted that stomatal density increased with increasing water stress, and gas entrance (g_s) was positively correlated with stomatal density, but stomatal size decreased with increasing water stress (Xu and Zhou, 2008). They suggested that greater g_s may appear under water stress concurrent with high stomatal density and small guard cell size. Moreover, small guard cells may cause stoma to remain open under drought to some extent (Spence *et al.*, 1986) or when the

effects of Abscisic acid are felt (Quarrie and Jones, 1977), indicating that there is greater g_s with a small guard cell size, which seems to be confirmed by our results. However, a parallel increase in g_s and photosynthetic rate (A) with stomatal density might not imply higher g_s and photosynthetic rate (A) under water stress, because severe drought might cause simultaneous declines in g_s , photosynthetic rate (A), as well as stomatal density. Just as g_s is not always closely associated with photosynthetic rate (A) (Maherali *et al.*, 2002; von Caemmerer *et al.*, 2004), the relationships of stomatal density and size with gas exchange may be complex, suggesting that some compromises can occur during plant adaptation to varying degrees of water status. The objective of this study was to evaluate the genotypes performance under both adequate watering and the impacts of drought upon flowering and seed development stage.

MATERIALS AND METHODS

This experiment was conducted at Institute Fur Gartenbauliche Produckions Systeme, Biologie, Leibniz Universitat, Hannover, Germany. 16 Barley (*Hordeum vulgare*) genotypes, namely G30, G54, G65, G74, G77, G83, G94, G98, G116, G119, G126, G127, G142, G144, G154 and G169,

to adequate irrigation and to drought during flowering and seed development stage.

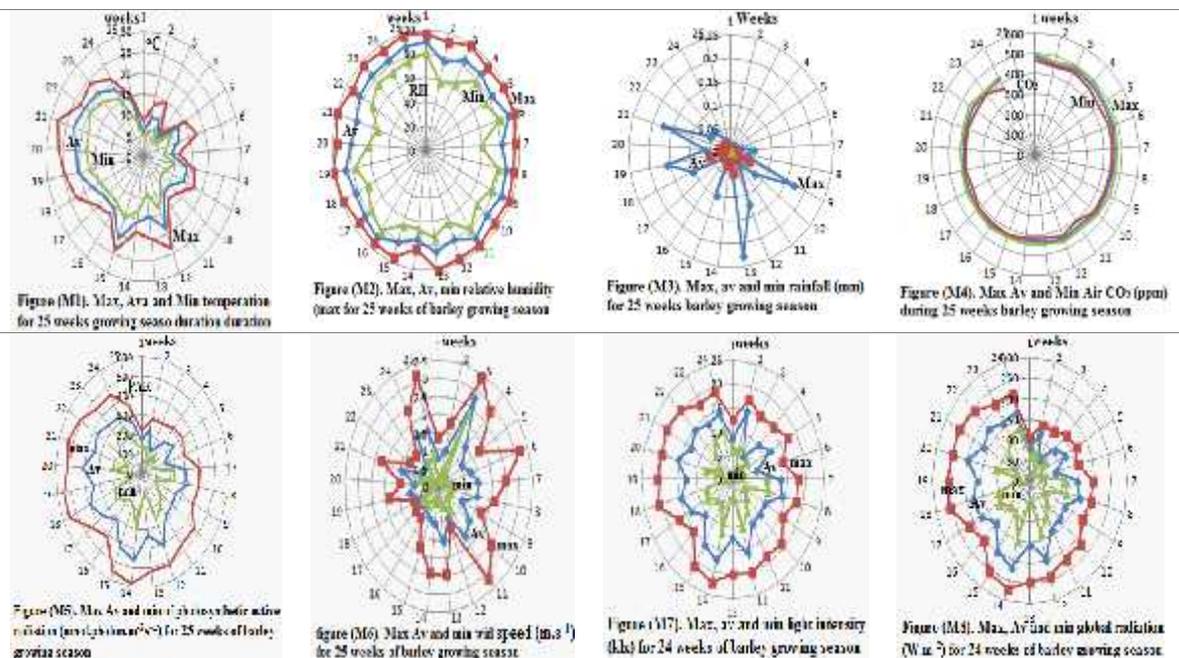
Experimental design

Split plot within Randomized Complete Block Design was selected for this investigation; the main plot represents irrigation (A), where adequate during whole growing season (a1) and droughted plots during flowering and seed development stage (a2). The sub plot (B) represented by 16 barley genotypes G30 (b1), G54 (b2), G65 (b3), G74 (b4), G77 (b5), G83 (b6), G94 (b7), G98 (b8), G116 (b9), G119 (b10), G126 (b11), G127 (b12), G142 (b13), G144 (b14), G154 (b15) and G169 (b16). Therefore, the experiment contained 32 treatments each was repeated four times and each replicate was grown in 7m² at seeding rate of 300seeds.m⁻².

Cultural practices

Two lines driving greenhouses motivated by electrical motors were used one for adequate irrigation plots and the other one for droughted plots. Barley was covered with greenhouse whenever rainfall should be

avoided during the growing season. Greenhouse land was ploughed, dissected to cope with the experimental design and then was sown with the above mentioned barley genotypes. Field meteorological data was obtained from the same institute environment control cabinet (figure, M1-8). Seeds were sown on 6th April 2014 according to the selected experimental design, seeding was fulfilled in rows with intra spaces of 15 cm and finally plants were harvested on 15th August 2014. Soil moisture content during the growing season for both irrigated and droughted greenhouses was monitored TIME DOMAIN REFLECTOMETRY (TDR). Irrigation frequencies, quantity and dates are illustrated in figure (M9). Finally, Barley leaf was sliced mounted on glass slides and they were examined under light microscope using graded slides and lenses, and then photographed.



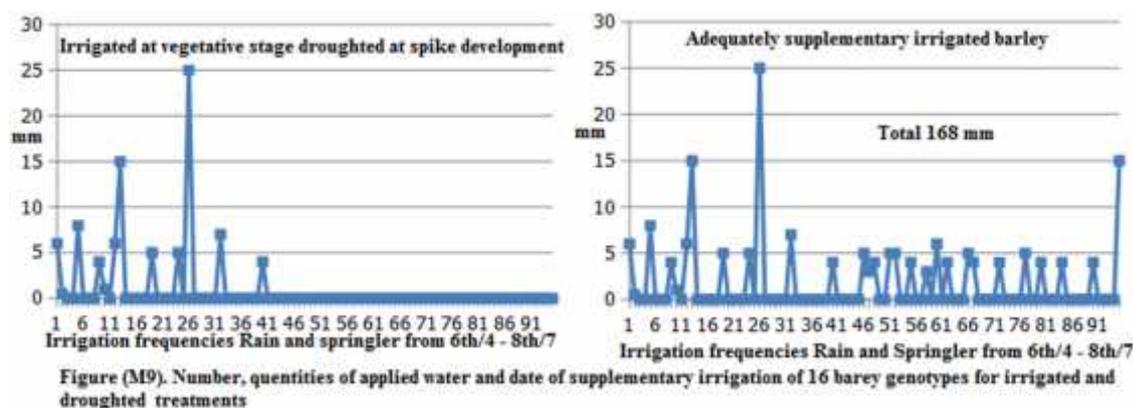


Figure (M9). Number, quantities of applied water and date of supplementary irrigation of 16 barley genotypes for irrigated and droughted treatments

RESULTS AND DISCUSSION

A. Effect of irrigation

The obtained results (table, R1) showed that stomata dimensions of adequately irrigated barley substantially exceeded that of droughted one in terms of stomata length at both upper and lower leaf surfaces (7.8 and 13.8%, respectively), stomata aperture length (6 and 13.52%, respectively), width of stomata plus subsidiary cell (5.9 and 6.5%, respectively) and stomata width (4.7 and 13.41%, respectively). It can be inferred from these results that lower leaf stomata dimensions were higher than that measured at upper leaf surface first and second drought adversities were more pronounced at upper leaf than lower leaf surface. Owing to the direct adhesion of upper leaf tissues to sun and continuous changes of air humidity as compared to shaded lower leaf surface and less frequent alteration of relative humidity. Drought results in low guard and subsidiary cells

growth rate because of low turgor pressure which is the main factor for initiating cell wall expansions and thereby cell enlargements. Water deficiency decreases plant growth by limiting water availability for cell expansion and nutrient uptake (Yang *et al.*, 2009). Drought stress has been shown to cause alterations in the chemical composition and physical properties of the cell wall (wall extensibility), and such changes may involve the genes encoding *S*-adenosylmethionine synthetase (Espartero *et al.*, 1994). Under nonstressful conditions, increased expression of *S*-adenosyl-L-methionine synthetase genes correlates with areas where lignification is occurring (Peleman *et al.*, 1989). Thus, the increased expression in drought-stressed tissue could thus also be due to lignification in the cell wall. Cell elongation stops under prolonged drought stress, and then lignification processes seem to begin (Nonami and Boyer, 1990).

Table(R1): Stomata length, width and aperture (μm) of 16 barley genotypes in response to irrigation levels. (*), (**)

Treatments	Upper leaf Surface				Lower leaf surface			
	Stoma leng	Apert. leng	SS Width	Stoma widt	Stoma leng	Aper leng	SS Width	Stoma widt
Irrigation	A 43.9583	A 41.7708	A 25.7813	A 8.1771	A 46.7708	A 45.4688	A 27.2917	A 8.5417
Drought	B 40.7813	B 39.4063	B 24.349	A 7.8125	B 41.1458	B 40.0521	B 25.625	B 7.2135

(*) Stoma leng = Stoma length; Apert. Leng = Stoma aperture length; Stoma Widt = Stoma width; SS Widt = Stoma + Subsidiary cells width

(**) Figures of unshared characters are significantly differ at 0.05 level, Duncan.

B. Genotype responses

The highest stomata length at upper leaf surface (table, R2) confined to G54 (49.167 μm). However, insignificant differences were found with G94 (45.833 μm), G 116 (47.083 μm), G127 (44.583 μm), G142 (46.875 μm) and G 169 (45.833 μm). Whereas, the highest stomata length at lower leaf surface was concomitant to the same

genotype G54 (49.375 μm), which was not differ substantially with G30 (49.167 μm), G83(45.417 μm), G94 (48.33 μm), G116 (48.75 μm), G127(48.75 μm) and G169 (47.5 μm). On the other hand the lowest stomata length at upper leaf surface was detected in G77 (36.25 μm), which was not differ significantly from G83 (40 μm), G98 (35.625 μm), G119 (38.75 μm) and

G154 (38.958µm). On the lower leaf surface, however, the lowest stomata length was observed with G144 (33.33µm), which was not varied significantly with G77 (35.41µm). The highest stomata aperture length at upper leaf surface was found in G166(45.625µm), which was insignificantly differs from G54 (45.208µm), G30 (41.45µm), G65 (40.208µm), G94 (44.208µm), G116 (45.625µm), G142 (45.417µm), G144 (40.833µm) and G169(44.167µm). At lower leaf surface the highest stomata aperture was concomitant to G54 (48.33µm), which differs insignificantly with G83(43.75µm), G94 (46.458µm), G116 (46.875µm), G127 (47.083µm) and G169 (46.042µm). On the other hand the lowest aperture length of upper leaf surface stomata was confined to G98 (38.125µm), which was not differ substantially from G74 (34.583µm), G77 (34.583µm), G83 (38.542µm), G119 (37.083µm) and G154 (37.292µm). At lower leaf surface, however, the lowest aperture length was accompanied by G77(33.75µm), which was not differs profoundly with G119 (37.78µm). The highest subsidiary and stomata (SS) width was detected in G54 (27.5µm), which was not differs apparently with G65 (26.5µm), G74 (26.25µm), G77 (24.167µm), G94 (23.75µm), G98 (25µm), G116 (27.083µm), G119 (27.083µm), G126 (24.583µm), G127 (25µm), G142 (26.667µm), G144 (27.083µm), G154 (25µm) and G169 (24.375µm). At lower leaf surface, however, the highest SS was found in G169 (31.042µm), which not significantly differs from G142 (30.208µm) and G154 (28.542µm). In contrast, the lowest SS at the upper leaf surface was observed in G30 (18.75µm) and at lower leaf surface the lowest SS was confined to G83 (22.083µm), which was not

differing significantly from G77 (24.583µm), G127 (24.792µm) and G144 (23.75µm). The highest stomata width at upper leaf surface was detected with G126 (12.917µm), at lower leaf surface G144 (9.833µm) gave the lowest stomata width which was not differing significantly from G30 (9.375µm) and G116 (8.75µm). The lowest stomata width at upper leaf surface was found in G77 (7.083µm), which was not differing substantially from all genotypes except G126. At lower leaf surface, the lowest stomata width was confined to G126 (6.875µm), which was not apparently differing from G65 (7.2917µm), G74 (7.2917µm), G77 (7.0833µm), G83 (7.0833µm), G94 ((7.2917µm), G98 (7.5µm), G119 (7.5µm), and G154 (7.2217µm). Barley genotypes differences can be attributed to the capability of individual genotype in expression of its gene at specific time to cope with the ambient environment in other words how each genotype can operate its acquired systematic resistance (ASR), such operation required tremendous switch on and/or off genes. Transgenic plants allow the targeted expression of drought related genes in vivo and are therefore an excellent system to assess the function and tolerance conferred by the encoded proteins. With ectopic expression of genes involved in controlling ABA biosynthesis, it should also be possible to alter the hormonal balance in vivo and thus to clarify the role of ABA in the drought response. Another purpose for using transgenic plants is to improve drought tolerance in agronomical valuable plants. However, despite extensive research, examples of transgenic plants with improved stress tolerance are scarce (Bohnert *et al.*, 1995).

Table (R2): Stomata length, width and aperture (µm) of 16 barley genotypes. (*), (**)

Genotypes	Upper leaf Surface				Lower leaf surface			
	Stoma leng	Apert. Leng	SS Width	Stoma widt	Stoma leng	Aper leng	SS Width	Stoma widt
Geno. 30	42.5B-D	41.458A-D	18.75C	8.333B	49.167A	42.292B-E	26.667C-F	9.375A
Geno 54	49.167A	45.208A	27.5A	8.333B	49.375A	48.333A	26.875C-E	8.3333BC
Geno. 65	42.083B-D	40.208A-D	26.25AB	8.125B	43.75B-E	41.875C-E	25.833C-F	7.2917DE
Geno 74	40B-E	38.125C-F	26.25AB	7.708B	43.75B-E	42.083B-E	26.042C-F	7.2917DE
Geno 77	36.25E	34.583EF	24.167AB	7.083B	35.417FG	33.75F	24.583E-G	7.0833E
Geno 83	40C-E	38.542C-F	22.5 B	7.083B	45.417A-D	43.75A-D	22.083G	7.0833E
Geno 94	45.833AB	44.208AB	23.75AB	7.292B	48.333AB	46.458A-C	27.083C-E	7.2917DE
Geno 98	35.625E	34.167F	25AB	7.5B	41.25DE	40DE	26.25C-F	7.5C-E
Geno 116	47.083AB	45.625A	27.083A	8.333B	48.75A	46.875A-C	27.917B-D	8.75AB
Geno 119	38.75DE	37.083D-F	27.083A	7.917B	39.583EF	37.708EF	25E-F	7.5C-E

Geno 126	42.083B-D	39.583B-E	24.583AB	12.917A	43.75B-D	42.292B-E	26.667C-E	6.875E
Geno 127	44.583A-C	42.917A-C	25AB	7.292B	48.75A	47.083AB	24.792E-G	8.3333BC
Geno 142	46.875AB	45.417A	26.667A	8.125B	43.125C-E	42.292B-E	30.208AB	8.125B-D
Geno 144	42.292B-D	40.833A-D	27.083A	7.5B	33.333G	42.708B-D	23.75FG	9.5833A
Geno 154	38.958DE	37.292D-F	25AB	7.083B	42.083DE	40.625DE	28.542A-C	7.2917DE
Geno 169	45.833AB	44.167AB	24.375AB	7.292B	47.5A-C	46.042A-C	31.042A	8.3333BC

(*) Stoma leng = Stoma length; Apert. Leng = Stoma aperture length; Stoma Widt = stomata Width; SS Widt = Stoma + Subsidiary cells width

(**) Figures of unshared characters are significantly differ at 0.05 level, Duncan.

C. Genotype responses to irrigation

The highest stomata length at upper leaf surface of irrigated barley (table, R3) was found in irrigated G116 (50µm), G54 (50µm) and G169 (50µm), which was not differing significantly with irrigated G65 (45.833µm), G74 (43.33µm), G83 (44.169µm), G142 (48.75µm) and G144 (43.33µm). At the lower leaf surface, however, the highest stomata length confined to irrigated G116 (55µm), which was insignificantly differing with G30 (52.5µm), G54 (51.667µm), G74 (48.33µm), G83 (50.833µm), G94 (54.167µm), G127 (48.33µm), G142 (49.167µm), G154 (48.33µm) and G169 (52.5µm). In contrast, under drought conditions, the highest stomata length was observed in droughted G127 (50.833µm), which insignificantly differing with G54 (48.33µm), G116 (44.167µm) and G142 (45µm). At lower leaf surface, the highest stomata length of droughted barley was coincided to G127 (49.167µm). On the other hand the lowest stomata length of adequately irrigated barley G77 (39.167µm), which was not differing significantly from G98 (36.25µm), G119 (39.16µm), G127 (38.33µm) and G154 (37.5µm). At upper leaf surface, the lowest stomata length of irrigated barley was accompanied with irrigated G77 (35µm). At upper leaf surface the lowest stomata length was found in droughted G98 (35µm), which was insignificantly differing with G74 (36.667µm), G83 (35.833µm), G144 (41.25µm) and G154 (40.41µm). However, at lower leaf surface the lowest stomata length confined to droughted G65 (40.833µm), which was not significantly differing from G74 (39.617µm), G77 (35.833µm), G83 (40µm), G98 (36.66µm), G119 (35.833µm), G142 (37.083µm), and G154 (35.833µm).

The highest stomata aperture at the upper leaf surface under irrigation condition was coincided to G116 (48.33µm), which was insignificantly differing from G30 (41.25µm), G54 (43.33µm),

G65 (43.33µm), G74 (40.833 µm), G83 (42.5µm), G94 (47.917µm), G126 (42.5µm), G142 (47.083µm), G144 (41.667µm) and G169 (47.91µm). Under drought, however, the highest stomata aperture was concomitant to G127 (48.75µm), which was not differ significantly with G30 (41.15µm), G54 (47.083µm) and G116 (47.1µm). At lower leaf surface of irrigated barley the highest stomata aperture was observed with G116 (52.5µm), which was not differ substantially with G30 (49.167µm), G74 (46.25µm), G83 (48.75 µm), G94 (51.667µm), G127 (46.25µm), G142 (47.917 µm), G15 (46.667 µm) and G169 950.83 µm). Under drought condition, the highest stomata aperture confined to G127 (47.917). At upper leaf surface, the lowest stomata aperture of irrigated barley was detected in G98 (34.583µm), which was not apparently differing from G77 (37.083µm), in G154 (35.417µm), G127 (37.083µm). Under drought condition, the lowest stomata aperture was confined to G77 (32.083µm), which insignificantly differing from G65 (37.08µm), G74 (35.417µm), G77 (32.083µm), G83 (34.583µm), G98 (33.75µm), G119 (37.083µm), G126 (36.667µm) and G154 (39.167µm). On the other hand at lower leaf surface, the lowest stomata aperture of droughted barley was observed in G77 and G119 (34.583µm) which insignificantly differing from G65 (39.583µm), G74 (37.917µm), G83 (38.75µm), G98 (35.417µm), G142 (36.667µm) and G154 (34.833µm). The lowest stomata aperture at lower leaf surface of irrigated barley confined to G77 (32.19µm).

The highest subsidiary and stomata cells (SS) width at upper leaf surface of irrigated barley observed in G116 and G144 (30.833µm). Under drought, condition the highest SS at leaf upper surface coincided to G54 (28.33µm), which insignificantly differing from G74 (24.167µm), G83 (23.33µm), G116 (23.33µm), G94 (25µm), G98 (28µm), G126 (25.833µm), G127

(25.833 μ m), G142 (25.833 μ m), G144 (23.33 μ m) and G154 (24.1 μ m). At lower leaf surface the highest SS of irrigated barley was recorded in G169 (35 μ m), which was insignificantly differing from G94 (31.66 μ m) and G154 (34.58 μ m). The highest SS at lower leaf surface of droughted barley accompanied to G142 (34.583 μ m). The lowest SS of irrigated barley at upper leaf surface detected in G30 (11.66 μ m). Droughted G119 gave the lowest SS at upper leaf surface (18.33 μ m), which insignificantly differing from G144 (23.33 μ m), G77 (21.667 μ m), G83 (23.33 μ m) and G169 (22.083 μ m). In contrast, the lowest SS of irrigated barley at lower leaf surface was confined to G77 (20 μ m), which insubstantially differing from G65 (25 μ m), G98 (25 μ m) and G144 (22 μ m). Under drought condition, however, the lowest SS was denoted to G127 (22.083 μ m), which was not significantly differ from G77 (23.33 μ m), G83 (23.33 μ m), G94 (22.5 μ m), G119 (24.167 μ m), G126 (24.167 μ m), G144 (25 μ m) and G154 (24.583 μ m). The highest stomata width at leaf upper surface of irrigated barley was confined to G 126 (17.5 μ m), which differed significantly from other irrigated and droughted genotypes. At lower leaf surface, the highest stomata width was confined to G114 and G30 (11.6667 μ m). The lowest stomata width at lower leaf surface was found in droughted G74 (7.0833 μ m). Insignificant differences were detected among other genotypes. These results suggested that some barley genotypes performed their stomata and subsidiary cells growth well under adequate irrigation, other under drought and others under both irrigation and drought.

percentages between individual genotype of barley revealed that G116, G119 and G169 were performed well under adequate irrigation where stomata dimensions reduced under drought. G65, G94, G126 and G142 improved only one trait under drought, G30, G54, G83, G98 and G144 improved 2 traits under drought, G154 improved 4 traits under drought and finally G127 improved 6 traits under drought, as compared to their individual values of irrigation (table, R4 and figures, 1-8). These results can be attributed to the genotypes to remove the oxidant generated under water stress by antioxidant particularly enzyme types for instance superoxide dismutase, catalyses and peroxidase. Enzymes concerned with removing toxic intermediates produced during oxygenic metabolism, such as glutathione reductase and superoxide dismutase, increase in response to drought stress and are probably very important in tolerance (Mittler and Zilinskas, 1994). Decreasing leaf water content and consequent stomatal closure result in reduced CO₂ availability and the production of active oxygen species such as superoxide radicals (Sgherri *et al.*, 1995). Increased photorespiratory activity during drought is also accompanied by elevated levels of glycolate-oxidase activity, resulting in H₂O₂ production (Mittler and Zilinskas, 1994). This could explain why genes encoding enzymes that detoxify active oxygen species such as ascorbate peroxidase (Mittler and Zilinskas, 1994) and superoxide dismutase (Perl-Treves and Galum, 1991; White and Zilinskas, 1991) have been found upregulated in response to drought.

Table (R3): Stomata length, width and aperture (μ m) of 16 barley genotypes in response to irrigation levels. * Figures of unshared characters are significantly differing at 0.05 level, Duncan.

Geno/Irrig	Upper leaf Surface				Lower leaf surface			
	Stoma leng	Apert. Leng	SS Width	Stoma widt	Stoma leng	Aper leng	SS Width	Stoma widt
30 W	42.5B-I	41.667A-H	11.667F	9.167B	52.5A-C	40F-J	26.667D-H	11.6667A
54 W	50AB	43.333A-F	26.667B-D	9.167B	51.667A-C	49.167A-D	28.333C-F	9.1667B
65 W	45.833A-E	43.333A-F	27.5B-D	9.167B	46.667C-F	44.167C-G	25E-J	7.5DC
74 W	43.333A-H	40.833A-H	28.333BC	8.333B	48.333A-E	46.25A-F	25E-J	7.5DC
77 W	39.167D-J	37.083E-I	26.667B-D	7.5B	35K	32.917K	25.833E-I	7.5DC
83 W	44.167A-G	42.5A-F	21.667DE	7.5B	50.833A-D	48.75A-D	20.833J	7.5DC
94 W	50AB	47.917A-C	22.5C-E	7.5B	54.167AB	51.667AB	31.667A-C	7.5DC
98 W	36.25G-J	34.583G-I	22.5C-E	8.333B	45.833C-G	44.583B-G	25E-J	7.5DC
116 W	50AB	48.333AB	30.833AB	9.167B	55A	52.5A	30B-D	10B
119 W	39.167E-J	37.083E-H	35.833A	9.167B	43.333E-I	40.833E-J	25.833D-H	7.5DC
126 W	45A-F	42.5A-G	23.333C-E	8.333B	44.167D-H	42.5E-I	29.167B-E	7.5DC

127 W	38.333E-J	37.083E-I	24.167CD	7.083B	48.333A-E	46.25A-F	27.5D-G	9.1667B
142 W	48.75A-C	47.083A-D	27.5B-D	8.75B	49.167A-E	47.917A-E	25.833D-I	8.75BC
144 W	43.333A-H	41.667A-H	30.833AB	7.5B	22.5L	42.5D-H	22.5H-J	11.6667A
154 W	37.5F-J	35.417F-I	25.833B-D	6.667B	48.333A-E	46.667A-E	32.5AB	7.0833D
169 W	50AB	47.917A-C	26.667B-D	7.5B	52.5A-C	50.833A-C	35A	9.1667B
30 D	42.5B-I	41.25A-H	25.833B-D	7.5B	45.833C-F	44.583B-F	26.667D-H	7.0833D
54 D	48.333A-D	47.083A-D	28.333BC	7.5B	47.083C-F	47.5A-E	25.417E-I	7.5DC
65 D	38.333E-I	37.083E-I	25B-D	7.083B	40.833F-K	39.583F-K	26.667D-H	7.0833D
74 D	36.667G-J	35.417F-I	24.167CD	7.083B	39.167G-K	37.917G-K	27.083D-G	7.0833D
77 D	33.333J	32.083I	21.667DE	6.667B	35.833JK	34.583JK	23.333G-J	6.6667D
83 D	35.833H-J	34.583G-I	23.333C-E	6.667B	40F-K	38.75G-K	23.333G-J	6.6667D
94 D	41.667C-I	40.5B-H	25B-D	7.083B	42.5E-J	41.25E-J	22.5H-J	7.0833D
98 D	35IJ	33.75HI	27.5B-D	6.667B	36.667I-K	35.417JK	27.5D-I	7.5DC
116 D	44.167A-G	42.917A-F	23.333C-E	7.5B	42.5E-J	41.25E-J	25.833D-I	7.5DC
119 D	38.333E-I	37.083F-I	18.333E	6.667B	35.833JK	34.583JK	24.167F-J	7.5DC
126 D	39.167E-I	36.667F-I	25.833B-D	17.5A	43.333E-H	42.083D-I	24.167F-J	6.25D
127 D	50.833A	48.75A	25.833B-D	7.5B	49.167A-E	47.917A-E	22.083IJ	7.5DC
142 D	45A-F	43.75A-E	25.833B-D	7.5B	37.083I-K	36.667H-K	34.583A	7.5DC
144 D	41.25C-J	40C-H	23.333C-E	7.5B	44.167D-H	42.917E-H	25E-J	7.5DC
154 D	40.417D-J	39.167D-I	24.167CD	7.5B	35.833JK	34.583JK	24.583F-J	7.5DC
169 D	41.667C-I	40.417B-H	22.083DE	7.083B	42.5F-J	41.25E-J	27.083D-G	7.5DC

(*) Stoma leng = Stoma length; Apert. Leng = Stoma aperture length; Stoma Wid = Stoma width; SS Wid = Stoma + Subsidiary cells width

(**) Figures of unshared characters are significantly differ at 0.05 level, Duncan.

Table (R4): Percentage differences between irrigated and droughted 16 barley genotypes [Wet-Dry/ Dry*100]. (*)

Genotypes	Upper leaf Surface				Lower leaf surface			
	St Up L	S Up A L	SS Width	Stoma widt	St Lo L	St lo AL	SS Width	Stoma widt
Geno. 30	0	1.01	-54.84	22.23	14.55	-10.28	0	64.71
Geno 54	3.45	-7.96	-5.88	22.23	9.74	3.51	11.47	22.22
Geno. 65	19.57	16.85	10	29.42	14.29	11.58	-6.25	5.88
Geno 74	18.18	15.29	17.24	17.65	23.4	21.98	-7.69	5.88
Geno 77	17.5	15.58	23.08	12.49	-2.32	-4.82	10.71	12.5
Geno 83	23.26	22.89	-7.14	12.49	27.08	25.81	-10.71	12.5
Geno 94	20	18.31	-10	5.89	27.45	25.25	40.74	5.88
Geno 98	3.57	2.47	-18.18	24.99	25	25.88	-9.09	0
Geno 116	13.21	12.62	32.14	22.23	29.41	27.27	16.13	33.33
Geno 119	2.18	0	95.46	37.5	20.93	18.07	6.89	0
Geno 126	14.89	15.91	-9.68	-52.38	1.92	0.99	20.69	20
Geno 127	-24.59	-23.93	-6.45	-5.56	-1.7	-3.48	24.53	22.22
Geno 142	8.33	7.62	6.45	16.67	32.59	30.68	-25.3	16.67
Geno 144	5.05	4.17	32.14	0	-49.06	-0.97	-10	55.56
Geno 154	-7.22	-9.57	6.89	-11.11	34.88	34.94	32.21	-5.56
Geno 169	20	18.56	20.76	5.89	23.53	23.23	29.23	22.22

(*) Stoma leng = Stoma length; Apert. Leng = Stoma aperture length; Stoma Wid = Stoma width; SS Wid = Stoma + Subsidiary cells width;

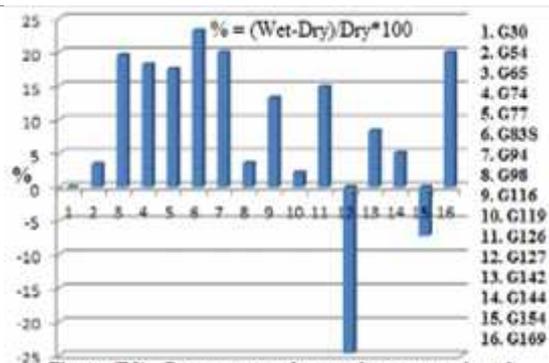


Figure (R1). Percentages of Δ wet-dry stomata length (micron) at upper leaf surface of 16 barley genotypes

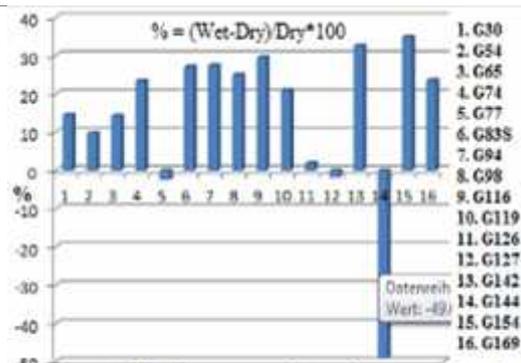


Figure (R2). Percentages of Δ wet-dry stomata length (micron) at lower leaf surface of 16 barley genotypes

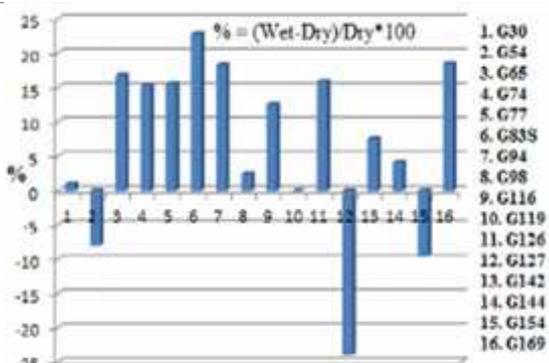


Figure (R3). Percentages of Δ wet-dry stomata aperture length (micron) at upper leaf surface of 16 barley genotypes

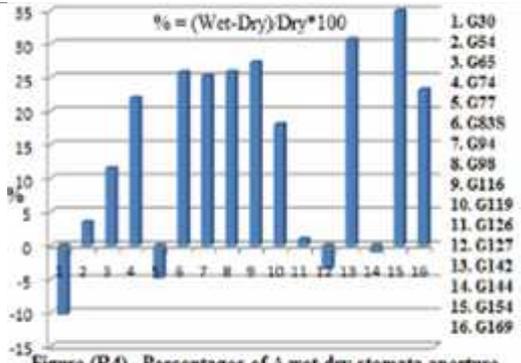


Figure (R4). Percentages of Δ wet-dry stomata aperture length (micron) at lower leaf surface of 16 barley genotypes

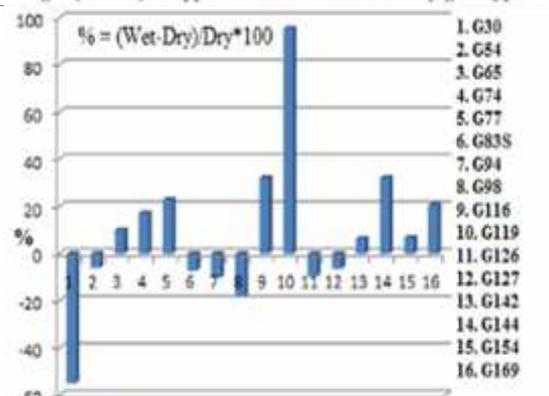


Figure (R5). Percentages of Δ wet-dry stomata and subsidiary cells width (micron) at upper leaf surface of 16 barley genotypes

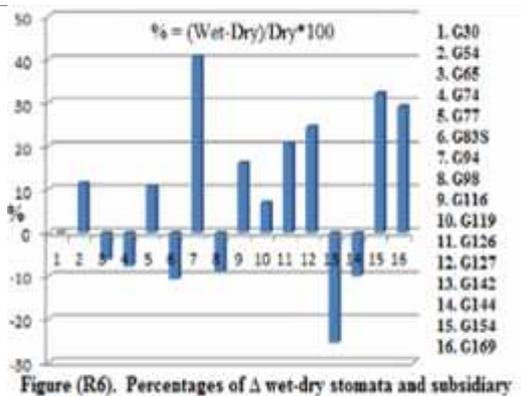


Figure (R6). Percentages of Δ wet-dry stomata and subsidiary cells width (micron) at lower leaf surface of 16 barley genotypes

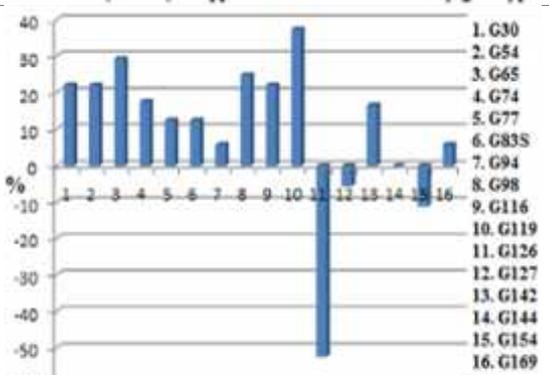


Figure (R7). Percentages of Δ wet-dry stomata width (micron) at upper leaf surface of 16 barley genotypes

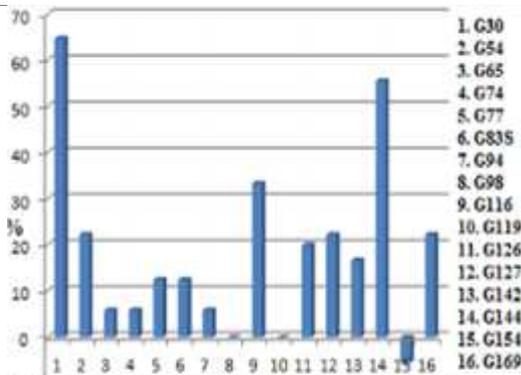
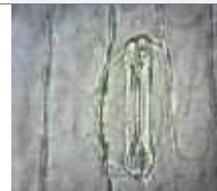
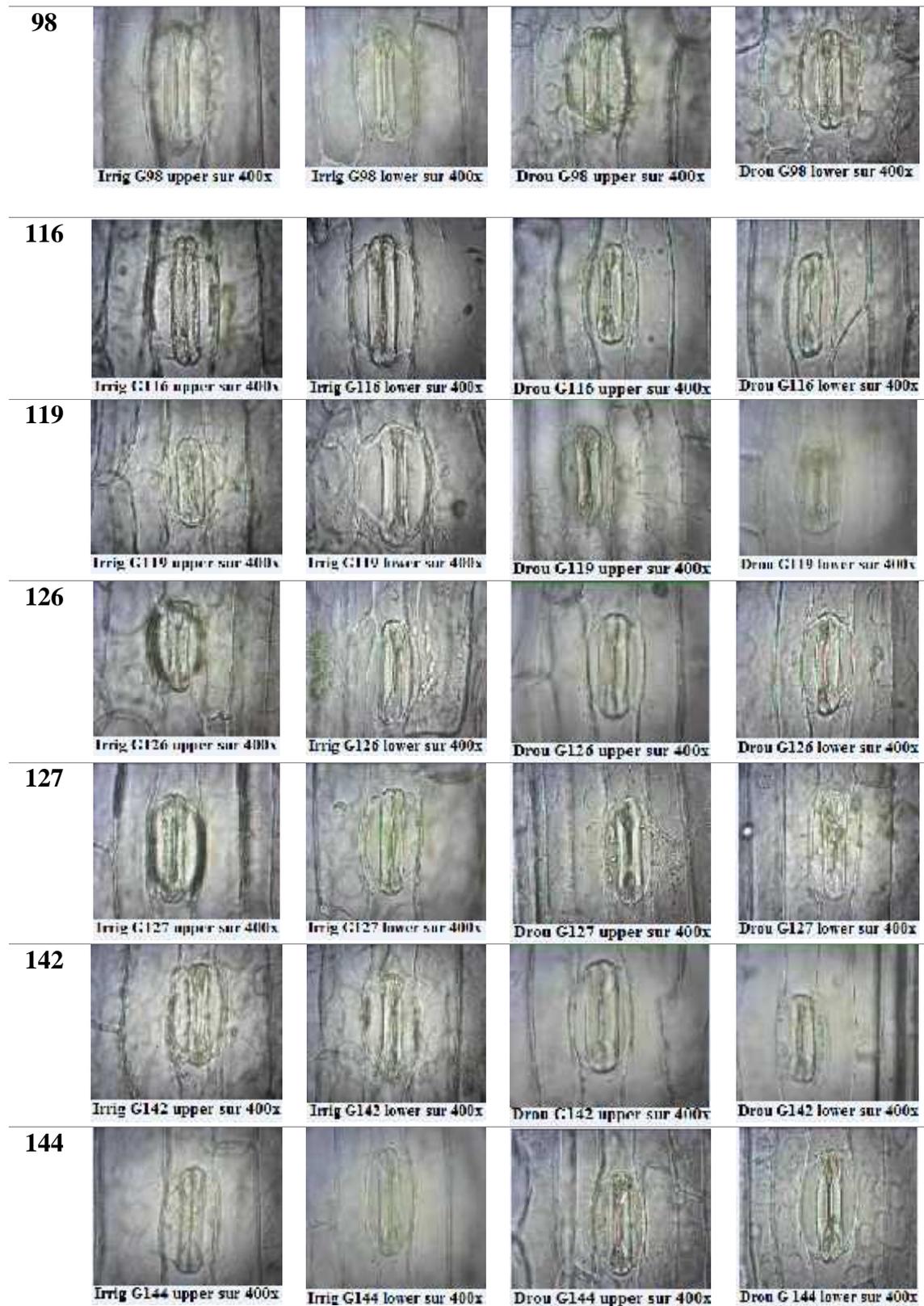
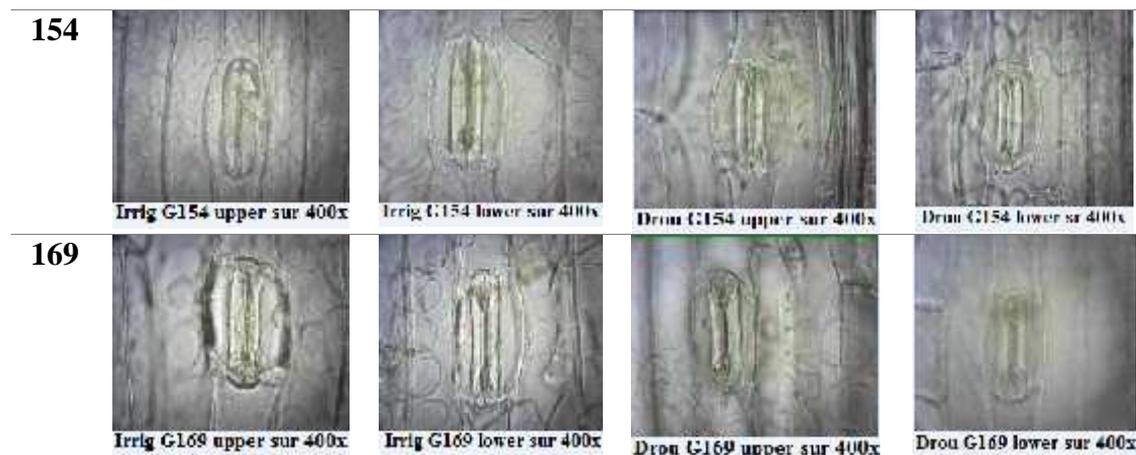


Figure (R8). Percentages of Δ wet-dry stomata width (micron) at lower leaf surface of 16 barley genotypes

Photograph (R1). Leaf stomata of 16 irrigated and droughted barley genotypes				
G	Irrigated		Drought	
	Upper surface	Lower surface	Upper surface	Lower surface
30	 Irrig G30 Lower Sur 400X	 Irrig G30 upprer sur 400 x	 Drou G30 upper sur 400x	 Drou G30 lower sur 400x
54	 Irrig G54 upper sur 400x	 Irrig. G54 Lower sur 400x	 Drou G54 upper sur 400x	 Drou G54 lower sur 400x
65	 Irrig G65 upper sur 400x	 Irrig G65 lower sur 400x	 Drou G65 upper sur 400x	 Drou G65 lower sur 400x
74	 Irrig G74 upper sur 400x	 Irrig G74 lower sur 400x	 Drou G74 upper sur 400x	 Drou G74 lower sur 400x
77	 Irrig G77 upper sur 400x	 Irrig G77 lower sur 400x	 Drou G77 upper sur 400x	 Drou G77 lower sur 400x
83	 Irrig G83 upper sur 400x	 Irrig G83 lower sur 400x	 Drou G83 upper sur 400x	 Drou G83 lower sur 400x
94	 Irrig G94 upper sur 400x	 Irrig G94 lower sur 400x	 Drou G94 upper sur 400x	 Drou G94 lower sur 400x





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THE LEAVE PROLINE CONTENT OF SOME BREAD AND DURUM WHEAT UNDER STRESS CONDITIONS IN THE FIELD AND RELATED SEEDLING TRAITS UNDER DIFFERENT REGIMES OF PEG

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ABSTRACT

A field study was carried out at two different isohyets locations of Iraqi Kurdistan Region (stress; Duhok and normal; Hawler) to investigate eight bread (Abu-Ghraib-3, Adana-99, Al-Iraq, Aras, Al-Rashid, Bohouth-4, Cham-6, and IBA A-99) and two durum (Doma and Simeto) wheat for leaf proline content during the growing season 2013/14. Also, an experiment was carried out at the laboratories of University of Natural resource and Life Sciences (BOKU), Vienna, Crop Breeding Department, to study the performance of these varieties under stress conditions for shoot and root growth measurements. Seeds were sown in normal water (PEG 0%= 0 bar) and stress (PEG 10% = -1.48 and PEG 20%= -5.11 bars) induced by Polyethylene Glycol (PEG8000) with six replications. The results indicated that the proline content significantly was higher under stress (0.969) as compared to (0.919) mg.g⁻¹fw under non stress conditions. Also, most of wheat varieties were superior in leaf proline content under stress conditions and both bread and durum varieties resembled similar responses. PEG experiment reflected the superiority of durum wheat varieties for all shoot and root traits included in the study. Also, all studied traits with the exception of root diameter were reduced as the stress by PEG8000 increased from 0% to 20%. Based on the obtained results, the proline accumulation can be utilized for wheat varieties; PEG test for wheat species screening programs as PEG test implied that durum varieties can be recommended for the areas with predicted drought stress

KEY WORDS: wheat, Polyethylene Glycol, stress, proline

INTRODUCTION

Wheat (*Triticum sp. L.*) is one of the oldest domesticated food crops; it's the most important economic crop in the world; used mainly for human consumption (65%), animal feed (21%), and industries (14%) and provides 20% of calories and proteins for humans needs (Reynolds *et al.*, 2012; Carena, 2009). Also it's along with maize and rice, underpin the world food supply, providing 44% of total edible dry matter and 40% of food crop energy consumed in developing countries (Buck *et al.*, 2007).

Abiotic stresses such as drought are the main causes for reducing average yields for the major worldwide crops by more than 50% (Ciarmiello *et al.*, 2011). Drought is an extended period of days, months or years when a region notes a deficiency in its water supply with respect to either surface or underground water. Usually, this occurs when a region receives consistently below average precipitation. Passioura (2006) emphasized the

importance of water in agriculture under drought prone environments by the statement 'more crop per drop' and demonstrated that crops that can't tolerate water shortage during their sensitive growth stages will not be productive. Therefore, studies with regards to genotypic drought resistance under different environments and including various plant organs may provide conclusive solutions.

Many physiological characters are affected under stress which consequently reflects on the final yield. Proline is an amino acid which is necessary for primary metabolism, accumulates in many crops in response to different abiotic stresses and plays a vital role in sustaining cellular function under stress conditions (Farooq *et al.*, 2012). Mohammadkhani and Heidari (2008) noted significant increases of proline in stressed maize crop and suggested that proline may play a role in minimizing the effect caused by dehydration. Blum (2011) stated that proline accumulates in leaves under stress conditions and that it plays a

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role in osmotic adjustment and increasing water uptake. An increased proline content in fresh leaves of wheat as a result of water stress also has been reported by Johari- Johari-Pireivatlou (2010), Ghaffari *et al.* (2011), Alaei *et al.* (2012), Bowne *et al.* (2012), and Chakraborty and Bhumika (2012).

Germinating of seeds in PEG solutions may give an overview and earlier predictions for resistant cultivars capacity based on some seedling physiological parameters. Craine *et al.* (2001) found a significant gradient for high root density among a broad range of grass species. Blum (2011) stated that plant roots are the primary sensors for stress attacks, and the uptake of minerals was maximum when water potential was near to field capacity (-0.3 bars); while when water increased in saturation (stress), the uptake of mineral decreased; this might be expected since oxygen which is limited in stress soils will be limited for metabolic energy and available only for nutrient uptakes that make plant growth also limited. In this respect, Sayar *et al.*, (2008) and Cseuz (2009) implemented different tests included polyethylene glycol (PEG) test and proline analysis for screening and evaluating bread wheat varieties to drought tolerance; their results revealed a significant correlation between results from laboratory tests and multi-location yield experiments.

Karamanos *et al.* (2008) stated in a comparison study of bread and durum wheat that durum had about 20% higher root surface area, higher water potential and less osmotic adjustment as compared to bread wheat varieties. Studies by Forgone (2009) and Raziuddin *et al.*, (2010) have shown that wheat genotypes had negative but variable response to PEG concentrations for some growth and yield characters, whereas PEG raised stress had positive impact on proline content in shoots. Accordingly, proline accumulation in stress can be used as a physiological indicator for wheat drought resistance. Ruta *et al.*, (2010) declared that PEG stress hamper the elongation of wheat roots. Also, Blum (2011) stated in an experiment of stress on wheat crop that the stress of PEG8000 solution (-0.5 MPa) reduced the seedling growth by 40% as compared to control unit. On the other hand, Ji *et al.*, (2014) demonstrated in a PEG tests that the stress induced wheat crop to produce apical root meristem and outgrowth of lateral root as a defense mechanism (tolerance) to cope the stress.

Phenotyping root architecture in the field is still a challenge, therefore sowing in small containers or hydroponics is helpful a quick determination of root traits of many genotypes (Gregory *et al.* 2009). Gupta *et al.* (2012) reviewed the evidences from many studies for a significant and positive correlation between root system size, length, and depth with wheat grain yield under drought conditions. Based on the previous review, this study was suggested to investigate the respond of different bread and durum wheat varieties in regards of leaf proline contents and some related seedling traits under water stress conditions.

MATERIALS AND METHODS

Wheat varieties:

Eight wheat varieties, *Triticum aestivum* (Abu-Ghraib-3, Adana-99, Al-Iraq, Al-Rashid, Aras, Bohouth-4, Cham-6, and IBA A-99) and two *Triticum durum* (Doma and Simeto) were cultivated in two different isohyets locations of Iraqi Kurdistan Region (Research Farm of Field Crops at the College of Agriculture, University of Duhok (longitudes 43.01° E, latitudes 36.847° N, and altitude 583 meter above sea level (masl) and Agricultural Research Station at Hawler Governorate (longitudes 44.32° E, latitudes 36.11° N, and altitude 420 masl), during the growing season 2013-2014. The first location considered normal condition as received (486.6 mm) and the second as a stress which received only (275.98 mm) annual rainfall. The trails were designed according RCBD with four replications.

Leaf Proline content (mg.g⁻¹fw):

Proline content in flag leaf was estimated according to Naqvi *et al.*, (2002) methods at heading stage in Duhok (non-stress) and Hawler (stress) locations as follows: 0.5 g fresh weight was chopped (grind) and placed in test tubes containing 10 ml of 0.5% aqueous Toluene and shaken by shaker for 60 minutes; the extract was filtered by #2 watman filter paper. The filtrate extract reacted with 2ml Acid-Ninhydrin (prepared by heating 1.25g Ninhydrin with 30ml of glacial acetic acid) and 2ml of glacial acetic acid added, then heated for 1 hour at 100 °C in water bath; the mixture then cold in ice bath, 4ml of Toluene added and mixed for 20 seconds. The upper phase (proline) separated by micropipette at room temperature; the absorbance read in Spectrophotometer at 520 nm using Toluene as

blank. The following equation was used for proline calculation:

$$Y = (Ab \times Kev. \times \text{dilution factor}) / (Wt. \times 100)$$

where:

Y= proline content Ab= absorption reading, Kev. = 0.998 (constant), and Wt. = sample weight

Germination and Seedling Growth in Polyethylene Glycol (PEG) Concentrations:

Germination in PEG8000 solutions (Sigma-Aldrich GmbH, Steinheim, Germany) was applied at the laboratories of University of Natural Resources and Life Science (BOKU), Austria, during 2013/14 via the methods of Ruta *et al.*, (2010) and Ji *et al.*, (2014) with minor modifications. The solution was prepared in two concentrations (10 and 20%) which were equivalent to -1.48 and -5.11 bars respectively according Michel (1983) equation. 100 and/or 200 grams of PEG8000 was dissolved in one liter of distilled water; stirred for 15 minutes using magnetic stirrer for homogenous mixing. Seeds of all varieties were surface sterilized with 1% ethanol for 3 minutes and 0.1% NaOCl for 15 minute, washed thoroughly with distilled water. The seeds pre-germinated in two layers of brown germination paper (A4-size); it sited in ventral while the embryo posited downward. The papers then saturated by distilled water and rolled (Cigar rolling); putted in baker (1000 ml) containing 200 ml distilled water, covered by black nylon and placed in a growth chamber at 22-25°C

After germination (5 days); 3 healthy seedlings with a primary root about 3-4 cm and shoot 1-2 cm long were transferred to another filter paper and saturated either with water (normal) or PEG8000 (stress) solutions and placed in growth chamber under 22-25 °C. All the papers were submerged daily twice in the basic solutions of PEG8000 (10 and 20%) or distilled water. After 4 days of full stress, the seeding were transferred to distilled water for three days and then returned to stress for another three days.

Root samples were scanned at resolution of 600 dpi and analyzed for measuring the root parameters such as root length, diameter, surface area and root volume by WinRHIZO software (Regent Instruments Inc., Québec City, Canada) as figured by Himmelbauer *et al.*, (2004). Also the shoot length, shoot and root dry weight was measured. The experiment was applied in six replications, arranged in RCBD and the data were analyzed using GenStat (2011) program. Least

significant differences (LSD) test at 0.05 level was used for the mean Comparisons.

RESULTS AND DISCUSSION

Leaf Proline content:

The ANOVA table for proline data analysis (table 1) showed significant differences for the each of locations ($F=0.005$), wheat varieties ($F=<.001$), and their interaction ($F=0.004$) was significant. The proline content significantly was higher under stress (Hawler location) (0.969) as compared to (0.919) mg.g⁻¹fw under non stress conditions (Duhok location). Regarding wheat varieties, Abu-Ghraib-3 variety significantly recorded higher proline content (1.005mg.g⁻¹fw), and each of IBA A-99 (1.034) and Doma (1.033) mg.g⁻¹fw comes after; while Cham-6 and Al-Iraq were inferior for giving lowest value of proline (0.877) and (0.888) mg.g⁻¹fw respectively (Table 2).

Figure (1) shows the interaction of wheat varieties and locations. Most of wheat varieties significantly recorded higher proline content under stress (Hawler location) than in normal conditions; Doma surpassed all wheat varieties with (1.080 mg.g⁻¹fw) at Hawler, also Al-Rashid variety was superior at Hawler (1.077) but inferior at Duhok location (0.825) for giving highest and lowest proline values. Likewise, Cham-6 variety at Duhok location significantly recorded lowest proline content (0.818 mg.g⁻¹fw).

It's observed from the results that the proline content in stress environments (Hawler location) was obviously higher than in non-stressed (Duhok location). Accumulation of proline in stress condition may related to the fact that it has a protective contribution in plants as it raises when the turgid pressure lost due to stress attacked (Baenziger *et al.* (2000) and Farooq *et al.* (2012). Also, increasing of proline in stress conditions is helpful for the water uptake improvement (Szabados and Arnould, 2009). On the other hand, the varieties which shows higher proline content under stress can be considered as a drought resistance and vice versus (Ghaffari *et al.*, 2011). Similarly, Mohammadkhani and Heidari (2008), Cseuz (2009), Johari-Pireivatlou (2010), Bowne *et al.*, (2012), Chakraborty and Bhumika (2012) and Alaei *et al.*, (2012) were reported increases of proline content for drought resistance wheat genotypes under unfavorable (stress) conditions. Accordingly it can be suggested that proline accumulation in water stress environments is

helpful for wheat varietal screening to drought resistance but not for wheat species, (Chandrasekar *et al.* (2000) also support these conclusions.

Table (1): Analysis of variation of wheat species, varieties and locations for field flag leaf proline content

S. O. V.	d.f.	M.S	F Prob.
LOC	1	0.049402	0.005
VAR	9	0.031741	<.001
LOC.VAR	9	0.017692	0.004
Residual	57	0.005654	-
Blocks	3	-	-

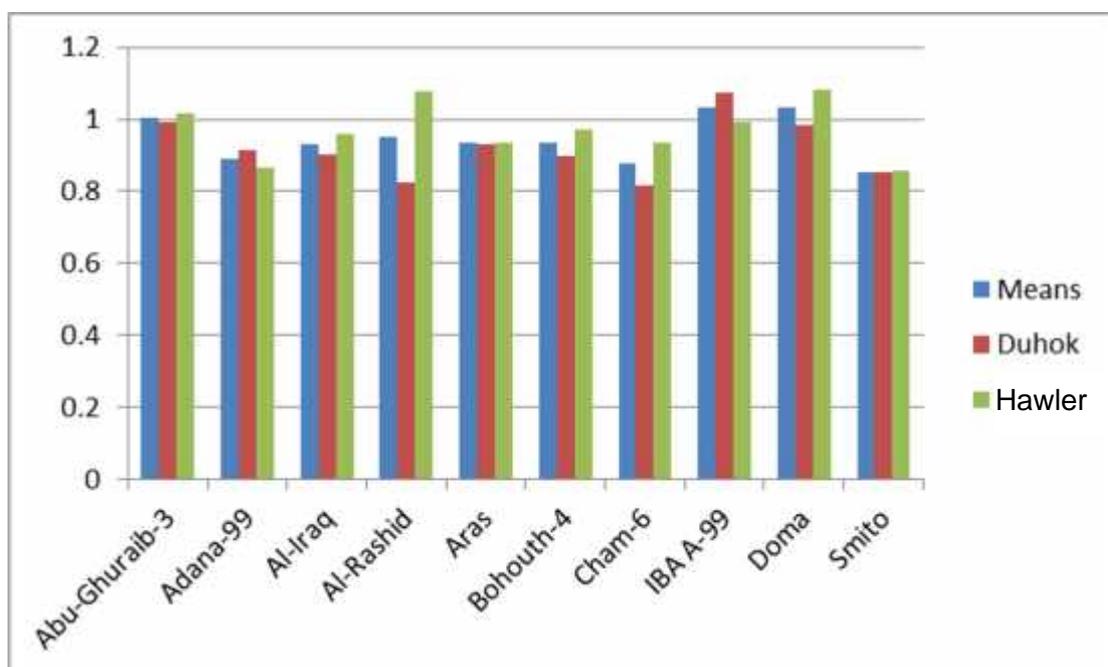


Fig (1): Interaction of locations and wheat varieties for leaf proline content

Table (2): means of locations, wheat varieties and their interactions for leaf proline content (mg.g⁻¹fw)

Wheat varieties	Leaf proline content (mg.g ⁻¹ fw)		
	Duhok	Hawler	Mean of varieties
Abu-Ghraib-3	0.992	1.018	1.005
Adana-99	0.913	0.864	0.888
Al-Iraq	0.904	0.959	0.932
Al-Rashid	0.825	1.077	0.951
Aras	0.932	0.935	0.933
Bohouth-4	0.896	0.971	0.933
Cham-6	0.818	0.935	0.877
IBA A-99	1.074	0.994	1.034

Doma	0.985	1.08	1.033
Simeto	0.853	0.858	0.855
Mean of locations	0.919	0.969	-

- LSD; LOC= 0.0337; VAR= 0.0753; LOC x VAR= 0.1066

PEG8000 experiment:

Tables (3 and 4) show the significant variations for polyethylene glycol (PEG8000) treatments in all wheat seedling measurements. Also, the wheat varieties effect was significant except for the number of root tips which was not significant ($F=0.100$). As for the PEG8000 treatment interactions with varieties; it was not significant for most traits excluding root diameter and volume.

Durum varieties (Doma and Simeto) significantly surpassed bread wheat varieties in almost all root studied traits except Bohouth-4, Aras and Adana-99 bread wheat in root diameter which were significantly not different with durum varieties, and the later (Aras) in number of root tips and root length. Also, all studied traits with the exception of root diameter were reduced as the stress by PEG8000 increased from 0% to 20%. Root diameter was higher in 10% (-1.48 bars) (0.352 mm) as compared to (0.331 mm) and (0.339 mm) for 0% (0 bar) and 20% (-5.11 bars) treatments respectively.

Wheat seedling responded differently to the stress induced by PEG8000 solution as physiological reaction which reflected thereafter on seedling shoots and root growth. Roots are the plant organ that act as a primary sensor for soil moisture deficit and send signs to other parts of plant to increase the water use efficiency (Blume 2011), and the interact of plant will also reflect on further shoot growth.

PEG8000 tests induced wheat crop to produce higher root meristem (diameter) as a defense mechanism (tolerance) to cope the stress (Ji *et al.*, 2014). On the other hand, Chandrasekar *et al.* (2000) referred to a fact that tetraploids wheat has better water use efficiency and stable membrane than hexploids wheat under stress environment which make it more resistance to stress. Likewise, these results are agreed with those of Karamanos *et al.* (2008) and Craine *et al.* (2001) in regards to the superiority of durum wheat on bread wheat varieties in stress conditions. Studying the root characteristics in fields is still a challenge. Therefore, root laboratories studies state as a

quick determination of root traits of many genotypes under various conditions which give an overview for the screening of well performance genotypes for drought stress environment; and in conclusion, this test is highly suggested for wheat species (bread and durum) screening and further laboratories along with field experiments are recommended to support and confirm the obtained gains. Also, the bread wheat varieties such as Aras which exhibited durums in some traits under stress can give a sign for the superiority of this variety for drought areas as compared to the others under this study which was the conclusion of a field studies implemented By Omer (2015) under different environments.

Table (3): Analysis of variance and mean values root traits in the PEG stress test

Source of variance	Probability of significance			
	RSURF ¹ (cm ²)	RDIAM (mm)	RVOLU (cm ³)	RTIPS (n)
PEG Treatment	<.0001	0.0002	<.0001	<.001
Varieties	<.0001	0.0126	<.0001	0.100
Treat. x Var.	0.286	0.029	0.024	0.450
Variety means				
Abu-Ghraib-3	7.29	0.335	0.0597	338
Adana-99	8.68	0.347	0.0747	315
Al-Iraq	7.91	0.334	0.0648	323
Al-Rashid	8.15	0.334	0.0663	353
Aras	9.09	0.343	0.0758	405
Bohouth-4	6.63	0.347	0.0566	283
Cham-6	7.05	0.342	0.0578	335
IBA A-99	7.27	0.324	0.0579	323
Doma	12.35	0.343	0.1055	397
Simeto	12.79	0.361	0.1151	425
LSD	1.825	0.018	0.0154	68.071
PEG Treatment means				
PEG 0%	13.71	0.331	0.115	710
PEG 10%	6.52	0.352	0.056	190
PEG 20%	5.92	0.339	0.049	148
LSD	0.999	0.0099	0.0084	37.274

¹ RSURF, root surface area; RDIAM, root diameter; RVOLU, root volume; RTIPS, root tips

Table (4): Analysis of variance and mean values of shoot and root traits in the PEG stress test

Source of variance	Probability of significance				
	SLGTH ¹ (cm)	RLGTH (cm)	SDWGHT (mg)	RDWGHT (mg)	S_R (%)
PEG Treatment	<.0001	<.0001	<.0001	<.0001	0.176
Varieties	0.0095	<.0001	<.0001	<.0001	0.708
Var. x Treat.	0.772	0.658	0.853	0.944	0.992
Variety means					
Abu-Ghraib-3	9.13	71.34	6.91	7.53	0.95
Adana-99	9.92	80.66	8.39	9.16	0.94
Al-Iraq	9.69	77.20	9.11	8.15	1.12
Al-Rashid	10.67	80.10	8.33	8.29	1.02
Aras	11.54	87.07	9.29	9.28	1.02
Bohouth-4	8.06	61.96	7.23	6.83	1.06
Cham-6	8.91	68.92	8.09	7.78	1.03
IBA A-99	9.67	72.80	7.50	7.42	1.02
Doma	12.43	115.30	11.64	11.85	0.98
Simeto	11.09	113.87	12.88	14.32	0.92
LSD	2.314	18.125	1.972	1.964	0.211
PEG Treatment means					
PEG 0%	13.43	131.24	10.66	11.23	0.965
PEG 10%	9.31	60.70	8.61	8.19	1.067
PEG 20%	7.81	56.83	7.55	7.32	0.983
LSD	1.267		1.080	1.076	0.116

¹ SLGTH, shoot length; RLGTH, root length; SDWGHT, shoot dry weight; RDWGHT, root dry weight; S_R, shoot to root ratio

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COMBINING ABILITY AND GENE ACTION FOR SOME TRAITS IN BREAD WHEAT USING LINE × TESTER

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ABSTRACT

Field experiments were carried out during 2011-2012 to study combining ability and gene action, to identify the best parents and crosses general and specific combining ability and evaluate F1 hybrid, by using seven genotype (Aras, Noor, Sham-6, Aiala, as line and Maxibak, Tamoz-2 and Adnanea as tester), 12 F1 hybrids evaluated at the research farm of the agriculture Duhok university. According to the results, the ratios of GCA:SCA variance were lower than one for all the traits except plant height and grains yield plant⁻¹. The additive gene actions were significant for all the traits except spike length, and hence the ratios of GCA/SCA variances for these characters were lower than one. The crosses Aras x Adnanea, Noor x Maxibak, and Noor x Adnanea and Sham-6xAdnanea might be considered as promising hybrid combinations in terms of most traits.

KEYWORDS: Wheat. Heterosis, line x tester, SCA, GCA.

INTRODUCTION

Wheat is unique as a "world food grain" because it contains a substance called gluten with physical and chemical properties which makes possible the production of a "risen" loaf of bread. The importance of gene action nature lies in the quantitative characteristics of economical importance like grain yield in wheat and its components while preparing a program for its breeding and its improving. Kaya, Y. (2005). There are many different cases in breeding methods which are depended by plant breeders in order to save time, labor and costs to achieve positive results, many authors applied different studies on this crop as well as others. Many genetic patterns were issued like those by Mather (1949); Hayman (1954); and Raawlings and Cockerham (1962) to test the effects of gene action on the quantitative characters by mean analysis of several self and crosses pollen crops like wheat, barley and rice. Fisher (1918) recorded resulted on partition the genetic variation in to additive effect, and dominant effect resulted from the effects of gene, line x tester analysis has widely been used for combining ability taste, suggested by Singh and Chaudhary (2000). Kempthorne (1957) reported that line x tester

analysis is an extension of top cross method in which several testers are used. Virupakshappa *et al.* (1997) Stated that two testers were enough efficiently to test GCA of inbred lines. High heterosis for yield and its components in wheat, being cross-pollinated crops has been reported by many previous researchers (Goksoy, and Turan (2004). Kan, & Sade. 2000 Khan *et al.*, 2004; Kaya, 2005). However, heterosis does not appear in all hybrid combinations of the F1 generation (Hladni *et al.*, 2007). Therefore to achieve the success in hybrid breeding is quite difficult and it takes some time. Hladni *et al.* (2007) reported that the occurrence of heterosis in wheat hybrids is highly correlated with genetic distance between the parental lines. The aim of this study was to estimate heterosis in twelve hybrids obtained from four lines and three tester, and to select parental lines having good combining abilities, and gene action control the grain yield and its components.

MATERIALS AND METHODS

Twelve hybrids developed by crossing 4 lines (Aras, Noor, Sham-6, Aiala) and three testers (Maxibak, Tamoz-2 and Adnanea) of wheat were used in this study cultivated in the research farm of the agriculture college, Duhok university

during season 2011-2012. The hybrids were obtained from 2011 plantings in the same field. Crossing was done as a line x tester method. A total of genotype (12 hybrids+7 parents) were planted according randomized complete block design with three replication. Each entry was planted in one row of 3 m length with a spacing of 60 cm between rows and 30 cm between plants. At maturities time five plants were selected randomly for each hybrids to study the following traits:- plant height cm, biological yield gm, No. of effected branches plant⁻¹, spike length, grains yield, Seed index, Harvest index, No.of grains spike⁻¹, No.of seed plant⁻¹. Analysis of variance for combining ability was done according to the line x tester method (Kempthorne, 1957), in

which estimates of GCA variances (²GCA) and SCA variances (²SCA) according to Singh and Chaudhary (2001). Heterosis was estimated as a F1 mean over its better parent. Means and heterotic effects were tested by the least significant differences (LSD) test at the 0.05 and 0.01 levels. The significance of GCA and SCA effects was determined at the 0.05 and 0.01 levels using the t-test.

RESULTS AND DISCUSSION

There were significant differences between genotypes for all traits (Table 1), this indicated to continue to genetic analysis for found it variance component.

Table (1): Analysis of variance for parents about line x tester by using R.C.B.D.

S.O.V.	df.	plant height(cm)	biological yield(g)	grains yield(g)	Seed index	Harvest index%	spike length (cm)	No. seed plant ⁻¹	No. grains Spike ⁻¹	No. effected branches
Rep.	2	5.54	2.14	2.64	1.91	9.03	0.52	1137.12	22.47	0.68
Genotypes	18	86.09**	46.54**	6.63**	57.56**	83.71**	5.51**	4698.09**	23.79**	3.05**
Parents	6	119.68**	20.99**	5.18**	43.16**	63.71**	7.54**	6399.42**	137.07**	3.38**
Crosses	11	75.58**	63.18**	6.65**	66.71**	87.26**	4.90**	18819.36**	397.43**	3.09**
Lines	3	18.98**	80.73**	13.12**	80.69**	13.12**	80.69**	77.31**	450.78**	2.58**
Tester	2	5.12	36.29**	10.0*	40.27**	89.43**	5.53**	22442.03**	137.65**	6.54**
Lines x Tester	6	5.01	30.78**	2.82*	35.28**	3.50*	4.82**	74.89**	408.96**	1.54**
Error	36	3.15	2.64	1.12	3.97	3.01	0.22	865.64	11.92	0.37
² GCA/ ² SCA		3.16	0.06	1.48	0.07	0.02	0.06	0.01	0.26	0.82

Similar result found between parents, crosses, lines, and tester excepted plant height (for tester), the result indicated that the variance between the genotypes and crosses, there was a chance for breeder for direct selection and to study the genetic variance and estimate. The variance between lines and testers means, the variance between line differ by using different tester. The result are in agreement with the findings of Chulam Hassan(2004).Joshi et al(2004).Javaid and Minhas(2001). Variances of "Lines x Tester" were not greater than variances for either lines or testers for any traits indicating the importance of additive. Line x tester interactions was highly significant for all traits except plant high and harvest. The ratio ²GCA/ ²SCA of GCA/SCA

variances for these characters were lower than one for all the traits except plant height and grains yield plant⁻¹. Thus non additive gene actions were more effective for all these characters. The same result were also obtained by Houshmand and Vanda (2008). The significant difference were maintained among inbred lines and their F1 hybrids regarding all the characters studied (Table 2&3), indicating the existence of genetic difference between the genotypes. The smallest average for plant height had [1x5] hybrid (53.27cm), and the tallest had Sham-6 (86.16cm). As regards biological yield, the lowest mean value had Aras (7.99 gm.) and the highest had [2x5] hybrid (15.80 gm.).

Table(2): The means of characters parents.

Parents	plant height (cm)	biological yield (gm)	grains yield (gm)	Seed index	Harvest index%	spike length (cm)	No. seed plant ⁻¹	No. grains spike ⁻¹	No. effected branches
1	56.93	7.99	2.77	33.63	34.70	5.17	82.33	36.00	2.32
2	71.50	12.50	3.97	26.82	31.79	4.46	149.33	32.00	4.67
3	86.16	14.85	5.09	32.08	30.23	7.40	159.33	43.67	3.67
4	77.23	16.14	6.62	28.27	40.96	8.83	235.33	44.33	5.33
5	55.33	10.81	3.40	27.49	31.34	6.06	123.33	37.33	3.33
6	66.53	12.45	4.56	33.18	36.41	7.53	138.33	51.67	2.67
7	61.60	12.24	3.26	23.44	26.84	5.16	142.33	35.67	7.00

Table (3): The means of characters hybrids.

Hybrids	plant height (cm)	biological yield (g)	grains yield (g)	Seed index	Harvest index	spike length (cm)	No. seed plant ⁻¹	No. grains Spike ⁻¹	No. effected branches
1x5	53.27	8.42	2.91	31.27	40.41	6.0	94.0	35.0	2.67
1x6	61.36	11.91	4.61	31.15	38.91	6.40	148.0	49.33	3.0
1x7	59.93	13.95	5.18	27.14	37.29	5.50	190.66	41.33	4.67
2x5	59.53	15.80	4.88	19.99	30.92	5.30	245.33	56.33	3.67
2x6	61.33	9.67	4.00	26.45	41.24	5.43	152.33	41.33	3.67
2x7	59.39	9.21	3.12	20.12	40.14	5.15	210.11	40.13	3.32
3x5	60.63	9.13	4.16	30.16	40.18	5.91	200.30	40.61	3.72
3x6	54.72	10.23	4.18	30.72	39.11	5.21	195.13	39.72	4.21
3x7	56.23	8.91	3.91	28.14	38.21	5.42	130.31	38.73	4.32
4x5	58.21	9.89	4.21	29.91	40.10	5.31	118.12	39.85	3.61
4x6	59.12	10.11	4.56	30.0	40.11	5.96	200.41	42.11	3.71
4x7	79.90	15.05	6.39	24.07	42.41	6.56	267.33	47.33	5.67

The smallest yield had Aras (2.77 gm) and [4x7] hybrid had the highest mean value for grains yield plant (6.39 gm). The smallest Seed index and Harvest index had [2x5] hybrid & Adnanea (19.99 & 26.84) and the highest had [1x5] & [1x6] hybrids (31.27 & 31.15) respectively. The parent Noor had smallest spike length (4.46 cm.) while the hybrid [4x7] had the highest (6.56 cm). The hybrid [1x5] had smallest No. of seed plant⁻¹ and No. of grains spike⁻¹, (94.0 & 35.0) and the hybrids had highest [4x7 & 2x5], (267.33 & 56.33). As regards No. of effected branches, the lowest mean value had Aras (2.32) and the highest had the parent Adnanea (7.0). From the following data we conclusion that the parent Andanea had highest No. of effected branches, for this we can use in feature breeding program. In regard of hybrids the hybrid [4x7] had highest biological

yield, spike length, No. of seed plant⁻¹. The results are in agreement with the findings of Al-layla & Askander (2011). Gorjanovic and Balaick (2005). Cifci and Ya di. (2007) Comparative analysis of the GCA effects of the parents is given in **(Tab.4)**. Female parent (5) had negative significant GCA effect for the plant height, while the parent [4] had positive and significant ,male parents [1,3] had positive and significant GCA effects for the same character. Male parent [2] had positive significant GCA effect for the biological yield while [1] showed significant and negative GCA effect while for the female only the parent [4] had positive significant GCA effect. For grains yield weight, all female and male parents gave highly significant positive GCA effect except [1&5] had negative GCA effect.

Table(4): General combining ability for agronomic traits for lines and testers.

Parents	plant height (cm)	biologic al yield (g)	grains yield (g)	Seed index	Harvest index	spike length (cm)	No. seed plant ⁻¹	No. grains Spike ⁻¹	No. effected branches
(L)1	9.02	-2.15	-0.73	0.87	2.60	-0.50	-24.94	-2.72	-0.34
(L)2	1.77	3.04	0.59	-3.65	-0.71	-0.20	59.72	9.27	0.57
(L)3	7.42	0.35	1.32	0.79	2.00	0.64	7.22	1.10	-0.01
(L)4	6.45	2.56	1.07	-3.83	3.74	0.89	0.82	6.30	1.04
S.E(^ σ _{gi} -^ σ _{gj})	2.13	1.45	0.46	0.67	1.9	0.41	24.95	2.31	0.32
(T)5	-5.75	-1.21	-1.18	0.24	-3.71	-0.77	-24.52	-2.81	-0.39
(T)6	0.06	-1.38	0.82	0.53	1.09	0.35	22.19	2.41	-0.84
(T)7	-0.53	1.68	0.86	0.40	4.07	-0.57	20.85	4.30	0.49
S.E(^ σ _{gi} -^ σ _{gj})	2.11	1.03	0.34	0.58	2.12	0.32	24.15	2.14	0.28

Significant positive GCA effects for seed index were obtained from male parents [1&3] whereas [2] showed negative significant GCA effect. Only female [4]. [4&7] had the same result, but [4] had opposite result. We can notice for the spike length, No. of effected branches and grains/spike traits the same results, they had Significant positive GCA effects for male [2&3] and negative significant for [1] and [5] female, whereas for the parents [4&6 and 7] had Significant positive. For No. of seed plant⁻¹ only the male [2] had Significant positive GCA effects while the for female [5] had negative significant. In previous studies, highly negative GCA effects for plant height were found by Al-layla and Askandar (2011). In addition, Dagüstü (2008) found that some parent lines had positively or negatively significant GCA effects for 1000 seed weight and seed yield. Our findings were similar to results of researchers given above. Data on the SCA effects of experimental hybrids for all the traits observed are illustrated in (Table 5) significant positive

SCA effective were obtained in eight crosses for plant height & seed index. Five in crosses for biological yield and No. of grains/spike, four crosses for grains yield & Harvest index and six in crosses for spike length, No. of effected branches and No. of seed plant⁻¹. However highly significant negative SCA effects were obtained in five crosses for plant height & No. of seed plant⁻¹ and Seven in crosses for biological yield and eight in crosses for grains yield & harvest index and four in crosses for seed index and Six in crosses for spike length & No. of effected branches & No. of grains spike⁻¹ and No. of seed plant⁻¹.

However, the previous crosses showed high positive SCA effects for yield and its components and high negative values for biological yield could be exploited in wheat breeding programs. The result are agreement with the findings of Singh *et al.*(2003) and Farshadfar *et al.* (2000) and Esmal (2007).

Table (5): Estimation specific combining ability for crosses by using Line x Testers.

Hybrids	plant height (cm)	Biological yield (g)	grains yield (g)	Seed index	Harvest index%	spike length (cm)	No. seed plant ⁻¹	No. grains spike ⁻¹	No. effected branches
1x5	-4.09	-3.88	-1.24	1.28	-0.50	-1.29	-76.05	-6.72	-0.88
1x6	0.05	-1.36	-0.09	2.02	0.28	0.93	-27.72	-3.94	-0.43
1x7	2.32	2.30	-0.38	1.62	-0.19	0.21	23.94	5.17	0.34
2x5	1.49	1.28	0.14	-2.25	-4.73	0.23	23.83	-4.72	0.67
2x6	0.25	-3.68	-0.19	3.42	3.98	-0.46	-45.72	-12.72	0.20
2x7	-4.48	0.83	0.55	-4.72	-0.06	-0.06	38.94	5.39	-0.31
3x5	0.42	3.41	-1.25	-3.09	-8.05	1.05	23.27	6.83	0.09
3x6	0.16	-2.21	-0.68	7.04	-1.05	-0.42	-72.5	-9.72	-0.90
3x7	0.25	6.32	0.25	4.61	-7.37	1.82	79.77	11.77	0.45
4x5	4.26	-0.71	-1.64	3.67	-4.11	-0.80	-53.22	-9.11	-0.10
4x6	-2.92	-6.95	0.46	3.47	4.34	-1.19	-89.22	-19.66	-0.65
4x7	-1.82	-0.31	-0.64	-2.79	1.95	0.26	37.66	6.78	0.01
S.E(sij-yij)	0.12	0.30	0.13	1.22	0.22	0.72	23.21	3.52	0.30

(Tab. 6) Significant positive heterosis values were recorded in tow hybrid for plant height (3x6 and 4x6), and three hybrids for biological yield (1x7, 2x6 and 4x6), and four crosses for grain yield (1x7, 2x7, 3x6 and 3x7), but one cross showed significant positive heterosis for seed index (2x7), While for harvest index % there were three hybrids showed significant positive heterosis (2x7, 3x6 and 3x7) and five crosses for

No .seed plants⁻¹ & No. grains spike⁻¹ (1x7, 2x5, 2x6, 3x7, and 4x6) and two crosses for No. effected branches plant⁻¹ (3x5 and 3x7), While the heterosis values ranged between significant negative value and not significant for other hybrids. The result are agreement with the findings of Singh *et al.* (2003). Significant heterosis values were observed for all experimental hybrids. Ghulam, Hassan. (2004).

Table (6): Heterosis values for the studied characters.

Heterosis	plant height (cm)	Biological yield (g)	grains yield (g)	Seed index	Harvest index%	spike length (cm)	No. seed Plant ⁻¹	No. grains spike ⁻¹	No. effected branches
1x5	-3.66	-2.39	-0.49	-2.36	-0.11	-0.06	-29.33	-2.33	-0.66
1x6	-5.17*	-0.54	0.05	-2.48	2.5	-1.13	9.67	-2.31	0.33
1x7	-1.67	10.69**	1.78*	-6.49*	2.59	0.33	48.33*	5.33*	-2.33**
2x5	-11.97**	3.30	0.91	-8.28*	0.87	0.76	96.0**	19.0**	-0.67
2x6	-1.24	5.7*	0.51	-11.27**	-8.98**	0.93	82.67*	11.33*	-0.67
2x7	-2.1	3.15	1.71*	5.09*	5.92*	-0.03	29.67	10.66	-1.67**
3x5	-12.23**	-3.28	-1.68	1.78	-1.76	-2.0*	-58.66*	-10.0	2.34**
3x6	13.6**	0.3	2.96**	-0.25	6.44*	-1.4	-92.33**	-23.34**	1.00
3x7	-13.1**	2.62	1.37*	-5.55*	13.2**	-0.73	46.34*	13.0*	2.67**
4x5	2.67	-1.09	-0.23	-4.2	1.45	-2.27*	32.0	3.00	0.34
4x6	4.9*	6.24*	0.94	-9.7**	-7.26**	0.87	105.0**	19.34**	-2.0**
4x7	-15.97**	-6.47*	-2.62**	-7.18*	0.28	-3.4**	-43.0	-3.0	-1.66**

** , * Significant at 1% and 5% respectively

. Mahajan and Nagarajan (2005). Similar results have been reported earlier by Khan *et al.* (2004) and Kaya (2005).

(Table 7) The value of average degree of dominance was more than one for all traits except plant height and grains yield indicating the absence of additive for this traits. High narrow and broad heritability estimates were recorded for plant height, grains yield, No. of effected branches. Heritability in broad sense which estimated from the genetic proportion (additive, dominant and interaction) to the total phenotypic variation while Heritability in narrow sense estimate only the additive proportion. The result is in agreement with the finding of Tawfiq (2004).

Table (8) appears the estimation of genetic components (²A. additive, ²D. dominant & ²E. environment) for all characters. We notice that ²D greater than ²A for biological yield, seed index, harvest index, spike length, No. of grains spike⁻¹ & No. of seed plant⁻¹, where ²A greater than ²D for plant height, grains yield & No. of effected branches traits. Such variation in heritability was also reported by Singh *et al.* (2003).

Table(7): Estimation average degree of dominance, Heritability in broad and narrow sense for studied traits.

Genetic parameters	plant height (cm)	Biological yield (g)	grains yield (g)	Seed index	Harvest index%	spike length (cm)	No. seed Plant	No. grains Spike	No. effected branches
a	0.55	3.89	0.82	3.72	6.46	10.09	2.88	2.68	1.10
%H _{B,S}	98.96	96.69	85.71	95.39	96.28	95.70	95.38	98.24	89.56
%H _{N,S}	85.47	11.28	64.09	12.06	4.39	1.34	18.56	21.38	55.56

Table (8). Components of genetic variance for all studied traits.

Variance	plant height (cm)	Biological yield (g)	grains yield (g)	Seed index	Harvest index%	spike length (cm)	No. seed plant ⁻¹	No. grains spike ⁻¹	No. effected branches
σ^2A	86.30	3.00	1.66	3.44	1.37	0.03	1213.89	46.10	0.64
σ^2D	13.63	22.71	0.56	23.77	28.64	1.53	5036.4	165.68	0.39
σ^2E	1.04	0.88	0.37	1.32	1.16	0.07	288.55	3.79	0.12
σ^2P	100.97	26.59	2.59	28.53	31.17	1.63	6538.85	215.57	1.15

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ESTIMATION OF HOMEOSTASIS AND GENETIC RESULTANT FOR MAZIE (*Zea mays* L.) HYBRIDS

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ABSTRACT

The study was conducted in three locations Erbil, Sulaimani and Kalar, during fall season 2015 to estimate the homeostasis and genetic resultant at each location. The experimental materials to compare eight hybrids, the experiment was laid out in randomized complete block design (RCBD) with three replications. Data was recorded to 50% tasselling date, plant and ear height, ear length, ear/plant, 300 kernel weight and yield. The results showed significant differences among characters at each location and among (genotype x environment) interaction for yield characters. Hybrid 4 showed the higher yield. The homeostasis and genetic resultant varied for the characters, the characters 50% tasseling, plant and ear height, ear length showed high homeostasis and genetic resultant, while the yield and 300 kernel weight show low homeostasis and genetic resultant, because of environmental interaction.

KEY WORDS: Maize, Homeostasis, Genetic resultant, stability.

INTRODUCTION

The aim of breeders is to develop hybrids with high yielding ability and high stability. The performance of hybrids is affected by environment (Nrayan and Verm, 2007). Worku (2001) reported that maize genotypes had different response to environment conditions. The yield was more affected by environmental conditions than other characters (Sharma, 1987). The stability of quantitative characters depending on genotype x environment interaction, therefore the phenotypic characters (P) are a result of two factors the genotype and environment and their interaction $P=G+E+GE$ (El-Sahookie, 1990). The main factor effect on selection response is (Genotype x Environment) (Baker, 1988). Daicf (2001) found significant differences among environment and the interaction of (Genotype x Environment) for grain yield and other characters in maize. The stability and adaptation estimation for genotypes in different environment is important for recommendation variety to planting in specific environment. Jockovic *et al.* (1995) confirmed the possibility of developing maize hybrid with high yield and a good stability. Valdivia-Bernal &

Hallauer (1991) found that the new inbred lines are more adapted than old one, and the genetic homeostasis is inherited from inbred lines to F₁, F₂ and Bc for most studied characters. Babic *et al.* (2006) evaluated 15 hybrids in two years at six locations and the results showed the early hybrids had better response for new environment. While (Worku *et al.*, 2001) found that most genotypes had significant deviation and were not stable.

The aims of this study to evaluate the performance of hybrid and estimate the homeostasis and genetic resultant for hybrid characters at three different locations.

MATERIALS & METHODS

Study was conducted during fall season 2015 at three different locations (Erbil, Sulaimani and Kalar) (6) hybrids developed from diallel cross at winter season 2014 and two commercial hybrids were used to control in this study.

The hybrids were planted in July 19, 25 and 26 at Kala, Sulaimani and Erbil respectively using (R.C.B.D) design with three replications. Each hybrid was planted in a row 3 meters long, 75 cm apart and 25 cm between plants. NPK (27,

27, and 27) fertilizer was applied at planting date and 200kg/ha urea as second dose was applied after 45 days from planting.

Data were recorded from five plants for the days to tasseling 50%, plant and ear height, ear length, ear/plant, 300kernel weight and yield. The data were subjected to analysis of variance (ANOVA) using excel programme all characters at each location. Analysis of (Genotype x Environment) interaction were applied for grain yield only. To study the stability using the following formula.

$$H\% = 1 - \left(\frac{S}{\bar{X}} \right) \quad (\text{El-Sabeh, 1985})$$

H= Homeostasis

$$S = \sqrt{\frac{\sum_{i=1}^n x_i^2 - \frac{(\sum_{i=1}^n x_i)^2}{n}}{n-1}}$$

When:

S= mean of genotype deviation at seasons or environments

x_i = Mean of the character for the genotype at each location

\bar{X} = Mean of the character for the genotype at all location

G.R = genetic resultant

$$G.R = H \% \times \frac{\text{mean of cultivar}}{\text{mean of all cultivar}}$$

RESULTS AND DISCUSSION

Table (1) showed the result at Erbil location hybrid (8) gave higher plant height and yield (178.3cm and 6.84 ton/ha) respectively. Hybrid (2) recorded 54 days to flowering and had superior ear length and ear/plant 18.1cm and 1.6 respectively. The highest weight of 300 kernel weight was recorded by hybrid (7).

Table (1): The mean of studied characters in Erbil.

Genotype	Plant height	Ear height	Ear length	Ear / plant	50% tasselling	300 kernel /weight	Yield ton/ha
1	162.1	78.2	15.7	1.6	52.0	101.6	4.93
2	146.9	62.9	18.1	1.6	54.6	92.9	4.62
3	150.9	54.3	13.4	1.0	52.6	94.1	2.61
4	162.0	79.9	16.6	1.2	51.6	97.2	6.80
5	171.8	90.9	15.2	1.0	49	95.1	4.44
6	169.4	89.5	15.2	1.0	50	83.4	6.56
7	156.2	77.4	14.5	1.0	49	103.8	4.55
8	178.3	77.7	16.1	1.0	51	102.9	6.84
M.G	162.2	76.3	15.6	1.17	51.2	96.4	5.17
L.S.D _{0.01}	25.336	15.018	3.103	0.496	4.908	24.419	2.129
L.S.D _{0.05}	18.255	10.821	2.235	0.357	3.536	17.595	1.53

At Sulaimani location table (2) produced hybrid (1) had higher plant height 186.6cm and hybrid (2) showed superior yield, ear/plant and later tasselling and the value were 9.8 ton/ha,

1.8, 61.3 days to tasselling respectively. The higher 300 kernel weight was recorded by hybrid (3). While hybrid (7) had lowest ear length 20.9cm.

Table (2): The mean of studied characters in Sulaimani.

Genotype	Plant height	Ear height	Ear length	Ear / plant	50% tasselling	300 kernel /weight	Yield ton/ha
1	186.6	78.2	20.7	1.0	54.0	75.2	5.9
2	173.6	62.9	20.5	1.8	61.3	73.7	9.8
3	164.3	54.3	19.5	1.0	53.6	81.2	7.4
4	169.3	79.9	20.8	1.3	60.6	56.1	6.8
5	152.3	90.9	15.8	1.0	55.6	58.2	5.8
6	139.3	89.5	17.7	1.0	56.3	47.5	3.7
7	146.0	77.4	20.9	1.0	60.3	71.6	7.2
8	164.6	77.7	18.3	1.3	58.6	47.5	3.1
M.G	162.0	73.79	19.3	1.19	57.5	63.9	6.260
L.S.D _{0.01}	1.789	1.313	1.120	0.154	1.500	8.241	3.055
L.S.D _{0.05}	1.289	0.946	0.807	0.111	1.080	5.938	2.201

Table (3) showed the result at Kalar location, hybrid (6) showed the highest plant and ear height 184.6, 91.1 cm. the dominance ear length found in

hybrid (7) and it was 22.6cm. The hybrid (5) was produced the highest yield 3 ton/ha.

Table (3): The mean of studied characters in Kalar.

Genotype	Plant height	Ear height	Ear length	Ear / plant	50% tasselling	300 kernel /weight	Yield ton/ha
1	160.3	71.0	21.1	1.8	55.6	82.9	1.6
2	151.0	58.1	20.8	2.3	56.0	80.3	1.7
3	144.5	38.0	17.6	1.6	56.0	84.5	1.1
4	171.3	73.6	19.3	1.4	56.0	85.8	2.5
5	175.6	77.2	16.4	1.8	51.3	79.5	3.0
6	184.6	91.1	18.8	1.3	56.0	61.7	2.7
7	163.6	68.7	22.6	1.6	56.6	91.9	1.9
8	170.6	62.5	19.7	2.7	56.3	72.9	1.8
M.G	165.1	67.5	19.5	1.8	55.5	81.2	2.0
L.S.D _{0.01}	27.274	21.864	4.109	2.061	2.671	36.174	3.055
L.S.D _{0.05}	19.652	15.754	2.960	1.485	1.925	26.064	2.201

Table (4) revealed that a significant differences among hybrids for yield characters in Erbil location the hybrids (8) and (4) had higher yield 6.843 and 6.807 ton/ha respectively. In Sulaimani location hybrid (2) showed was superior in yield 9.833 ton/ha while in Kalar location the hybrid (5) gave the highest yield 3.0 ton/ha.

Combined analysis for yield at three location showed significant differences among Kalar location and both Sulaimani and Erbil location. Kalar location shown low yield comparing to other locations, because of high temperature and low humidity at flowering time caused low pollination and consequently lead to reduce seed setting in the ear. The hybrid (2) and (5) shown higher yield across three locations. The character differences among the genotypes were studied by many researchers, (Yousif, 2001; Daief, 2001; Delemy,2003 and Baktash, 2005) as well as the

differences among location as a results of (Genotype x Environment) interaction was confirmed by (Sadalla *etal*,1997; Narayan 2007 and Satyanarayana *etal*, 2009).

Homeostasis and genetic resultant.

According to El- Sahookie (1985) the homeostasis lowers than 85% mean that the variety is not stabile across environments. The genotypic resultant close to unite 0.90-0.99 means the variety is highly yielding and stability.

The estimation of homeostasis and genetic resultant (table 5). Most of the characters the days to 50% tasseling, plant height and ear length had more stable and high genetic resultant, its mean these characters les effect by the environment, while most hybrids had low homeostasis and genetic resultant for yield characters and 300 kernel weight. This result was confirmed by Sharma, (1987).

Table (4): Combined analysis for three locations for yield characters.

Yield	Erbil	Sulaimani	Kalar	main
1	4.943	5.933	1.637	4.17
2	4.623	9.833	1.787	5.41
3	2.613	7.400	1.103	3.70
4	6.807	6.867	2.537	5.4
5	4.447	5.800	3.023	4.35
6	6.560	3.733	2.780	4.35
7	4.550	7.267	1.997	4.60
8	6.843	3.167	1.813	3.94
M.G	5.173	6.250	2.085	4.50
LSD _{0.05}	1.435	0.775	1.597	1.491

Table (5): Estimation of homeostasis and genetic resultant for maize hybrids at three locations.

Genotype	50% tasseling		Plant height/ cm		Ear height /cm		Ear/plant		Ear length/cm		300 kernel weight		Yield ton/ha	
	H	G.R	H	G.R	H	G.R	H	G.R	H	G.R	H	G.R	H	G.R
1	0.971	0.95	0.914	0.939	0.94	0.94	0.66	0.72	0.84	0.89	0.85	0.93	0.46	0.42
2	0.885	0.92	0.855	0.893	0.82	0.79	0.82	1.16	0.93	1.01	0.89	0.91	0.85	0.30
3	0.861	0.84	0.934	0.866	0.73	0.53	0.72	0.64	0.82	0.76	0.92	0.99	0.12	0.09
4	0.908	0.93	0.971	0.985	0.94	0.99	0.99	0.97	0.89	0.92	0.73	0.72	0.44	0.52
5	0.929	0.892	0.926	0.933	0.81	0.91	0.85	0.70	0.97	0.85	0.76	0.73	0.69	0.68
6	0.932	0.91	0.776	0.773	0.84	0.95	0.85	0.70	0.90	0.95	0.72	0.57	0.55	0.50
7	0.893	0.903	0.943	0.887	0.93	0.94	0.72	0.64	0.78	0.83	0.82	0.90	0.44	0.44
8	0.920	0.925	0.727	0.754	0.89	0.86	0.64	0.68	0.90	0.90	0.63	0.58	0.34	0.29

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HALF DIALLEL CROSSES IN CORN (*Zea mays* L.) TO ESTIMATE SOME GENETIC PARAMETERS

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ABSTRACT

Half diallel crosses involved 5 inbred lines of maize to estimate some genetic parameters of F1 hybrids and parents. The experiment was conducted at Grdarash Research Station in Collage of Agriculture/ Erbil. In fall season 2014 half diallel crosses among inbred lines were done 10 hybrids were obtained with 5 parents were planted in yield trail in R.C.B.D with three replication. The results showed highly significant differences among genotypes for most characters. The ratio of 2 GCA/ SCA was less than one for number of days to 50% tasseling, plant and ear height, ear length, 300 kernel weight and yield ton/ha. The average degree of dominance was more than one indicated the important of non-additive genes action in the inheritance these characters. Heritability in broad sense ranged from 0.404 for 300 kernels weight to 0.84 for ear length. While narrow sense heritability was very low for all characters indicate the hybridization method suitable to improve these characters.

KEYWORDS: Diallel cross, General and Specific Combining ability, Heritability.

INTRODUCTION

Diallel cross define by Hyman (1954) as all possible crosses among number of parents to estimated. The ability of inbred line to transmit its characters to the hybrids progeny known as combining ability (Chawdery *etal*, 1998). Since (Green, 1948) found that the combining ability is inherited characters and can be used to develop highly yielding varieties and inbred lines. Ünay *etal*. (2004) reported the effect of G.C.A and S.C.A were difference significantly according to the parents and grain yield under dominant gen effect. The evaluation of many inbred lines using diallel cross (Zivanovic, 2005) found there were significant differences for G.C.A and S.C.A. Alam *etal*, (2008) observed the variance of G.C.A and S.C.A were significant for all characters except ear height; also Abdel-Moneam (2009) found that G.C.A and S.C.A were significant for all characters. Mostafavi *etal*, (2008) in their results obtained the characters, No of row/ear and 1000 kernel weight were controlled by additive genes and Mohamad, (2008) resulted that grain yield, plant height, grain/row and grain/ear controlled by non-additive genes. The additive genes had greater role in No grain/row while No row/ear and yield affected by non-additive gene (Bocanski *etal*, 2010). Dawood and Ali, (2009) confirmed that the additive gene effect was very important in the

heritability of plant height, ear length and 1000 kernel weight, and non-additive gene was important for ear height, No ear/plant, row/plant and grain yield heritability among characters was found by Shakoor, (2007) it was (29.6, 39.4, 45.7, 49, 78.1)% for the characters plant and ear height, No days for tasseling and silking (50%) and grain yield/plant respectively.

MATERIALS AND METHODS

During fall season 2014 half diallel cross were done among five inbred lines according to (Griffing, 1956), ten (10) hybrids and five parents were planted at Qerda-rash Research Station during fall season 2015 using Randomize Complete Block Design (RCBD) with three replications. Each replication consists of 15 treatments (10 hybrids + 5 parents). Data were recorded for from five plants the characters, No days to 50% tasseling, plant and ear height, ear length, 300 kernel weight and yield.

The analysis of general and specific combining abilities effect according to Griffing (1956) method 2, model 1:

RESULT AND DISCUSSION

Days to 50% tasseling

Table (1) shown the effect G.C.A parents and S.C.A effect of hybrids. Parent 4, gave the maximum positive value of (\bar{g}_{ii}) (1.257) indicate the high contribution of this parent in the inheritance if this characters to its hybrid to

increase the require days to tasseling while parent 2, gave negative value of ($\hat{\sigma}_{ij}^2$) indicate its contribution in reducing number of days to tasseling. Estimation of ($\hat{\sigma}_{ij}$) most crosses had a negative effect ranging from -0.48 to -2.48 for the hybrids 4×1 and 2×1 respectively, while caused an reduce in number of days to tasseling. Hybrid 3×2 gave maximum positive value (3.19) indicate the delay in tasseling date, most parent

gave negative value of σ^2 G.C.A effect, ratifying the large contribution of these parents to transfer this character to its hybrids while the high positive value of σ^2 SCA effect was found for all parents, its mean contribution of all parent in transferring this character to one or a few hybrids.

Table (1): Estimation general and specific combining abilities effect their variances for a days to 50% tasseling.

	$\hat{\sigma}_{ij}$				$\hat{\sigma}_{ii}$	$^2\hat{\sigma}_{ii}$	$^2\hat{\sigma}_{ij}$
	4	3	2	1			
5	0.10	-1.67	-1.57	-1.33	0.114	-1.081	1.968
4		0.19	-1.05	-0.48	1.257	0.487	3.188
3			3.19	-1.90	0.019	-1.094	12.063
2				-2.48	-1.076	0.064	7.206
1					-0.314	-0.995	9.00
S.E		5.469			0.912		

Plant height (cm)

Most parents shown positive value of ($\hat{\sigma}_{ii}$), (table 2) parent 3, gave maximum positive value (2.446) indicate the high contribution of this parent in the inheritance of this character to its hybrid. Parent 1, gave high negative value of $\hat{\sigma}_{ii}$ (-3.864) indicate the contribution of this parent to reduce this character in its hybrid. The hybrids (5×1), (4×1) and (5×2) gave high positive value of $\hat{\sigma}_{ij}$, it were 21.41, 18.04 and 15.06 respectively. This confirm the high ability of these hybrids in the increasing of plant height. The negative value of $\hat{\sigma}_{ij}$ obtained in the hybrids (5×4) (3×2) and

(2×1) with value (-8.23, -5.65 and -6.77) respectively indicate reduce in the plant height in these hybrids. Estimation of the variance of GCA $^2\hat{\sigma}_{ii}$ affect all parents shoed negative value, while express the contribution of these parents in the reduction in plant height character in some of its hybrids. The highest value of 2 SCA effect was 727.505 for parent 1, pointing out the contribution of this parent in transferring this trait to one or few number of its hybrids similar result was recorded previously by (Mostafavi etal, 2008; Dawood and Ali, 2009).

Table (2): Estimation general and specific combining abilities effect their variances for plant height.

	$\hat{\sigma}_{ij}$				$\hat{\sigma}_{ii}$	$^2\hat{\sigma}_{ii}$	$^2\hat{\sigma}_{ij}$
	4	3	2	1			
5	-8.23	12.09	15.06	21.41	-3.864	-9.878	380.115
4		11.16	8.16	18.04	1.003	-23.801	480.926
3			-5.65	1.10	2.446	-18.825	200.621
2				-6.77	0.050	-24.804	222.994
1					0.63	-24.674	727.505
S.E		124			20.67		

Ear height (cm)

Table (3) represented the estimation of $\hat{\mu}_{ij}$, $\hat{\sigma}_{ij}$ and their variance. Parent 1, showed the highest positive effect of $\hat{\mu}_{ij}$ which was 0.648. This clearly indicated a high contribution of these parent to increase this trait in its hybrids, while the parent 3, showed a negative effect of $\hat{\mu}_{ij}$ (-3.637) indicating that this parent contribution to reduce this trait. Most hybrids showed positive effect $\hat{\sigma}_{ij}$.

The highest positive variance of GCA effect was (10.268) and other parents showed negative variance effect of $\hat{\mu}_{ij}$. The highest value of ^2SCA variance was 368.530 for parent 3, revealed that contribution of parent in transferring this trait to one or few numbers of its hybrids. This result in agree with (AL-Janaby, 2003).

Table (3): Estimation general and specific combining abilities effect their variances for ear height.

	$\hat{\sigma}_{ij}$				$\hat{\mu}_{ij}$	$^2\hat{\mu}_{ij}$	$^2\hat{\sigma}_{ij}$
	4	3	2	1			
5	1.22	13.02	12.21	6.22	0.601	-31.201	201.930
4		13.19	-3.52	4.45	-1.337	-29.774	76.222
3			12.45	0.79	-3.637	-18.333	368.530
2				-2.62	-2.094	-27.176	185.577
1					0.648	10.268	-65.537
S.E		157.8			26.3		

Ear length (cm)

Table (4) showed the $\hat{\mu}_{ij}$ effect revealed that parent 3, had highest positive effect which was 1.807 its mean the high contribution of this parent to increase ear length in this hybrid. The $\hat{\sigma}_{ij}$ effect confirmed that the hybrid (5×1) (4×1) and (3×1) had highest positive value 4.21, 4.0 and 2.27 respectively. Revealed that ability of these hybrids

to increase this trait. The highest variance of GCA effect was 3.553 in parent 5, which significant the large contribution of parent in transferring this trait to its hybrids, while the highest negative effect of $^2\hat{\sigma}_{ij}$ was -0.934 in parent means the contribution of this parent to transferring this trait to most of its hybrid was high.

Table (4): Estimation general and specific combining abilities effect their variances for ear length.

	$\hat{\sigma}_{ij}$				$\hat{\mu}_{ij}$	$^2\hat{\mu}_{ij}$	$^2\hat{\sigma}_{ij}$
	4	3	2	1			
5	-1.70	0.95	0.03	4.21	-2.133	3.553	12.166
4		1.21	1.89	4.00	-1.522	1.321	19.751
3			-2.05	2.27	1.807	2.269	7.550
2				1.21	1.599	1.559	12.866
1					0.250	-0.934	36.138
S.E		4.931			0.83		

300 kernel weight (g)

Table (5) the parent 3, gave height $\hat{\mu}_{ij}$ effect which was 2.19. The $\hat{\sigma}_{ij}$ effect showed that most hybrids had positive value. The hybrids (2×1) (5×2) and (4×2) which was 2.97, 2.30 and 2.22 respectively. Confirm the high ability of these hybrids to increase the trait the highest variance of $^2\hat{\mu}_{ij}$ effect was 2.558 in parent 2, and highest

variance of GCA was -3.948 in parents 2. All parent showed high negative variance of $^2\hat{\sigma}_{ij}$ means the contribution of this parent to transferring this trait to most of its hybrid was high.

Table (5): Estimation general and specific combining abilities effect their variances for 300 kernel weight.

	\hat{s}_{ij}				\hat{g}_{ii}	$^2_{g_{ii}}$	$^2_{s_{ij}}$
	4	3	2	1			
5	1.54	1.94	2.30	-0.50	-0.642	-3.721	-6.806
4		-2.93	2.22	0.46	-2.587	2.558	-1.049
3			1.14	1.78	2.190	0.661	-0.288
2				2.97	0.430	-3.948	-2.552
1					0.609	-3.763	-4.745
S.E		20.665			3.442		

Grain yield (ton/ha)

Table (6) represented the estimation of \hat{g}_{ii} and \hat{s}_{ij} the parent 3 and 2 exhibited positive effect of \hat{g}_{ii} which was 0.655 and 0.338. This clearly indicated a high contribution of these parents to increase the yield, while parent 4 and 1 showed negative effect of \hat{g}_{ii} indicating that these parents contributed to reduce the yield in their hybrids. Estimation of \hat{s}_{ij} revealed that most diallel hybrids have positive effect, which restricted between 1.57

to 3.64. This positive effect of \hat{s}_{ij} in most hybrids caused an increase grain yield, while negative effect caused decrease in the grain yield. All parents showed negative effect of GCA variance indicating that this parent contributed in the reduction of the value of these characters in some of its hybrids. The highest value of SCA effect variance was 30.713 for parent 2, express the ability of these parent in transferring this character to one or a few number of its hybrids.

Table (6): Estimation general and specific combining abilities effect their variances for yield.

	\hat{s}_{ij}				\hat{g}_{ii}	$^2_{g_{ii}}$	$^2_{s_{ij}}$
	4	3	2	1			
5	-1.64	1.70	3.64	2.44	-0.317	-0.785	20.045
4		1.57	1.58	2.13	-0.663	-0.446	8.498
3			-3.27	2.81	0.655	-0.456	20.291
2				-0.70	0.338	-0.771	30.713
1					-0.013	-0.885	15.184
S.E		4.427			0.738		

Table (7) showed the estimation all genetic parameters the variance component of SCA was larger than variance component of GCA. This reflected on the average degree of dominance, which was more than one to for all studied characters. This value indicated the importance of non-additive gene action in the inheritance of

these characters. Heritability value in broad sense reflected between 0.404 for 300 kernel weight to 0.84 for ear length, while narrow sense heritability was very low for all characters. These results indicated that this traits can improved by hybridization.

Table (7): estimation of some genetic parameters for some studied characters.

characters	² Mse	² GCA	² SCA= ² D	² GCA/ ² SCA	² A	$\bar{\mu}$	$h^2_{b.s}$	$h^2_{n.s}$
Tasseling	3.19	0.36	3.36	0.10	1.122	2.447	0.584	0.146
Plant height	72.35	2.07	227.37	0.11	4.136	19.97	0.761	0.013
Ear height	92.06	11.01	124.27	0.088	22.030	3.359	0.613	0.092
Ear length	2.91	3.05	10.04	0.303	6.098	1.815	0.840	0.320
300 kernel weight	12.05	2.54	3.10	0.819	5.078	1.222	0.404	0.250
yield	2.58	0.15	7.11	0.070	0.296	6.931	0.740	0.029

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RESPONSE OF SOME OAT (*Avena sativa* L.) CULTIVARS TO DIFFERENT CLIPPING INTERVALS AND ITS EFFECT ON GROWTH, YIELD AND QUALITY

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ABSTRACT

An experiment was carried out in 2013-2014 at Ainkawa Agriculture Research Center., to study the response of some oat (*Avena sativa* L.) cultivars to clipping at different intervals and its effect on growth, yield and quality. Three oat cultivars were compared to response to five clipping intervals. The factorial experiment was arranged according to randomized complete block design with three replications, differences among treatment means were tested using Duncan's multiple range test at 5% level of significant. The results shown that oat varieties varied significantly in number of days from sowing to each of flowering stage, maturity stage and harvest time, the highest period (124.67, 173.33 and 173.92) days were recorded for the mentioned stages for Possum, Kangaro and Kangaro respectively. ICARDA and Possum recorded highest stem height and flag leaf area which were 55.87cm and 20.58 cm² respectively. While the highest value was recorded for the clipping interval from sowing to harvesting for fodder at 105 days after planting and 50% flowering was affected significantly on green fodder and dry matter yield; the highest values were 3996.67 and 1441.3 kg .ha⁻¹ respectively. The significant interaction effect of varieties and clipping intervals on the period to flowering, maturity and harvesting stages, their values were (136.33, 180.33 and 182.00) days for interaction treatment (ICARDA short and clipping after 105 days). Significant differences for seed yield and straw yield were recorded from the treatment combination of (ICARDA x no clipping).

KEYWORDS: Oat varieties, clipping intervals, oat yield, oat quality.

INTRODUCTION

Cultivated oats (*Avena sativa* L.) is an important winter fodder and pasture crop of both irrigated and rainfed areas which have the potential of producing nutritious and high fodder yields. Therefore, high yielding and more nutritious varieties of oats capable of feeding more animals are needed (Naeem *et al*, 2005).

Oats are forage crops with multi-purpose, it can be used as fodder (graze before stem elongation) allowing the crop to recover, hay, silage, chaff, bedding, used as green manure, and its grain is used for feeding (Armstrong *et al*, 2016). It is the most important winter cereal fodder which is a rich source of energy, protein, vitamin B1, phosphorus, iron and other minerals and is mainly grown in temperate and cool sub-tropical environments (Jehangir *et al*, 2013).

Although oat was perceived as a fodder crop, its grain has also become a part of the staple diet

of human beings in some countries (Feyissa, *et al*, 2008), its grain is used for human consumption because it contains many anti-oxidants such as vitamin E and the avenanthramides which prevent cholesterol accumulation and atherosclerosis so led to decrease the risk of coronary heart disease (Steven *et al*, 2000). Oat grains are used for flour or coarse meal for human consumption high starch, protein and fat absence of sprouting, no glumes (Heyland *et al*, 1981).

Green fodder is an important component of livestock feed and nutrition, As oats has the ability to grow in cold conditions it will take a great role in forage production (Armstrong *et al*, 2016). More nutritious and high yielding fodder varieties are needed to run an efficient livestock industry (Ayub *et al*, 2011). Generally fodder becomes available for livestock feeding in late April as a result of which both milk and meat production has been reduced, winter forage plants can be grown in cool sub-tropical environment

for increase fodder availability during traditional fodder deficit period (Jehangir *et al*, 2013). In many countries chronic shortage of fodder particularly in winter season is a major limiting factor for livestock production. The farmers face fodder deficiency in winter when they have only dry stalks of summer cereal fodders or dry summer (Viswavidyalaya, 2013).

Demetrio *et al.*, (2012) obtained higher fodder yield by using single cut in the flowering stage or two cut in the vegetative stage. In view of this, an effort was made to adjust nutrient level and cutting management in such a way that some green fodder becomes available to the livestock during winter months.

The shortage of fodder particularly in winter season is a major limiting factor for livestock production and on the other hand the importance of oat grain for human consumption, since there are little studies in our country about the time of clipping and its effect on yield and quality of oat, for this reason this investigation was suggested to study the effect of clipping at various times on yield and quality of oat fresh ,dry

herbage yield ,seed yield and quality of some oat varieties at Erbil, Iraqi Kurdistan region.

MATERIALS AND METHODS

The experiment was conducted at Ainkawa Agriculture Research Center (AARC) ,which located at 36.14⁰ N 43.59⁰ E and lies at an elevation of 415 m above sea level ,the annual rainfall of the area is 276 mm. during growing season of (2013-2014), the maximum and minimum temperature varied from 29.65⁰C to 2.67 ⁰C respectively, mean of relative humidity (RH) was 48.33% during the experiment period. Table(1) shows some physical and chemical properties of the soil of AARC.

The aim of this investigation was to evaluate the effect of three oat cultivars and clipping intervals on growth stages, yield, dry matter yield, seed yield and seed quality of oat cultivars.

Table (1): Some physical and chemical properties of the soil of Ainkawa agricultural research center.

Location	Soil texture	Sand	silt	Clay	K	P	N	pH	EC (dS.m ⁻¹)
		%			PPM		%		
Ainkawa	Silty clay loam	19	43	38	100	7.00	0.07	7.92	0.20

The studied factors included:

First factor: three oat cultivars://///

1-Icarda short: Introduced from ICARDA.
Kangaroo: Australian variety. -**Possum:** Australian variety.

2-Clipping factor: at five levels as follow:

1-Clipping for fodder after (85 days) then left to seed at maturity.

2-Clipping for fodder after (65 days) then left to seed at maturity.

3-For Sec fodder after (105 days) then left to seed at maturity.

4-Clipping for fodder after 50% flowering stages only for fodder.

5- No clipping for fodder but for seed only.

The varieties were sown on 24/12/2013 in a Randomized Complete Block Design (RCBD) with three replicates ,sowing was made by drilling the

seeds in rows of 0.2m between rows and area of each experimental unit was (1.5×1.5) m² . A starter dose of fertilizer at the rate of 200kg urea.ha⁻¹ (92 kg N. ha⁻¹), 200kg TSP.ha⁻¹ (92 kg P₂O₅. ha⁻¹), and 256 kg K₂SO₄.ha⁻¹ (152 kg K₂O. ha⁻¹) were added to each plot half dose of N and the other fertilizers were applied to all plots at sowing time, the remainder dose of nitrogen was applied at elongation stage according to Al-Jobouri (2012).The weed control was done manually.

The studied characteristics included:

1-Green forage were taken after the clipping intervals at ground level for each plot then let for seed yield at maturity.

2- Dry matter was determined after drying the fresh forages in oven at 70 ⁰C for 72 hours, and then calculate dry matter yield kg.ha⁻¹.

3- Five plants were selected randomly from the middle rows for recording the plant height and flag leaf area using the following equation: Leaf area = Leaf length × maximum leaf width × 0.95 (Thomas, 1975). 4- Data of number of days from sowing to (flowering, maturity and harvesting) were recorded.

5- Seed yield and biological yield were recorded after harvesting and HI was recorded

HI = (Seed yield / Biological yield) × 100 according to Sharma and Smith, (1986) except for the clipping interval at 50% flowering.

6-Protein %: Total Nitrogen was determined using Kjeldahl method then protein% was determined according to Agrawal *et al.*, (1980) as follow: Protein % = N % × 6.25

7- The crude fiber and total ash were determined according to AOAC, (2000) as follow:

Crude fiber% = Weight of crude fiber / Weight of dried sample × 100

8- Total ash.

The samples were burned in (Muffle furnace) at 550 °C for four hours and was determined as follow:

Total ash = [Ash (g) / weight of dried sample] × 100

Statistical analysis:

The data were statistically analyzed according to the technique of analysis of variance (ANOVA) for randomized complete block design (RCBD) using SPSS program version (20) the difference among means of treatments were tested using Duncan's multiple range test at level of significant 5%. (Duncan, 1955).

RESULTS AND DISCUSSION

Data in table (2) shows that oat varieties varied significantly in number of days from sowing to each of flowering stage, maturity stage and harvest time, The highest mean period (124.67 ,173.33 and 173.92) days were recorded for the mentioned stages for Possum and Kangaro respectively ,this may be due to genetic variation or adaptability (Nawaz *et al.*, 2004) .Icarda short superior among the other varieties in this study ,as it has lowest period to maturity which helps in case of the fluctuation of rainfall at grain filling stage in semi-arid regions (Waly , 2015 and Stevens, 2000)

The stem height and flag leaf area were obtained from ICARDA Short and Possum the highest values were (55.87cm and 20.58 cm²) respectively this results agree with Waly, (2015).Table (2) refers also to significant difference between varieties in dry weight, seed yield and harvest index the highest values were (807.92 kg.ha⁻¹ , 1838.08kg.ha⁻¹ and 22%) were recorded for ICARDA short variety this may be due to earliest maturity of this variety which reduce the vegetative growth period and increase the maturity stage. While other studied parameters were not affected significantly by varieties. Similar results were obtained by (Naem *et al.*, (2005), Ahmed, (2008) and Waly, (2015).This may be attributed to genetic variation of the varieties (Pandy *et al.*, 2012). Table (3) Indicated to that the longest period length from sowing to flowering, maturity and harvest stage affected significantly by clipping interval of 105 days from sowing, this may be physiological habits to continue the plant growth to reach the flowering stage, The highest stem height was recorded from the non-clipping treatments, this may be due to the fact that the plants were at early growth stage at 65 days clipping which regrowth easily. The researchers explained that with winter habit that has been sown and irrigated on March the normally increase of the total amount of oat dry matter was recorded from grazed oats (Rochester *et al.*, 2009). Harvesting for fodder at 105 days after planting and 50% flowering was affected significantly on green fodder and dry matter yield; the highest values were 3996.67 and 1441.3 kg .ha⁻¹ respectively. It means that there were increasing in both forage yield and dry matter with the advance in plant maturity, the minimum green fodder and dry matter were recorded in clipping intervals of 65 days after planting, this results may be due to the fact that oat crop in this clipping interval may be in the early vegetative growth stage .Non –clipping means no fodder yield (fresh and dry) but only for the grain yield.

While the highest seed and straw yield (2322.33, 7545, 78 kg.ha⁻¹) were recorded from non-clipping treatment. On the other hand the highest value of HI was recorded from 65 days clipping after planting. As a management practice when oats were grazed at 50% flowering, there will no seed yield (zero yield) because the plant cannot regrowth , under dry conditions when the

plants are establishing slow plant growth and root development, in the same table minimum seed yield ($307.22\text{kg}\cdot\text{ha}^{-1}$) was recorded for treatment clipping for fodder after 105 days from planting. Similar results were recorded by Hussain *et al.*, (2004).

To ascertain the palatability and nutritive value of the seed, protein and fiber content were determined, protein% decreased with advanced maturity maximum value was 14.37% which was recorded in clipping after 65 days of planting followed by non-clipping treatments, while fiber and ash% were not affected. This results in agreement with Hussain *et al.*, (2004).

Table (4) explains the significant interaction effect of varieties and clipping intervals on the period to flowering stage, maturity stage and harvesting stage, the values of them (136.33, 180.33 and 182.00) days were recorded from the interaction treatments (ICARDA short and clipping after 105 days). This may be due to the interaction between the early maturity varieties and the late clipping which encourage the plant to obtain seed yield. The highest stem height and flag leaf area were recorded from treatment combinations (non-clipping * ICARDA short and

non-clipping * Possum) respectively. The fresh and dry matter were affected significantly by the interaction treatments, the highest values were noticed from treatment combinations (ICARDA short * clipping after 105 days and ICARDA short * and clipping at 50% flowering), for early maturing variety (which should be sown late autumn or early winter) causes less yield and total dry matter in most cases especially if grazed. However a late maturing variety Both of highest significant seed yield and straw yield were recorded from treatment combination of (ICARDA short * non-clipping). The longer the period of time the plant will be growing, the more grazing that can be done without reducing the total grain and dry yield but less grain yield. (Rochester *et al.*, 2009). While the highest significant value of HI was obtained from treatment combination (ICARDA short * clipping after 85 days). On the other hand the highest protein% was recorded from treatment combination (Kangaroo * clipping after 65 days). Because this interaction may create the best condition for plant growth and nitrogen absorption which caused increase in protein content.

Table (2): Effect of oats varieties on some growth characteristics, yield and quality of Oats.

Oat varieties	Flowering day	Maturity day	Harvest day	height Cm	Flag leaf area Cm ²	Fresh matter kg.ha ⁻¹	Dry matter kg.ha ⁻¹	Seed yield kg.ha ⁻¹	Straw yield kg.ha ⁻¹	HI	Protein %	Fiber %	Ash %
Icarda	118.58b	154.42b	167.83c	55.87a	11.73b	2590.33	807.92a	1838.08a	5437.00	0.25a	12.47	0.180	0.177
Kangaro	121.08b	173.33a	173.92a	54.28a	11.96b	2159.58	600.33c	1355.92b	5692.6	0.19b	13.42	0.133	0.157
Possum	124.67a	170.33a	172.50b	37.32b	20.58a	2463.08	712.50ab	1362.67b	5092.50	0.21b	13.66	0.162	0.166

Table (3) : Effect of clipping intervals on some growth characteristics, yield and quality of Oats.

Clippig intervals (day)	flowering (day)	Maturity day	Harvest day	Stem height Cm	Flag leaf area Cm ²	Fresh matter kg.ha ⁻¹	Dry matter kg.ha ⁻¹	Seed yield kg.ha ⁻¹	Straw yield kg.ha ⁻¹	HI	Protein %	Fiber %	Ash %
65	114.33c	163.00c	171.44b	57.82a	14.92	177.33c	57.89d	2028.67a	6533.22b	0.24a	14.37a	0.169	0.172
85	119.56b	165.44b	166.22c	46.80b	14.20	1780.00b	296.11c	1417.33b	5096.33c	0.21a	12.49b	0.171	0.149
105	129.67a	180.44a	182.11a	31.38c	14.15	3996.67a	1032.33b	307.22 c	2454.22d	0.11b	12.46b	0.140	0.164
50% flowering.						3663.33a	1441.33a						
No- clip.	122.22b	158.11d	163.00d	60.62a	15.76			2322.33a	7545.78a	0.23a	13.43ab	0.153	0.181

Table (4) : Effect of clipping intervals on some growth characteristics, yield and quality of oats varieties.

Oat varieties	Days to clipping	Flowering day	Maturity day	Harves day	Stem height cm	Flag leaf area Cm ²	Fresh matter kg.ha ⁻¹	Dry matter kg.ha ⁻¹	Seed yield kg.ha ⁻¹	Straw yield kg.ha ⁻¹	HI	Protein %	Fiber%	Ash%
ICARDA	65	115.00e	147.00e	163.00c	67.93ab	11.27b-d	154.67d	48.67d	2231.00b	6325.67bc	26ab	13.46ab	0.17a	0.19a
	85	115.00e	148.00e	163.00c	53.00c	10.80cd	1553.33c	263.67d	1843.00bc	4518.67d	29a	11.42b	0.23a	0.14a
	105	136.33a	180.33a	182.00a	32.00fg	10.34d	4863.33a	1253.33b	173.33f	1911.00e	08f	12.19ab	0.12a	0.17a
	50% fl.						3790.00ab	1666.00a						
	No clip	108.00f	142.00f	163.33c	70.53a	14.50a-d			3105.00a	8992.67a	26ab	12.80ab	0.21a	0.22a
Kangaro	65	108.00f	170.00c	176.33b	61.80b	13.86a-d	211.67d	71.67d	1703.67bcd	6592.67bc	21bc	14.83a	0.15a	0.17a
	85	119.00de	173.00bc	174.00b	49.73cd	11.59b-d	1806.67c	281.33d	1345.33cd	5540.67cd	19cd	12.65ab	0.11a	0.13a
	105	123.67cd	181.00a	182.00a	37.80ef	11.08b-d	3183.33b	768.33c	437.00ef	2963.00e	13ef	13.13ab	0.16a	0.18a
	50% fl.						3436.67b	1280.00b						
	No clip	133.67ab	169.33c	163.33c	67.80ab	11.32b-d			1937.67bc	7674.33b	20b-d	13.07ab	0.10a	0.16a
Possum	65	120.00de	172.00bc	175.00b	43.73de	19.64a-c	165.67d	53.33d	2151.33b	6681.33bc	24a-c	14.77ab	0.19a	0.16a
	85	124.67cd	175.00b	161.67c	37.67ef	20.22ab	1980.00c	343.33d	1063.67de	5229.67cd	16de	13.40ab	0.17a	0.19a
	105	129.00bc	180.00a	182.33a	24.33g	21.02a	3943.33ab	1075.33bc	311.33f	2488.67e	11ef	12.06ab	0.14a	0.15a
	50% fl.						3763.33ab	1378.00ab						

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STABILITY AND GENOTYPIC RESULTANT IN F1 GENOTYPES OF BARLEY (*Hordeum distichum* L.), UNDER DIFFERENT ENVIRONMENTAL CONDITIONS IN KURDISTAN REGION, IRAQ

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ABSTRACT

Breeding barley for high yield and other desirable traits is a dire need of the day. Five cultivars and pure lines of two-rowed barley (*Hordeum distichum* L.) with their twenty F1 progeny were evaluated at Kurdistan Region-Iraq at three different locations, Sulaimani, Erbil and Kalar during the winter season 2011-2012 using randomized complete block design with three replications. Various plant phenotypic traits as number of days to 50% anthesis, flag leaf length, plant height, number of days to 50% maturity, biological yield plant⁻¹, number of tillers plant⁻¹, number of spikes plant⁻¹, peduncle length, peduncle diameter, average spike weight, spike length awns length, number of Spikelets spike⁻¹, number of grains spike⁻¹, 1000- grain weight, harvest index and grain yield plant⁻¹ were investigated. Means comparison were carried out using least significant differences (LSD) test (P 0.05). The results of study revealed highly significant mean squares in different locations for all studied traits. Qilyasan location exceeded significantly in all studied traits except for the traits, tillers plant⁻¹ and spikes plant⁻¹. Stability and genotypic resultant were also estimated. Genotypes mean squares showed highly significant differences for all traits at each location. The study of stability and genotypic resultant revealed the presence of highly significant effects due to genotypes x locations in all studied traits with exception of the peduncle diameter which was merely significant. Peduncle diameter had the highest stability and genotypic resultant with average values 0.951 and 0.951, respectively, while grain yield plant⁻¹ manifested the lowest were 0.459 and 0.450, respectively. Better genotypic resultant were observed in two genotypes viz., parent 3 and hybrid 5x2 having high grain yield plant⁻¹ value with 0.602 and 0.567, respectively. These were found promising for wide adaptation over sites across environments.

KEY WORDS: two-rowed barley, agronomic traits, stability and genotypic resultant analysis.

INTRODUCTION

Barley is most widely adapted cereal grain species with good drought, cold, and salt tolerance (Ullrich, 2011). Barley is grown worldwide in many countries and regions with temperate and subtropical climates. Barley in recent years has been the fourth most-produced cereal after maize, rice and wheat with average of 8 years (2000 – 2008) by 140, 672, 609 and 598 million Mt, respectively (Ullrich, 2011). Barley has remained as a major food in western and eastern Asia, Himalayan nations and in northern and eastern Africa (Grando and Gomez, 2005).

In barley breeding and in many aspects of barley research, the analysis of genotype-by-environment interactions is of primary

importance, as it is also for other crops (Ceccarelli, 1996; Annicchiarico 2002; Voltas et al., 2002 and Rodriguez, et al., 2008). Genotype-by-environment interactions can affect breeding progress because they often complicate the evaluation and selection of superior genotypes. The genetic resources are a determinant instrument for improvements in crop productivity (Haussmann et al., 2004). Generally, heterozygous individuals (e.g., F1 hybrids) are more stable in their performance than their homozygous inbred parents (Acquaah, 2007). Modern agriculture requires determining the stable genotypes and high performance (Becker and Leon, 1988; Ceccarelli, 1996 and Elsahookie and Al-Rawi, 2011).

To increase the yield of barley, certain information required regarding the nature and

magnitude of gene actions involved in the expression of quantitative traits of economic importance in a hybridization program. Diallel analysis also provides a unique opportunity to obtain a rapid and overall pictures of genetical control of a set of parents in the early generation (Ullrich, 2011).

There is an increasing number of phenotypic stability measures used to assess the response of genotypes when grown in different environments. El-Sahookie and Al-Rawi, (2011) summarized genotype-by-environment (GxE) interaction through stability and genotypic resultant. The main aim of the present study is to estimate the adaptation of two-row barley and improvements in grain yield and its components under condition in Kurdistan region -Iraq.

MATERIAL AND METHODS

This study was conducted at three locations in Kurdistan region -Iraq, first location: Qilyasan Agricultural Research Station , Faculty of Agricultural Sciences , University of Sulaimani (35° 34 307 N, 45° 21 992 E and 765 masl), 2 Km North west of Sulaimani city, second location : Erbil-Grdarasha (36° 07 14 N, 44° 00 23 E and 419 masl), 9 Km south of Erbil city and third

location: Kalar (34° 21 558 N, 45° 22 681 E and 178 masl) during the growing seasons 2010-2011(according of full diallel, crossing between parents were done at the first location only) (to produce the first filial at the three locations at 2011- 2012) . Five varieties and Pedigrees of two-rowed barley (*Hordeum distichum* L.) were used as follows :

- 1.MORA/NB1054/3/MOLA/SHYRI//ARUPO*2/J ET/4/...CBSS99M00293T-G- 5M-1Y-1M-0Y
2. ABN-B/KA-B//RAISA/3/ALELI/4/LIMON/5/...CBSS99M00228 T-K-6M-1Y- 1M-0Y
3. Arabi aswad
4. Clipper
5. Bohoth H1

were crossed in the season 2010-2011 in full diallel mating design to form 20 F1 hybrids (Table 1). All the F1 hybrids along with their parents were grown in the following growing season. Seeds of 20 F1s with their 5 parents (25 genotypes) were sown in the field experiments; during the second half of October 2011 at three locations in a randomized complete block design (RCBD) with three replication. Each experimental unit was one row of 2 meter length, 40 cm between rows and 20 cm between plants within a row.

Table (1a): Studied breeding materials

No	Diallel, Reciprocal Crosses and Parents No.	Parentage	No	Diallel, Reciprocal Crosses and Parents No.	Parentage
1	1x2	MORA x ABN	14	5x2	Bohoth H1 x ABN
2	2x1	ABN x MORA	15	3x4	Arabi aswad x Clipper
3	1x3	MORA x Arabi aswad	16	4x3	Clipper x Arabi aswad
4	3x1	Arabi aswad x MORA	17	3x5	Arabi aswad x Bohoth H1
5	1x4	MORA x Clipper	18	5x3	Bohoth H1 x Arabi aswad
6	4x1	Clipper x MORA	19	4x5	Clipper x Bohoth H1
7	1x5	MORA x Bohoth H1	20	5x4	Bohoth H1 x Clipper
8	5x1	Bohoth H1 x MORA	21	parent1	MORA
9	2x3	ABN x Arabi aswad	22	parent 2	ABN
10	3x2	Arabi aswad x ABN	23	parent 3	Arabi aswad
11	2x4	ABN x Clipper	24	parent 4	Clipper
12	4x2	Clipper x ABN	25	parent 5	Bohoth H1
13	2x5	ABN x Bohoth H1			

Table (1b): A pidgree name, Sources and its Origins

Parents	Source	Origin
1 (pedigree line)	Center Research of Sulaimani	ICARDA
2 (pedigree line)	Center Research of Sulaimani	ICARDA
3 (cultivar)	Center Research of Kalar	ICARDA
4 (cultivar)	Center Research of Erbil	Australia
5 (pedigree line)	Center Research of Erbil	ICARDA

In supplementary tables (1 and 2) brief descriptions are shown for the soils and climates under study.

Evaluated traits:

Data of agronomic traits were recorded from five plants of each genotype from each replications as number of days to 50% anthesis, flag leaf length, plant height, number of days to 50% maturity, biological yield plant⁻¹, number of tillers plant⁻¹, number of spikes plant⁻¹, peduncle

length, peduncle diameter, average spike weight, awns length, number of Spikelets spike⁻¹, number of grains spike⁻¹,1000- grain weight, harvest index and grain yield plant⁻¹ were determined.

Statistical analysis:

1. Estimation of Combined Analysis of Variance

$$Y_{ijk} = \sim + \dagger_i + \dots_{jk} + X_k + (\dagger X)_{ik} + V_{ijk} \begin{cases} i = 1, 2, 3, \dots, t \\ j = 1, 2, 3, \dots, r \text{ (replicates or Blocks)} \\ k = 1, 2, 3, \dots, l \text{ (locations)} \end{cases}$$

$$\sim = \bar{Y}_{\dots}$$

$$\dagger_i = \bar{Y}_{i..} - \bar{Y}_{\dots}$$

$$\dots_{jk} = \bar{Y}_{.jk} - \bar{Y}_{\dots k}$$

$$X_k = \bar{Y}_{..k} - \bar{Y}_{\dots}$$

$$(\dagger X)_{ik} = \bar{Y}_{i.k} - \bar{Y}_{i..} - \bar{Y}_{..k} + \bar{Y}_{\dots}$$

$$V_{ijk} = Y_{ijk} - \bar{Y}_{i..} - \bar{Y}_{.jk} - \bar{Y}_{..k} + \bar{Y}_{\dots}$$

where

Y_{ijk} : The value of observation belongs to the experimental unit designated

\sim : The general mean value

\dagger_i : The value of the actual effect of the genotype

\dots_{jk} : effect of block (j) in location (k)

X_k : location effect value

$(\dagger X)_{ik}$: interaction effect value between treatment (i) and location (k)

V_{ijk} : experimental error for the observed value of the experimental unit (Y_{ijk})

Locations mean comparisons conducted by using Least significant difference test (L.S.D.) at 5% and 1% significant levels according to the following equation: $L.S.D_{Location} = t_r (df_{E(a)}) \times \sqrt{\frac{2MS_{E(a)}}{tr}}$

2. *Stability Analysis:*

$stability (H) \% = (1 - S / \bar{X}_i) \times 100$

Where:

S: The Standard Deviation

$$S = \sqrt{S^2} = \sqrt{\frac{\sum X_i^2 - \frac{(\sum X_i)^2}{n}}{n-1}} \quad (\text{Elsahookei,1995})$$

i : The value of genotype

X_i : the average character value crossing studied environments

3. *Estimation of Genotypic Resultant :*

Genotypic Resultant (GR) = $(1 - \frac{s}{X_i}) \times (\frac{X_i}{X..})$ (Elsahookei,1995)

X_i : The average character value crossing studied environments

X_j : The average character value for particular environment crossing genotypes

$X..$: The general mean of particular character for all genotypes and all environments

RESULTS AND DISCUSSION

Table (2) confirms the presence of highly significant interaction due to genotypes × locations for all studied traits with exception peduncle diameter which was merely significant. This is in agreement with (Sinebo, 2005) who obtained highly significant GE interaction by Sixteen barley genotypes in three sowing date and

three seasons for the traits spike number meter⁻², harvest index, kernels spike⁻¹, kernel weight, mature plant height, vegetative duration, time to maturity and flag leaf length;(Bleidere, 2008) for 1000-grain weight; . Rodriguez et al., 2008 for 1000 grain weight, number of grains spike, plant hight and days to maturity; (Jalata et al., 2011) for grain yield plant⁻¹, 1000-grain weight, number of spikelets spike⁻¹ and number of grains spike⁻¹.

Table (2): Anova table for combine analysis for studied traits at three locations.

Traits	Locations	Blocks/ locations= E(a)	Genotypes/ locations	Genotypes	Genotypes x Locations	Error / Location = E(b)
Days to 50% anthesis	13085.813**	0.396	17.329**	42.360**	4.813**	0.271
Flag leaf length (cm)	80.977**	0.681	6.370**	16.887**	1.112**	0.463
Days to 50% maturity	18053.898**	0.236	9.367**	25.509**	1.296**	0.231
Plant height (cm)	21505.338**	16.502	114.142**	237.028**	52.699**	10.410
Biological yield plant ⁻¹ (g)	42050.195**	32.144	454.112**	479.042**	441.647**	13.639
No. of Tillers plant ⁻¹	5767.314**	17.362	67.444**	65.127**	68.603**	4.134

No. of Spikes plant ⁻¹	6323.533**	17.515	63.555**	59.589**	65.538**	3.720
Peduncle length (cm)	7284.071**	4.087	15.708**	30.696**	8.214**	1.005
Peduncle diameter (mm)	0.230**	0.007	0.037**	0.100**	0.005*	0.003
spike length (cm)	27.130**	0.194	1.342**	3.447**	0.289**	0.116
spike weight (g)	7.502**	0.003	0.085**	0.157**	0.049**	0.002
awn length (cm)	104.599**	0.219	2.350**	5.872**	0.589**	0.138
No. of Spikelets spike ⁻¹	124.239**	0.466	8.182**	20.728**	1.910**	0.378
No. of Grains spike ⁻¹	231.920**	1.083	58.839**	164.427**	6.045**	0.921
1000 grains weight (g)	5917.419**	5.412	70.287**	156.972**	26.945**	1.874
Harvest Index	0.231**	0.000	0.005**	0.010**	0.003**	0.000
grains yield plant ⁻¹ (g)	9784.631**	6.803	105.062**	122.389**	96.398**	2.884

The data in table 3 confirm the presence of highly significant effect due to locations for all studied traits. Qilyasan location exceeded the rest significantly for all studied traits with the exception of the traits number of tillers plant⁻¹ and number of spikes plant⁻¹, in which Kalar location outyielded the rest in these two traits. It was observed the exceeding of Erbil location compared to Kalar location due to the traits, days to 50% anthesis and days to 50% maturity. Kalar location predominated Erbil location in the traits flag leaf length, plant height, biological yield plant⁻¹, no. of tillers plant⁻¹, no. of Spikes plant⁻¹, peduncle length, peduncle diameter, spike length, spike weight, awn length, No. of Spikelets spike⁻¹, no. of grains spike⁻¹, 1000 grains weight, harvest Index and grains yield plant⁻¹, while the lowest value for almost all studied characters exhibited by Erbil location with exception of the characters days to 50% anthesis and days to 50% maturity compared with these recorded at Kalar location. Table (2) also indicated that there were highly significant interaction between the locations and genotypes in regard to all the studied traits except

the trait peduncle diameter in which shows only significant interaction. Qilyasan location was superior over Kalar and Erbil locations. In Erbil location, the reduction was high comparing with Qilyasan, its clear that the effect of environment was the main reason.

Many studies carried out across diverse environments have reported for barley. By means of 9 x 9 half diallel, F1 progenies under four diverse environments, the environmental effect was found significant for the traits days to heading, days to maturity, plant height, flag leaf area, effective tillers plant⁻¹, spike length, number of grains spike⁻¹, test weight, biological yield plant⁻¹, grain yield plant⁻¹ and harvest index (Kanaki and Sharma., 2010). Rodriguez et al., 2008 across six Mediterranean environments for 24 barley genotypes, obtained that the environment significantly affected of the recorded traits like grain yield m⁻², number of kernels m⁻², number of spikes m⁻², number of kernels spike⁻¹, 1000-kernel weight (g), plant height and degree days to maturity.

Table (3): Effect of locations on two-rowed barley genotypes traits.

Traits	Days to 50% anthesis	Flag leaf length (cm)	Days to 50% maturity	Plant height (cm)	Biological yield plant ⁻¹ (g)	No. of Tillers plant ⁻¹	No. of Spikes plant ⁻¹	Peduncle length (cm)	Peduncle diameter (mm)
Locations									
Qilyasan	146.653	11.339	187.400	102.347	75.637	28.239	27.844	31.600	1.381
Erbil	135.160	9.380	172.293	68.627	29.367	16.706	15.097	11.996	1.275
Kalar	120.307	10.962	156.373	82.760	61.235	33.916	32.920	20.026	1.355
LSD (P 0.05)		0.330	0.194	1.623	2.265	1.665	1.672	0.808	0.033
	0.251								

Traits	spike length (cm)	spike weight (g)	awn length (cm)	No. of Spikelets spike ⁻¹	No. of Grains spike ⁻¹	1000 grains weight (g)	Harvest Index	grains yield plant ⁻¹ (g)
Locations								
Qilyasan	9.045	1.411	16.267	29.804	22.716	50.872	0.415	31.484
Erbil	7.952	0.793	14.075	27.239	19.204	33.514	0.320	9.389
Kalar	8.933	0.983	14.408	28.337	21.128	38.920	0.417	25.463
LSD (P 0.05)	0.176	0.023	0.187	0.273	0.416	0.930	0.007	1.042

Table (4) confirms variant values of stability and genotypic resultant for the studied traits. In general, the traits peduncle diameter, number of spikelets per spike, spike length, awn length, days to 50% maturity, number of grains spike⁻¹ and days to 50% anthesis should be stable and close to high genotypic resultant with average values 0.951 and 0.95, 0.949 and 0.950, 0.925 and 0.926, 0.918 and 0.918, 0.910 and 0.910, 0.906 and 0.903, 0.901 and 0.901 respectively, while the trait flag leaf length had stability value 0.890, the rest traits showed unstable and low genotypic resultant average values. However the traits grain yield plant⁻¹, peduncle length and biological yield plant⁻¹ showed the lowest unstable and genotypic resultant average values 0.459 and 0.450, 0.534 and 0.534 and 0.550 and 0.543 respectively. Elsahookie (1995) and Elsahookie and Al-Rawi (2011) noticed the highest stability is manifested as $S_i=1$ and if stability value was less than 0.85, it should be not stable, while genotypic resultant value more than 1.00 meaning the genotype had high yield and high stability.

According to the grain yield plant⁻¹ and their components (number of spikes plant⁻¹, 1000-grain weight and number of grains spike⁻¹) traits, should be not stable and had low genotypic resultant values. For the trait grain weight plant⁻¹ were observed among the genotypes. The hybrid 3x4 versus all hybrids and parent (1) versus all parents had the greatest stability values with 0.720 and 0.604 respectively indicating that these

two genotypes more stable for yield performance among divers environments than others, while parent (3) versus all parents and hybrid 5x2 versus all hybrids had the greatest genotypic resultant values of 0.602 and 0.567, respectively, indicating these genotypes having the highest stable yield performances among divers environments. Experimental studies comparing hybrids and lines showed higher (Jordaan, 1996 and Koekemoer et al., 2011) or similar yield stability (Bruns and Peterson, 1998 and Koemel et al. 2004).

There were low stability and genotypic resultant values for the trait number of spikes plant⁻¹. The hybrid 3x4 versus all hybrids and parent (1) versus all parents had the greatest stability values with 0.794 and 0.728 respectively indicating these genotypes having more stable spiking performance among divers environments than others, while hybrid 5x2 versus all hybrids and parent (3) versus all parents had the greatest genotypic resultant values with 0.788 and 0.714 respectively indicating these genotypes having the highest stable spiking performance among divers environments.

For the trait 1000-grain weight. The hybrid 3x4 versus all hybrids and parent (3) versus all parents had the greatest stability values with 0.877 and 0.817, respectively indicating these genotypes having more stability grain weighting performances among divers environments than others, while hybrid 3x4 versus all hybrids and parent (4) versus all parents had the highest

genotypic resultant values with 1.035 and 0.799, respectively indicating these genotypes having the highest stable grain weighing performances among divers environments. Kaczmarek et al. (2002) for 1000-grain weight in six environments (three locations, two years) suggested that effects of heterozygous loci are more stable in contrasting environments than effects of homozygous loci.

Regarding yield and the three yield components, number of grains spike⁻¹ demonstrated the greatest performance stability and genotypic resultant values across diverse environmental conditions. The hybrid 4x3 versus all hybrids and parent (1) versus all parents had the highest stability values with 0.977 and 0.925 respectively indicating that these two genotypes more stable for spike graining performance among divers environments than others, while hybrid 1x5 versus all hybrids and parent (1) versus all parents had the highest genotypic resultant values with 1.111 and 1.062 respectively indicating that these two genotypes having the highest stable spike graining performance among divers environments. The stability and genotypic for grain yield is strong for genotypes with extreme number of grains spike⁻¹ values. Hallauer et al. (1988) noticed that the main advantages of hybrid versus line varieties are larger yield stability especially in marginal environments. Rodriguez et al. (2008) in set of 24 barley genotypes that were grown across six environments (location-by- year combinations) from using the additive main effects and multiplicative interaction (AMMI) model, obtained the stability and performance for the traits 1000-grain weight (0.82), number of grains spike⁻¹ (0.62), plant height (0.55), days to maturity (0.56) and grains yield m² (0.64).

Very high genotypic resultant values were obtained in the present study for the characters flag leaf length (1.132 by the hybrid 4x5), peduncle diameter (1.103 by the parent 5 and 1.042 by the hybrid 5x1), spike length (1.059 by the hybrid 5x2), and number of spikelets spike⁻¹ (1.049 by the hybrid 5x1). Indicating these genotypes having high performances among divers environments and should be not ignored in future studies.

In particular, the data of Table (4) revealed that the best genotypes indicated to the genotype parent 3 was the overall “winner” in this trial which had the highest genotypic resultant

values for five traits days to 50% anthesis (0.914), number of tillers plant⁻¹ (0.794), number of spikes plant⁻¹ (0.714) , biological yield plant⁻¹ (0.659) and grain yield plant⁻¹ (0.602), while the hybrid 5x2 was over all hybrids which had the highest genotypic resultant values for four traits spike length (1.059), number of spikes plant⁻¹ (0.788), number of tillers plant⁻¹ (0.787) and grain yield plant⁻¹ (0.567) . So the stability of these genotypes needs to be better evaluated in a set of environments tested across different years.

CONCLUSION

Highly significant mean squares of locations for studied traits. Qilyasan location exceeded significantly in fifteen out of seventeen studied traits. Strong genotype x environment interaction for all traits was found. Moreover, there were negative crossovers between traits levels of genotypes grown in different environments. The presence of the genotype x environment interaction was indicated by changes in relative rankings over environments. The stability pattern revealed by the analysis indicated that the tested barley genotypes are narrowly adapted, and no genotype was found to have high grain yield plant⁻¹ performances in all environments.

Table (4): Stability (H%) and genotypic resultant(GR) of traits for tow-rowed barley genotypes , a crossing locations.

Characters	Days to anthesis		Flag leaf length		Days to maturity		Plant height		Biological yield plant ⁻¹		Tillers plant ⁻¹		Spikes plant ⁻¹		Peduncle length		Peduncle diameter	
	H	G.R	H	G.R	H	G.R	H	G.R	H	G.R	H	G.R	H	G.R	H	G.R	H	G.R
1 x 2	0.904	0.880	0.922	0.820	0.911	0.897	0.791	0.791	0.650	0.661	0.688	0.728	0.666	0.708	0.494	0.526	0.964	0.904
2 x 1	0.902	0.883	0.924	0.761	0.915	0.902	0.839	0.863	0.694	0.503	0.690	0.556	0.678	0.546	0.523	0.551	0.944	0.873
1 x 3	0.887	0.871	0.876	0.773	0.911	0.903	0.879	0.958	0.450	0.391	0.471	0.447	0.455	0.434	0.533	0.497	0.962	0.876
3 x 1	0.890	0.878	0.930	0.876	0.914	0.908	0.812	0.849	0.705	0.549	0.705	0.635	0.671	0.601	0.505	0.484	0.966	0.891
1 x 4	0.905	0.910	0.847	0.931	0.914	0.917	0.743	0.781	0.395	0.482	0.625	0.652	0.581	0.606	0.483	0.508	0.928	0.957
4 x 1	0.907	0.911	0.897	0.971	0.913	0.915	0.772	0.741	0.500	0.581	0.609	0.624	0.582	0.600	0.407	0.387	0.950	1.017
1 x 5	0.903	0.901	0.892	0.898	0.911	0.903	0.808	0.830	0.605	0.593	0.663	0.538	0.640	0.517	0.545	0.637	0.935	0.973
5 x 1	0.901	0.896	0.928	0.944	0.912	0.907	0.852	0.941	0.624	0.675	0.787	0.733	0.756	0.705	0.614	0.724	0.960	1.042
2 x 3	0.908	0.919	0.847	0.736	0.913	0.911	0.813	0.816	0.506	0.478	0.500	0.552	0.497	0.558	0.559	0.517	0.951	0.846
3 x 2	0.905	0.912	0.890	0.770	0.913	0.913	0.826	0.866	0.545	0.540	0.573	0.636	0.570	0.641	0.490	0.487	0.949	0.832
2 x 4	0.900	0.925	0.906	0.844	0.903	0.906	0.768	0.724	0.434	0.426	0.541	0.505	0.520	0.492	0.476	0.481	0.940	0.976
4 x 2	0.903	0.928	0.835	0.801	0.906	0.908	0.756	0.742	0.412	0.446	0.495	0.521	0.474	0.498	0.437	0.429	0.926	0.939
2 x 5	0.903	0.913	0.863	0.867	0.906	0.904	0.764	0.780	0.531	0.614	0.631	0.663	0.590	0.611	0.507	0.551	0.950	0.959
5 x 2	0.904	0.910	0.865	0.905	0.907	0.904	0.830	0.868	0.595	0.666	0.743	0.787	0.739	0.788	0.517	0.570	0.952	0.971
3 x 4	0.894	0.899	0.907	0.863	0.908	0.918	0.790	0.801	0.753	0.677	0.807	0.759	0.794	0.753	0.555	0.501	0.974	0.938
4 x 3	0.891	0.893	0.875	0.965	0.909	0.917	0.760	0.802	0.496	0.585	0.624	0.693	0.580	0.643	0.495	0.476	0.945	0.973
3 x 5	0.894	0.875	0.929	0.961	0.909	0.909	0.800	0.804	0.500	0.510	0.554	0.609	0.525	0.583	0.599	0.620	0.968	0.990
5 x 3	0.900	0.881	0.938	1.092	0.909	0.909	0.786	0.822	0.436	0.482	0.566	0.634	0.537	0.602	0.563	0.559	0.959	0.963
4 x 5	0.893	0.906	0.914	1.132	0.910	0.926	0.770	0.722	0.534	0.523	0.629	0.640	0.577	0.586	0.558	0.505	0.944	1.028
5 x 4	0.895	0.905	0.902	1.111	0.909	0.920	0.777	0.736	0.554	0.613	0.748	0.782	0.682	0.701	0.543	0.532	0.918	1.004
1 x 1	0.921	0.908	0.895	0.698	0.910	0.907	0.848	0.803	0.708	0.521	0.734	0.605	0.728	0.594	0.652	0.646	0.962	0.919
2 x 2	0.907	0.892	0.762	0.604	0.904	0.890	0.751	0.770	0.486	0.449	0.654	0.671	0.625	0.642	0.519	0.569	0.964	0.860
3 x 3	0.916	0.914	0.886	0.937	0.909	0.897	0.860	0.793	0.676	0.659	0.679	0.794	0.637	0.714	0.569	0.477	0.952	0.859
4 x 4	0.907	0.932	0.884	0.922	0.912	0.931	0.730	0.629	0.358	0.359	0.580	0.523	0.537	0.483	0.558	0.476	0.954	1.086
5 x 5	0.895	0.890	0.936	1.110	0.910	0.919	0.784	0.697	0.616	0.592	0.681	0.624	0.660	0.611	0.654	0.644	0.969	1.103
mean	0.901	0.901	0.890	0.892	0.910	0.910	0.796	0.797	0.550	0.543	0.639	0.636	0.612	0.609	0.534	0.534	0.951	0.951
Characters	Days to anthesis		Flag leaf length		Days to maturity		Plant height		Biological yield plant ⁻¹		Tillers plant ⁻¹		Spikes plant ⁻¹		Peduncle length		Peduncle diameter	

Crosses	H	G.R																
1 x 2	0.904	0.880	0.922	0.820	0.911	0.897	0.791	0.791	0.650	0.661	0.688	0.728	0.666	0.708	0.494	0.526	0.964	0.904
2 x 1	0.902	0.883	0.924	0.761	0.915	0.902	0.839	0.863	0.694	0.503	0.690	0.556	0.678	0.546	0.523	0.551	0.944	0.873
1 x 3	0.887	0.871	0.876	0.773	0.911	0.903	0.879	0.958	0.450	0.391	0.471	0.447	0.455	0.434	0.533	0.497	0.962	0.876
3 x 1	0.890	0.878	0.930	0.876	0.914	0.908	0.812	0.849	0.705	0.549	0.705	0.635	0.671	0.601	0.505	0.484	0.966	0.891
1 x 4	0.905	0.910	0.847	0.931	0.914	0.917	0.743	0.781	0.395	0.482	0.625	0.652	0.581	0.606	0.483	0.508	0.928	0.957
4 x 1	0.907	0.911	0.897	0.971	0.913	0.915	0.772	0.741	0.500	0.581	0.609	0.624	0.582	0.600	0.407	0.387	0.950	1.017
1 x 5	0.903	0.901	0.892	0.898	0.911	0.903	0.808	0.830	0.605	0.593	0.663	0.538	0.640	0.517	0.545	0.637	0.935	0.973
5 x 1	0.901	0.896	0.928	0.944	0.912	0.907	0.852	0.941	0.624	0.675	0.787	0.733	0.756	0.705	0.614	0.724	0.960	1.042
2 x 3	0.908	0.919	0.847	0.736	0.913	0.911	0.813	0.816	0.506	0.478	0.500	0.552	0.497	0.558	0.559	0.517	0.951	0.846
3 x 2	0.905	0.912	0.890	0.770	0.913	0.913	0.826	0.866	0.545	0.540	0.573	0.636	0.570	0.641	0.490	0.487	0.949	0.832
2 x 4	0.900	0.925	0.906	0.844	0.903	0.906	0.768	0.724	0.434	0.426	0.541	0.505	0.520	0.492	0.476	0.481	0.940	0.976
4 x 2	0.903	0.928	0.835	0.801	0.906	0.908	0.756	0.742	0.412	0.446	0.495	0.521	0.474	0.498	0.437	0.429	0.926	0.939
2 x 5	0.903	0.913	0.863	0.867	0.906	0.904	0.764	0.780	0.531	0.614	0.631	0.663	0.590	0.611	0.507	0.551	0.950	0.959
5 x 2	0.904	0.910	0.865	0.905	0.907	0.904	0.830	0.868	0.595	0.666	0.743	0.787	0.739	0.788	0.517	0.570	0.952	0.971
3 x 4	0.894	0.899	0.907	0.863	0.908	0.918	0.790	0.801	0.753	0.677	0.807	0.759	0.794	0.753	0.555	0.501	0.974	0.938
4 x 3	0.891	0.893	0.875	0.965	0.909	0.917	0.760	0.802	0.496	0.585	0.624	0.693	0.580	0.643	0.495	0.476	0.945	0.973
3 x 5	0.894	0.875	0.929	0.961	0.909	0.909	0.800	0.804	0.500	0.510	0.554	0.609	0.525	0.583	0.599	0.620	0.968	0.990
5 x 3	0.900	0.881	0.938	1.092	0.909	0.909	0.786	0.822	0.436	0.482	0.566	0.634	0.537	0.602	0.563	0.559	0.959	0.963
4 x 5	0.893	0.906	0.914	1.132	0.910	0.926	0.770	0.722	0.534	0.523	0.629	0.640	0.577	0.586	0.558	0.505	0.944	1.028
5 x 4	0.895	0.905	0.902	1.111	0.909	0.920	0.777	0.736	0.554	0.613	0.748	0.782	0.682	0.701	0.543	0.532	0.918	1.004
1 x 1	0.921	0.908	0.895	0.698	0.910	0.907	0.848	0.803	0.708	0.521	0.734	0.605	0.728	0.594	0.652	0.646	0.962	0.919
2 x 2	0.907	0.892	0.762	0.604	0.904	0.890	0.751	0.770	0.486	0.449	0.654	0.671	0.625	0.642	0.519	0.569	0.964	0.860
3 x 3	0.916	0.914	0.886	0.937	0.909	0.897	0.860	0.793	0.676	0.659	0.679	0.794	0.637	0.714	0.569	0.477	0.952	0.859
4 x 4	0.907	0.932	0.884	0.922	0.912	0.931	0.730	0.629	0.358	0.359	0.580	0.523	0.537	0.483	0.558	0.476	0.954	1.086
5 x 5	0.895	0.890	0.936	1.110	0.910	0.919	0.784	0.697	0.616	0.592	0.681	0.624	0.660	0.611	0.654	0.644	0.969	1.103
mean	0.901	0.901	0.890	0.892	0.910	0.910	0.796	0.797	0.550	0.543	0.639	0.636	0.612	0.609	0.534	0.534	0.951	0.951

- Continued-

Table (4): Continued

Characters	Spike length		Spike weight		Awn length		Spikeletes spike ⁻¹		Grains spike ⁻¹		1000-grain weight		Harvest index		Grains yield plant ⁻¹		
	H	GR	H	GR	H	GR	H	GR	H	GR	H	GR	H	GR	H	GR	
crosses																	
1 x 2	0.956	0.957	0.711	0.652	0.919	0.890	0.973	0.997	0.912	1.016	0.755	0.663	0.775	0.801	0.496	0.527	
2 x 1	0.928	0.909	0.629	0.584	0.912	0.856	0.959	0.976	0.867	0.993	0.745	0.623	0.792	0.850	0.543	0.423	
1 x 3	0.938	0.902	0.728	0.623	0.893	0.832	0.971	0.994	0.875	0.689	0.851	0.878	0.887	0.824	0.364	0.293	
3 x 1	0.929	0.879	0.709	0.609	0.950	0.912	0.947	0.934	0.897	0.692	0.838	0.884	0.808	0.753	0.584	0.419	
1 x 4	0.923	0.971	0.645	0.747	0.900	0.967	0.954	1.005	0.903	1.079	0.707	0.702	0.838	0.887	0.305	0.399	
4 x 1	0.913	0.957	0.705	0.762	0.928	0.985	0.960	1.022	0.890	1.019	0.748	0.733	0.813	0.819	0.463	0.535	
1 x 5	0.899	0.972	0.607	0.742	0.909	0.920	0.933	0.993	0.885	1.111	0.690	0.671	0.759	0.781	0.452	0.467	
5 x 1	0.954	1.046	0.659	0.778	0.916	0.936	0.957	1.049	0.887	1.066	0.706	0.690	0.788	0.816	0.475	0.536	
2 x 3	0.914	0.917	0.743	0.613	0.905	0.892	0.953	0.930	0.909	0.624	0.814	0.887	0.848	0.741	0.369	0.306	
3 x 2	0.892	0.865	0.623	0.547	0.939	0.926	0.917	0.878	0.864	0.645	0.806	0.851	0.916	0.865	0.493	0.455	
2 x 4	0.918	0.975	0.685	0.722	0.905	0.947	0.965	0.987	0.902	1.016	0.772	0.743	0.842	0.910	0.346	0.374	
4 x 2	0.882	0.934	0.650	0.695	0.889	0.917	0.928	0.954	0.825	0.914	0.788	0.764	0.760	0.811	0.303	0.367	
2 x 5	0.964	1.056	0.565	0.643	0.933	0.947	0.973	1.033	0.861	1.027	0.690	0.641	0.808	0.816	0.387	0.459	
5 x 2	0.951	1.059	0.657	0.731	0.892	0.912	0.952	1.007	0.918	1.093	0.716	0.672	0.829	0.892	0.470	0.567	
3 x 4	0.952	0.952	0.768	0.704	0.922	0.940	0.960	0.927	0.933	0.659	0.877	1.035	0.915	0.811	0.720	0.556	
4 x 3	0.899	0.973	0.814	0.842	0.898	0.975	0.948	0.992	0.977	0.786	0.850	0.991	0.941	0.862	0.495	0.517	
3 x 5	0.939	0.946	0.878	0.719	0.947	0.939	0.927	0.887	0.970	0.613	0.866	1.003	0.910	0.724	0.481	0.381	
5 x 3	0.955	0.987	0.853	0.794	0.947	0.932	0.940	0.918	0.974	0.648	0.859	1.018	0.888	0.752	0.451	0.409	
4 x 5	0.923	0.815	0.685	0.723	0.932	0.979	0.957	0.880	0.951	0.985	0.752	0.766	0.843	0.930	0.432	0.472	
5 x 4	0.949	0.882	0.602	0.647	0.916	0.963	0.933	0.885	0.934	1.001	0.668	0.648	0.851	0.838	0.427	0.467	
1 x 1	0.924	0.841	0.713	0.624	0.931	0.879	0.975	0.960	0.925	1.062	0.743	0.591	0.861	0.879	0.604	0.449	
2 x 2	0.898	0.875	0.636	0.585	0.881	0.804	0.920	0.858	0.887	0.948	0.704	0.619	0.847	0.923	0.390	0.396	
3 x 3	0.901	0.833	0.685	0.603	0.933	0.803	0.915	0.802	0.901	0.876	0.817	0.784	0.872	0.934	0.585	0.602	
4 x 4	0.893	0.759	0.702	0.814	0.944	0.985	0.947	0.918	0.908	1.026	0.785	0.799	0.911	0.988	0.295	0.319	
5 x 5	0.939	0.881	0.855	0.902	0.911	0.916	0.962	0.956	0.898	0.984	0.785	0.787	0.808	0.855	0.553	0.552	
mean	0.925	0.926	0.700	0.696	0.918	0.918	0.949	0.950	0.906	0.903	0.773	0.778	0.845	0.842	0.459	0.450	

Supplementary table (1): physical and chemical properties of the soil at three locations in the date of sowing season, 2011-2012*

Soil properties	Qiyasan	Erbil (Grdarasha)	Kalar
PSD	Silty clay	Silty clay loam	Silty clay
Sand %	5.83	9.94	12.6
Silt %	42.07	52.06	45.9
Clay %	52.10	38.50	41.5
PH	7.13	8.22	7.35
Organic matter %	2.13	0.30	1.35
Total Nitrogen %	0.15	0.25	0.089
Available phosphate(ppm)	4.49	3.20	5.50

* Soil samples were analyzed at the laboratory of soil and water department, Faculty of Agricultural Science, University of Sulaimani.

Supplementary table (2): Total rainfall, average maximum and minimum temperatures from October to May at three locations during the crop season, 2011-2012*

Period	Qiyassan		Erbil (Grdarasha)				Kalar		
	Temp. C°		Temp. C°		Temp. C°		Rainfall mm		
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	
Oct	33.0	15.0	37.3	36.32	9.81	10.4	37.4	10.9	1.5
Nov	21.0	8.0	54.1	22.7	8.0	5.6	23.0	9.0	3.2
Dec	17.0	8.0	48.0	22.9	8.0	4.6	22.9	8.0	67.8
Jan	14.7	-5.7	94.2	16.3	-4.8	43.7	17.5	-1.0	21.2
Feb	15.5	-0.6	96.5	17.4	-0.4	33.6	20.9	2.0	53.5
Mar	21.1	-2.2	141.4	24.0	-1.7	56.6	29.5	8.5	27.3
Apr	30.5	6.1	34.0	34.1	10.2	12.7	36.5	14.8	11.0
May	35.5	13.7	36.0	39.5	15.9	9.4	41.0	20.8	5.3
Jun	38.6	16.8		40.2	18.5		42.1	24.5	
Total			541.5			176.3			190.8

*Metrological stations (Sulaimani, Erbil and Kalar 2011-2012)

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EFFECT OF SOWING DATES, RATES AND THEIR INTERACTIONS ON YIELD AND QUALITY OF RAPESEED (*Brassica napus* L.) GENOTYPES.

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ABSTRACT

The study was conducted at Grdarasha Research Field / College of Agriculture / University of Salahaddin / Erbil during the winter growing season (2014-2015), to investigate the effect of different sowing dates and seeding rates on the yield and quality of Rapeseed genotypes.

The highest seed yield ,harvest index and oil % (4494.55 kg.ha⁻¹ , 31.77% and 39.55%) were recorded from the interaction treatments (Pactol* 15th Oct.*4 kg.ha⁻¹ ,Raja*31st Oct.* 4 kg.ha⁻¹ and Pactol*15th Nov.*6 kg.ha⁻¹) respectively .While the highest values (68.80,21.16,9.34 and 15.09 %) of fatty acids (oleic, linoleic, linolenic and erucic acids) were obtained from interaction treatments (Raja*31st Oct.* 4 kg.ha⁻¹,Rendy*15th Oct*6 kg.ha⁻¹ , Pactol*15thOct.*6kg.ha⁻¹and Raja*15th Oct.*4 kg.ha⁻¹)respectively .The highest seed yield(3769.11 kg.ha⁻¹) was recorded from Pactol genotype ,while the lowest value (1584 kg.ha⁻¹) was recorded from Rendy genotype. On the other hand the highest seed yield was recorded from sowing rate of 4kg.ha⁻¹ and sowing date 15th October.

KEY WORDS: Rapeseed genotypes, Fatty acids, sowing dates, seeding rates.

INTRODUCTION

Rapeseed (*Brassica napus* L.) belongs to (*Brassicaceae*) family which becomes one of the most important sources of the vegetable oil in the world (Baghdadi *et al.*, 2013). It is a valuable oil seed that has attracted the attention of many people in recent years. The production and usage of Brassica seed oils has a making it rank third among the oil seed crops after soybean and oil palm in production of vegetable oils, while fifth in the production of oil seed proteins (Armin and Golparvar, 2013).

Canola is a specific type of rapeseed associated with high quality oil and meal. It has less than 2% erucic acid and its meal has less than 30 µg of glucosinolates (El-Nakhlawy and Bakhshwain, 2009). It contains (40-45%) oil and (39%) protein, rapeseed oil contains a desirable profile of saturated fatty acids (7%) and high level of unsaturated fatty oleic acids about (61%) medium level of unsaturated fatty linoleic acids (21%) and (11%) linoleic acid (Molazem *et al.*, 2013),therefore it considers as a healthy edible oil. Over 13.2% of

the world's edible oil supply now comes from the oil seed Brassica, rapeseed and mustard (Eskandari and Kazemi, 2012).

On the other hand, oil obtained from conventional rapeseed is not considered as regular cooking oil because of its inferior quality due to the presence of high erucic acid (more than 40%) and glucosinolates (more than 100 µm.g⁻¹ of dry meal) and low level of oleic and linoleic acid (Abdul Sattar *et al.*, 2013). that is the reason for using rapeseed oil potentially in the bio-diesel market (El-Nakhlawy and Bakhshwain, 2009).Romanian investigation with 50 rapeseed cultivars showed significant differences in the siliques yields (Gheorghie *et al.*, 2013).

Fink, *et al;* (2006) stated that sowing date is one of the most important production decisions. Timely sowing of rapeseed has proven a key to

maximize yield potential and by default reduce risk. With the delay in sowing date, all the investigated traits declined (Baghdadi *et al;* 2013).A part from other factors responsible for

increasing yield per area, plant density or seeding rate is considered to play a remarkable role in boosting up production. In oilseed rape, row spacing or plant density vary considerably worldwide, depending on Plant density in rapeseed governs the components of yield, and thus the yield of individual plants (Nasiri *et al;* 2014). Bagheri *et al.*,(2011) explained that genotypes had significant effect on protein% and seed yield ,the highest values were obtained

from RGS003, while the lowest values were recorded from Hyola 308. Gheorghe *et al.*, (2013)

showed significant difference among silique yield of 50 rapeseed cultivars.

Since, there are little or no studies in Kurdistan region about the interaction effect of genotype, sowing date and seeding rate on growth, yield and quality of rapeseed. For these reasons this investigation was suggested.

MATERIALS AND METHODS

The study was conducted at Grdarasha Research Field / College of Agriculture / University of Salahaddin, Erbil with GPS reading of (Latitude 36°4' N and Longitude 44°2'E) during the winter growing season (2014-2015). The field was prepared before cultivation (by flooding up the soil) in 7th of September, 2014 then plowing with two perpendicular directions by using moldboard plow to soften the soil, the land was divided manually to plots, each replicate consists of 18 experimental units the area of each experimental unit was (2x2) m². Each experimental unit consists of 5 rows, the distance between them was 40 cm, then the seed was sown manually. Table (1) shows some chemical and physical properties of the soil. A factorial experiment had been carried out using randomized complete block design (RCBD) with three replications. The first factor included three genotypes: (Pactol, Raja and Rendy), the second factor included three sowing dates (15th October, 31th October, and 15th November), while the third factor represented two seeding rates (4 Kg.ha⁻¹ and 6 Kg.ha⁻¹).

Each plot was fertilized with 400 kg urea .ha⁻¹, 320 kg Triple Super Phosphate (TSP) ha⁻¹ and 240 kg K₂SO₄.ha⁻¹, which were equivalent to (160 g urea, 128 g TSP and 96 g K₂SO₄) (Sarkees, 2015). The fertilizers were applied during the sowing time except nitrogen fertilizer (urea) which was divided into two parts or doses, half of urea applied at sowing time, the second part applied at inflorescence initiation stage. Normal cultural practices of growing rapeseed were conducted in the usual manner followed by the farmers of the district.

The studied characters:

-Seed yield (kg.ha⁻¹):

The plant seeds from the middle lines were collected, ground, and sieved and then the seeds weighted. The weighted was converted to (kg.ha⁻¹),

while the seed yield was adjusted to 9.8% moisture.

-Harvest index (HI):

The HI was calculated according to Hunt (1982) as follows:

$$HI = (\text{Seed yield} / \text{Biological yield}) \times 100$$

2- Seed Quality Characteristics, which included:

-Oil percentage: The rapeseed seed oil % was determined using Sechelt apparatus (Model, 12 x Germany) for oil extraction as mentioned by Association of Official Analytical Chemists (A.O.A.C, 1980).

-Fatty acid composition (%):

Percentages of saturated and unsaturated fatty acids were determined by using Gas Chromatography (GC). Samples of oil extracted taken to identify the variation in fatty acid percentage through the studied factors. The analysis was done by the General Company for Vegetable oils –Baghdad to determine the fatty acids in the oil; the following unsaturated fatty acids were determined which included -Oleic acid (C18:1), -Linoleic acid (C18:2), Linolenic acid (C18:3), -Erucic acid (C 22:1).

Statistical Analysis:

Data analysis was done using SPSS (V.20) and the mean comparison was fulfilled according to Duncan's multiple range test at probability 5 % (Duncan, 1955).

RESULTS AND DISCUSSION

Table (2) shows the significant effect of sowing dates, seeding rates, genotypes and their interaction on seed yield. The highest value of seed yield was obtained from sowing date 15th October which was 3338.7 kg.ha⁻¹, while the lowest value was recorded from sowing date 15th November, the same trend was also determined by Siadat and Hemayati (2009) they explained that early sowing produced higher seed yield this may be due to the variation in temperature, or attributed to more light, water and mineral absorption by plant canopies thus, increasing photosynthetic capacity.

At the same time the increase in the seeding rates caused non-significant decrease in yield. The genotypes affect significantly on seed yield, the highest value (3769.11 kg.ha⁻¹) was recorded for Pactol, while the lowest value (1584.55 kg.ha⁻¹) was for Rendy (Table, 2). It means the yield of pactol is 2.38 times more than Rendy yield this difference contributed to their genetic properties. Or this may be due to the adaptation of pactol to

Iraqi Kurdistan Region environment due to its cultivation in this region but Rendy is cultivated for the first time in this region and the environment is less suitable for its growth.

Table (2) also shows significant effect of the interaction between Genotypes and sowing dates on seed yield. The highest value ($4316.25 \text{ kg.ha}^{-1}$) was recorded from the interaction treatment (Raja and 15th October), while the lowest value ($1239.06 \text{ kg.ha}^{-1}$) was from the interaction treatment (Rendy and 15th November). This findings were in conformity with Shirani (2012) that mentioned the significant effects of sowing date and variety on seed yield and its components. On the other hand the interaction between sowing dates and seeding rates also affected significantly on seed yield. The highest value ($3588.47 \text{ kg.ha}^{-1}$) was recorded from the interaction treatment (15th October and 4 kg.ha^{-1}), while the lowest value ($2310.07 \text{ kg.ha}^{-1}$) was from the interaction treatment (15th November and 6 kg.ha^{-1}).

The interaction between Genotypes and seeding rates affected significantly on seed yield. The highest value ($3903.49 \text{ kg.ha}^{-1}$) was recorded from the interaction treatment (Pactol and 4 kg.ha^{-1}), while the lowest value ($1424.03 \text{ kg.ha}^{-1}$) was recorded from the interaction treatment

(Rendy and 6 kg.ha^{-1}). Rahnama and Asl (2014) mentioned that with increasing seeding rate from 3 to 7 kg.ha^{-1} rapeseed seed yield apparently increased. These results were in line with the finding of Etemadi *et al.*; (2013) they recorded the maximum value of seed yield in seeding density of 8 kg.ha^{-1} and also they referred to significant differences between the seed yield of the studied cultivars. The interaction between (sowing dates and seeding rates) affected on seed yield was not significant.

While the interaction among the three studied factors affected significantly on seed yield, the highest value ($4494.58 \text{ kg.ha}^{-1}$) was recorded from the triple interaction treatments (Pactol and 15th October and 4 kg.ha^{-1}) and the lowest value ($967.50 \text{ kg.ha}^{-1}$) was recorded from the triple interaction treatments (Rendy and 15th November and 6 kg.ha^{-1}). The ratio between the highest and lowest seed value was 4.65 times, it means the triple interaction is more effective in increasing yield than the single effects of the studied factors and the interactions between two factors. This may be due to that the interaction between the studied factors created different growth conditions for plant growth and yield.

Table(3) indicates to significant effect of genotypes, interaction between (genotypes and sowing dates), interaction between (genotypes and seeding rates) and the interaction among (genotypes and sowing dates and seeding rates) on harvest index. On the other hand the remain single factors and the interaction treatments not affected significantly on harvest index.

It appears that the highest value (28.71%) of HI was recorded for Raja genotypes and the lowest value (13.47%) was recorded for Rendy. This due to values of seed yield and biological yield of the mentioned genotypes or Raja could profited better from environment source and yielded higher HI by transforming more photosynthetic matters to seed or could more efficiently use sunlight to producing economic yield by generating more green canopy (Naseri *et al.*, 2014).

The interaction between (genotypes and sowing dates) affected significantly on HI. The highest value (30.28%) was recorded from the interaction treatment (Raja and 31st October), while the lowest value (11.20%) was obtained from the interaction treatment (Rendy and 15th October), the same results were obtained by Shirani (2012). He pointed out there were significant effects of sowing dates and variety on HI. The highest and lowest values of HI (30.54 and 12.67 %) were recorded from the interaction treatments (Raja and 4 kg.ha^{-1} and Rendy and 6 kg.ha^{-1}) respectively. This may be the interaction treatments created different conditions for plant growth.

The interaction among sowing date, seeding rates and genotypes affected significantly on HI, the highest value of HI was obtained from the interaction treatments (Raja and 31st October and 4 kg.ha^{-1}) but the lowest value (10.31%) was recorded from (Rendy and 15th November and 6 kg.ha^{-1}). This may be due to the role of the single effect and the interaction between factors in limiting seed yield and biological yield then HI.

Table (4) shows significant effects of sowing dates, seeding rates and genotypes on oil %, the highest values (37.66, 36.16 and 36.77%) were obtained from (15th November, 6 kg.ha^{-1} and Pactol genotype), this results in agreement with Shamsi (2012) reported that sowing date had significant effect on oil %, the reduction in oil% with delayed after 15th Oct may be due to the increase of temperature during the grain filling stage. An increase in temperature above $16 \text{ }^{\circ}\text{C}$

after flowering stage causes (1.2-1.5) decrease in oil % for each 1 °C increase in temperature (Pritchard *et al* ,1999).

On the other hand Keivanrad and Zandi (2014) showed that there were significant effect of plant density on oil content of rapeseed.The interaction between (genotypes and sowing dates),(sowing dates and seeding rates) and (genotypes and seeding rates) were affected significantly on oil%,the highest values (38.95,38.27 and 37.33%) were recorded from interaction treatments (Pactol and 15th Nov.),(15th Nov and 6kg.ha⁻¹) and (Pactol and 6kg.ha⁻¹) respectively ,while the highest value off oil% was recorded from the interaction treatments (Pactol and 15th Nov. and 6kg.ha⁻¹). This finding was in conformity with Soleymani and Shahrajabian (2013) they replied that oil yield affected significantly by the interaction between sowing date* cultivars .

Table(5,6,7and 8) explain the percentage of unsaturated fatty acids in rapeseed oil , the series of them were as follow: oleic linoleic linolenic erocic acid

Most of the single factors affected significantly on the studied fatty acids ,these results agree with the founding of Turhan *et al* (2011) they revealed the influence of sowing date and different genotypes on fatty acid synthesis of rapeseed (linoleic,linolenic,and oleic acid). At the same time there were significant differences between

genotypes in fatty acids content as mentioned by Mekki (2013). While AL-Hariry and Sarkees (2011) stated that the level of linoleic ,linolenic and erucic acid reached their maximum value at seeding rate 7 kg.ha⁻¹ which was in agreement with our result from (table 6,7and 8).

The interaction treatments were affected significantly on oleic acid % the highest value (68.8%) was recorded from the interaction between (Raja ,31st Oct. and 4kg.ha⁻¹) while the lowest value (51.65%) was recorded from (Pactol, 15th Oct.) .The lowest value of linoleic acid (16.02%) was recorded from (Raja , 31st Oct. and 4kg.ha⁻¹) While the highest value (21.16%) was recorded from (Rendy ,15th Oct and 6kg.ha⁻¹).

The highest value of linolenic acid (9.34%) was recorded from (Pactol ,15th Oct and 6kg.ha⁻¹), while the lowest value (5.20%) was obtained from (Rendy,15th Nov.and 46kg.ha⁻¹). From table (8) the highest value of erucic acid (15.09%) was recorded from interaction treatment (Raja ,15th Oct. and 4kg.ha⁻¹).while the lowest value 0.47% was recorded from (Rendy,15th Oct. and 6kg.ha⁻¹).it is clear from the mentioned results that the studied factors and their interactions have great effects on types of fatty acids content of rapeseed for these reasons it is necessary to select the best treatment or treatment combination for the future studies.

Table (1): Some physical and chemical properties of soil of Ainkawa research center field.*

location	Soil texture	sand	silt	clay	O.M	Total N	EC dS.m ⁻¹	pH	Available p(µg.g ⁻¹)	Available K(µg.g ⁻¹)
Grdarasha	Silty clay	13.0	41.5	45.50	0.90	0.10	0.20	7.73	4.50	180

* Soil analysis were conducted at Agricultural research center ,Erbil, Ainkawa
 O.M =Organic matter EC =Electrical conductivity of soil extract.

Table (3): Effect of genotypes, sowing dates, seeding rates and their interactions on seed yield (kg.ha⁻¹).

Genotypes	Sowing dates	Seeding Rates		Genotypes × Sowing dates
		4 kg.ha ⁻¹	6 kg.ha ⁻¹	
Pactol	15 th October	4494.58 a	3586.86 b-d	4040.73 a
	31 st October	4193.13 ab	4221.25 ab	4207.19 a
	15 th November	3022.75 d	3096.04 d	3059.40 b
Raja	15 th October	4362.29 ab	4270.21 ab	4316.25 a
	31 st October	4040.83 a-c	3581.86 b-d	3811.35 a
	15 th November	3335.21 cd	2866.67 d	3100.94 b
Rendy	15 th October	1908.54 e	1710.21 ef	1809.38 c
	31 st October	1816.04 e	1594.38 ef	1705.21 cd
	15 th November	1510.63 ef	967.50 f	1239.06 d
Genotypes × Seeding Rates		4 kg.ha ⁻¹	6 kg.ha ⁻¹	Means of Genotypes
	Pactol	3903.49 a	3634.72 a	3769.11 a
	Raja	3912.78 a	3572.92 a	3742.85 a
	Rendy	1745.07 b	1424.03 b	1584.55 b
Sowing dates × Seeding Rates		4 kg.ha ⁻¹	6 kg.ha ⁻¹	Means of Sowing date
	15 th October	3588.47 a	3189.10 ab	3388.79 a
	31 st October	3350.00 ab	3132.50 ab	3241.25 a
	15 th November	2622.86 ab	2310.07 b	2466.47 b
Means of Seeding Rates		3187.11 a	2877.22 b	

Table (3): **Effect of genotypes, sowing dates, seeding rates and their interactions on harvest index (%).**

Genotypes	Sowing dates	Seeding Rates		Genotypes × Sowing dates
		4 kg.ha ⁻¹	6 kg.ha ⁻¹	
Pactol	15 th October	25.93 a-c	23.86 b-d	24.89 b
	31 st October	26.30 a-c	27.45 a-c	26.86 ab
	15 th November	24.33 b-d	27.16 a-c	25.75 ab
Raja	15 th October	30.78 ab	28.36 a-c	29.57 ab
	31 st October	31.77 a	28.78 a-c	30.28 a
	15 th November	29.06 a-c	23.47 cd	26.27 ab
Rendy	15 th October	9.62 f	12.78 ef	11.20 c
	31 st October	14.66 ef	14.92 ef	14.79 c
	15 th November	18.54 de	10.31 f	14.42 c
Genotypes × Seeding Rates		4 kg.ha ⁻¹	6 kg.ha ⁻¹	Means of Genotypes
	Pactol	25.52 b	26.16 b	25.84 b
	Raja	30.54 a	26.87 b	28.71 a
	Rendy	14.27 c	12.67 c	13.47 c
Sowing dates × Seeding Rates		4 kg.ha ⁻¹	6 kg.ha ⁻¹	Means of Sowing date
	15 th October	22.11 a	21.67 a	21.89 a
	31 st October	24.25 a	23.72 a	23.98 a
	15 th November	23.98 a	20.32 a	22.15 a
Means of Seeding Rates		23.44 a	21.90 a	

Table (4): Effect of genotypes, sowing dates, seeding rates and their interactions on oil percentage (%).

Genotypes	Sowing dates	Seeding Rates		Genotypes × Sowing dates
		4 kg.ha ⁻¹	6 kg.ha ⁻¹	
Pactol	15 th October	34.50 g	35.50 e	35.00 e
	31 st October	35.78 de	36.94 c	36.36 cd
	15 th November	38.35 b	39.55 a	38.95 a
Raja	15 th October	32.77 j	33.17 i	32.97 g
	31 st October	34.60 fg	34.95 ef	34.78 e
	15 th November	35.87 de	37.10 c	36.49 c
Rendy	15 th October	33.30 g	33.95 h	33.62 f
	31 st October	35.50 e	36.01 d	35.75 d
	15 th November	36.95 c	38.17 b	37.56 b
Genotypes × Seeding Rates		4 kg.ha ⁻¹	6 kg.ha ⁻¹	Means of Genotypes
	Pactol	36.21 ab	37.33 a	36.77 a
	Raja	34.41 c	35.07 bc	34.74 c
	Rendy	35.25 bc	36.04 a-c	35.64 b
Sowing dates × Seeding Rates		4 kg.ha ⁻¹	6 kg.ha ⁻¹	Means of Sowing date
	15 th October	33.52 d	34.20 d	33.86 c
	31 st October	35.29 c	35.97 c	35.63 b
	15 th November	37.06 b	38.27 a	37.66 a
Means of Seeding Rates		35.29 b	36.15 a	

Table (5): Effect of genotypes, sowing dates, seeding rates and their interactions on oleic acid % (C18:1).

Genotypes	Sowing dates	Seeding Rates kg.ha ⁻¹		Genotypes × Sowing dates
		4 kg.ha ⁻¹	6 kg.ha ⁻¹	
Pactol	15 th October	52.63 h	50.68i	51.65 d
	31 st October	58.37 f	52.07 h	55.22 cd
	15 th November	53.51 g	65.17 d	59.34 b
Raja	15 th October	51.98 h	63.26 e	57.62 bc
	31 st October	68.80 a	66.83 c	67.81 a
	15 th November	66.96 c	67.74 b	67.35 a
Rendy	15 th October	67.04 c	65.15 d	66.09 a
	31 st October	64.88 d	66.57 c	65.72 a
	15 th November	64.72 d	65.15 d	64.93 a
Genotypes × Seeding Rates		4 kg.ha ⁻¹	6 kg.ha ⁻¹	Means of Genotypes
	Pactol	54.83 b	55.97 b	55.40 c
	Raja	62.58 a	65.94 a	64.26 b
	Rendy	65.54 a	65.62 a	65.58 a
Sowing dates × Seeding Rates		4 kg.ha ⁻¹	6 kg.ha ⁻¹	Means of Sowing date
	15 th October	57.22 c	59.70 bc	58.46 c
	31 st October	64.01 ab	61.82 a-c	62.92 b
	15 th November	61.73 a-c	66.02 a	63.87 a
Means of Seeding Rates		60.99 b	62.51 a	

Table (6): Effect of genotypes, sowing dates, seeding rates and their interactions on linoleic acid % (C18:2).

Genotypes	Sowing dates	Seeding Rates		Genotypes × Sowing dates
		4 kg.ha ⁻¹	6 kg.ha ⁻¹	
Pactol	15 th October	16.05 i	16.64 gh	16.34 d
	31 st October	16.46 hi	16.47 hi	16.47 d
	15 th November	17.13 ef	20.11 b	18.62 bc
Raja	15 th October	17.38 e	16.80 f-h	17.09 d
	31 st October	16.02 i	18.15 d	17.08 d
	15 th November	17.95 d	17.25 ef	17.60 cd
Rendy	15 th October	17.00 e-g	21.16 a	19.08 ab
	31 st October	20.27 b	19.54 c	19.91 ab
	15 th November	20.85 a	19.56 c	20.21 a
Genotypes × Seeding Rates		4 kg.ha ⁻¹	6 kg.ha ⁻¹	Means of Genotypes
	Pactol	16.55 b	17.74 b	17.14 b
	Raja	17.12 b	17.40 b	17.26 b
	Rendy	19.37 a	20.09 a	19.73 a
Sowing dates × Seeding Rates		4 kg.ha ⁻¹	6 kg.ha ⁻¹	Means of Sowing date
	15 th October	16.81 b	18.20 ab	17.50 c
	31 st October	17.58 ab	18.05 ab	17.82 b
	15 th November	18.64 a	18.97 a	18.81 a
Means of Seeding Rates		17.68 b	18.41 a	

Table (7): Effect of genotypes, sowing dates, seeding rates and their interactions on linolenic acid % (C18:3).

Genotypes	Sowing dates	Seeding Rates		Genotypes × Sowing dates
		4 kg.ha ⁻¹	6 kg.ha ⁻¹	
Pactol	15 th October	8.39 c	9.34 a	8.86 a
	31 st October	8.05 de	8.69 b	8.37 ab
	15 th November	7.94 e	5.46 j	6.70 cd
Raja	15 th October	8.14 d	7.47 f	7.81 b
	31 st October	7.31 f	6.66 h	6.98 c
	15 th November	6.97 g	6.70 h	6.83 cd
Rendy	15 th October	6.81 gh	6.37 j-l	6.09 de
	31 st October	6.27 i	5.24 kl	5.75 ef
	15 th November	5.20 l	5.42 jk	5.31 f
		4 kg.ha ⁻¹	6 kg.ha ⁻¹	Means of Genotypes
Pactol		8.12 a	7.83 a	7.98 a
Raja		7.47 ab	6.94 b	7.21 b
Rendy		6.09 c	5.34 c	5.72 c
		4 kg.ha ⁻¹	6 kg.ha ⁻¹	Means of Sowing date
Sowing dates × Seeding Rates	15 th October	7.78 a	7.39 a	7.59 a
	31 st October	7.21 a	6.86 ab	7.04 b
	15 th November	6.70 ab	5.86 b	6.28 c
Means of Seeding Rates		7.23 a	6.70 b	

Table (8): Effect of genotypes, sowing dates, seeding rates and their interactions on Erucic acid % (C22:1).

Genotypes	Sowing dates	Seeding Rates		Genotypes × Sowing dates
		4 kg.ha ⁻¹	6kg.ha ⁻¹	
Pactol	15 th October	14.57 b	15.42 a	15.00 a
	31 st October	8.85 d	14.55 b	11.70 ab
	15 th November	13.86 c	0.79 fgh	7.33 c
Raja	15 th October	15.09 a	4.97 e	10.03 bc
	31 st October	1.07 fg	1.18 fg	1.12 d
	15 th November	1.19 fg	1.35 f	1.27 d
Rendy	15 th October	1.36 f	0.47 h	0.92 d
	31 st October	0.62 gh	0.66	0.64 d
	15 th November	0.91 fgh	0.99 fgh	0.95 d
Genotypes × Seeding Rates		4 kg.ha ⁻¹	6kg.ha ⁻¹	Means of Genotypes
	Pactol	12.43 a	10.25 a	11.34 a
	Raja	5.78 b	2.50 bc	4.14 b
	Rendy	0.96 c	0.71 c	0.83 c
Sowing dates × Seeding Rates		4 kg.ha ⁻¹	6kg.ha ⁻¹	Means of Sowing date
	15 th October	10.34 a	6.95 ab	8.65 a
	31 st October	3.51 b	5.46 ab	4.49 b
	15 th November	5.32 ab	1.04 b	3.18 c
Means of Seeding Rates		6.39 a	4.49 b	

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کاري کات و چري تودان له سهر بهرهم و جوړی چوند ته رزنيک له سه لجه م

پوخته

نهم تويزينه وهيه له كيلگه ي گرده په شه / کوليزي کوشتو کال / زانکوي صلاح الدين / ههولير له وهري زستاني (2014-2015) نه جامدرا ، به مه بهستي تويزينه وهي کاري بهرواري چاندن و تیکرای تووکردن وه ههردو کيان به يه که وه له سهر بهرهم و جوړی سه لجه م . بهر زترين بهرهم و پيوهري دورينه وه و % پون (4494.05 کغم / هکتار ، 31.77% و 39.05%) له مامه لکانی به يه که وهي (Raga x 31 October x 4kg.ha-1) (pacto) و (x 15th October x 4kg.ha-1) و (pactal x 15 Nov. x 6kg.ha-1) تو مار کران يه که له دواي يه که ، بهر زترين ريژه ي (68.8 و 21.16 و 9.34 و 10.09%) ترشه چهوريه کان (erucic , linoleic , olieic) له مامه له کاني (raja x 31 Oct. x 4 kg.ha-1) (ranja x 5 Oct. x 4kg.ha-1) (randy x 15 Oct. x 6kg.ha-1) (randy x 15 Oct. x 6kg.ha-1) تو مار کرا يه که له دواي يه که . بهر زترين وه نزمترين بهرهم (3769.11 و 1084 کغم/هکتار) له پیکهاته ي بوماوه ي Paktol و Rendy تو مار کرا يه که له دواي يه که .

تأثير موعد و معدل بذار في حاصل و نوع بعض التراكيب الوراثية للسلمج

الخلاصة

اجريت هذه الدراسة في حقل كرده ره شه كلية الزراعة / جامعة صلاح الدين / اربيل خلال موسم النمو الشتوي (2014-2015) ، لبحث تأثير تاريخ الزراعة و معدل البذار والتداخل بينهما في حاصل و نوعية السلمج . تم تسجيل اعلى الانتاج و دليل الحصاد و % للزيت (4494.05 كغم . هكتار ، 31.77% و 39.05%) في المعاملات (Raga x 31 October x 4kg.ha⁻¹) و (Pacto x 15th October x 4kg.ha⁻¹) و (Pactal x 15 Nov. x 6kg.ha⁻¹) على التوالي ، اما اعلى القيم (68.8 و 21.16 و 9.34 و 10.09%) للاحماض الدهنية (و Erucic, Linoleic و Olieic) حصلت في (Raja x 31 x Oct. x 4 kg.ha⁻¹) و (Raja x 5 Oct. x 4kg.ha⁻¹) 6kg.ha⁻¹) و (Randy x 15 Oct 6kg.ha⁻¹) ، (Randy x 15 Oct 6kg.ha⁻¹) على التوالي . دونت اعلى الانتاج (3769.11 كغم هكتار⁻¹) في التركيب الوراثي Paktol اما ادنى الانتاج (1084 كغم . هكتار⁻¹) سجلت في التركيب الوراثي Rendy.

A COMPREHENSIVE STUDY ON BIRD SEED MIXTURES ENTERED TO IRAQI KURDISTAN REGION MARKETS

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ABSTRACT

Bird seed mixtures samples were collected in (23/2/2013) from the local public grocer market from Iraqi Kurdistan Region Governorates- Erbil, Sulaimani, Duhok and Kirkuk by (Abdulla and Khalaf, 2014). These sample were subjected to many tests such as germination, viability, moisture, physical test and seed infestation by fungi and insects to give adequate information for these bird seed mixtures entered to Kurdistan Region as there are no survey or studies in this direction. The results revealed that these mixtures were not blended properly within the standard rules, as great variation was evident even within the seed of same species; while it supposes to be no less than 5% for each species. Most of the seeds species were viable according to standard germination tests, seeds were varied for normal percentage, abnormalities and non-germinated seeds within the same species but with different governorates, country source, and package materials. It suppose that the birds seeds must be non-germinable and must treated either by heat or sterilizing methods to prevent misuse as a narcotic purpose such as hemp. The highest non-germinated seeds were recorded from Poland at Kirkuk for some seeds according storage for long time or treatments (millet, canary, oat, flax, safflower, sorghum, niger, sunflower). Such variation in moisture content could be attributed to the permeability of packaging materials, their storage condition, and duration which was not specified. Low moisture content, in general was evident for oily seeds as they posses lower affinity with water in comparison to starchy or proteinous seeds. Two species of fungi (*Aspergillus sp.*, *Rhizopus stolonifer*) and three species of insects (*Sitophilus granarius*, *Tribolium castaneum*, and *Tribolium confusum*) were identified in some bird seed samples.

KEY WORDS: Birdseed, Mixtures, Infestation, Kurdistan.

INTRODUCTION

Bird seeds have been identified as a pathway for the introduction of invasive alien plants as contaminants. It is estimated that the market for bird seeds is increasing by 4% every year; this is linked to the increase of income and leisure time in industrialized countries, (EPPO, 2007). Some researchers and regulators are concerned that noxious weeds may be disseminated through bird seeds. So the identity of seeds in bird seed mixes must be determined, exactly and checked for the viability and germination.

Occasionally birdseed plants may appear as casuals. Mixtures sold as wild bird food are often scattered in gardens or on waste ground where some of the seeds germinate, (Hanson and Mason,

1985). Buddenhagen and Jewell (2006) studied how the seed viability of important invasive plant species was affected by processing and digestion by endemic birds; this impact the viability of seeds which their viability exceeded than 90%. They suggested that distance in which seeds may be dispersed depends on the bird's movement patterns.

Twigg *et al.* (2009) confirmed that various birds' species have a potential of dispersing viable seeds that pass through their gut, although the germination of passed seeds reduced to 42% compared with that of untreated which was 67%.

WBFI (2011) reviewed paper of scientific studies on the subject of noxious weed seeds in wild bird feed, they found that there were general assumptions that noxious weed seed that may occur in wild bird feed products consumed by

various wild birds will germinate when eliminated from the bird as a component of fecal matter.

Seed viability before and after processing by mockingbirds was high for all plant species, though the extent to which this relates to germination rates is not clear, since tetrazolium tests generally overestimate germination and the relationship between the two variable needs to be established experimentally (Baskin and Baskin, 2001).

Domenghini and Media (2013) assumed inviting flocks of birds to visit yard by enticing them with bird seed that means you inviting weeds. When seed falls from the feeder to the ground there is potential for germination, but not for all types of bird food.

Poisoned countless bird species across America to minimize the seeds infection by pathogen agents of *Aspergillus sp.*. The toxicological evidence and risk assessment have been studied by Boermans *et al.* (2007) they illustrated that mycotoxin contamination in pet food becomes a serious health threat animals. Various toxins have been found in the ingredients and final products of pet food, resulting in both toxicity and chronic health problems in pets. Thompson and Henke (2000) noted that aflatoxin can be produced regardless of type of storage container, time of storage, and climatic conditions.

As there is no information or statically issues on bird seed mixtures entered to Iraqi Kurdistan Region (the quality, types of seeds, and their components). It was suggested to carry on this study for the grocers of the governorates of Iraqi Kurdistan Region (Erbil, Sulaimani, Duhok and Kirkuk) to determine some tests for these seed mixtures such as: germination, viability, moisture content, some physical characteristics of the seeds, fungus and insect's infestation to have clear information about them.

MATERIALS AND METHODS

Samples of bird seed mixtures were collected in (23/2/2013) from the local public grocer market from Iraqi Kurdistan Region Governorates- Erbil, Sulaimani, Duhok and Kirkuk by Abdulla and Khalaf (2014). The samples were kept at the laboratory of Field Crops Department, University of Salahaddin. Thereafter sample of 100 gm from

each replication was taken randomly to be analyzed for the following trait:

Seed weight in percentage (Agrawal, 1980):

$$\% \text{ Weight of each fraction} = \frac{\text{Weight of individual fraction}}{\text{Total weight of sample (100g)}} \times 100$$

Number of each species in the samples: This was determined by hand sorting then recording the number of seeds for each species in each sample (100g).

Thousand seed weight in the birdseed mixtures for all seed species:

$$\text{Thousand seed weight (gm) on wet basis} = \frac{\text{Weight of individual fraction (gm)}}{\text{Number of individual fraction}} \times 1000$$

Seed moisture content in percentage: species was determined according to ISTA rules (2013). Initial sample weight of 0.5 up to 2 g depending on the availability of the seed species in the sample for oily seeds was placed in oven dried for 17 hours at 105°C and for non oily seeds for two hours at 130°C, then placed in desiccators for 30 minutes to cool and weighed.

$$\text{Moisture content \%} = \frac{\text{Sample weight before drying} - \text{weight after drying}}{\text{Sample weight before drying}} \times 100$$

Seed germination test was carried out for each seed component in the mixture, according to ISTA rules (2013); Four replicates of 25 pure seeds was germinated on filter paper placed in a light transparent plastic container (CD-box) of dimension (10X15cm) approx. With addition of 10 ml of water, covered with the lid, and placed in the growth chamber prefixed on either 20° or 25° C for winter and summer species respectively. The germination test evaluated through sorting the seedling to normal seedling, abnormal, and none germinated seeds.

Biochemical viability test by tetrazolium chloride for non-germinated seeds to distinguish between the viable dormant seeds and dead seeds TZ test was carried out. According to the reaction of tetrazolium test (Agrawal, 1980).

The oat seeds were bisected longitudinally only one of the halves was tested by immersing in (0.1%) solution at 35°C for two hours. While for hemp seeds were bisected longitudinally, then the half seed was immersed in (0.5%) solution at 40°C for two hours.

Seed health assessment for all seed species in bird seed mixtures for each sub-sample. This test was carried out for the presence of insects or fungi. Samples were examined visually by naked

eye for the presence of insects, while checking out the samples during germination test.

Detection of storage fungal pathogens test. During germination test, whenever fungi's was observed, they were identified and the percentage of infestation was recorded. Seeds were then examined for fungal growth under a stereo microscope.

The collected data were subjected to statistical analysis utilizing SAS version 9.1 (2003), to determine the seed weight percentage, thousand seed weight, seed moisture content%, germination% test, and viability by tetrazolium test for ungerminated seeds were analyzed as completely randomized design (C.R.D.), one way analysis of variance and Duncan's Multiple Range Test (1955) was used for means comparison at 0.05 level of significant.

RESULTS AND DISCUSSION

As there were sample collected data, discussion was focused only on some valuable traits.

Table (1) shows the comparison between eighteen samples of canary seed, sixteen samples of flax seed, and twenty samples of safflower that exists in the twenty two collected samples. The highest weight of seed percentage for canary seed was recorded from the sample entered from Iran in woven polypropylene bags at Duhok governorate (68.89%), followed by the sample entered from Turkey in woven polypropylene at Duhok governorate (11.06%) for flax seed, and for safflower seed from Iran in woven polypropylene at Duhok governorate (18.31%).

The highest normal seedlings percentage was recorded for the sample collected from Belgium at Sulaimani governorate in paper bag which was similar to sample from Turkey at Kirkuk in

Table (1): Means of some seed physical characteristic, moisture content% and germination components%.

Government	Erbil				Duhok						Sulaimani				Kirkuk						
	Canary	Country	Turkey	Turkey	Spain	Turkey	Turkey	Spain	Iran	Iran	Russia	Turkey	Iran	Belgium	Belgium	Turkey	Turkey	Spain	Spain	Poland	
		Package	P	Wp	Cb	Cb	Wp	P	P	Wp	Wp	P	Wp	P	Pb	P	Cb	Cb	Wp	Wp	
Seed weight		45.31 e	43.47 f	30.33 g	49.34 c	50.20 c	31.53 g	14.17 h	68.89 a	0.57 l	47.11 de	61.59 b	2.19 l	7.10 j	47.42 d	4.60 k	30.70 g	49.34 c	9.26 i		
No. seeds/ sample		6073.00 e	5626.30 f	4184.00 h	6681.50 d	7181.30 c	4604.30 g	2024.30 i	9641.80 b	78.5 l	6246.80 e	10474.00 a	304.0 l	979.80 k	6778.80 d	729.0 k	4226.80 h	6312.80 e	1367.30 j		
Thousand/ seed wt.		7.50 bcd	7.72 ab	7.25 c-f	7.38 cde	6.98 fg	6.84 gh	7.01 fg	7.12 efg	7.29 c-f	7.54 abc	5.88 j	7.19 def	7.25 c-f	6.99 fg	6.32 i	7.26 c-f	7.83 a	6.65 h		
Moisture (%)		6.17 e	7.50 a-e	7.00 b-e	7.25 b-e	8.12 a-e	7.00 b-e	6.66 cde	6.60 cde	7.50 a-e	9.00 ab	8.00 a-e	9.50 a	6.25 de	7.75 a-e	6.00 e	7.67 a-e	8.75 abc	8.50 a-d		
Normal		55.00 ab	55.00 ab	55.90 ab	26.00 c	62.00 ab	57.00 ab	53.00 b	60.00 ab	33.00 c	49.00 b	25.00 c	55.00 ab	70.00 a	55.00 ab	70.00 a	50.00 b	35.00 c	3.00 d		
Abnormal		8.00 bc	11.00 ab	11.00 ab	16.00 a	9.00 abc	10.00 ab	9.00 abc	8.00 bc	5.00 bc	6.00 bc	7.00 bc	10.00 ab	8.00 bc	6.00 bc	6.00 bc	5.00 bc	4.00 bc	1.00 c		
Non-germinated		37.00 def	34.00 ef	33.10 def	58.00 bc	29.00 def	33.00 def	38.00 def	32.00 def	62.00 b	45.00 cd	68.00 b	35.00 def	22.00 f	39.00 de	24.00 ef	45.00 cd	61.00 b	96.00 a		
Flax	Country	Turkey	Turkey	Spain	Turkey	Turkey	Spain	Iran	Russia	Turkey	Iran	Belgium	Turkey	Turkey	Spain	Spain	Poland				
	Package	P	Wp	Cb	Cb	Wp	P	P	Wp	P	P	Pb	P	Cb	Cb	Wp	Wp				
Seed weight		9.50 b	5.66 e	5.90 e	7.98 c	11.06 a	6.30 de	1.31 g	0.10 h				6.64 d	1.30 g	4.44 f		8.97 b	0.60 h	5.72 e	8.89 b	1.61 g
No. seeds/ sample		1504.50 b	717.14 d	865.0 d	1301.50 c	1805.50 a	807.2 d	150.7 e	17.25 f				1144.75 c	217.50 ef	218.25 ef		1335.75 bc	83.75 ef	774.5 d	1503.75 b	230.0 e
Thousand/ seed wt.		6.32 bc	5.71 c	6.84 bc	6.13 bc	6.13 bc	7.85 b	9.63 a	6.35 bc				5.80 c	5.96 bc	6.67 bc		6.72 bc	7.22 bc	7.40 bc	5.89 c	7.03 bc
Moisture (%)		3.00 de	2.75 e	2.75 e	5.75 b	5.50 bc	3.75 b-e	4.50 b-e	11.00 a				4.50 b-e	5.00 bcd	4.25 b-e		4.25 b-e	5.00 bcd	3.50 cde	4.00 b-e	3.50 cde
Normal		38.00 fgh	44.0 d-g	58.00 bc	67.00 b	92.00 a	56.00 bcd	32.00 gh	13.00 i				53.00 cde	42.00 efg	47.00 c-f		12.00 i	0.00 i	26.00 h	53.00 cde	1.00 i
Abnormal		51.00 a	29.00 bcd	23.00 cd	14.00 de	7.00 e	13.00 de	32.00 bc	6.00 e				33.00 bc	34.00 bc	29.00 bcd		52.00 a	40.00 ab	26.00 bcd	13.00 de	2.00 e
Non-germinated		11.00 hi	27.00 efg	19.00 fgh	19.00 fgh	1.00 i	31.00 efg	36.00 de	81.00 b				14.00 gh	24.00 e-h	24.00 e-h		36.00 de	60.00 c	48.00 cd	34.00 def	97.00 a
Safflower	Country	Turkey	Turkey	Spain	Poland	Turkey	Turkey	Spain	Iran	Iran	Russia	Poland	Turkey	Iran	Germany	Belgium	Belgium	Turkey	Spain	Spain	Poland
	Package	P	Wp	Cb	Pl	Cb	Wp	P	P	Wp	Wp	P	P	Wp	P	P	Pb	P	Cb	Wp	Wp
Seed weight		7.81 de	10.46 c	2.23 h	1.83 h	7.19 ef	7.63 de	5.23 fg	1.25 h	18.31 a	0.08 h	6.98 efg	7.79 de	9.91 dc	4.74 g	13.08 b	4.73 g	6.21 efg	2.44 h	5.88 efg	0.99 h
No. seeds/ sample		223.25 c-f	287.75 c	57.0 hi	41.25 i	206.75 ef	220.75 d	110.0 gh	31.00 i	542.50 a	2.75 i	259.50 cde	219.75 def	278.75 cd	125.75 g	353.50 b	114.0 gh	193.75 ef	60.00 hi	156.25 fg	37.50 i
Thousand/ seed wt.		35.70 b-e	36.89 bcd	39.22 abc	44.18 a	34.83 b-e	34.79 b-e	38.53 abc	40.53 ab	40.31 ab	30.41 def	28.91 ef	35.47 b-e	35.62 b-e	37.62 a-d	36.97 a-d	41.75 ab	32.10 c-f	40.64 ab	37.99 a-d	26.41 f
Moisture (%)		3.00 c	3.00 c	3.00 c	3.00 c	4.50 bc	5.00 bc	3.75 bc	4.00 bc	4.90 bc	8.00 a	4.50 bc	3.75 bc	5.00 bc	4.00 bc	4.25 bc	5.50 b	4.75 bc	3.50 bc	3.75 bc	8.00 a
Normal		17.00 b	16.00 b	19.00 b	16.00 b	10.00 bc	2.00 c	4.00 c	17.00 b	0.00 c	0.00 c	11.00 bc	32.00 a	0.00 c	0.00 c	0.00 c	0.00 c	0.00 c	0.00 c	0.00 c	0.00 c
Abnormal		55.00 c-f	66.00 bcd	68.00 a-d	76.00 abc	74.00 abc	88.00 a	73.00 abc	55.00 c-f	14.00 hi	14.00 hi	38.00 fh	31.00 gh	14.00 hi	49.00 d-g	15.00 hi	60.00 cde	45.00 efg	41.00 efg	81.00 ab	10.00 i
Non-germinated		28.00 efg	18.00 ghi	13.00 hgi	9.00 i	16.00 ghi	10.00 hi	23.00 fgh	28.00 efg	86.00 a	86.00 a	51.00 bcd	37.00 def	86.00 a	51.00 bcd	85.00 a	40.00 cde	55.00 b	59.00 b	19.00 ghi	90.00 a

* For each seed species, within each character, values sharing similar alphabetical letters are not significantly different at 5% level, according to DMRT (1955).

P= Polyethylene Wp= Woven polypropylene Cb= Cardboard box Pb= Paper bag Pl= Plastic buckets

cardboard box (70.0%), while the highest for flax from Turkey in woven polypropylene at Duhok governorate (92%).

The bird seed supposed not to be viable through heat treatment or radiation, but the results showed that these seeds have a high germination percentage that might cause a serious problem especially in dispersing of noxious invasive species such as: the sample entered from Iran in woven polypropylene bags at Duhok governorate (68.89%), and the sample from Iran also in woven polypropylene at Sulaimani governorate (61.59%).

The comparison between seventeen samples of oat seed and also seventeen samples of hemp seed that exists in the twenty two collected samples display in table (2). Concerning thousand seeds weight, for oat seed the highest was (35.41g) from Germany in polyethylene at Sulaimani, but the highest for hemp seed from Belgium in polyethylene at Sulaimani (37.90g).

Although the package are different in their permeability but seeds moisture content in polyethylene, woven polypropylene are similar to that of cardboard box, this situation cannot be judged as the storage period was not declared. In addition to storage condition and the date of moisture test was made package difference in permeability was stated by (Copeland and McDonald, 2001).

The lowest values for non-germinated seed were for Spain in polyethylene (53.0%) at Duhok. This revealed that these mixtures weren't blended systematically. Moreover they were entered from different sources.

This low germination ability of oat seeds is due to the fact that these seeds were dehulled and might be without germ or at least with damaged. Although, the germination percentage is too low, but it can be considered as a source of dispersion if they fall in the yard and transport with the household waste to the field.

The result of TZ test for oat seed after the initial evaluation of the physiological germination. The highest No. of viable seeds was from Germany in polyethylene at Sulaimani governorate (77.50%), while the remainder was similar statistically.

The initial evaluations of the physiological viability of hemp seeds. The highest value for red stained seeds was at Sulaimani governorate from

Iran in woven polypropylene (98.50%). It must take a great attention on the high percentage of viable hemp seed that entered from Iran, as hemp is one of narcotic seeds and must take attention seriously.

Fifteen samples of brassica seed, eight samples of sorghum seed, and nine samples of millet seed that exists in the twenty two collected samples were statistically analyzed and display in table (3). The highest moisture content percentage was for rapeseed sample from Turkey in cardboard box at Duhok (6.25%), while the least value was for Spain in polyethylene at Erbil (1.75%). Such low moisture content in rapeseeds in general is attributed to their lower affinity with water as they belong to oily seeds, while the variation between samples due to packages porosity and permeability.

Non significant differences were noticed in moisture content between sorghum seed samples; almost they were very closed as values ranged from 6.50% up to 8.75%. The highest moisture content percentage was for sample from Poland in woven polypropylene at Kirkuk (8.75%), while all other samples were nearly similar.

The highest moisture content percentage was for sample from Turkey in woven polypropylene at Duhok (20.0%). Comparing these values, with bird seed mixtures standards that fixed by

Table (2): Means of some seed physical characteristic, moisture content, germination components and TZ test.

Government		Erbil				Duhok				Sulaimani				Kirkuk			
Oat	Country	Turkey	Spain	Turkey	Turkey	Spain	Iran	Russia	Turkey	Iran	Germany	Belgium	Belgium	Turkey	Spain	Spain	Poland
	Package	P	Wp	Cb	Cb	Wp	P	P	Wp	P	Wp	P	P	Pb	P	Cb	Wp
Seed weight	11.03 _d	4.10 g	27.13 b	9.87 e	6.38 f	1.39 ij	2.07 hi	0.90 j	14.08 c	1.80 _{hij}	2.27 hi	6.63 f	2.34 h	9.99 e	33.55 a	10.62 _{de}	1.34 ij
No. seeds/ sample	549.00 _c	158.25 _h	1344.0 _{0 b}	373.75 _{ef}	319.25 _{fg}	95.75 _{hi}	97.00 _{hi}	31.25 _i	513.75 _{cd}	58.00 _i	64.50 _i	276.75 _g	160.50 _h	429.50 _{de}	1504.0 _{0 a}	512.75 _{cd}	49.00 _i
Thousand/ seed wt.	20.26 f	26.00 _{cde}	20.40 f	26.50 _{cde}	20.00 f	14.53 _g	21.31 f	28.63 _{bc}	27.49 _{bcd}	31.57 _{ab}	35.41 a	23.96 _{def}	14.99 g	22.95 _{ef}	22.33 _{ef}	20.71 f	27.59 _{bcd}
Moisture (%)	7.00 _{ab}	7.25 ab	6.50 ab	5.00 ab	5.50 _{ab}	3.00 b	9.00 ab	6.00 _{ab}	8.00 ab	6.00 _{ab}	7.50 ab	9.50 a	7.50 ab	9.00 ab	7.66 ab	8.17 ab	7.50 ab
Normal	0.00 c	0.00 c	12.00 _{bc}	0.00 c	20.00 _b	32.00 _a	0.00 c	0.00 c	0.00 c	5.00 c	20.00 b	1.00 c	1.00 c	0.00 c	4.00 c	1.00 c	0.00 c
Abnormal	3.00 _{bc}	1.00 c	9.00 ab	0.00 c	15.00 _a	15.00 _a	0.00 c	1.00 c	0.00 c	3.00 _{bc}	6.00 bc	0.00 c	2.00 c	0.00 c	3.00 bc	1.00 c	1.00 c
Non-germinated	97.00 _a	99.00 a	79.00 b	100.00 a	65.00 _{cd}	53.00 _d	100.00 a	99.00 a	100.00 a	92.00 a	74.00 bc	99.00 a	97.00 a	100.00 a	93.00 a	98.00 a	99.00 a
Stained (%) - TZ	0.00 b	0.00 b	0.00 b	0.00 b	0.00 b	0.00 b	0.00 b	0.00 b	0.00 b	0.00 b	77.50 a	0.00 b	0.00 b	0.00 b	0.00 b	0.00 b	0.00 b
Non stained (%) - TZ	100.00 a	100.00 a	100.00 a	100.00 a	100.00 a	100.00 a	100.00 a	100.00 a	100.00 a	100.00 a	22.50 b	100.00 a	100.00 a	100.00 a	100.00 a	100.00 a	100.00 a
Hemp	Country	Turkey	Spain	Poland	Turkey	Turkey	Spain	Iran	Russia	Poland	Turkey	Iran	Belgium	Belgium	Turkey	Spain	Spain
	Package	P	Wp	Cb	Pl	Cb	Wp	P	P	Wp	P	P	Wp	P	Pb	P	Cb
Seed weight	3.79 e	10.51 b	1.49 g	1.68 g	3.97 e	2.68 f	1.41 g	1.14 g	0.03 h	6.10 c	3.99 e	12.77 _a	6.43 c	3.94 e	4.95 d	1.26 g	3.57 e
No. seeds/ sample	226.25 _{fg}	719.25 _a	112.00 _{hi}	73.50 i	399.25 _c	239.50 _f	106.2 _{5 i}	78.00 i	2.50 j	380.00 _{cd}	361.50 _{cde}	637.7 _{5 b}	169.50 _{gh}	218.25 _{fg}	326.25 _{de}	88.75 i	304.25 _e
Thousand/ seed wt.	16.76 _{de}	14.58 _{efg}	13.36 _{ghi}	23.19 b	10.68 j	11.21 ij	13.33 _{hij}	14.58 _{efg}	12.08 _{hij}	16.02 _{ef}	11.12 ij	20.24 _c	37.90 a	18.41 _{cd}	15.23 _{efg}	14.19 _{fgh}	11.73 ij
Moisture (%)	3.25 _{bc}	4.25 _{abc}	2.75 c	3.00 c	6.50 _{abc}	5.00 _{abc}	6.50 _{abc}	8.00 ab	8.50 a	3.75 _{abc}	4.50 abc	3.75 _{abc}	4.50 abc	4.50 abc	5.75 _{abc}	8.00 ab	4.50 abc
Normal	0.00 c	27.00 b	0.00 c	0.00 c	0.00 c	0.00 c	0.00 c	5.00 c	0.00 c	0.00 c	0.00 c	42.00 _a	0.00 c	2.00 c	1.00 c	0.00 c	1.00 c
Abnormal	20.00 _b	21.00 b	5.00 cd	0.00 d	2.00 cd	1.00 d	0.00 d	2.00 cd	0.00 d	0.00 d	0.00 d	36.00 _a	0.00 d	7.00 c	4.00 cd	0.00 d	3.00 cd
Non-germinated	80.00 _d	52.00 e	95.00 _{abc}	100.00 a	98.00 _{ab}	99.00 _{ab}	100.00 a	93.00 _{bc}	100.00 a	100.00 a	100.00 a	22.00 _f	100.00 a	91.00 c	95.00 _{abc}	100.00 a	96.00 _{abc}
Stained (%) - TZ	10.50 _e	9.50 e	67.00 b	12.50 e	0.00 h	51.00 _c	5.00 f	3.50 _{fgh}	0.50 _{gh}	0.00 h	4.50 fg	98.50 _a	5.50 f	48.50 c	5.00 f	16.50 d	5.00 f
Non stained (%) - TZ	89.50 _d	90.50 d	33.00 g	87.50 d	100.00 a	49.00 f	95.00 _c	96.50 _{abc}	99.50 _{ab}	100.00 a	95.50 bc	1.50 h	94.50 c	51.50 f	95.00 c	83.50 e	95.00 c

* For each seed species, within each character, values sharing similar alphabetical letters are not significantly different at 5% level, according to DMRT (1955).

TZ= Tetrazolium test P= Polyethylene Wp= Woven polypropylene Cb= Cardboard box Pb= Paper bag Pl= Plastic buckets

Table (3): Means of some seed physical characteristic, moisture content% and germination components%.

Government		Erbil					Duhok				Sulaimani			Kirkuk			
Rapeseed	Country Package	Turkey P	Turkey Wp	Spain Cb	Turkey Cb	Turkey Wp	Spain P	Iran P	Russia Wp	Turkey P	Iran Wp	Belgium Pb	Turkey P	Turkey Cb	Spain Cb	Spain Wp	
Seed weight		14.82 bc	9.87 d	25.31 a	13.30 c	10.39 d	25.01 a	1.77 g	0.26 g	13.30 c	3.83 f	7.95 e	15.16 b	1.73 g	24.95 a	15.68 b	
No. seeds/ sample		4609.3 b	3024.5 d	6214.50 a	3979.00 c	2382.80 e	6523.80 a	472.80 g	65.00 g	3897.50 c	1817.00 f	1892.80 f	4174.80 c	438.30 g	6123.30 a	3330.00 d	
Thousand/ seed wt.		3.25 g	3.26 g	4.09 bcd	3.34 fg	4.36 ab	3.84 cde	3.74 def	4.04 b-e	3.41 fg	2.12 h	4.20 bc	3.63 efg	3.94 b-e	4.14 bcd	4.72 a	
Moisture (%)		3.25 cd	3.25 cd	1.75 d	6.25 a	6.00 ab	4.50 abc	4.00 bc	3.33 cd	4.50 abc	5.25 abc	3.75 cd	5.25 abc	6.00 ab	4.50 abc	4.00 bc	
Normal		43.00 bc	29.00 c-g	54.00 b	41.00 bcd	37.00 b-f	76.00 a	47.00 bc	20.00 d-g	29.00 c-g	17.00 fg	38.00 b-e	14.00 g	19.00 efg	40.00 b-e	45.00 bc	
Abnormal		25.00 c-f	28.00 cde	9.00 g	18.00 efg	55.00 a	19.00 efg	16.00 efg	12.00 fg	25.00 c-f	20.00 d-g	17.00 efg	34.00 bcd	43.00 ab	20.00 d-g	37.00 bc	
Non- germinated		32.00 cd	43.00 bc	37.00 cd	41.00 bc	8.00 e	5.00 e	37.00 cd	68.00 a	46.00 bc	63.00 ab	45.00 bc	52.00 abc	38.00 cd	40.00 c	18.00 de	
Sorghum	Country Package	Poland		Russia		Poland		Turkey		Germany	Belgium	Belgium	Poland				
		PI		Wp	P			Wp	P	P	Pb	Wp					
Seed weight		17.33 d		50.24 a	24.92 b			15.72 d	21.08 c	6.99 f	10.50 e	2.81 g					
No. seeds/ sample		602.50 c		2011.75 a	867.75 b			633.25 c	896.25 b	273.75 de	405.25 d	119.25 e					
Thousand/ seed wt.		28.76 a		24.98 b	25.74 b			25.08 b	23.51 c	25.61 b	25.96 b	23.51 c					
Moisture (%)		7.5		8.1	7.5			8.3	7.75	8	6.5	8.75					
Normal		24.00 b		59.00 a	3.00 b			68.00 a	55.00 a	25.50 b	61.00 a	1.00 b					
Abnormal		40.00 a		16.00 b	5.00 b			10.00 b	12.00 b	33.00 a	12.00 b	4.00 b					
Non- germinated		36.00 bc		25.00 c	92.00 a			22.00 c	33.00 bc	42.00 b	27.00 bc	95.00 a					
Millet	Country Package			Turkey Wp	Iran P	Russia Wp			Turkey Wp	Iran Wp	Germany P	Belgium Pb	Turkey Cb	Poland Wp			
Seed weight				0.18 g	38.58 c	13.74 d			11.20 de	0.43 g	4.94 fg	6.99 ef	76.65 a	69.40 b			
No. seeds/ sample				30.8 f	5418.00 b	2243.80 c			1417.90 de	75.80 f	1994.50 cd	1171.30 e	11417.8 a	11083.00 a			
Thousand/ seed wt.				5.26 d	8.05 a	6.14 c			6.22 bc	5.74 dc	2.47 e	6.00 c	6.74 b	6.26 bc			
Moisture (%)				20.00 a	7.87 b	9.67 b			8.50 b	10.00 b	9.00 b	8.50 b	11.50 b	9.00 b			
Normal				74.00 ab	60.00 b	77.00 a			3.00 d	61.00 b	23.00 c	68.00 ab	62.00 b	2.00 d			
Abnormal				18.00 a	10.00 bc	4.00 cd			2.00 cd	16.00 ab	0.00 d	3.00 cd	5.00 cd	1.00 d			
Non- germinated				8.00 e	30.00 cd	19.00 de			95.00 a	23.00 cd	77.00 b	29.00 cd	33.00 c	97.00 a			

* For each seed species, within each character, values sharing similar alphabetical letters are not significantly different at 5% level, according to DMRT (1955).

P= Polyethylene Wp= Woven polypropylene Cb= Cardboard box Pb= Paper bag PI= Plastic buckets

(CSBS, 1998) and (QAM, 2012) shows that the moisture content are mostly with minimum the maximum of the standard (13%), with the exception of sample from Turkey in woven polypropylene at Duhok (20.0%) which was too high.

The germination test of different samples displays in table (4) shows that the highest normal seedlings percentage of niger seeds was recorded for the sample collected from Iran at Duhok in polyethylene (84.0%), but the highest for buckwheat seed was from Turkey in cardboard box at Duhok, which was similar to Turkey in woven polypropylene at Duhok and to Turkey at Sulaimani in polyethylene all was (63.0%), and for sunflower seed was from Iran in woven polypropylene also at Duhok Governorate (73.0%).

Bird seed mixtures were not blended properly on standard base as their contribution as percentages were at different rates from Iran and Turkey. There were great variations in seed moisture content, from Iran and Turkey even within the same species due to storage conditions and packages material and most of seed moisture content it's above the standard.

Most of seed in the mixtures were viable mostly, that could be serious in dispersion particularly the non- identified seeds which consider as exotic seeds such as hemp and niger.

Fungus and insect's infestation in bird seed mixture as the storage facilities within local stores are not environmentally controlled; we hypothesized that environmental condition in which seeds stored were different geographically within different Kurdistan Governorates.

During testing all samples for their physical properties and germination, it was found that some samples were infested by fungus, table (5) shows the fungus were belong to two species (*Aspergillus sp. Micheli*, *Rhizopus stolonifer* (Ehrenb. Fr. Vuill.)).

Meanwhile it was observed some samples were infested by insects. Then identified the insects present in samples which was (*Tribolium castaneum* Herbst, *Tribolium confusum* Jacquelin du Val, and *Sitophilus granarius* L.). The infestation was high at Erbil and Kirkuk governorates, but the lower extent at Sulaimani and Duhok governorates.

Table (4): Means of some seed physical characteristic, moisture content% and germination components%.

Government	Erbil		Duhok		Sulaimani			Kirkuk
Niger	Country	Turkey	Turkey	Iran	Belgium			Poland
	Package	Wp	Wp	P	Pb			Wp
Seed weight		12.02 a	0.05 c	2.20 b	2.74 b			2.21 b
No. seeds/ sample		3413.25 a	13.25 d	895.75 b	781.75 bc			639.0 c
Thousand/ seed wt.		3.52 a	3.81 a	2.46 b	3.48 a			3.46 a
Moisture (%)		8.50 ab	20.00 a	11.50ab	5.00 b			4.00 b
Normal		2.00 d	64.00 b	84.00 a	15.00 c			1.00 d
Abnormal		7.00 ab	10.00 a	13.00 a	0.00 b			6.00 ab
Non- germinated		91.00 a	26.00 b	3.00 c	85.00 a			93.00 a
Buck wheat	Country	Turkey		Turkey	Turkey	Germany	Belgium	Belgium
	Package	Cb		Wp	P	P	P	Pb
Seed weight		0.06 c		0.05 c	0.27 c	3.59 b	9.44 a	3.61 b

No. seeds/ sample	12.75 c	10.75 c	16.50 c	153.50 b	389.50 a	149.0 b				
Thousand/ seed wt.	5.29 b	4.90 b	5.77 b	23.40 a	24.27 a	24.25 a				
Moisture (%)	19.50 a	16.66 a	15.00 a	6.50 b	9.00 b	8.00 b				
Normal	63.00 a	63.00 a	63.00 a	20.00 b	23.00 b	26.00 b				
Abnormal	9.00 b	11.00 b	8.00 b	33.00 a	27.00 a	28.00 a				
Non- germinated	28.00 b	26.00 b	29.00 b	47.00 a	50.00 a	46.00 a				
Sunflower	Country	Poland	Iran	Russia	Poland	Germany	Belgium	Belgium	Turkey	Poland
	Package	PI	Wp	Wp	P	P	P	Pb	Cb	Wp
Seed weight	38.04 a	7.22 d	3.69 ef	13.58 c	5.60 de	25.62 b	2.31 f	14.60 c	5.55 de	
No. seeds/ sample	529.50 a	143.50 c	72.75 c	106.00 c	90.00 c	388.75 b	31.25 c	366.50 b	71.75 c	
Thousand/ seed wt.	74.94 b	50.33 d	52.76 d	128.34 a	54.41 cd	65.95 bc	75.04 b	44.17 d	77.41 b	
Moisture (%)	3.00 b	4.00 ab	3.50 ab	3.00 b	4.50 ab	5.25 a	4.00 ab	4.00 ab	3.75 ab	
Normal	10.00 c	73.00 a	13.00 bc	0.00 d	20.00 b	13.00 bc	13.00 bc	8.00 cd	0.00 d	
Abnormal	74.00 a	10.00 d	76.00 a	40.00 b	44.00 b	23.00 c	27.00 c	5.00 d	0.00 d	
Non- germinated	16.00 e	17.00 e	11.00 e	60.00 c	36.00 d	64.00 c	60.00 c	87.00 b	100.00 a	

* For each seed species, within each character, values sharing similar alphabetical letters are not significantly different at 5% level, according to DMRT (1955).

P= Polyethylene Wp= Woven polypropylene Cb= Cardboard box Pb= Paper bag PI= Plastic buckets

Table (5): Samples infested with fungus (*Aspergillus sp.*, *Rhizopus stolonifer*).

Gov.	Country	Package	Characters	
			Seeds	Fungus
Erbil	Turkey	Woven polypropylene	Oat	<i>Aspergillus sp.</i>
			Safflower	<i>Aspergillus sp.</i> , <i>Rhizopus stolonifer</i>
	Poland	Plastic buckets	Sorghum	<i>Aspergillus sp.</i> , <i>Rhizopus stolonifer</i>
			Ground nut	<i>Rhizopus stolonifer</i>
Duhok	Turkey	Woven polypropylene	Safflower	<i>Aspergillus sp.</i> , <i>Rhizopus stolonifer</i>
	Iran	Polyethylene	Flax	<i>Rhizopus stolonifer</i>
			Hemp	<i>Aspergillus sp.</i> , <i>Rhizopus stolonifer</i>
			Sunflower	<i>Aspergillus sp.</i> , <i>Rhizopus stolonifer</i>
	Russia	Woven polypropylene	Wheat	<i>Rhizopus stolonifer</i>
			Mungbean	<i>Aspergillus sp.</i>
Sulaimani	Turkey	Woven polypropylene	Mungbean	<i>Aspergillus sp.</i>
			Lentil	<i>Rhizopus stolonifer</i>
	Iran	Woven polypropylene	Oat	<i>Aspergillus sp.</i> , <i>Rhizopus stolonifer</i>
			Safflower	<i>Aspergillus sp.</i> , <i>Rhizopus stolonifer</i>
	Belgium	Polyethylene	Squash	<i>Aspergillus sp.</i> , <i>Rhizopus stolonifer</i>
	Belgium	Paper bag	Sunflower	<i>Aspergillus sp.</i> , <i>Rhizopus stolonifer</i>
			Pine	<i>Aspergillus sp.</i> , <i>Rhizopus stolonifer</i>
Kirkuk	Turkey	Polyethylene	Canary	<i>Rhizopus stolonifer</i>
			Safflower	<i>Aspergillus sp.</i> , <i>Rhizopus stolonifer</i>
	Spain	Woven polypropylene	Oat	<i>Aspergillus sp.</i> , <i>Rhizopus stolonifer</i>
			Flax	<i>Aspergillus sp.</i>
	Poland	Woven polypropylene	Sunflower	<i>Rhizopus stolonifer</i>
			Sorghum	<i>Aspergillus sp.</i> , <i>Rhizopus stolonifer</i>

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USE OF COMPARATIVE ANATOMY FOR SEPARATING MIMOSACEAE TAXA GROWING IN KURDISTAN-IRAQ

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ABSTRACT

Trips started during 2013 revealed the presences of three species from Mimosaceae in Kurdistan – Iraq: Two of them occur in cultivation [*Prosopis juliflora* (Sw.) DC. and *Acacia Cyanophylla* Lindl.] and one (*Prosopis farcta* Banks et Sol.) is growing naturally. The anatomical study includes leaf blade and petiole cross sections. Results revealed that the phyllode is isobilateral, while *P. juliflora* and *P. farcta* are dorsiventral.

Two-layered palisade parenchyma exist in *A. cyanophylla* both abaxial and adaxial faces immediately beneath the epidermis. One layer in *P. juliflora* and two layer layers in *P. farcta*, each at adaxial face only. In the Phyllode, the central region located between the palisades layers consist of ground tissue of thin-walled parenchyma cells. Many minor collateral bundles are embedded in the ground parenchyma. Each bundle directs the xylem to the upper and lower surfaces alternately. In *P. juliflora* and *P. farcta* the spongy parenchyma exists at the abaxial face with xylem oriented towards the adaxial face and phloem towards the abaxial. *P. farcta* leaves show great differences from that of *P. juliflora* in respect to number of palisade layers, structure and shape of mesophyll. In the petiole cross section of *P. juliflora* and *P. farcta*, there is a single-stranded vascular bundle. Only in *P. juliflora* there are two more secondary wing bundles.

KEY WORDS: *Prosopis juliflora*, *Prosopis farcta*, *Acacia cyanophylla*, Dorsiventral, isobilateral.

INTRODUCTION

Classification based on anatomical characters has a long history, from the early days of microscopy, in which it has fascinated people who saw first the wide range of variation in plant anatomy. Plants shearing large numbers of anatomical characters in common are probably closely related.

The anatomical data have been used to identify taxa at all levels of hierarchy, as well as for assessment of the taxonomic relationships among taxa of all plants, especially the flowering plants (Stuessy, 1990). The arrangement and distribution of sclerenchyma and the nature of palisade and spongy tissues proved highly significant regarding relationships at the generic level in Australian and South African Restionaceae (Briggs and Johnson, 1979).

Petioles provide many useful anatomical applications. High variation was shown in petioles of some bi-collateral vascular bundles of *Cucurbita* L. (Agbaywa and Ndukwu (2004). Several petiole anatomical characters were employed by Saquaro (2005) for the delimitation

and assessment of species of genus *Ficus* L. Two members of the family Leguminosae: *Bauhinia* L. and *Hardwickia* Roxb. (Seetharam and Kotresha, 1998), and 10 mimosoid species (Shaheen, 2006) were also delimited and assessed using their petiole anatomical characters.

Altamimy (2008), in Iraq, made a comparative anatomical study using characters of adaxial and abaxial surface of leaf blade, petiole, and indumentums for *Caesalpinia gilliesii* L., *Cassia didymobotrya* Fres. and *Parkinsonia aculeata* L. belonging to Caesalpiniaceae. The researcher concluded that leaf blades and petioles contribute significantly to the identification of taxa.

Duarte and Wolf (2005) studied the anatomy of the phyllode and stem of *Acacia podalyriifolia* A. Cunn. ex G. Don (Fabaceae) using light and scanning microtechniques, in order to characterize the anatomy of the phyllode and stem and contribute to the species identification. Researchers found that the epidermal cells are polygonal and coated with striate and thick cuticle, and filaments of epicuticular wax, moreover, paracytic stomata and unicellular non-glandular trichomes represent distinct features of

the cuticular structure. In addition to palisade and ground parenchymas, and minor collateral bundles with xylem directed alternately to upper and lower sides occur in the blade. Researchers indicated that the midrib shows two collateral bundles facing each other.

In a study conducted by Teixeira and Gabrielli (2006) on *Dahlstedtia pentaphylla* and *D. pinnata* (Leguminosae), using leaflet surface assessment, histology and venation analyses to obtain taxonomic characters of diagnostic value. Histological sections are stained with toluidine blue, safranin/alcian blue, ferric chloride, acid phloroglucin. Results indicated the presence of secretory cavities in the lamina, petiolule, petiole, pulvinus and leaf primordium in *D. pentaphylla*, but not in *D. pinnata*, therefore the presence or absence of these characters can be considered important for species diagnosis.

Because leaf anatomy of Caesalpiniaceae and Mimosaceae has received little attention, anatomical data have been used to identification and assessment of the taxonomic relationships among taxa of the flowering plants at the generic and specific levels. **MATERIALS AND METHODS** Leaves of Mimosaceae species were

collected from naturally growing physiographic regions and from plants cultivated in gardens, parks, landscape and roadsides. Field and other trips were started during 2013. Several leaves from 3-5 shrubs and trees for each species were collected. Specimens were deposited in the herbarium of the Faculty of Agriculture, University of Duhok (DPUH). Details of specimen used for anatomy investigation are shown in the table (1).

Leaves were fixed in formalin: glacial acetic acid: 70% alcohol (5:5:90). Section was prepared according to the method described by Alexander (1940).

Transverse sections were prepared by using a rotatory microtome (Leitz 1512-West Germany) and stained with safranin. The slides were then mounted with DPX (A mixture of distyrene (a polystyrene), a plasticizer (tricresyl phosphate), and xylene) and covered with cover slip.

A light microscope (Olympus CX21) was used to view the slides and adjusted to finest resolution. Suitable image were photographed focused through the microscope eyepiece and documented using camera (Sony 18.2 meg-pixel).

Table (1): Herbarium Specimens Used for Anatomical Study. Vouchers Deposited in the Herbarium of Faculty of Agriculture / University of Duhok (DPUH).

<u>Species</u>	<u>Collected Position</u>	<u>Altitude</u>	<u>Date of Collection</u>	<u>No.</u>
<i>Prosopis juliflora</i>	Duhok	548 m	25.Jun.2013	3323
	Hawler (FAR)	453 m	15.Apr.2013	3327
	Rashanki (MAM)	803 m	10.Jun.2013	3298
<i>Prosopis farcta</i>	Darkari (MAM)	907 m	15.Jun.2013	3295
	Zawita (MAM)	963 m	22.May.2013	3264
	Semil	470 m	30.May.2013	3263
<i>Acacia cyanophylla</i>	Duhok	550 m	11.Apr.2013	3275
	Hawler (FAR)	424 m	13.Apr.2013	3269

RESULTS AND DISCUSSION

Prosopis juliflora

Leaflet Blade and Midrib

The lamina of the leaflet is 0.125-0.205 mm thick, it is dorsiventral. The adaxial and abaxial epidermal layers are 15.2-26.6, 9.5-22.8µm thick, respectively (table 2). The cuticle is prominent, with the adaxial is 3.8-11.4 µm thick, and the abaxial is slightly less, 3.8-9.5 µm thick. Both the

epidermal layers are stomatiferous. The mesophyll has a single palisade cell layer measuring 30.4-49.4µm in height, and contains many more chloroplasts than the spongy cells. The spongy mesophyll tissue is 41.8-110.2 µm wide and has four to five layers of loosely arranged parenchyma cells. Large mucilage cavities are very common in the mesophyll tissue; this is in agreement with results of Robertson, *et al.* (2010).

The midrib of the leaflet is slightly biconvex in transectional view, sometimes flat from the abaxial face. It is not, as indicated by Robertson, *et al.* (2010), flat and not projecting above the leaflet surface (figure 1). The vascular system is single-stranded and collateral, enclosed by a bundle sheath. The xylem is thick and broad. The phloem is thin and less prominent. It has very thick sclerenchyma bundle sheath, widens greatly towards the abaxial face.

Leaf Petiole

The cross section of the leaf petiole is semicircle, adaxially flat and abaxially strongly convex (figure 1C). Epidermis is unilayered, with a prominent cuticle layer and simple trichomes of different length. Trichome density on the petiole is found to be more than that on the blade.

The cortex of this species possesses parenchyma or ground tissue is arranged in continuous strata (figure 1C, D).

The petiole vascular system consists of two secondary adaxial bundles (wing bundles), occupying the corners of the two very small petiole wings, and one closed wide cylinder of mai

n abaxial bundle. The sclerenchyma sheath is thick and found all around the vascular bundles. The main cylindrical bundle encloses a central pith area.

Tissues and cells, displayed in figure (1D), reveal thick sclerenchyma and gelatinous fibers cupping the wing vascular bundle.

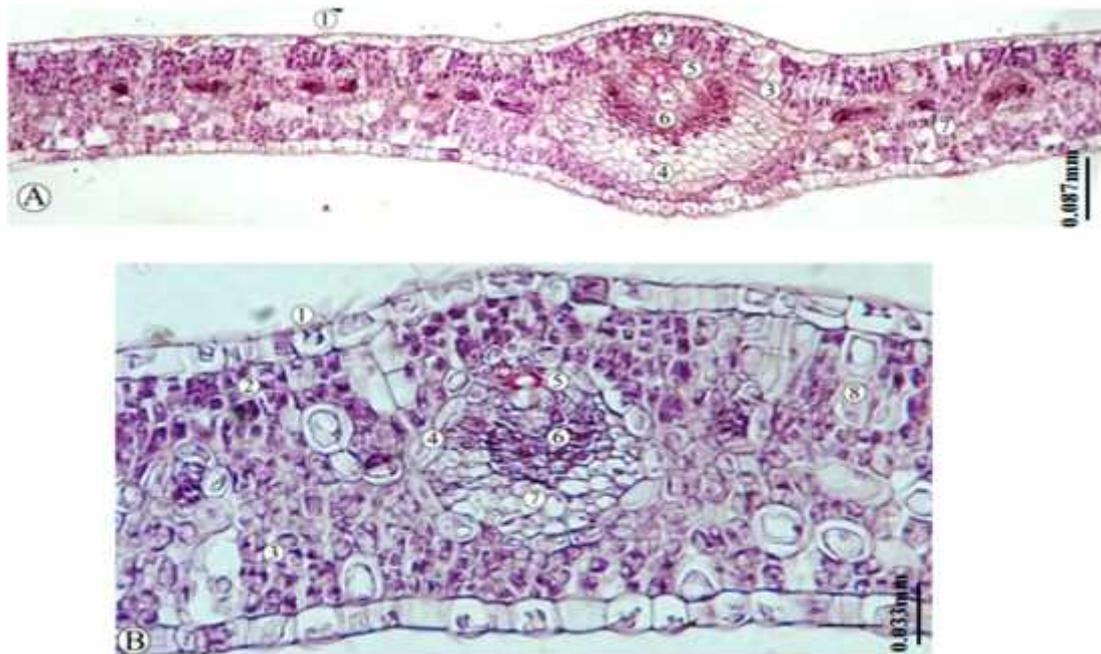
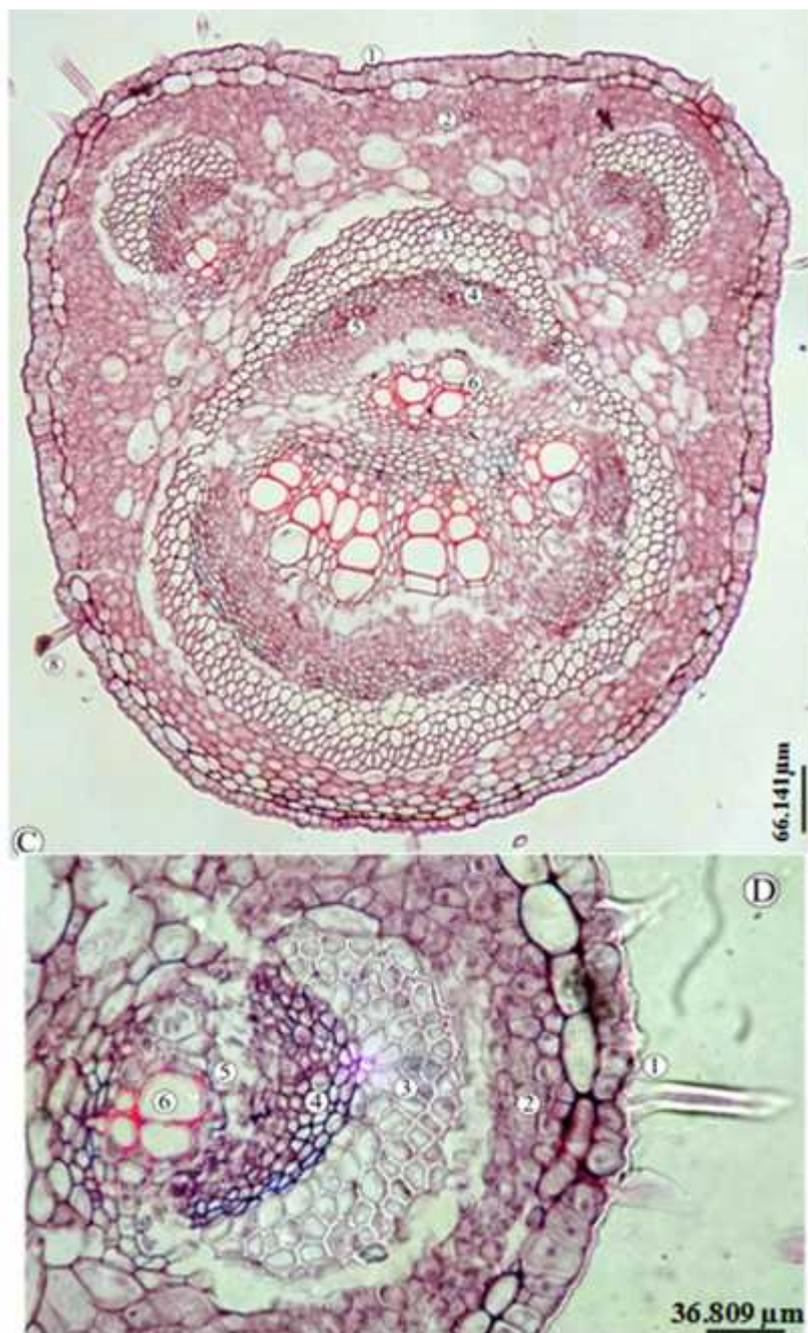


Fig. (1): *Prosopis juliflora*. A. Leaflet cross section: 1. Adaxial epidermis, 2. Palisade layer, 3. Bundle sheath, 4. Sclerenchyma, 5. Xylem, 6. Phloem, 7. Spongy parenchyma. B. Midrib cross section: 1. Adaxial epidermis, 2. Palisade parenchyma, 3. Spongy parenchyma, 4. Bundle sheath, 5. Xylem, 6. Phloem, 7. Sclerenchyma, 8. Mucilage cavity.



Continue Fig. (1): C. Petiole cross section: 1. Adaxial epidermis, 2. Ground tissue, 3. Pericycle sclerenchyma 4. Sclerenchyma arching vascular bundle, 5. Phloem, 6. Xylem 7. Medulary rays, 8. Simple trichome, 9. Secondary vascular bundle. D. Enlarged part of petiole cross section: 1. Epidermis with a simple trichome, 2. Parenchyma of the ground tissue, 3. Getatinous fibers, 4. Sclerenchyma arc, 5. Phloem, 6. Xylem.

Prosopis farcta

Leaflet Blade and midrib

The leaflet lamina thickness of *Prosopis farcta* ranges between 0.095-0.213mm which is slightly thinner than lamina of *Prosopis juliflora*. The internal leaf structure shows both epidermises formed by one cellular layer (figure 2A). The

adaxial and abaxial epidermal layers were 19-34.2, 19-32.2μm thick, respectively. Cuticle thickness of the both faces (adaxial and abaxial) is also prominent, 5.7-13.3, 5.7-11.4. From data given in (table 2), it is apparent that the epidermis and the cuticle layers of *Prosopis farcta* are much thicker than those of *Prosopis juliflora*. The

strongly stained epidermal cells is probably due to the phenolic content. Both the epidermal layers are stomatiferous.

The mesophyll has two adaxial palisade layers were 19- 47.5µm in height, and forming 55.3- 57.8% of the mesophyll thickness, with the thickest layer in direct contact and perpendicular to the adaxial epidermal layer. Palisade cells are loosely packed with many air spaces among cells (figure 2A, B). The spongy cells are highly variable in sizes and shapes, many exhibit palisade-like appearances. *Prosopis farcta* show great differences from that of *Prosopis juliflora* in respect to number of palisade layers and structure and shape of mesophyll.

The shape of midrib outline (figure 2B) is slightly biconvex. The vascular system is single-stranded and collateral. The xylem is thick, but the phloem is thin and less prominent. It has very thick collenchymas surrounding the vascular bundle, but this collenchyma tissue replaces only the inner palisade layer.

Leaf Petiole

The petiole cross section as shown in figure (2C) is spherical in shape. The anatomical

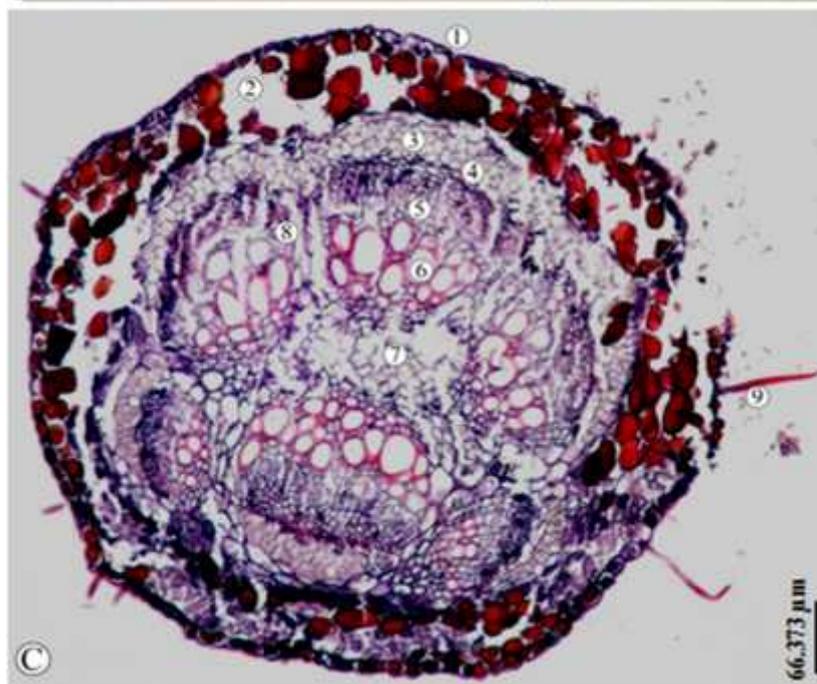
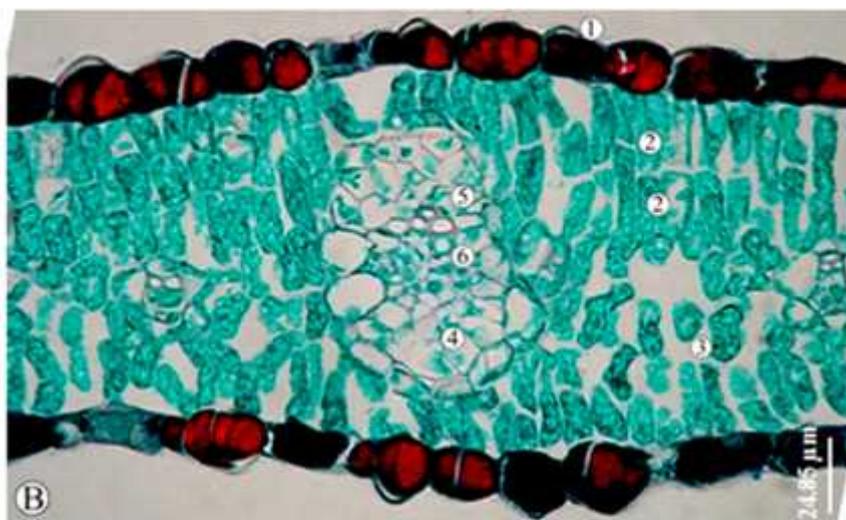
structure starts with one layer epidermal cells and is covered by a thick cuticular layer. Immediately below the epidermis, start the ground tissue of the cortex of variable thickness and arranged in continuous strata. The parenchyma cells of the cortex are filled of stained cell inclusions.

The petiole vascular system consists of a main cylindrical bundle arranged in a ring. The bundle is entirely surrounded by the sclerenchyma of the pricycle which is differentiated into a thick-walled sclerenchyma strips cupping over phloem regions, and the gelatinous fibers to the outside, forming a complete sheath surrounding the vascular bundle (figure 2C). Medullar rays extend from the pith and ending in the cortex, thus separating the main vascular bundle into 6 recognizable secondary bundles. Careful investigation of figures (2) reveals considerable similarities between *Prosopis farcta* and *Prosopis juliflora* in petiole vascular system, but considerable differences also occur.

Trichome structure and distribution of *Prosopis farcta* do not differ significantly from trichome of *Prosopis juliflora*, they are simple, unicellular, unbranched and denser on the leaf petiole than on leaflet blade.



Fig. (2): *Prosopis farcta*. A. Cross section of the leaflet blade: 1. Adaxial epidermis, 2. Palisade layers, 3. Spongy parenchyma, 4. Midrib, 5. Secondary vascular bundle.



Continue Fig. (2): B. Midrib cross section: 1. Adaxial epidermis, 2. Palisade layers, 3. Spongy paranchyama, 4. Collenchyma, 5. Xylem, 6. Phloem. C. Petiole cross section: 1. Adaxial epidermis, 2. Ground tissue of the cortex, 3. Gelatinous fibers, 4. Sclerenchyma arc, 5. Phloem, 6. Xylem, 7. Pith, 8. Medullary rays, 9. Simple trichome.

Acacia cyanophylla

Phyllode and Midrib

Both adaxial and abaxial surfaces are covered by thick cuticle, 5.7-11.4µm adaxial thick, 3.8-9.5 abaxial thick, (table 3). The epidermises have highly variable cell sizes with the upper epidermis thickness ranging 11.4-28.5, the lower from 17.1-26.6 µm. stomata are on the same level of the other epidermal cells (figure 3A, B). Adjacent to the upper and lower epidermal sides, a two-layered palisade parenchyma exists. The adaxial two palisades ranges 26.6-38µm in height, while the abaxial ranges 26.6-36.1µm in height.

The central region which is located between the adaxial and abaxial palisade layers consists of ground parenchyma, harboring few chloroplasts. The ground parenchyma ranges 171-307.8µm in width. Many minor collateral bundles with a cap of perivascular fibers next to the phloem are embedded in the mesophyll. Each bundle directs the xylem to the upper and lower surfaces alternately.

The midrib in the cross section is biconvex and the epidermis is similar to the epidermis of the blade. In the region below, an annular collenchyma is seen, and two major collateral bundles facing each other. The xylem is oriented towards the centre, and adjoining the phloem a perivascular fiber cap is encountered. The parenchyma cells of the ground tissue may contain calcium oxalate prisms, moreover abundant phenolic compounds are detected in the epidermis,

ground parenchyma and phloem. These results are in agreement with those indicated by Duarte and Wolf (2005) in his study on the phyllode of *Acacia podalyriifolia*.

Phyllode Stalk

The phyllode stalk transaction shown in figure (3C) is spherical in shape. The anatomical structure starts with one layer epidermal cells covered by a moderately thick cuticular layer. Immediately below the epidermis there start the ground tissue of the cortex of variable thickness and arranged in continuous strata. The parenchyma cells of the cortex are filled of stained phenolic compounds as referred by Duarte and Wolf (2005).

The vascular system greatly resembles the system of *Prosopis farcta* in regard of structure and shape. It seems that the vascular bundles of *Prosopis farcta* are more developed by possessing larger bundles and more supported sclerenchymatous tissue compared to those of *prosopis farcta*. phyllode stalk vascular system consists of a main cylindrical bundle arranged in a ring. The bundle is entirely surrounded by the sclerenchyma of the pricycle.

The small zone of the pith is located in the center of the stalk with medullary rays running radially through the vascular tissue into the ground tissue of the cortex. Like *Prosopis farcta*, the medullary rays cause separation of the vascular system into distinct 6 bundles.

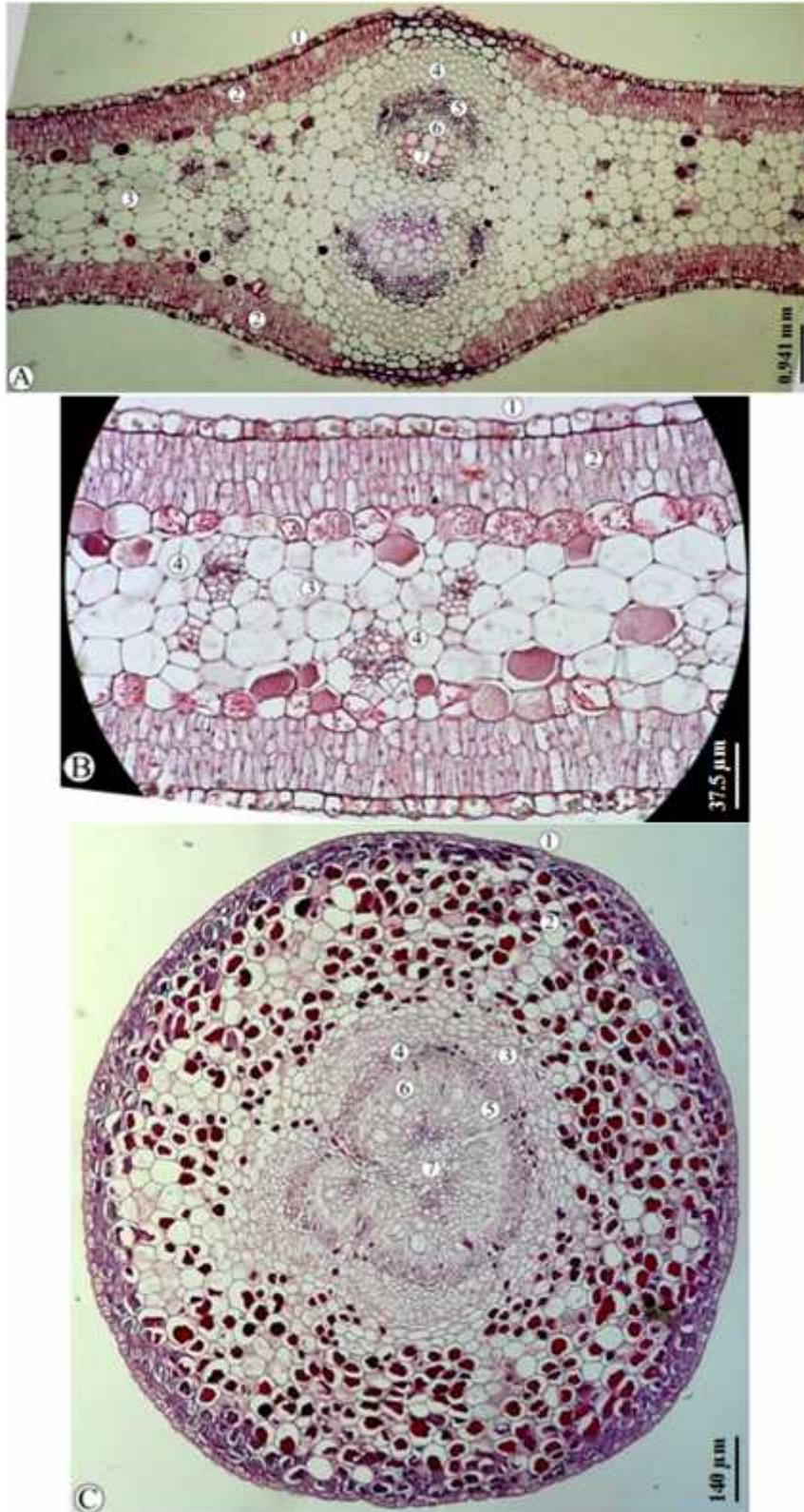


Fig. (3) *Acacia cyanophylla*. A. Phyllode cross section: 1. Adaxial epidermis, 2. Palisade layers, 3. Ground parenchyma, 4. Collenchyma, 5. Sclerenchyma, 6. Phloem, 7. Xylem. B. Part of phyllode blade: 1. Adaxial epidermis, 2. Palisade layers, 3. Ground parenchyma, 4. Vascular bundles. C. Petiole cross section: 1. Epidermis, 2. Ground tissue of the cortex with phenolic compounds, 3. Collenchyma, 4. Sclerenchyma, 5. Phloem, 6. Xylem, 7. Pith.

Table (2): Quantitative Characters of Cells and Tissues Measurements in Cross Section of Leaflet Blade or Phyllode of Mimosaceae Species.

<u>Characters</u>		<i>Prosopis juliflora</i>	<i>Prosopis farcta</i>	<i>Acacia cyanophylla</i>
Leaflet thickness or Phyllode (mm)	Mean	0.167	0.162	0.339
	Range	0.125-0.205	0.095-0.213	0.266-0.437
	STD	±0.027	±0.034	±0.045
Upper cuticle thickness (µm)	Mean	6.935	8.531	8.414
	Range	3.8-11.4	5.7-13.3	5.7-11.4
	STD	±2.487	±2.158	±1.847
Lower cuticle thickness (µm)	Mean	7.220	9.215	6.189
	Range	3.8-9.5	5.7-11.4	3.8-9.5
	STD	±1.910	±1.877	±1.953
Upper epidermis thickness (µm)	Mean	22.420	24.605	20.176
	Range	15.2-26.6	19-34.2	11.4-28.5
	STD	±3.928	±4.423	±3.962
Lower epidermis thickness (µm)	Mean	17.005	25.555	21.352
	Range	9.5-22.8	19-32.3	17.1-26.6
	STD	±3.458	±4.247	±2.998

Continues table (2): Quantitative Characters of Cells and Tissues Measurements in Cross Section of Leaflet Blade or Phyllode of Mimosaceae Species.

<u>Characters</u>	<i>Prosopis juliflora</i>	<i>Prosopis farcta</i>	<i>Acacia cyanophylla</i>	
Palisade parenchyma height, first row (µm)	Mean	19.665	29.83	31.757
	Range	15.2-26.6	19-41.8	26.6-38
	STD	±3.278	±6.439	±3.562
Palisade parenchyma one cell width, first row (µm)	Mean	12.008	12.065	11.599
	Range	7.980-16.34	7.6-17.1	8.36-17.1
	STD	±2.682	±2.974	±2.634
Palisade parenchyma height, second row (µm)	Mean	18.107	31.065	28.681
	Range	15.2-22.8	22.8-47.5	26.6-36.1
	STD	±2.741	±6.444	±2.812
Spongy parenchyma diameter (µm)	Mean	80.18	49.21	236.36
	Range	41.8-110.2	30.4-72.2	171-307.8
	STD	±18.157	±11.920	±41.983

Table (3): Quantitative Characters of Cells and Tissues Measurements in Cross Section of Leaflet Petiole or Phyllode Stalk of Mimosaceae Species (μm).

Characters		Prosopis juliflora	Prosopis farcta	Acacia cyanophylla
Epidermis thickness	Mean	22.90	22.67	20.9
	Range	11.4-34.2	19-29.64	15.2-26.6
	STD	± 6.93	± 3.20	± 3.8
Cortex thickness	Mean	144.85	130.91	296.86
	Range	98.8-243.2	106.4-159.6	163.2-380
	STD	± 48.25	± 14.66	± 73.60
Collenchymas diameter	Mean	96.12	88.16	308.75
	Range	45.6-186.2	64.6-121.6	254.6-380
	STD	± 45.79	± 14.72	± 39.91
Pith diameter	Mean	59.91	76.19	96.27
	Range	49.4-79.8	53.2-98.8	60.8-125.4
	STD	± 8.34	± 12.72	± 18.03
Parenchyma thickness	Mean	55.21	44.46	66.88
	Range	38-68.4	30.4-72.2	30.4-98.8
	STD	± 9.22	± 12.46	± 21.12
Phloem diameter	Mean	69.31	64.98	38.95
	Range	41.8-98.8	41.8-83.6	19-60.8
	STD	± 22.32	± 12.38	± 12.57
Xylem diameter	Mean	112.44	99.56	101.46
	Range	68.4-159.6	60.8-125.4	57-140.6
	STD	± 34.02	± 18.48	± 21.61

CHARACTERS OF IMPORTANT TAXONOMIC APPLICATION

The anatomical sections of the leaflet of *Prosopis juliflora* indicate the presence of large mucilage cavities common in the mesophyll tissue of *P. juliflora* but are absent in *P. farcta*.

The leaflet is dorsiventral in both species, but the phenomena of dorsiventry is stronger in *P. juliflora*, because most spongy parenchyma cells in *P. juliflora* are palisade like oriented in different directions, while in *P. farcta* spongy cells show high variability with large lacunae. The two species also differ in number of palisade layers at the adaxial face, which are two in *P. farcta* and one in *P. juliflora*.

The midrib vascular system of the two species show high similarity in respect of shape, structure and the sclerenchyma sheath around the bundle. Similarity is obvious in possessing ground tissue in the cortex of petiole of the both species. The main cylindrical vascular bundle is a common structure between the two species, but the

occurrence of two wing bundles in petiole of *P. juliflora* constitutes a major difference between the two species.

The phyllode

The phyllode is considered as a modified petiole, possessing characters of both the petiole and the leaf blade as follow:

1. Phyllode wherever exists is isobilateral, while, *P. juliflora* and *P. farcta* are dorsiventral.
2. Two-layered palisade parenchyma exists at the both abaxial and adaxial faces immediately beneath the epidermis. One layer in *P. juliflora* and two layers in *P. farcta*, each at adaxial face only.
3. In the phyllode, the central region located between the palisades layers consist of ground tissue of thin-walled parenchyma cells. Many minor collateral bundles are embedded in the ground parenchyma. Each bundle directs the xylem to the upper and lower surfaces alternately. In *P. juliflora* and *P. farcta* the spongy parenchyma exists at the abaxial face interspersed

by minor vascular bundles with xylem oriented towards the adaxial face and phloem towards the abaxial.

4. In the center (midrib) of *Acacia cynophylla*, there are two major collateral bundles facing each other. The central vascular bundles are surrounded by sclerenchymatous bundle sheath. and possess well developed xylem and phloem tissues. The phloem in the central two vascular bundles is facing towards the epidermis, while it is facing the abaxial face in *P. juliflora* and *P. farcta*. In the petiole cross section, there is a single-stranded vascular bundle with thick collenchymas surrounding the vascular bundle in *P. juliflora* and *P. farcta*. Only in *P. juliflora* there are two more secondary wing bundles.

5. In the midrib phyllode, the continuity of palisades is interrupted by the presence of sclerenchymatous patches below and above the central bundle. In *P. juliflora* and *P. farcta* the continuity of palisades is not interrupted by the presence of sclerenchymatous tissue.

6. The phyllode stalk transection shows much similarity to *P. farcta* petiole transection, they have similar ground tissue of cortex, and vascular bundles of the vascular system, with less developed sclerenchyma surrounding the bundles.

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CHEMOTAXONOMICAL STUDY OF THE GENUS *Fritillaria* L. (Liliaceae) IN KURDISTAN REGION OF IRAQ

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ABSTRACT

According to available standards compounds this study showed diagnosis seven phenolic compounds in HPLC as follows: Seven taxa belonging to the genus *Fritillaria* L. that are *Fritillaria alfreda* subsp. *glaucoviridis* Rix., *F. assyriaca* Bak., *F. crassifolia* subsp. *hakkarensis* Rix., *F. crassifolia* subsp. *kurdica* Boiss. & Noe. *F. imperialis* L., *F. uva-vlpis* Rix., *F. persica* L. has been studied through the diagnosis of phenolic compounds. As it has been checking the chemical composition of these species for their content of phenolic compounds used which: - Caffeine, Estragole, 2-6Dimethyl phenol, Coumarin, Eugenol, Salicylic acid and P-Cresol using a technique high performance liquid chromatography (HPLC) and the results showed the absence of phenolic compound P-Cresol in all taxa careless but phenolic compounds are most abundant: Caffeine, Coumarin Eugenol and which was found in all the studied taxa, followed by Salicylic acid, which is found in all studied taxa except *Fritillaria alfreda* subsp. *glaucoviridis* Rix while the phenolic compound Estragole (4- Allyl anisole) diagnosis in each of the *Fritillaria alfreda* subsp. *glaucoviridis* Rix., *Fritillaria imperialis* L., *F. persica* L. and *F. uva-vlpis* Rix. while 2-6Dimethyl compound phenol found in two types *F. persica* L., *F. uva-vlpis* Rix. Therefore, only the wide difference in the distribution of phenolic compounds in studied taxa belong to the genus *Fritillaria* can be used as chemical information that support in other taxonomic characteristics and not less important than in the area of classification of flowering plants.

KEY WORDS: Phenolic compounds, aerial parts, Liliaceae, (HPLC), Iraqi Kurdistan Region.

INTRODUCTION

The species of the genus *Fritillaria* L. are distributed especially in the Mediterranean regions and eastern parts of Asia, South and east of Europe, North of Africa and North America (Jordanov, 1964; Lozina-Lozinskaya, 1968; Heywood, 1978; Tutin, 1980; Pignatti, 1982; Rix, 1984, 2001; Townsend, 1985; Meikle, 1985; Feinbrun-Dothan, 1986; Rechinger, 1990; Özhatay, 2000; Xinqi & Mordak, 2000; Wallis & Wallis, 2003; Özhatay & Kültür, 2006; Tek en & Aytac, 2004, 2008; Özhatay et al., 2009). The species of the genus *Fritillaria* were first described in 1753, as *F. imperialis* L., *F. persica* L., *F. pyrenaica* L., and *F. meleagris* L. (Linnaeus, 1753, 1754).

Genus *Fritillaria* is a large genus of monocots with approximately 165 taxa grouped into 6 subgenera, 130 species, 17 subspecies, and 9 varieties (Kosenko VN., 1991, Zhang et al., 2010). Seven taxa of this genus grows in Kurdistan

region of Iraq (Khal, 2013). The bulbs of various *Fritillaria* species were traditionally used as an important antitussive, expectorant, and antihypertensive drug in Turkish, Chinese, Japanese, Pakistani and southeastern Asian folk medicines (Kaneko K, et al. 1981, Lin G et al. 2001). The morphological and physiological characterization of *Fritillaria* has been studied by various researchers. However, a chemotaxonomical systematic evaluation of the genus has not been thoroughly done. To the increased market demand, wild *Fritillaria* species is in short supply. Long-term excessive digging has Currently in Kurdistan region of Iraq, more and more wild medical increasingly exhausted wild resources, and as a plants are being cultivated. Such measures play an result, the species has been classified as a level-3 important role in the conservation of biodiversity protected medicinal plant. In recent years, with (Ishtiaq et al. 2010; Yang et al. 2010; Tisdell 2011; continuous

research and development of new drugs Pradhan & Badola 2012).

The level of Phenolic compounds are vary greatly within species which can be utilized as comparative data for understanding relationships, and one of main tools of chemotaxonomy (Stuessy, 1990). Which is one of the more modern and rapidly expanding areas of plant taxonomy as the taste and smell of plants belonging to chemical continents of plant mostly play important role in distinguishing some infrageneric taxa, (Al-Musawi, 1987). Phenolic compound considered as secondary metabolite in the plants, with high taxonomical value. A wide range of phenolic compounds have been reported from the members of this family (Zegorka and Glowniak, 2001). In plant materials it was difficult for detection of the phenols, however a number of methods have been proposed for the separation and determination of phenolic compounds mainly based on a high performance liquid chromatography (HPLC) technique and recently modern method of HPLC was conducted for analysis of naturally occurring phenolic compounds in aromatic plants such as the study of (Proestos and Komaitis, 2013). However because there is no phenolic profile available on the chemical composition of the *Fritillaria L.* species family (Liliaceae) growing in Kurdistan region of Iraq so this study was conducted in order to use it for taxonomical relationship between these species, the current work includes a chemotaxonomical systematic study of the taxa relating to the genus by using HPLC technique.

MATERIALS AND METHODS

Sample collection and Preparation:

The Harborne method was followed for extraction of phenolic compound in vegetative plant parts as follows, Harborne(1973) as the following:

1- Living samples of leaves and scapes of plants of the studied taxa were obtained from deferent locations in Kurdistan region of Iraq were dried at 25 °C in darkness and grinded by electric grinder.

2- The extraction method used for dried samples was done by adding :50 ml of alcohol %70 was

added to 5 gm of each specimen, and left at room temperature for 48 hrs.

3- The extraction mixture was then filtered by filter paper (medium pores filtering).

4-The extract was concentrated to adequate volume in order to get rid of alcohol by using air conditioner.

5-As much as volume of Petroleum Ether (80-100 boiling point) was added to the product, mixture shaken gently, placed in separating funnel and left for some time to be separated clearly into two layer. Thereby, the major part of chlorophyll dissolved in petroleum ether, and float because of its lesser density than water extraction of phenolic compounds that dissolve in water and make the lower layer, which draw from lower of funnel.

6-Extracts of phenolic compounds were concentrated approximately into a half volume by exposing to dry air and injected to HPLC.

HPLC Analysis:

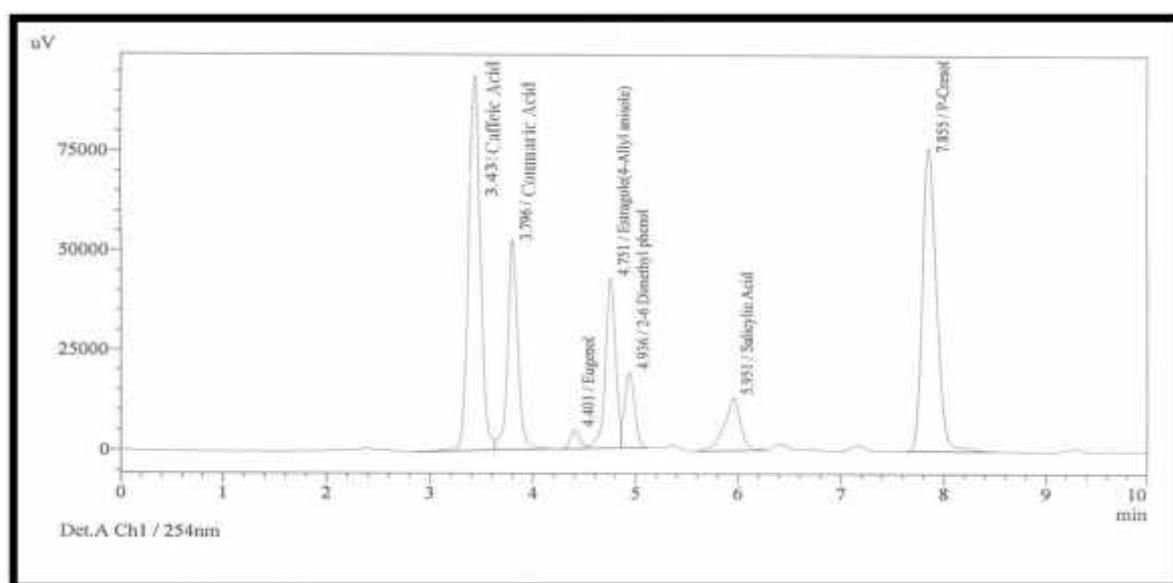
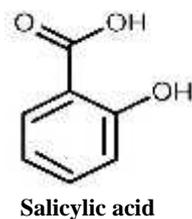
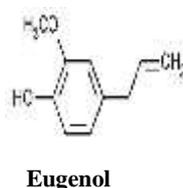
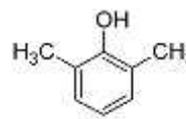
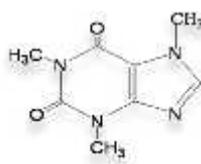
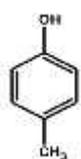
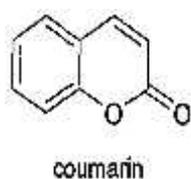
The analysis was conducted in the Sulaimani Polytechnic University, Agricultural Technical College. The prepared phenolic extracts of the step 6 (as earlier mentioned) were used, to diagnosis and determine the phenols quality of each species, by using HPLC. The analytical HPLC system employed consisted of high performance liquid chromatograph apparatus .The separation was achieved on Analytical column: Eurospher 100, C18, 5µm, 250 x 4.6 mm at ambient temperature. The mobile phase consisted of water-acetonitrile water: concentrated phosphoric acid (400:600: 3± 0.05). The flow rate was 0.8 mL/min and the injection volume was 20 µL. The monitoring wavelength was 254. Temperature: 25C°. The identification of each compound was based on a combination of retention time and spectral matching.

RESULTS AND DISCUSSION

The kinds of phenolic compounds which detected in the samples are presented in Table (1) with the Retention times of each of them and with their structure figure (1), the standard curves of them illustrated in Figure (2), Figure (3), Figure (4) Figure (5) and Figure (6).

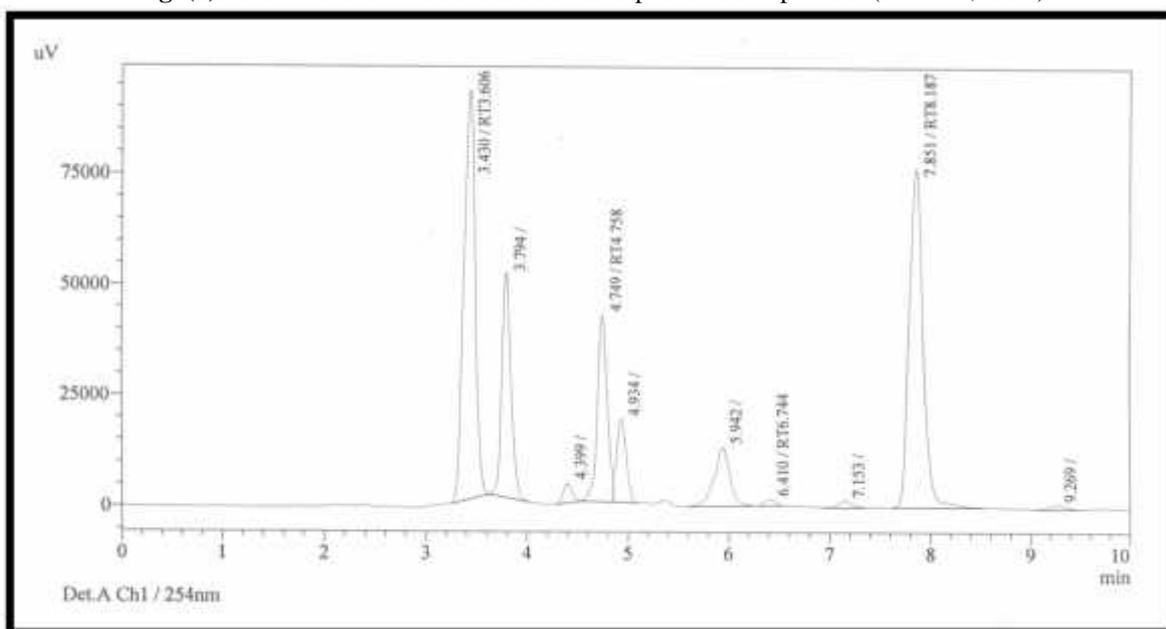
Table (1): Retention time of standard phenolic compounds by (HPLC).

No.	Compound names	Retention time (minute)
1	Caffeine	3.431
2	Coumarin	3.796
3	Eugenol	4.401
4	Estragole(4- Allyl anisole)	5.751
5	2-6Dimethyl phenol	5.936
6	Salicylic acid	5.951
7	P-Cresol	7.855



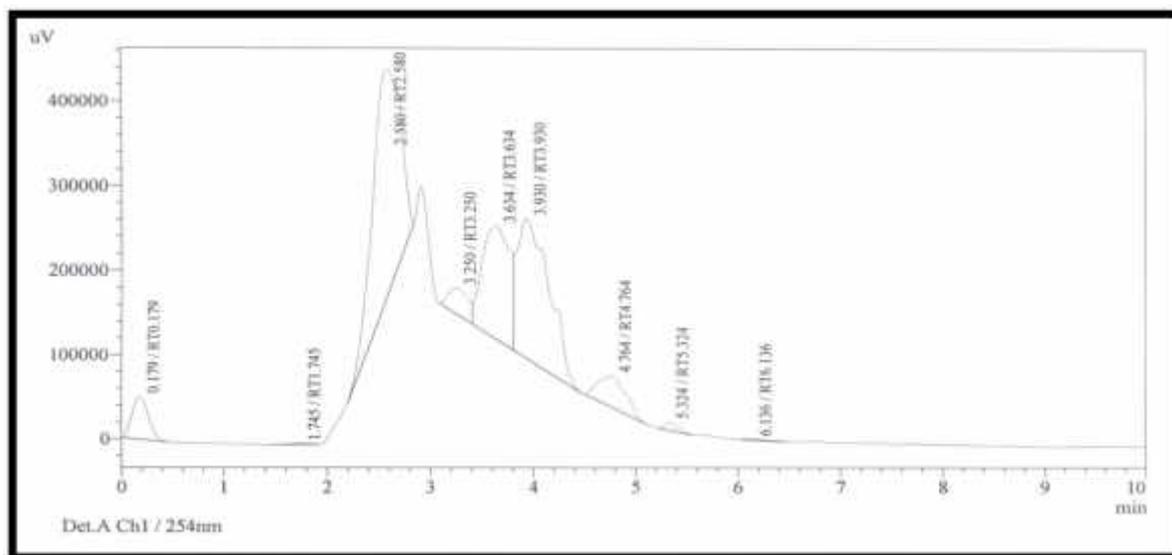
A

Fig. (1): Chemical structures of used standard phenolic compounds. (Dewick, 1997) .

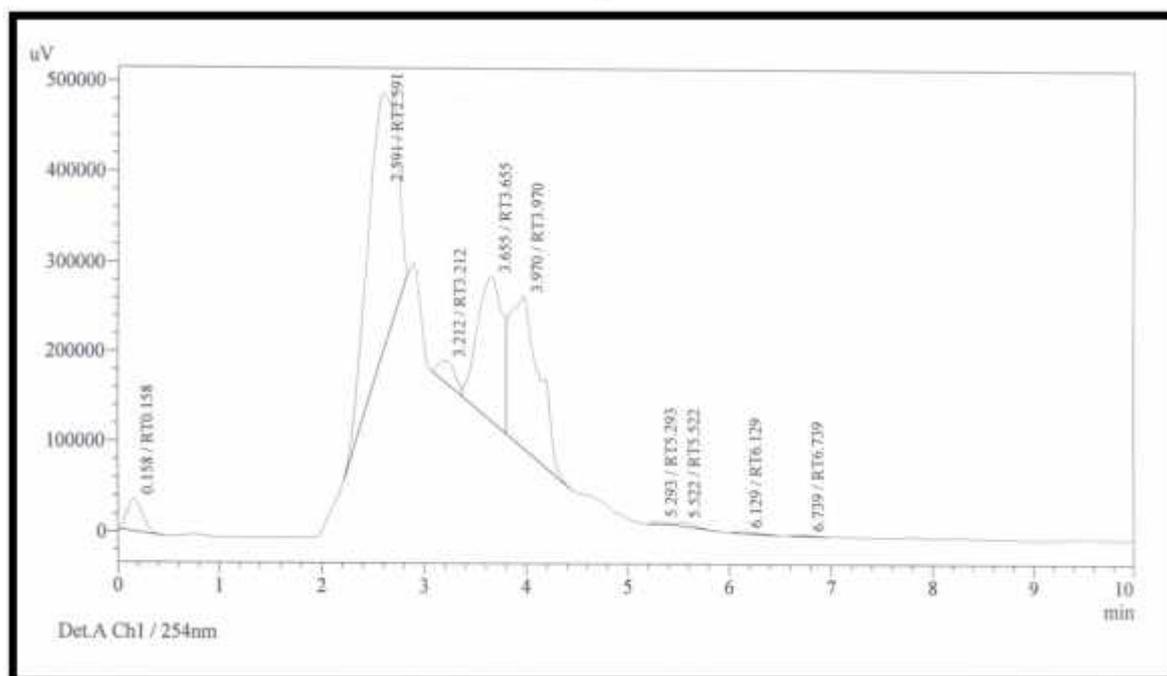


B

Fig. (2 A&B): Diagram of separated standard by HPLC.
Caffeic acid, Coumaric acid, Eugenol, Estragole (4- Allyl anisole), 2-6 Dimethyl Phenol, Salicylic acid and P-Crecol.

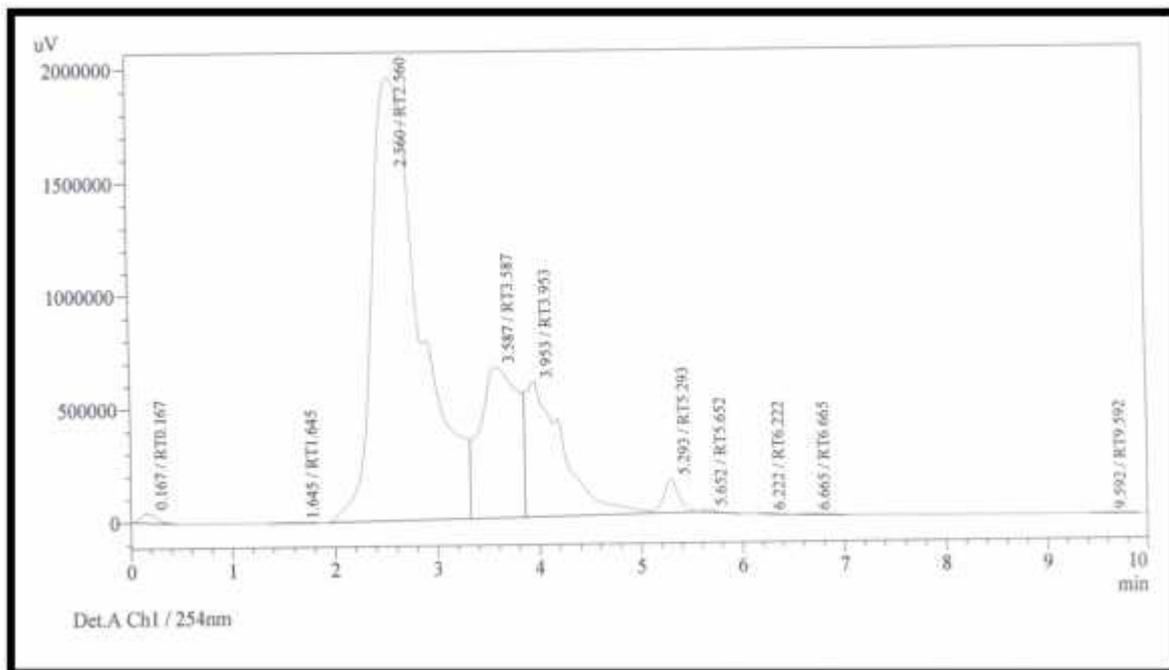


A

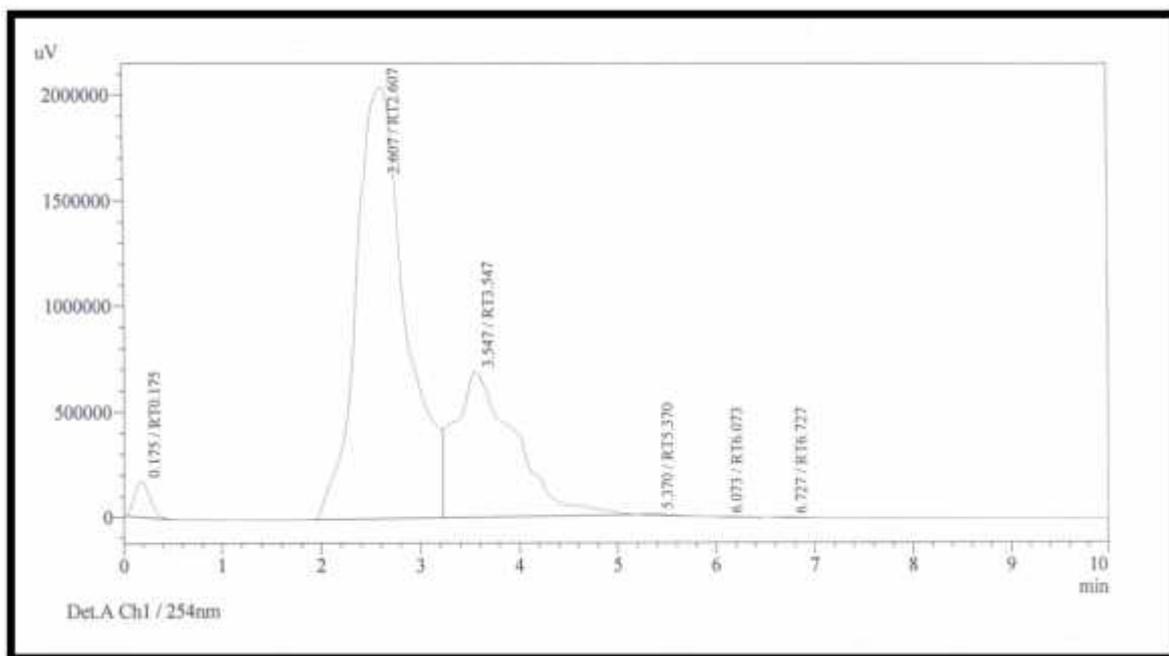


B

Fig. (3): Phenolic compound by HOLC of
A- *Fritillaria alfreda* sub sp. *gloucoviridis*
B- *F. assyrica*

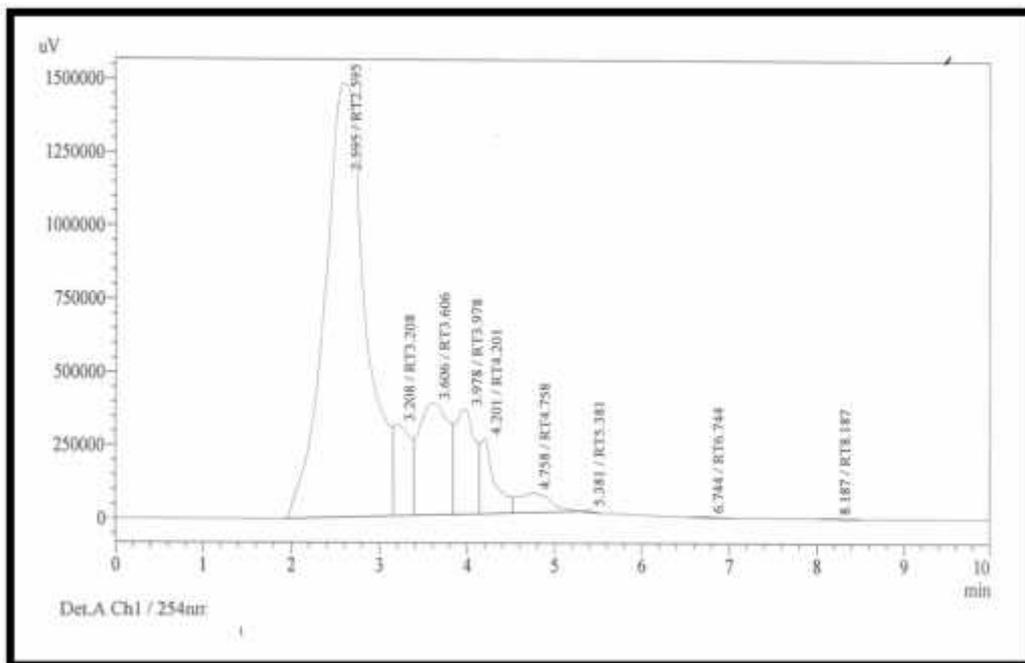


A

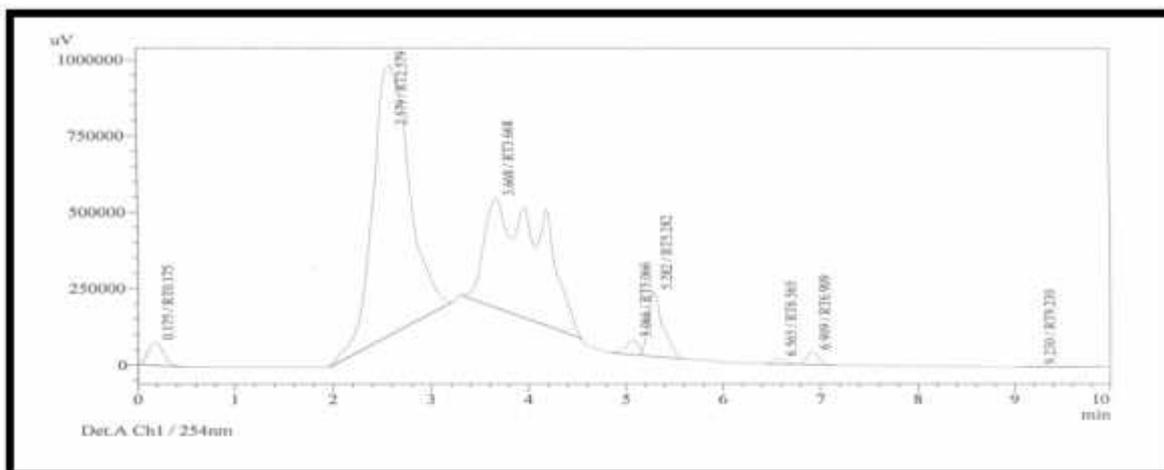


B

Fig. (4): Phenolic compound by HPLC of
A - *F. crassifolia* sub sp. *hakkarensis*
B - *F. crassifolia* sub sp. *kurdica*



A



B

Fig. (5): Phenolic compound by HPLC of
A - *Fritillaria imperialis*
B - *F. persica*

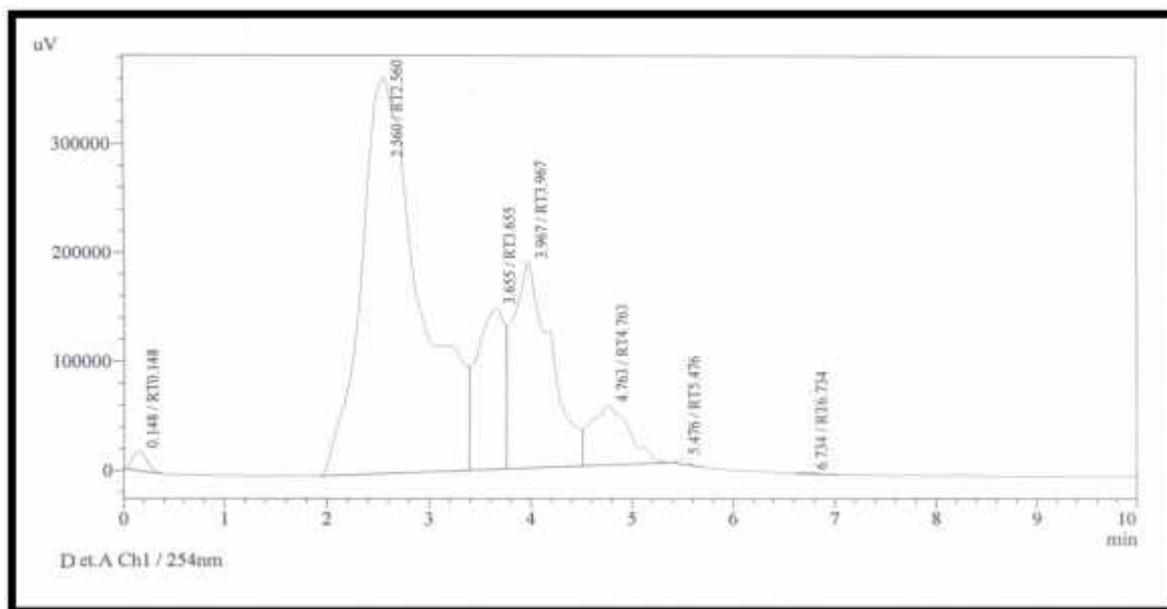


Fig. (6): Phenolic compound by HPLC of *F. uva-vlpis*

The results in Table (2) showed the kinds of phenolic compounds which obtained by methanolic extracts of the plant material from the seven samples, the results show that there is increased variability in the analysed species and found that the most abundant phenolic compounds were Caffeine, Coumarin and Eugenol. According to available standards compounds this study showed diagnosis seven phenolic compounds in HPLC as follows:

1- Solver ethanol was identified in all species which studied.

2- Caffeine, Coumarin and Eugenol present in all studied taxa .

3- Salicylic acid was revealed in all studied taxa except *Fritillaria alfreda* subsp. *glaucoviridis* Rix. .

4- Estragole(4- Allyl anisole) was identified in species *Fritillaria alfreda* subsp. *glaucoviridis* Rix., *Fritillaria imperialis* L., *F. persica* L. and *F. uva-vlpis* Rix..

5- P-Cresol was not found in any taxa of the genus *Fritillaria*.

Table (2): Distribution of phenolic compound in all studied taxa of the genus *Fritillaria*.

Species	Phenolic compounds							Number of compounds
	Caffeic acid	Coumaric acid	Eugenol	Estragole	2-6 Dimethyl phenol	Folycylic acid	P-cresol	
<i>Fritillaria alfreda</i> subsp. <i>glaucoviridis</i> Rix.	X	X	X	X				4
<i>F. assyriaca</i> Bak.	X	X	X			X		4
<i>F. crassifolia</i> subsp. <i>hakkarensis</i> Rix.	X	X	X			X		4
<i>F. crassifolia</i> subsp. <i>kurdica</i> Boiss. & Noe.	X	X	X			X		4
<i>Fritillaria imperialis</i> L.	X	X	X	X		X		5
<i>F. persica</i> L.	X	X	X	X	X	X		6
<i>F. uva-vlpis</i> Rix.	X	X	X	X	X	X		6
Number of taxa	7	7	7	4	2	6		---

So there were differences in the phenolic profile of the studied taxa because of the difference in their genomic structure and this is in agreement with (Proestos and Komaitis, 2013) who found that the presence of polyphenols in any plant is largely influenced by genetic factors.

The identification of each phenolic compound was based on a combination of retention time and spectral matching, since polyphenols absorb in the ultraviolet (UV) region and using aqueous methanol for performing the extraction due Methanol has a protective role. It can prevent phenolic compounds from being oxidized by enzymes, such as phenoloxidases this is in agreement with (Harborne, 1998). Chemotaxonomic study of herbs provides only a quantitative account of secondary metabolites. HPLC is popularly used for the analysis of plant because it is easy to perform and its use is not limited by the volatility and stability of the sample compound and have been used to distinguish genuine plant from adulterants. HPLC is a versatile, robust, and widely used technique for the isolation of natural products,

HPLC is a versatile, reproducible chromatographic technique for the estimation of secondary metabolites in the plants. It has wide applications in different fields in terms of isolation, quantitative and qualitative estimation of active molecules. In addition, this study has presented an overview of advanced extraction techniques to isolate and purify compounds from plant-based sources, primarily by HPLC technique.

The phenolic content in any plant using HPLC was very necessary as in the event of complex plant matrix selection of appropriate chromatographic condition for HPLC is a matter of great importance as well as a potential analytical problem and extremely reduce time and efforts compared with other chromatographic methods.

CONCLUSIONS

The presence of phenolic compounds, usually called polyphenols, in aromatic plants proved by employing high performance liquid chromatography was different not only within the genera, but also within the species of the same genus, which can be used for determining taxonomic relationships between the taxa belonging to these genera. This study showed some important parameters to analyze bioactive

compounds occurring in plant material, since they consist of multi-component mixtures, and their separation determination still creates problems.

The results of this study are agreed with the results found by (Khal, 2013)

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ECONOMIC EVALUATION OF ECO-TOURISM FOR ZAWITA FOREST LOCATION IN DUHOK PROVINCE/IRAQI KURDISTAN REGION

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ABSTRACT

This study covered Zawita forest Location in Duhok province for estimating the Eco-tourism demand function by using travel cost model. The questionnaire method was used for collecting required data for estimating the Eco-tourism demand function, which included the relationship between visitors rate as a dependent variable and the independent following variables: Travel cost from place of residence, cost of travel within the selected tourist spots, cost of boarding and lodging, other miscellaneous expenditure, part of travel cost incurred within the selected tourist spot, Per-capita household income per day corrected for number of days spent in the selected tourist spot, reason for visiting the selected tourist spot, education levels, age (years), and gender. The statistical analysis was conducted to find the relationship between the dependent variable in Eco-tourism demand function and the other independent variables using more than relationship, done to the best of those relations. Simple and multiple regressions were used; moreover the logarithmic transformation of data was done for the values of the dependent variable and introduced in the analysis. Thus, the best results were obtained presented for the selected location in this study and the questionnaires included (100) sample, however some observations have been excluded, as a result of incompleteness accuracy of the data which have been recorded in those forms.

The results showed high relationship between the demand for eco-tourism and the other independent variables in the location, referred to that the values of (R^2) for selected location was (75.80 %), so the results of simple regression were presented in tables to shows the different relationships between the visitation rate and the independent variables. Conclusions and recommendations were presented to develop the aspects of eco-tourism in Duhok province / Iraqi Kurdistan Region.

KEYWORDS: Eco- tourism Evaluation, Travel Cost Method (TCM), Duhok province /Iraqi Kurdistan Region, Forestry Recreation.

INTRODUCTION

Eco-tourism, Whether called natural tourism, recreational and educational travel based on natural attractions is a promising mean of advancing social, economic, and environmental objectives in developing countries. Eco-tourism offers new opportunities in these countries for small-enterprise investment, employment and increased the national stake in protecting their biological resources. However, making Eco-tourism a positive economic and environmental tool requires policies that foster responsible natural tourism development, broad-based and active local participation in its benefits, and conservation of developing countries. The scientific and rational value of the eco-tourism resources is in favor of the cost - benefit analysis

of the tourism development and investment and the protection of the eco-tourism resources development, specification, and sustainable development. At present, the main method and system are initially formed by the international resources and environmental value accounting to the theory and evaluation methods of the utility theory basis, the scarcity of resources, welfare economics and environmental economics. (Wang et al., 2012).

Environmental resources in today's world are considered as valuable assets, the protection of which should be the fundamental human efforts. Whereas economic considerations generally play a key role in decisions, economic valuation of ecosystem services has attracted special attention in recent years. In fact, the idea of economic valuation of environmental benefits of parks and

recreation Locations has been considered since 1947 (Majnonian, 1995). Many efforts have been conducted to determine the benefits of visitors who visit recreation Locations of forest and national parks. (Amirnejad and Khalilian, 2006). In the last three decades, a range of economic valuation methods for ecosystem services have been developed to determine their values via people's preferences as expressed by willingness to pay. Such activities are an important part of benefit-cost analysis in parks' management plans (Amirnejad, et al., 2006). Tourism industry is one of the main driving forces of the global economy, and plays a key role in location and destination development. Successful tourism operations can generate significant foreign exchange, employment, and numerous revenue opportunities for local communities. (Perera, 2011).

This study discusses the relationship between forests and eco-tourism within the framework of applying the Travel cost method in evaluation this relationship which depend on the demand function.

The Problem of this research was that some forests habitats are destroyed and some of the wildlife they contain is driven to extinction under the pressures of hunting, logging, arbitrary pasturing, burning, agricultural production etc. Where Locations have been officially reserved for natural conservation, many governments of developing countries don't allocate sufficient funds to manage and protect them. These Locations are being destroyed because they are not fully valued for their role as natural's genetic reservoirs of the world's biological resources. This problem exit in forests of Kurdistan Region which reflect in most aspects of living such as economic, social, and environmental aspects. For that objectives for this research putted which were: development of the economic value of eco-tourism for natural areas and parks, using approaches and criteria of evaluation methods and techniques that have been implemented in eco-tourism Locations, to enables natural Location managers, such as National and Park administrators and rangers to easily gauge the economic contribution of eco-tourism to localities and Locations by measuring the level of direct expenditure brought by tourism to natural locations depending on data used to present cases to better resource the management of the natural environmental locations, to help make tourism a more sustainable industry in Kurdistan Region

with existence of natural resources such forestry land and water, conduct a socioeconomic evaluation of the current consumptive resource utilization practices; evaluate the existing and potential eco-tourism resources for alternative utilization practices for poverty reduction and environmental conservation, and develop a motivational and behavioral profile of visitors to forest-based recreational attractions in Iraqi Kurdistan Region.

There are many studies dealt with the subject of eco-tourism because of the importance of this topic, some of these studies are:

Dony et.al (2013). The aim of this research was to identify the natural resources and features in the Kelantan Delta Location with regard to the suitability for Eco-tourism. Field observation was carried out in some islands of the delta. The study clearly showed that the mangrove forest is the main attraction of the delta. Other resources and features also support the location to be promoted as an Eco-tourism site such as the diversity of flora and fauna, rivers, and delta environment .maps and satellite images showed the results and conclusions were there is a wide potential of the Kelantan Delta Location to become an Eco-tourism site. The potential of Eco-tourism development in the Location is mainly based on its natural resources and features, such as mangrove forests, diversity of flora and fauna, rivers, and delta environment. It is believed that there are some factors which support and influence Eco-tourism development there, such as environment, socio-culture, economic condition, and infrastructures. However, another important factor is local community empowerment. Putting Eco-tourism on a truly sustainable path is a major challenge, requiring partnership and cooperation. Local communities or villagers have to play important rule in the location, working together and collaborate with some parties, such as researchers/academics, authorities, private sectors (developers, operators, and so on), and visitors (eco tourists). Improving condition and infrastructures in the Location and good management and planning are very important to develop the delta.

In the research of Kolahi et al. (2013) Considered Eco-tourism as the impetus and economic investment for management of natural resources. The research used data mining from the recreation values of Iran's parks and separating influential factors on visitors' willingness to pay

(WTP). This study delved into the main findings of 31 researches applied to assess the recreation value of 33 different parks across Iran from 2004 to 2011. Those researches collected 9216 questionnaires in total. It was conducted using R software and Rattle user interface to analyze gathered data and information. Results showed that 69% of respondents were male. The averages of age and academic years were 34.4 and 13.7 respectively. The majority of the visitors were willing to pay money to visit the parks. Variables of education levels, household size, marital status, age, and bid amount had an effect on visitors' rate of WTP for visiting, and variables of gender, education levels, and marital status affected the general amount of WTP. The average amount of WTP. This study provides justification for the decision to support the quality of Iran's parks.

MATERIALS AND METHODS

Duhok province:

-The study location (Zawita):

Zawita is located in the province of Duhok in the Kurdistan Region of Iraq, away from the city of Duhok about 16 kilometers and it is a famous tourist location in the area. Most of the residents of the town are Kurds. The climate is temperate in the summer and sometimes snows, in addition rainfall most winter days.

Zawita is famous for its dense pine forests. In addition to the presence of red soil in the location which distinguishes it from the rest of the other locations, in this area there are a valley Senior called (Zawita Valley). The place is characterized by a moderate weather in the summer and there are restaurants and tourist stalls scattered in the valley. Zawita is one of the most important tourist places in the province of Duhok, and one of the places that flock to the more number of visitors from the rest of the other places in the province. (Tourist Guide for Kurdistan Region.2012).

The empirical side:

The sampling procedure is an important factor to take into account because it might affect the estimates of recreational values. But in this study the population of visitors to the selected location was used for the empirical side, and the questionnaire method of data collection was depended. The formulation of questionnaire forms which used in this study depended on the below questions and information:

The questionnaire:

The calculation of direct tourism expenditure based on the following items:

- Average expenditure per person/day;
- Duration of stay;
- Total visitors numbers based on data sources;
- Total visitor expenditure (average expenditure per person/day \times average length of stay \times total visitor numbers);
- Attribution factor (expenditure that can be directly attributed to the natural sites);
 - Substitution factor (expenditure that would occur outside the site if the Location did not exist).

Application of the Individual Travel Cost Approach:

In a travel cost study, the demand for recreation to a specific site is analyzed besides travel costs, income and variables related to quality. Using the survey data, the researcher can precede in a similar way to the model, by estimating, using regression analysis, the relationship between number of visits and travel costs and other relevant variables. This time, the researcher would use individual data, rather than data for each zone. The regression equation gives us the demand function for the "average" visitor to the site. And travel cost method measures the demand function for visits to a site, a demand function is an empirical relationship between the variables which show as:

The general form of the used demand function for the purpose of this study took the following form:

$$V_{ij} = f(\text{TTCPP}, \text{TLCPP}, \text{OPPTIME}, \text{EDU}, \text{AGE}, \text{AHHI}, \text{GEN})$$

Where TTCPP = Travel cost from place of residence, cost of travel within the selected tourist spots, cost of boarding and lodging, other miscellaneous expenditure.

TLCPP = That part of travel cost incurred within the selected tourist spots.

OPPTIME = Per-capita household income per day corrected for number of days spent in the selected tourist spots.

ENV = Reason for visiting the selected tourist spots (dummy variable)

EDU = Education (Levels of education)

AGE = Age (years)

AHHI = Annual household income per family

GEN = Gender (0=female, 1= male).

V_{ij} = Visitation Rate

And the applicable function used in this study was:

$V_{ij} = f(TT CPP, TLC PP, AH HI, NFP, EDU, AGE, GEN)$

TT CPP = Travel cost from place of residence, cost of travel within the selected tourist spots, cost of boarding and lodging, other miscellaneous expenditure for the person / 10000(ID).

TLC PP = That part of travel cost incurred within the selected tourist spots / 10000 (ID).

AH HI = 1 / (Annual household income per family / family visitations/ 10000) (ID).

NFP = Number of Family Persons in the selected tourist spots.

EDU = Education (Levels of education), (1 = educated, 0 = uneducated), Dummy variable.

AGE = Age (years)

GEN = Gender (1 = male, 2 = female), Dummy variable.

V_{IJ} = Visitation Rate (family visitations/ total visitations).

RESULTS AND DISCUSSION

Based largely on the results of this non-market valuation study. The tables of require data have been prepared for the purposes of the empirical side of this study, which depended on the data and information collected by the questionnaire forma, after that the statistical analysis was conducted to find the relationship between the dependent variable in Eco-tourism demand function and the other independent variables using more than one relationship, done to the best of those relations. So the simple and multiple regression were used, moreover the logarithmic transformation of data

was done for the values of the dependent variable and introduced in the analysis. Thus, the best results were obtained presented for selected location in this study. Note that the questionnaires included (100) sample in the site, however some cases have been excluded, as a result of lack of completeness and accuracy of the data which have been recorded in those forms, with depended the following variables of tourism demand function after some conversions:

TT CPP = Travel cost from place of residence, cost of travel within the selected tourist spots, cost of boarding and lodging, other miscellaneous expenditure for the person / 10000(ID).

TLC PP = That part of travel cost incurred within the selected tourist spots / 10000(ID).

AH HI = 1 / (Annual household income per family / family visitations/ 10000) (ID).

NFP = Number of Family Persons in the selected tourist spots.

EDU = Education (Levels of education), (1 = educated, 0 = uneducated), Dummy variable.

AGE = Age (years)

GEN = Gender (1 = male, 2 = female), Dummy variable.

V_{IJ} = Visitation Rate (family visitations/ total visitations).

The best formulas for statistical analysis in this site featured the following relationship when using multiple regression analysis with statistical and econometric tests which shown in table (1) and beyond, with reference to it was deleted (30) questionnaires from the total because it didn't contained full answers, that means the analysis included only (70) questionnaires :

Table (1): Multiple Regression Model on Log (Visitation Rate) (Demand for Eco-tourism), Zawita Location in Duhok province.

Explanatory variable	Coefficient	Std. error	t-value	p- value
TT CPP	-0.0165**	0.0047	-3.48	0.0000
TLC PP	-0.0039**	0.0064	-0.60	0.0000
AH HI	0.4696**	0.0481	9.75	0.5453
NFP	-0.0098	0.0118	-0.82	0.0000
EDU	0.0725*	0.0328	2.20	0.4118
AGE	0.0088*	0.0021	4.09	0.0308
GEN	0.0221	0.0495	0.44	0.0001
Intercept	-2.3672	0.1111	-21.29	0.6561

Indicates that the significant differences at (* p 0.05), (** p 0.01).

Notes: 1- Coefficient of Determination= 78.25 % 2- Adjusted Coefficient of Determination = 75.80 % 3- F statistic = 31.86535

Standard Error of Est. = 0.0945034

Mean absolute error = 0.0708248

Durbin-Watson statistic = 1.89281

Interpretation of results:

Economic Interpretation:

According to the results obtained show that the travel cost (TTCPP) from the location housing, the tourist location has a negative impact on the rate of the visit, the fact that the signal coefficient variable (TTCPP) is negative, which means that there is an inverse relationship between (V_{ij}) and the independent variable. This result is consistent with economic theory as the relationship between the price of any commodity or service representative at their cost is an inverse relationship. Regarding the effect of the relationship in the rate of the visit shows that if the relationship rose by (10,000) dinars, followed by a decrease in the rate of the visit at a rate (V_{ij}) of (0.0165) and so steadily in the rest of the factors affecting tourism demand.

The second variable, which was the costs of tourists (TLCPP) during the days they spent in the tourist location have coefficient of variation is the negative signal which means that there is an inverse relationship between (V_{ij}) and the independent variable, which is compatible with economic theory, which is that the increase in prices (costs) leads to a decrease in demand, meaning that the relationship between cost and price are inversely related, with regard to the extent of the impact of the relationship in the rate of the visit shows that if the relationship rose by (10,000) dinars, will cause a decline in the rate of visit (V_{ij}) by (0.0039) and so steadily the rest of the factors affecting the demand for tourism.

The variable of income (AHHI), the coefficient of variation has positive signal and this is compatible with the operative economic theory, it is mean that the more income increased demand, with regard to the extent of the impact of the relationship in the rate of visit (V_{ij}) shows that if it went up the relationship by (10,000) dinars, followed by a rise in the rate of the visit at a rate (V_{ij}) of (0.4696) and so steadily the rest of the factors influencing the tourism demand.

The last significant variable in this model was AGE, with positive sign which refers to higher interest in tourism with increasing in people age,

by (0.0088), it is a logical result in the society of the study.

While the other three independent variables did not explain significant variations, with regard to variable of number of family persons in the selected tourist spot, could be the reason of its insignificantly due to the differing number of persons in the different families, while most of the head of the families were male made the Gender variable insignificant. In determining whether the model can be simplified, notice that the highest P-value on the independent variables is 0.5453, belonging to income variable. Since the P-value is greater or equal to 0.10, that term is not statistically significant at the 90% or higher confidence level. But we can't remove income variable from the model because it is one of the important variables in the model.

Statistical interpretation:

(T) Test : In (Table 1) shows that the independent of the three variables, traveling from location housing to tourist location (TTCPP), travel costs at the tourist location (TLCPP), and the average per capita income (AHHI) and age variable (AGE) have significant effect on the rate of the visit (V_{ij}) because the (t) value calculated for these factors is greater than the (t) value tabulated for the level of significance (1 %) of the degrees of freedom (92) is 2.9 and for the rest of the four variables do not have any significant effect on the rate of the visit (V_{ij}) referring to the fact that their (t) calculated value is less than the t tabulated value .

The adjusted coefficient of determination R^2 : shows the value of the Adjusted coefficient of determination that (75.80%) refer to the average of changes in the rate (V_{ij}) is due to visit the seven independent variables included in the estimated function of tourism. Either the remaining unexplained attributed to other factors that are not taken into consideration.

In the other side of the statistical analysis we tested the relationship between the dependent variable and independent variables each individually, the results of that analysis shown in table (2):

Table (2): Simple Regression Model on Log (Rate of Visitation), (Demand for Eco-tourism),
 Zawita Location in Duhok province.

Explanatory variable	Intercept	Slope	Correlation Coefficient	Std. error	t-value	p-value
TTCPP	-1.7829	-0.0264*	-0.63	0.0038	-6.78	0.0000
TLCPP	-1.8241	-0.0309*	-0.57	0.0052	-5.84	0.0000
AHHI	-2.1016	0.4621*	0.70	0.0560	8.24	0.0000
NFP	-1.8262	-0.0164	-0.11	0.0171	-0.95	0.3424
EDU	-1.8838	0.0013	0.002	0.0635	0.02	0.9837
AGE	-1.7734	-0.0034	-0.11	0.0037	-0.91	0.3639
GEN	-1.9627	0.0756	0.09	0.0992	0.76	0.4485

Indicate that the significant differences at $p < 0.05$, * $p < 0.01$

Note: * indicates that the values highlight significant statistical results.

This results presented different values of variables coefficients, variables significantly, and the correlation coefficient compared to the results using Multiple Regression Model, the best relationships were between dependent variable and the income and total costs variables, with referring to, it wasn't Multicollinearity among the independent variables (the correlation matrix among independent variables explained that). Finally these results could be argued compatibility with some of the previous Eco-tourism studies in forestry locations such as the selected Zawita Location in Duhok province.

CONCLUSIONS

By the results that have been obtained from the practical side of this study we conclude the following:

- 1-**The importance of eco-tourism as a result of the large numbers that were faring selected locations to study in the Kurdistan Region of Iraq, despite the weakness services provided to visitors in these locations, with the fact that non- completion of the eco-tourism concept for the people in the society.
- 2-**The results of the study in selected Location that the economic side and the increasing household income leads to increasing demand for tourism, especially in times of occasions and holidays.
- 3-**Through the survey, which was conducted on the location in this study, and the inclusion question in list of questionnaire to identify the point of visitor views (not included in the statistical analysis), it is the role of forestry in developing eco- tourisms, and the people desire in forestry foundation in this location, it has been showed that the presence of the forests and trees

have a deep impact upon visitors to the area mentioned and this reinforces the fact that the forests are one of the important concepts of eco-tourism topic.

4-Generally the costs and income showed influences in eco- tourism demand function, this is compatible with the economic theory operative, and demonstrates the correct approach in the people interaction with the subject, and their commitment to meeting their desires, with taking in to account the economic aspects.

5-The theoretical side of this study presented the general uses of travel cost method is which were to estimate the relationship between benefits and costs for recreational locations, and for testing the Eco-tourism demand function, but this method is relatively uncontroversial, because it is modeled on standard economic techniques for measuring value, and it uses information on actual behavior rather than verbal responses to hypothetical scenarios. It is based on the simple and well-founded assumption that travel costs reflect recreational value. It is often relatively inexpensive to apply.

SUGGESTIONS

Some suggestions may be eventually recommended as follows:

- 1-**Depending the eco-tourism issues inside the forest location can be done applying different tools and equipment to improve the eco-tourism culture of the visiting people, because the forests are major destinations for tourists.
- 2-**The Eco-tourism approach of demand function using the worldwide-accepted methods depending travel cost method can be done for other forestry

locations to prevent their further demolition and limitation, and determine the most appropriate locations.

3-Our recommendation for Kurdistan Region is to establishing more recreational locations and parks because of the growing population, changing patterns of settlement, environmental pollution of cities, these make more needs for leisure have increased the importance of recreation places.

4-Convert the appropriate forestry locations for eco- tourism to parks for control possibility through the forest organization, and arranging services presentation for the visitors, with issuance of instructions about the exploitation of these recreational location, and the creation of other forest parks in other suitable locations across the provinces will reduce the tourist pressure on the selected area in this study which facing hard conditions especially in seasonal and national events.

5-The forests of Kurdistan Region are wood unproductive, for that it's possible to utilized for recreational purposes and getting revenues from this utilization on the local and national levels, by setting an entrance fee to access the park, this measure will increase the awareness of people for maintaining the recreational locations.

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EFFECT OF ROOT CUTTING DIAMETER, LENGTH AND INDOLEBUTYRIC ACID CONCENTRATIONS ON THE ROOTING ABILITY AND GROWTH OF (*Rhus coriaria* L.) ROOT CUTTINGS.

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ABSTRACT

The concern about the propagation of native shrubs is increasing; many ecologically and economically important species that are difficult to propagate by seeds have been under study by nursery propagators. In Kurdistan region-Iraq, *Rhus coriaria* L. - Anacardiaceae or Sumac is the only native species of the genus *Rhus* in Iraq; with considerable ethnobotany and ecological values. This species is difficult to be propagated sexually and asexually via shoot cuttings. This study analyzed the potential of producing Sumac seedlings using root cuttings. Effects of cutting size (1cm > diameter >1cm, length 7-15cm), and exogenous indole-3-butyric acid IBA hormone pretreatment (0, 2000, 3000 and 4000 ppm) on rooting were studied in three replicates under outdoor nursery conditions from March – October of 2014. Rooting percentage %, number of roots, root length, shoot length, number of branches and number of leaves of newly generated cuttings statistically analyzed in a complete randomized block design (CRBD). The results of the study showed that cutting diameter, length, and IBA application and the interactions between them significantly affected all the measured traits. For optimal rooting and producing good quality seedlings, the findings recommended thinner but longer root cutting (diameter < 1 cm; 15cm) treated with 4000 ppm IBA.

KEYWORDS: Cutting diameter, Sumac, *Root cutting*, *Rhus coriaria*, Indolebutyric acid.

INTRODUCTION

Native plants represent a wide range of shrubs that evolved over the years to adapt to their specific ecosystem conditions. In climatically fragile zones such as arid and semi-arid shrubs greatly support the ecosystem stability by ensuring soil protection and making their habitat more hospitable for their offspring and /or for other species by buffering environmental stress and /or increasing resource availability (Castro et al., 2004).

In Kurdistan region-Iraq, *Rhus coriaria* L. – (Anacardiaceae) or Sumac in Kurdish is the only native shrub of the genus *Rhus* in Iraq; is a common shrub throughout this region, often dominant the lower forest zone. It grows in diversified habitats ranges of 550 – 1354 m a.s.l, including woodland borders, thickets and rocky barrens with sparse woody vegetation under a variable rate of temperature, but not less than 500 mm of annual precipitation. Sumac is a 1-3 m high shrub naturally distributing from the Sinjar Mountain (MJS) near the Syrian frontier to Biara

valley (MSU) near the Iranian frontier (Shahbaz, 2010). In these areas people used to use a Sumac fruit sour infusion in preparing many traditional dishes and in traditional medicine (Shahbaz, 2010; Mohammadi et al., 2010). The main ecological value of this species is controlling soil erosion where vigorous root system that tends to be shallow and wide-spreading prevents soil erosion on sloping sites (Hamilton et al., 1972, Ogle et al., 2000). From an industrial perspective, Sumac fruit and leaves contain coloring stuff and tannins can be used in dyeing and tanning fine leather (Shabbir, 2012).

In the last decade a retreat has been observed in the populations of Sumac as a result of wildfire and persistent anthropogenic disturbances (e.g., urbanization of natural areas). In this context, vegetative propagation would be a useful way for the large-scale multiplication, improvement and conservation program. Interest in the propagation of native shrubs is increasing where ecologically and economically important species that are difficult to propagate sexually have been under study by nursery propagators (Ruchala, 2002).

The main idea behind adapting the vegetative propagation is that same copy of the genome (the genetic material of an organism) of a donor plant is made and continued in new individuals. In the other words, having the advantage of gaining all the genetic superiority traits without any gene segregation. This is possible since plants have meristematic, undifferentiated cells can be later differentiated into various types of essential organs to structure a whole new plant individual (Jaenicke and Beniast, 2002).

Several of vegetative propagation methods have been tested for native woody plants. However, many of these methods have not shown satisfying results with certain genera. For example, using stem cuttings of Anacardaceae, the family of resinous species. (Yu et al., 2001; Hartmann et al., 2002; Haapala et al., 2004). Root cuttings can be considered as a useful technique of propagating species that are otherwise difficult to reproduce (Macdonald, 1990). In spite that roots cutting materials are difficult to secure and collect (Flemer, 1961). Eley, (1970) refereed that root cutting is by far the best way to increase certain species which do not root easily by stem cuttings, or produce root suckers or when high root:shoot seedling produce targeted. Furthermore, the root cutting method does not need high technique facilities and therefore it is a competitive and inexpensive alternative compare, for example to micropropagation techniques (Stenvall et al., 2004).

Adventitious rooting in root cuttings has been known to be affected directly by growing conditions, exogenous (e.g., auxins) and cutting size (e.g., length and diameter) (OuYang et al., 2015). The exogenous hormones have a role in signaling the proteins to stimulate new cell to expand, lead to initiate of numerous lateral roots (Hameed et al., 2004; Durbak et al., 2012). Raju and Prasad (2010) found that the types and concentrations of used hormone significantly changed the rooting percentage of *Celastrus paniculatus* Willd. According to Das et al., (1997) and Aminah et al., (1995), applying IBA may have an indirectly role in promoting starch hydrolysis and mobilize sugars and nutrients to the cutting base, consequently stimulate rooting in many shrubs (Husen and Mishra, 2001; Husen, 2003) and trees (see Kaul, 2008; Husen and Khatoon, 2012). Tracz, (1983) reported that rooting and sprouting in *Rhus aromatica* Ait. was more after treatment with 1 g/l IBA. Nokes,

(1986) also displayed that semi-hardwood cutting of evergreen Sumac treated with an auxin-talc preparation of 0.8 g/l IBA has rooted better than control. As well as to IBA effects, cutting size also considered a very important factor influencing the rooting ability and early growth (Burgess et al., 1990; Foster et al., 2000). Cuttings with a larger diameter and longer length result in better survival and growth under normal conditions (Leakey, 1983; Vigl and Rewald, 2014). For example, Gopale and Zunjarrao (2011) observed reductions in the number of roots with the reduction in the length of cuttings (10, 20, 30, 40, and 50cm). According to Singh and Negi, (2014) among various concentrations of IBA, 500, 1000 and 1500 ppm and different length cuttings (20, 35 and 50 cm) of *Ticoma stans* L, 1500ppm and 50 cm were shown the best performance in terms on a callus formation, number of sprouted cuttings, average number of leaves, height of plant, number of primary roots, longest root, fresh and dry weight of roots. Similarly to the cutting length, cutting diameter is often used as an index of potential cutting vigor. Larger diameters are generally considered to be positively correlated with the rooting ability and early growth, therefore nursery practices generally exclude cuttings smaller than 0.6 cm diameter (see Dickmann et al., 1980 in *Populus* clones; Burgess et al., 1990 in *Salix alba* and Foster et al., 2000 in *Loblolly pine*). Moreover, Leakey and Mohammed (1985) found *Triplochiton scleroxylon* cuttings of the similar length, but the largest diameter recorded the greatest rooting ability which indicates that the cutting storage capacity may be in some cases more crucial than length. According to Smalley et al., (1991) a minimal level of carbohydrate is required to emerge roots, below this level the physiological activities may be possibly inhibited. Same conclusion has been reported by Zhang et al., (2010) where a significant increase in root length, root biomass and shoot length of cuttings found with an increase in diameter of cuttings in *Feijoa sellowiana*.

Many studies cleared a positive effect of the interaction between the cutting length and cutting diameter in increase the regeneration ability of root cuttings of most woody plants where, more rooting were obtained with thicker and longer cuttings (Ky-Dembele et al., 2010 and OuYang et al., 2015). It has been reported that the poor performance of the small size of cuttings returned to inadequate supply of nutrients and leaching of

them because the cuttings were still under maturity and consequently the necessary food materials are not available for induction of roots and shoots (Good and Tukey 1966; Hegde 1988). In contrast, larger cuttings store more carbohydrates and less liable to desiccation in comparison to small sized (Rana and Sood.2012). On the other hand, the underperformance of large sized cuttings (in length and diameter) with certain species may be due to that these cuttings are more woody, too mature and inactive and more likely consumed most of food material for lignification (Stenvall et al., 2006). According to our knowledge, the combined effects of root cutting size and auxin concentrations, for maximum root initiation and survival of *Rhus corriaria* root cuttings have not been reported yet. The objectives of this study were intended to fill this gap by determining the effects of diameter, length and IBA concentrations on root-initiation of *Rhus corriaria* root cuttings. Consequently, determination of a proper routing protocol to produce shrubs with developed root system for planting bare watershed slopes.

MATERIALS AND METHODS

The experiment was conducted in a plastic house in Malta nursery - Directorate of Forests and Rangelands-Duhok, Kurdistan Region- Iraq (N36 51' 28", E42 51' 06") during March – October of 2014. The root cuttings of Sumac were taken from parent shrubs (2-3m high) growing naturally in Goherzi village, Deralok district. Ten shrubs growing on gentle slope have been selected to facilitate the digging and the root collection process. To leave enough roots for the parent shrub to recover, approximately one-third of healthy, living root cuttings carefully were harvested. The collected roots were divided then after into two diameter groups ($0.5 < d < 1$ and $1 < d < 2$ cm); and into the two cutting lengths (7.5 and 15 cm). Both ends of the cuttings quick dipped in water prior to dipping in the talcum powder of four IBA concentrations (0, 2000, 3000 and 4000 ppm). The IBA talc prepared for each concentration as following: for example for 2000ppm (0.2%) IBA, or 2g of IBA directly mixed with 98 g of talc (Fabbri, et al 2004). The IBA first dissolved in a small quantity of alcohol,

and then mixed with the talc to form slurry. The slurry dried with gentle heat to evaporate the alcohol. Once dry, it passed a fine sieve. The both wetted ends of the cuttings were treated with the powder and planted horizontally in plastic boxes filled with sand and peat moss medium (75:25). Boxes were covered by a thin layer of the used medium about 3 cm and then manually irrigated with tap water when needed (about twice a week). In October the cuttings were removed from planting boxes and the following measurements were recorded:

1. Rooting percentage, R %.
2. Number of roots, NR. per cutting
3. Root length, RL (cm) by measuring the mean of three largest roots.
4. Shoot length (cm), SL.
5. Number of branches, NB. per cutting
6. Number of leaves, NL. per cutting

The experiment was laid out in a Complete Randomized Block Design (CRBD) with three factors performed in three replicates and each treatment involved 10 root cuttings per replicate. The statistical analysis was done after percentile values of rooting percentage converted into angular transformation using SAS program, means values were compared with Duncan test at 0.05 levels, (SAS 9.1).

THE RESULTS AND DISCUSSION

Studies of the effect of cutting size on rooting of tree species have typically considered the cutting length or diameter alone and mostly for shoot cuttings (Foster et al., 2000; Rana and Sood, 2012). Only a few studies have investigated both traits together using root cuttings (Stenvall et al., 2006; Ky-Dembele et al., 2010). In this experiment our results showed that cutting size (both length and diameter) as well as IBA conc. has a significant effect on the rooting ability and early growth in Sumac root cuttings (Table 1).

Based on the ANOVA (Table 1) most of the root cuttings growth parameters as the rooting percentage R%, the number of roots NR, root length RL, shoot length SL, number of branches NB, and the number of leaves NL were significantly influenced by the cutting size and hormone application.

Table (1): Analysis of variance of the effect of root cutting size (length and diameter) treated with different IBA concentration on rooting percentage R %, Number of roots NR, Root length RL, Shoot length SL, Number of branches NB, and the Number of leaves NL. of *Rhus coriaria* root cuttings

Variance source	df	R%	NR	RL (CM)	SL (CM)	NB	NL
		MS	MS	MS	MS	MS	MS
Block	2	1.161	0.313	0.469	0.056	0.243	1.18
Cutting diameter	1	231.88**	16.649**	127.46**	85.60**	1.113*	76.48**
IBA Conc.	3	1595.86**	8.79**	117.59**	89.74**	8.60**	169.72**
Cutting length	1	2248.17**	5.514**	99.994**	192.40**	29.37**	175.98**
Diameter x IBA Conc	3	24.83*	0.599*	0.318	3.84*	0.358	3.77*
Diameter x Length	1	7.13	3.376**	43.28**	24.94**	0.29	0.99
IBA Conc. X length	3	48.38**	0.703*	4.04	12.97**	2.11**	16.58**
Length x IBA Conc. x Diameter	3	10.42	0.315	3.38	3.188	0.185	2.98
Error	32	9.2	0.19	1.79	1.47	0.17	1.15

* Significant at 0.05; ** significant at 0.01.

The analysis of variance showed a significant difference between the diameters of root cuttings. The cuttings with less than 1cm diameter produced significantly higher R%, NR, RL, SL, NB, and NL (56.8%, 3.7, 19.69cm, 17.1cm, 3.2 and 18.5 respectively) (Figure 1). Similar results were obtained with the length of root cuttings, where all studied parameters significantly increased with increasing cutting length from 7.5cm to 15cm. Root cuttings with 15 cm length had a significant higher R%, NR, RL, SL, NB and NL (61.54%, 3.7, 19.5cm, 17.7 cm, 3.8 and 19.1 respectively) compared to 7.5cm length (47.9%, 3.0, 16.6, 13.7, 2.3 and 15.3) (Figure 2).

Among the factors that influencing the rooting ability, it is generally accepted that root thickness (cutting diameter) has a clear effect on survival, shoot production and vigor when propagating woody species from root segments, this possibly related to the availability of greater food materials for root formation. Especially, carbohydrates have been regarded as a key factor of root and shoot formation from root cuttings (Lawes and Sim 1980). The diameter of the root reflects mainly the carbohydrate content of the cutting where the thickest cuttings have the largest nutritional reserves (Michael and Charles 1987, Kolb and McCormick 1991). Thorpe and Murashige (1970) have reported that prompting of primordial buds takes place only when a sufficient amount of starch has accumulated. The carbohydrate content support survival of the cutting by providing nourishment for the emerging shoot part before they become ready for photosynthesis (Davis

1988, Veierskov 1988). Very thin root cuttings may do not contain sufficient nutritional reserves for bud burst and shoot emerging (Stenvall *et al.*, 2009). In contrast to these studies, under our study conditions the thinner cuttings (diameter <1cm) rooted better and developed more roots than those of thicker cuttings where the parameters R%, NR, RL, SL, NB, and NL decreased with increasing the root diameter (diameter >1cm). This under performance of thick cuttings may be attributed to reason that thick roots may regenerate slowly, because the tissue may be too mature and inactive (Stenvall *et al.*, 2006) in the other words, the poor rooting efficiency of the thickest root cuttings may be due to the ageing of the used root cuttings, woody roots covered with a layer of thin-walled corky cells like those found in woody stems that may affect the regeneration capacity of root cuttings (Kramer and Kozlowski, 1960). According to Michael and Charles (1987) to optimize the regeneration ability of root cuttings, it is important to use physiologically young material, which has the best regeneration capacity and growth rate. Same finding has been obtained with five hybrid aspen (*Populus tremula* × *P. tremuloides*) clones where both the rooting efficiency and the number of burst buds lowered with increasing root diameter (Zsuffa, 1992). In line with that, both Suchockas, 2010 and Stenvall, 2006 concluded, that despite the fact that larger root cuttings produce larger planting material, over 15 mm or 1 cm thick root cuttings should not be used for efficient rooting of hybrid

aspen (*Populus tremula* L. x *P. tremuloides* Mich).

Like cutting diameter, the rooting percentage in Sumac significantly increased with the increasing length of the root cuttings (15 cm) and associated with the higher values of NR, RL, SL, NB, and NL. The length (7.5 cm) root cutting recorded lower values of the studied traits (Figure 3). According to many studies (e.g., Good and Tukey 1966 and Hartmann *et al.*, 2002) the poor performance of shorter cuttings is due to inadequate carbohydrates and leaching of nutrients and the endogenous auxins level, which leads to reduced rooting percentage or the absence of rooting in short cuttings (Hegde, 1988). It was also reported by Smalley *et al.*, (1991) that a minimal level of carbohydrate is required of cutting to run physiological activity to emerge roots, below such level of carbohydrate, these activities may be possibly inhibited. We believe that under our study conditions Sumac cutting using thin-rooted <1 cm cuttings with longer root section 15 cm contained such level of carbohydrate with enough inert buds. This is in line with Ky-Dembele *et al.*, (2010) as they pointed out that the size of root cuttings significantly affected the regeneration ability of *Detarium microcarpu*, where root segments of 20

cm length produced more new roots than those from 10 cm cuttings.

- In the present study, auxins concentration significantly influenced all rooting traits, all of the parameter values increased with increasing the IBA concentrations up to 4000 ppm IBA compare to non treated cutting where lower values have been recorded for R%, NR, RL, SL, NB and NL (67.25%, 4.4, 21.04, 19.1, 4.1 and 22.2) respectively (Figure 3). The ability of auxins to promote adventitious root in tree cuttings is well known (Ragonezi *et al.*, 2010).. Applying IBA conc. has an indirect influence by enhancing the speed of translocation and movement of carbohydrates to the base of cuttings and consequently stimulates rooting (Aminah *et al.*, 1995). The best rooting was achieved in cuttings treated with a higher IBA concentration (4000ppm). This is in line with many studies that have shown that treating cuttings with proper auxin and concentration can increase the percentage of rooting for shrubs (Husen and Mishra, 2001) and trees (Husen and Khatoun, 2012). The effect of auxins has been reported to promote starch hydrolysis and mobilize sugars and other nutrients to the rooting zone beside cell enlargement and cell division induced (Das *et al.*, 1997; Durbak *et al.*, 2012).

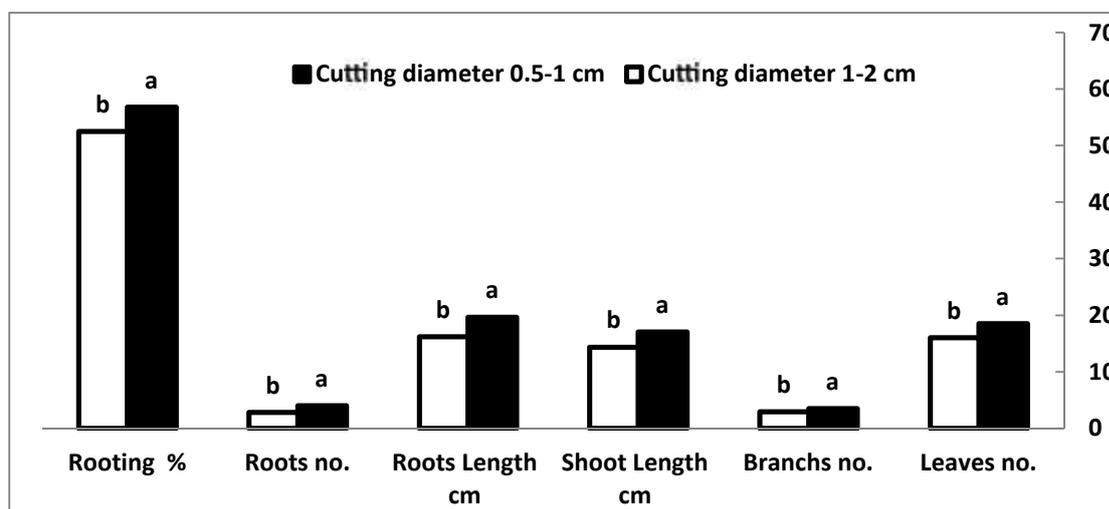


Fig. (1): Effect of root cutting diameter on the rooting and growth characteristics of *Rhus coriaria* root cuttings

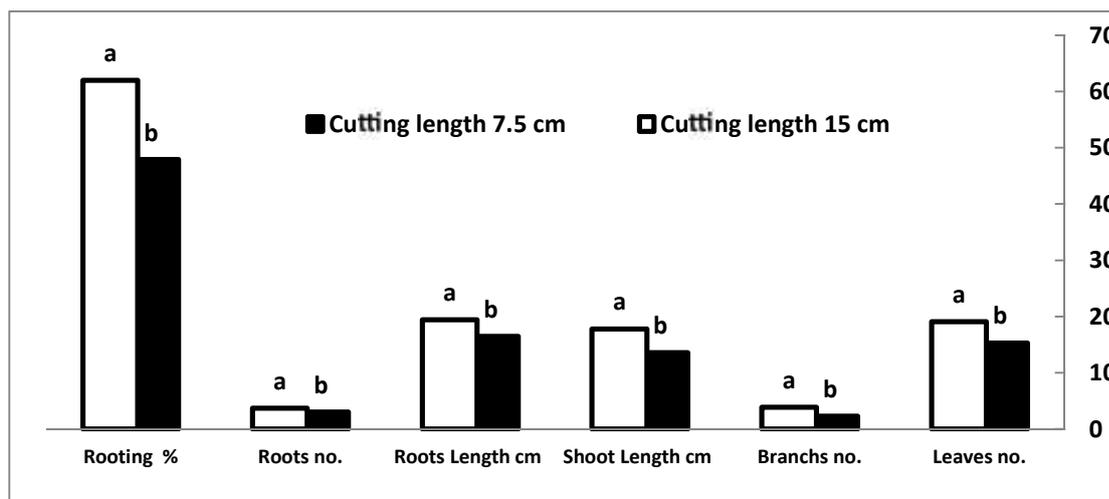


Fig.(2): Effect of cutting length on the rooting and growth characteristics of root cuttings of *Rhus coriaria*.

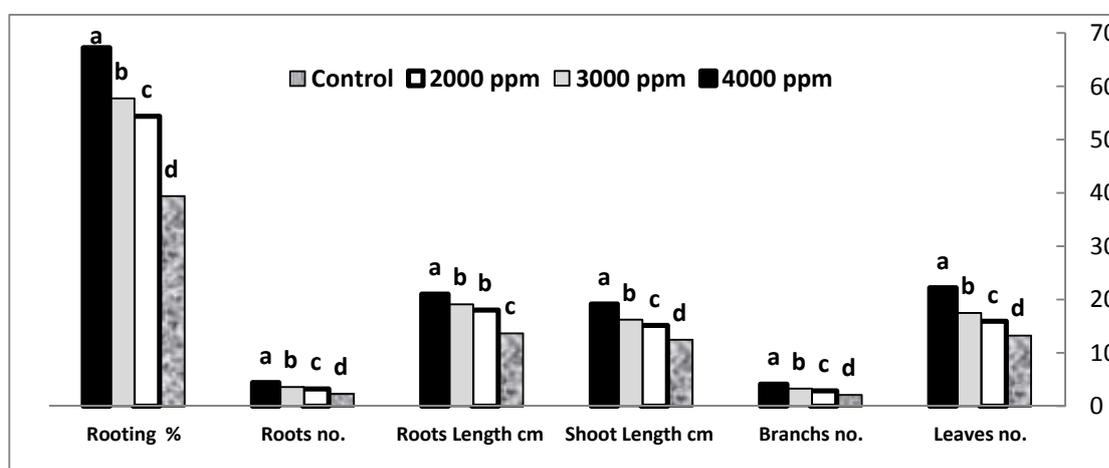


Fig. (3): Effect of IBA concentrations on the rooting and growth characteristics of root cuttings of *Rhus coriaria*.

The comparison of the means by using Duncan test (Table 2) showed that all the measured rooting variables, R %, NR, RL, beside SL, NB, and NL were higher when thin and long cuttings interact

(<1cm and 15cm) where the optimum values obtained were 64.12%, 4.5, 22cm, 19.8cm, 4.1 and 20.5 respectively.

Table (2): The effect of the interaction treatments between cutting diameter and cutting length on the rooting and growth characteristics of *Rhus coriaria* root cuttings.

Treatments	Cutting length	Rooting percentage %	Root numbers	Root Length (cm)	Shoot Length (cm)	Branch number	Leaves Number
Cutting diameter 0.5-1 cm	7.5 cm	49.66 c	3.3b	17.2b	14.3 c	2.4c	16.4c
	15 cm	64.12 a	4.5a	22a	19.8 a	4.1a	20.5a
Cutting diameter 1-2 cm	7.5 cm	46.04 d	2.7c	15.9c	13.16 d	2.2c	14.2d
	15 cm	58.95 b	2.8 c	16.9b c	15.7 b	3.6b	17.7b

Tables (3 and 4) of the Duncan test, showed that interactions of IBA concentration with, both cutting diameter and cutting length significantly influenced the studied traits. The interaction of less 1 cm diameter × IBA 4000mg/L and 15cm length × IBA 4000mg/L exhibited maximum R% (71.08%, 71.6%), NR (5.2, 5.0), RL (22.7cm, 22.9cm), SL (20.5cm, 22.6cm), NB (4.5, 5.4), NL (24.3, 25.8) respectively.

Table (3): The effect of the interaction treatments between cutting diameter and IBA on rooting and growth characteristics of the propagation of *Rhus corraria* root cuttings.

Cutting diameter	IBA conc. ppm	Rooting percentage %	Root numbers	Root Length (cm)	Shoot Length (cm)	Branch number	Leaves Number
Cutting diameter 0.5-1 cm	Control	42.41e	2.6de	15.1e	13cd	2.2e	14.1e
	2000	55.58 cd	3.8bc	19.8bc	16.8b	2.8d	17.1d
	3000	58.5 c	4.2b	21b	18.0b	3.4bc	18.4c
	4000	71.08 a	5.2a	22.7a	20.5a	4.5a	24.3a
Cutting diameter 1-2 cm	Control	36.5 f	2.0 e	12.2f	12d	2.0e	12.4f
	2000	53.16 d	2.5de	16.6de	13.6c	2.8d	14.7e
	3000	56.91cd	2.9d	17.4d	14.5c	3.1cd	16.6d
	4000	63.41b	3.6c	19.3c	17.6b	3.7b	20.1b

Table (4): The effect of the interaction treatments between IBA conc. and cutting length on the rooting and growth characteristics of *Rhus corraria* root cuttings.

IBA conc.ppm	Cutting length	Rooting percentage %	Root numbers	Root Length (cm)	Shoot Length (cm)	Branch number	Leaves Number	
Control	Cutting length 7.5 cm	30.58 e	2.2 d	12.7 f	11.2f	1.8 e	11.4e	
		2000	46.3 d	2.8 c	16.2 d	13.6e	2 de	14.8d
		3000	51.66 c	3.4b	18.3 c	14.4de	2.6c	16.4c
		4000	62.83 b	3.7b	19.1bc	15.5cd	2.8c	18.6b
Control	Cutting length 15 cm	48.33 cd	2.5 cd	14.6 e	13.7e	2.4cd	15.1d	
		2000	62.41 b	3.5 b	20.2 b	16.7bc	3.7b	17c
		3000	63.7b	3.7 b	20.2 b	17.9b	4b	18.6b
		4000	71.6 a	5.0 a	22.9 a	22.6a	5.4a	25.8a

Duncan's multiple-range test showed also a significant differences between the means of the combined interacted treatments with a clear cumulative influence (Table5), where the optimum combination was less than 1cm diameter x 15cm length x IBA 4000ppm resulted in maximum R% 76.6, NR 6.2, SL 24.6cm, NB 6 and NL 28.6 while no significant differences were found for RL between the three used IBA conc. 2000, 3000, 4000 ppm, however 4000 ppm recorded the longest mean root 25 cm when interacted with thin and long cuttings (Table 5). The interaction of the cutting size with IBA hormones (less than 1 cm x 15 cm x 4000ppm) significantly increased the all cutting traits as a result of the accumulation of the positive effect of each factor separately. (Table 5)

Table (5): The effect of the triple interaction treatments between cutting diameter and IBA conc. and cutting the size on rooting and growth characteristics of *Rhus coraria* as root cuttings.

Cutting diameter	IBA con. Ppm	Cutting length	Rooting percentage %	Root numbers	Root Length (cm)	Shoot Length (cm)	Branch number	Leaves Number
Cutting diameter 0.5-1cm	Control	7.5 cm	34.5 f	2.4ghi	13.5 e	11.6ef	1.9 gh	12 ij
	2000		47 de	3 efg	16.3 cd	14d	1.7 gh	16 fg
	3000		51.66 d	3.8 cde	18.8bc	15.4cd	2.8 def	17.8def
	4000		65.5 bc	4.1 bc	20.5b	16.5c	3.08 de	19.9c
	Control	15 cm	50.33 de	2.8 fgh	16.6cd	14.3cd	2.5efgh	16.3 efg
	2000		64.16 bc	4.6 b	23.2 a	19.6b	3.9c	18.1 cde
	3000		65.33 bc	4.5 bc	23.3a	20.6b	4.0c	19.1cd
	4000		76.6a	6.2 a	25a	24.6a	6a	28.6a
Cutting diameter 1-2 cm	Control	7.5 cm	26.6 g	2 i	12 e	10.8 f	1.73 h	10.8 j
	2000		45.6 e	2.6f-i	16.08d	13.3de	2.2 fgh	13.5 hi
	3000		51.66 d	3fgh	17.8 cd	13.8 de	2.4efgh	15.1gh
	4000		60.16c	3.3def	17.8cd	14.6cd	2.58 efg	17.3def
	Control	15 cm	46.3 de	2.16 hi	12.5e	13.1 de	2.3efgh	14h
	2000		60.66 c	2.5f-i	17.13cd	13.9d	3.5cd	15.9fg
	3000		62.16bc	2.9fgh	17.15cd	15.1cd	3.9c	18.1cde
	4000		66.6b	3.9bcd	20.8b	20.6b	4.9 b	23b

CONCLUSION

In conclusion, the cutting length, cutting diameter, and the interactions between them affected the rooting ability of *Rhus coraria* root cuttings, more rooting can be obtained with thinner but longer cuttings treated with 4000 ppm IBA. Our finding about the better response of thinner root cuttings to root formation could be a notable finding, where in comparing to thick cuttings that locate near the root collar of shrubs, better rooting produced from thin cuttings locating near distal parts of the root system of sumac, hence appropriate root materials required to propagate Sumac can be collected easily with less disturbance to the donor shrubs.

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EFFECT OF STEM CUTTING TYPE AND DEPTH OF PLANTING ON THE EARLY GROWTH OF ORIENTAL PLANE (*Platanus orientalis* L.) SEEDLINGS.

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ABSTRACT

The present study was conducted at the forest nursery in Sumel at the elevation (583 m.a.s.l.), longitudes (43° 01' 12" E), latitude (36°, 847', 27" N), during the period mid of February to late October of 2010. The study aimed to determine the best stem cutting type and planting depth to gain reasonable root-initiation with best shoot growth characters. The study comprised two types of stem cuttings (Terminal and Lateral) in 30cm length planted in plastic polyethylene bags contained sandy loam soil. The cuttings were planted at three depths (1/3, 2/3 and entirely cutting length). In compare to terminal cutting the lateral cutting showed significantly superior results for both root and growth characters with highest results for (rooting percentage (40.13%), height growth (73.15cm), stem diameter (8.15mm), number of branch (3.81), number of leaves (36.31), number of roots (22.75), dry weight of shoot system (33.49g), dry weight of root system (20.31g). On the other hand, planting of lateral cutting at entirely depth of its length in compare to the 1/3, 2/3 planting depths significantly increased the studied parameters (35.62%, 69.82cm, 7.56mm, 3.78, 36.84, 23.19, 31.65g, 20.39g) respectively. Accordingly; we can recommend the lateral cuttings for reproducing oriental plane tree seedlings by planting the cuttings of 30cm length completely leaving the last upper buds above the soil surface.

KEYWORD: cutting type, planting depth, *Platanus orientalis* L, polyethylene bags.

INTRODUCTION

Recently consideration turned to propagates fast-growing trees with short cutting rotation, especially native species in order to provide greatest quantity of wood with best quality to meet the increasing demand for its uses as raw material in various wood industries such as cellulose paste, pulpwood, match wood...etc. In addition to the other benefits that are related to the environmental improvement such as minimizing soil erosion; revitalization of tourism, water and soil conservation, which have a significant role in supporting and developing the economic structure of many countries.

Oriental Plane tree (*Platanus orientalis* L.) (Chinar) in Kurdish belongs to genus *Platanus* and family *Platanaceae* (Cronquist, 1988). It is a large, deciduous, hardwood tree, commonly up to 25m height with diameter at DBH at mature stage (1-2.5m). This species is indigenous to the eastern Mediterranean region and growing exclusively along permanent watercourses where soil varies from silt to gravel. It can withstand the low

temperature, severe frost and rather high temperature (Hardin, et al., 2001; Goor, 1976).

The annual volume growth of oriental plane was estimated to be (20m³/ha) (Chapman, 1957). It can be used as ornamental or shelter trees in roadsides and national parks (Gilman, 1994). It is a very useful species for planting along water courses and this type can be used for the reclamation and soil conservation, windbreaks, sand dunes fixation (Gilman, 1994; FAO, 1986).

The tree produces valuable wood, tough and dense. It has a nice grain in cross-section for decorative works (Gilman, 1994; FAO, 1986 and Shahbaz, 1979).

In Iraq there are two species of this genus, one of them is cultivar named sycamore or American plane (*Platanus occidentalis* L.) as an exotic species and the other is native named oriental plane (*Platanus orientalis* L.) (Townsend and Guest, 1980). Due to the multipurpose of the native tree species as mentioned before and because of the low rooting ability and early growth of this species via vegetative propagation (Hawramee, 2003). Therefore it is necessary to investigate various silvicultural treatments and

methods leading to improve the reproduction of this species. Accordingly, this study was conducted to investigate the effect of stem cutting type and planting depth on the rooting ability and the growth of oriental plane under field conditions in Sumel area. We aimed find out the best type of stem cuttings of *Platanusorientalis* L. to be planted at a suitable depth to increase rooting and growth characters.

MATERIALS AND METHODS

1- Study site :

The present study was conducted under field conditions at forest nursery of the Faculty of Agriculture & forestry Sumel-Duhok located 15 km west of Duhok city, at the elevation (583 a.m.s.l.), at (N 36°, 847', 27"; E 43° 01' 12"). during the period from February 15th to late of October 2010, The total annual rainfall was about 278.2 mm restricted from December to May. The lowest average temperature 9.2C° in Jan. and the maximum average temperature 33.1C° in Aug., while the relative humidity ranged (66.7% - 20.3%).

2- Collection and Preparation of Cutting:

The cuttings were taken from one year old shoots of oriental plane trees from the upper one third of the crown of dominated healthy vigor young trees grown naturally in the Ashawa area at January 15th. Two types of stem cuttings (Terminal and Lateral) of 30 cm length were prepared. The lateral cutting cut off horizontally from the upper and obliquity from the lower whereas the terminal cuttings cut off only obliquity from the lower part (Abdullah, et al., 1988). Then after, the cuttings were stored for four weeks in the soil media, until the timing of planting in February 15th.

The experiment included a study of the effect of two factors:

2.1- Type of stem cutting (T) both terminal and lateral cuttings

2.2- Planting depth (D) included three depths 1/3, 2/3 of cutting length and entirely of cutting length leaving an upper bud above the soil surface, in Feb. 15, 2010.

3- Experimental design and Sampling

The study was designed as a factorial experiment in a randomized complete block design (RCBD) using 6 treatments, each treatment replicates four times and 20 cuttings for each replicate; At the end of experiment in late of October 2010, seedlings of each treatment for

each replicate were taken to consider the following measurements: rooting percentage (%), height (cm), stem diameter (mm), number of branches cutting, number of leaves, number of root per cutting. The dry weight of shoot system and root system (g) and shoot and root systems were separated and there were oven dried at 70C° for 48 hours until to be constant.

4- Statistical analysis

The obtained data were analyzed statistically using the statistical analysis system (SAS 2001). The means were compared using Duncan multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Survival percentage: the results of the statistical analysis showed that the highest rooting percentage 40.13% was found with lateral cuttings, while the lowest value was 14.30% found with terminal cutting (Table 1). This may be due to the accumulation of auxin in the lateral cutting rather than in terminal cutting, which was responsible for creating initiated root primary (Marks, 1996). On the other hand, the concentration of natural accumulation of auxin in the base of lateral is more than in terminal, which help to the development of roots in the lateral cutting than in the terminal cutting (Abdullah et al., 1988; Devlin, 1975 and Briscoe, 1979). When comparing the effect of the depths of planting, Duncan test Table (1), the complete depth differed significantly than the other depths (1/3 depth and 2/3 depth), where the highest survival percentage value 35.62% was found with complete depth. This may attributed to the availability of moisture in deep planting. On the other hand, because by deep planting the most part of cutting become under soil, in which to be protectable from difficult climatic conditions (temperature, wind, light, ... etc.) consequently to be less subjected to loss moisture by transpiration particularly during summer. These results are in agreement with those of Rathjens (2009), who obtained better results with red maple planted at depth of 30 cm. From the table (2), it was noticed that the interaction of lateral cutting with deep planting do not differ significantly with lateral cutting with 2/3 depth interaction, however it differed significantly with the other interactions and gave the maximum survival percentage 51.66%, while the minimum survival percentage

7.08% was appeared with the interaction terminal cutting planted with shallow depth(1/3).

Height and diameter growth: the analysis of the data showed that lateral cutting significantly affected on the height growth and stem diameter of cutting and increased significantly which were (73.15cm, 8.15mm) while the lowest height growth and diameter of the seedling (58.37cm, 5.89mm) given by terminal cutting as shown in Table (1). This result may be due to the difference of the physiological conditions between terminal and lateral cuttings which related to endogenous mechanisms, such as growth inhibitors of primary meristem of terminal cutting, or might be result of the difference in concentration of growth regulators in the base of cuttings which is more in the lateral cutting than in the terminal one (Abdullah et al., 1988; Yagi, 2004). Furthermore, this result also might be as a consequence of that lateral cutting which contains more storage nutrient substrate than terminal cuttings which contribute for division of cells and conjunction of stem diameter, and diameter has often been considered the best single predictor of field survival and growth (Thompson, 1985).

The Duncan test from Table (1), to compare the effect of planting depth on these two characters, showed that the deepest planting was superior on other planting depths, giving highest height growth and diameter values (69.82cm, 7.56mm), while the lowest (60.83cm, 6.19mm) was appeared with shallow depth. These results may be attributed to responses of cutting to deep planting where availability of moisture facilitated the absorption of water and nutrient elements in deep soils for photosynthesis process effectively. Moreover available the moisture at this planting depth was faraway difficult climatic conditions (Ali, 1999; Fare, 2005 and Arnold, et al., 2007).

And compare the effect of interactions between (cutting type and planting depth) on these two characters, as Table (2), showed the interactions of lateral cutting and deep planting were differed significantly from the other interactions in their effect on these traits, with highest height growth and diameter values (77.37cm, 8.80mm), while the minimum value (54.61 cm, 5.46mm) was recorded from the terminal with planted shallow depth.

The number of branches and leaves: The result in (Table 1) shows that there were significant differences between terminal and lateral cuttings. The lateral cutting increase significantly the

number of branches and leaves, with highest value (3.81, 36.31) respectively. While, the lowest values were which appeared with the terminal cutting (3.03, 25.70). This increase may be due to the nutrient substance stored in such cutting to be more which can contribute for forming branches in addition to existence of direct relationship between diameter and the number of branches then due to more leaves (Wilson, 2000 and Kajornsrichom, 1994).

From the same table, the plating depth showed significant differences effects, in the number of branches and leaves. The deep planting was superior on others which recorded highest values (3.78, 36.84) respectively, compared with lower values (3.10, 25.73) with shallow depth. Table (2) indicated that there were no significant differences in number of branches by the effect of the interactions of lateral cutting with deep planting and the lateral cutting with 2/3 depth; the high number of branches per cutting belong to the lateral cutting with deep planting was (4.13) and the lowest number was (2.75) from terminal with shallow depth interaction. Concerning the interaction between cutting type and planting depth, it had significant effects on the number of leaves. The highest number of leaves 42.01 was observed with interaction of lateral with deep planting, while the lowest number 21.89 was observed with interaction of terminal with shallow depth (Table 2).

The number of roots: Duncan's test (Table 1) showed that the lateral cuttings was significantly differed from the terminal cutting and increased the number of roots and gave the highest number 22.75 compared with the lowest number 18.87 with terminal cutting. The responses of this character to lateral cutting which is containing a lot of stored carbohydrates or nutrient elements more than those stored in terminal cutting as well as the concentration of hormones is more which may play a critical role for stimulation of adventitious buds exist on main root forming further lateral roots (Rieckermann, et al. 1999 and Vlachov, 1988).

On the other hand from the same table, it is obvious that increasing planting depth may cause a significance increase in the number of roots. The highest number of lateral roots 23.19 was observed with deep planting of cuttings, while the shallow planting significantly impaired the number of roots 18.19. Regarding the effect of interactions (cutting type and planting depth) on

the number of roots, Table (2) demonstrated that the interaction had significant effects on this character. The interaction lateral cutting with deep planting caused an increase in the number of roots (24.96), whereas the less number of roots was recorded from interaction terminal with shallow depth (16.48).

Dry weight of shoot system: Table (1) indicated that there was a significant difference between terminal and lateral cutting on dry weight of shoot system, the highest value (33.49g) was observed with lateral cutting, while the lowest value (24.62g) belongs to terminal cutting. This result may be due to increase in the number of branches and leaves which obtained by this type of cutting, and since the dry weight of shoot is considered the combination of these components so it is reasonable to see increasing dry weight in relation to the increase of their components. Furthermore, a strong relationship likely reported between seedling dry weight and stem diameter (see Ritchie 1984).

Also planting depth, revealed a significant effect on dry weight of shoot system. However deep planting was superior significantly to the other depths and caused an increase in dry weight significantly at the highest value 31.65g compared with the minimum dry weight 25.46g with shallow depth. As it was obvious from the Table (2), the effect of interactions (cutting type and planting depth) on the dry weight of shoot system, demonstrated that interaction of lateral with deep planting caused to increase weights of shoot system which were (36.22g), the lowest weights (20.35g) were appeared with the interactions of terminal with shallow depth.

Dry weight of root system: From the (Table 1) shows that there were significant differences between terminal cutting and lateral cutting. Where the lateral cutting increased significantly the dry weight of root system and gave the highest weight 20.31g, the lowest weight 17.65g was appeared with terminal cutting. This increasing could be attributed to the improvement of the number of roots, which permit increase in dry weight of root system. These results are supported by our results obtained from the number of lateral roots mentioned previously. These results are in agreement with those of (Abdullah, et al., 1988) on vegetative reproduction of *Platanus occidentalis* L. by distance from the base of stem cutting.

Regarding the effect of planting depth, results represented in (Table 1) show that planting depth has a significant effect on dry weight of root system. The deep planting was superior to the other planting depths which gave highest weight 20.39g, while the lowest dry weight of root system per seedling 17.14g was recorded from shallow depth. Table (2) showed that there were no significant differences of the effect between interactions of lateral cutting with deep planting and lateral cutting with 2/3 depth on dry weight of root system but the interaction lateral cutting with deep planting gave the highest dry weight of root system which was 21.59g, while the lowest weight 15.65g was from the interaction of terminal with shallow depth.

CONCLUSION

Under our study conditions, the lateral cuttings with entirely cutting length leaving only an upper bud above the soil surface considered to be the best method for reproducing oriental plane vegetatively to gain reasonable surviving with good growth characters. We also recommend to conducting further studies for reproducing of *Platanus orientalis* L. vegetatively in nurseries using a new silvicultural technique under various silvicultural treatments and environmental conditions.

Table (1): Effect of cutting type and planting depth on some rooting and shoot growth parameters of *Platanusorientalis* L. seedlings from Duncan test.

Growth parameters	Stem cutting type			Planting depth	
	Terminal cutting T1	Lateral cutting T2	1/3 of cutting length (D1)	2/3 of cutting length (D2)	entirely cutting length (D3)
Survival %	14.30b	40.13a	13.75c	32.29b	35.62a
Height growth (cm)	58.37b	73.15a	60.83c	66.64b	69.62a
Diameter (mm)	5.89b	3.81a	3.10c	3.38b	3.78a
Number of branches	3.03b	3.81a	3.10c	3.38b	3.78a
Number of leaves	25.70b	36.31a	25.73c	30.45b	36.84a
Number of roots	18.87b	22.75a	18.18c	21.04b	23.19a
shoot dry weight (g)	24.62b	33.49a	25.46c	30.06b	31.65a
root dry weight (g)	17.65b	20.31a	17.14c	19.41b	20.39a

Table (2): Effect of interaction treatments of cutting type and planting depth on some rooting and shoot growth parameters of *Platanus orientalis* L. seedlings from Duncan test.

Growth parameters	Terminal cutting T1			Lateral cutting T2		
	1/3 of cutting length (D1)	2/3 of cutting length (D2)	entirely cutting length (D3)	1/3 of cutting length (D1)	2/3 of cutting length (D2)	entirely cutting length (D3)
Survival %	7.08d	16.25c	19.58b	20.41b	48.33a	51.66a
Height growth (cm)	54.61f	58.22e	62.28d	67.04c	75.05b	77.37a
Diameter (mm)	5.46e	5.90d	6.32c	6.92b	8.73a	8.80a
Number of branches	2.75c	2.90c	3.44b	3.46b	3.85a	4.13a
Number of leaves	21.89f	23.55e	31.66c	29.57d	37.34b	42.01a
Number of roots	16.48e	18.69d	21.43c	19.88d	23.40b	24.96a
shoot dry weight (g)	20.35e	26.41d	27.09d	30.57c	33.70b	36.22a
root dry weight (g)	15.65c	18.11b	19.19b	18.63b	20.72a	21.59a

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ESTIMATING WASTE WOOD THROUGH CONVERSION OF WHOLE STEM INTO LUMBER OF *Eucalyptus camaldulensis* GROWING IN ASKIKALAK KURDISTAN REGION OF IRAQ*

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ABSTRACT

To estimate the additional income which can be realized by exploiting whole stem wastes after log sawing, 22 *Eucalyptus camaldulensis* uniform trees were studied. Income was estimated by prediction of lumber and waste volumes which involved waste wood produced before and after sawing process. Utilizing processes were conducted in two different sawing techniques were applied. The results showed that stacked wood comprised more than double volume of sawing wastes. Summer cutting maintained better income than that of winter. Although quarter sawing resulted in higher waste income, flat sawing assured higher total income, that because of the higher volume of lumbers obtained by this method.

KEYWORDS: Whole Stem, Wood Waste, *E. camaldulensis*, Lumber

INTRODUCTION

Eucalypt is cultivated as an exotic tree worldwide. Range of distribution is extended from tropical to subtropical and warm temperate, and from arid to semi-arid regions. It tolerates temperature from 3 to 5 °C. in winter and in dry season it tolerates (34-45 °C) four to eight month or more and even more severe temperatures. Frosts are rare (5-20 days per year) according to Mariani *et al.*, (1981). *Eucalyptus* wood has been included in the forest products industry as an important wood material GEF, (2002). Focusing on adaptability, diversity, adverse environmental conditions, its resistance to various pests and pathogens, its ability to coppice (reproduction of harvested stem) and fast growth rate, Zahid and Quraishi (2002) reported that the popularity of *Eucalyptus* among the farmers and people engaged in forestry and landscaping. Flynn, (2009) stated that the vast majority of *Eucalyptus* resource has been managed to produce pulpwood or fuel wood, that's mean all stem parts including sawing wastes could have their importance since they can be used as a raw materials for such uses.

Wide areas-among big project of forestation were planted in Iraq since the mid of last century where eucalyptus was the predominant species.

Some plantations were established in Kurdistan region. Unstable political and economic circumstances before 2003 resulted in sever deterioration of all plantations. Currently, serious efforts are being exerted for new forestation projects either by eucalypt or by other species.

E.camaldulensis is the main species of artificial forestation in Iraq till the moment. The species is attending in about almost all Iraqi territories. At higher elevations of Kurdistan the growth slows down or inhibits. The area of eucalypt plantations was about 3000 hectare in 70th of last century FAO, (1979).

Kurdistan region has different climatic conditions and soil properties compared to other parts of Iraq. While *Eucalyptus camaldulensis* is the most dominant species in almost all parts of the country, the status is quite different in Kurdistan where only limited areas have been planted by the species. High elevations, rocky mountains, and frequent frost are the most effective factors made eucalypt less preferable species in the region. Forestry officials reports referred that the main two species of eucalypt in Iraq (*E.camaldulensis* and *E. microtheca*) were planted in Kurdistan at an elevations of 400 - 800 meters.

*A part of PhD dissertation of first author

It is well known that environmental conditions could have their crucial effects on the wood properties. Because of scarcity of studies dealing with eucalypt wood in Iraq especially those related to its drying and multi-use utilization, this study has planned to search in possibility of utilizing the trees of *E. camaldulensis* grown in Kurdistan for lumber industry as main object in addition to other uses for remaining parts of tree. This paper has focused on the profit could be realized by exploiting waste wood resulting from conversion of whole stem to lumbers.

MATERIALS AND METHOD

The study site was in Askikalak, at Erbil governorate, Kurdistan Region of Iraq

Twenty two uniform trees of *E. camaldulensis* were felled from a tree stand in Askikalak ; 10 in summer and 12 in winter. After limbing they were top cut to merchantable diameter. Stem diameter was measured at each end and midpoint by taking the average of two opposite directions. Whole stem volume was calculated based on mid diameter and stem length by using Hubber equation. Bucking has done to cut the stem into equal-length logs. Log volume was estimated by taking the average of 4 readings for each of length and under bark diameter.

Sawing was conducted in private sawmill in Erbil city. Two sawing techniques were employed; flat (FS) and quarter sawing (QS) methods in summer and according to results of summer cutting which gave a priority to quarter sawing, only this technique has applied in converting wood logs to lumbers. To maintain maximum

volume of lumbers, the boards were prepared in 3 thicknesses (2, 4, and 6) cm.

RESULTS AND DISCUSSION

Optimum utilization could be realized with whole tree utilization system, but this may not possible in most cases. Therefore, exploiting of maximum volume offers additional income which makes utilization more beneficially.

Woody biomass is the form of wood, which is found in size and shape unsuitable for lumber. This part of utilized tree could have one or more from other uses.

As the main product was sawn timber, it has been deeply investigated previously Abd Ali and Taha, (2013a,b,) Taha and Abd Ali, (2015). This paper has focused on wastes that produced from whole stem after conversion to lumbers; other parts of tree were not investigated.

Volume estimations from field measurements and calculations offered required data for approximation of additional income which can be achieved by exploiting other parts than lumber.

Two main components of constituted wood biomass were included; stacked wood and sawing residues. Branches, limbs, stump and root volumes were not included, they were out of the study objects.

Stacked wood is generally measured in term of cords that is of course in case of large volumes. In our case, it has measured in cubic meters for more accuracy. Estimation of stacked wood was done by subtraction of technical round wood from merchantable stem volume. Table (1) shows that stacked wood comprised big part of merchantable volume. About 38% of total stem volume was classified as stacked wood

Table (1): Stacked wood, Sawing wastes volumes and corresponding income of summer.

Tree	Stem Volume (m ³)	Technical Round wood (m ³)	Stacked Wood (m ³)	Lumbers (m ³)	Sawing Wastes (m ³)	Total Wastes (m ³)	Income as Wood Chips (\$)
1	0.764	0.514	0.2500	0.2198	0.2942	0.5442	52.24
2	0.889	0.446	0.4430	0.2614	0.1846	0.6276	60.25
3	0.777	0.475	0.3020	0.3408	0.1342	0.4362	41.87
4	1.095	0.650	0.4450	0.4309	0.2191	0.6641	63.75
5	0.820	0.496	0.3240	0.1965	0.2995	0.6235	59.86
6	0.695	0.424	0.2710	0.2678	0.1562	0.4272	41.01
7	0.678	0.460	0.2180	0.3688	0.0912	0.3092	29.68
8	0.596	0.363	0.2330	0.3378	0.0252	0.2582	24.79
9	0.818	0.465	0.3530	0.3275	0.1375	0.4905	47.09
10	0.860	0.676	0.1840	0.4142	0.2618	0.4458	42.79
Total	7.990	4.970	3.0230	3.1655	1.8035	4.8265	463.33
Mean	0.7990	0.4970	0.3023	0.3166	0.1804	0.4827	46.33

Sawing wastes were estimated by subtraction of sawn board's volume from that of technical round wood. It comprised about 22% of total merchantable volume and 36% from technical round wood. This percentage remarked the encouraging opportunities for the utilization of this species.

Because of diameter, stacked wood together with sawing wastes were classified as chips wood.

The price range is \$100-140/ton (Tab.2). To convert the price of metric ton into cubic meter, mean price (\$120) multiplied by (0.8) as reasonable factor remedying the effect of moisture and wood specific gravity. Total income of these two parts of wood biomass was (\$463.33), with a mean of (\$46.33) per single tree. Regarding volumes, income of stacked wood was about twice that of sawing wastes.

Table (2): Prices of some products of Eucalypt Jarrah (*E. marginata*) wood in the world markets.*

Type of Product	Unit Price
Construction Purposes	US \$200-500 / Cubic Meter
Tiles & Flooring	US \$150-320 / Cubic Meter
Furniture Grade & Plywood	US \$220-500 / Cubic Meter
Wood Chips	US \$100-140 / Ton
Wood Door	US \$350-980 / Cubic Meter
Wood Board	US \$150-320 / Cubic Meter

There was clear evidence that (FS) maintained less percentage of wastes. Table (3) shows that about 39% of total summer wastes were produced as a result of using flat sawing technique. It is not a high percentage of waste regarding the primitive available procedure followed in sawing. Modern technology will certainly, assist in decreasing waste amounts. About (\$70) has obtained as income of flat sawing wastes of the ten summer trees.

Higher percentage of sawing wastes means lower volume of lumbers, but on the other hand, higher income has ensured by applying this technique from wood biomass. Final result was lesser income since lumbers price is much more

than the price of wood chips. While quarter sawing has recommended in sawing such woods as *Eucalyptus* (Vermass, 1995), in the previous study it could not realize higher volume of sawn boards than flat sawing.

Sawing wastes in quarter method were 20% more than that of flat sawing (Tab. 4). Total sawing wastes offered (\$106.3) as additional income in case of marketing these wastes as wood chips. Log diameter, slenderness, straightness, and defects are main factors affecting degree of utilization of a single tree. In sawmill, method of sawing is the fundamental one. In (QS) around 45% of technical round wood has wasted, while only 28% was the waste wood in (FS).

Table (3): Sawing wastes volumes and corresponding income of summer flat-sawn boards.

Tree	Technical Round Wood (m ³)	Lumbers (m ³)	Sawing Wastes (m ³)	Income as Wood Chips (\$)
1	0.321	0.1577	0.1633	15.676
2	0.184	0.1171	0.0669	6.422
3	0.262	0.2245	0.0375	3.600
4	0.398	0.3164	0.0816	7.834
5	0.190	0.1006	0.0894	8.582
6	0.264	0.1896	0.0744	7.142
7	0.197	0.1035	0.0935	8.976
8	0.139	0.1103	0.0287	2.755
9	0.292	0.2467	0.0453	4.349
10	0.273	0.2516	0.0214	2.054
Total	2.515	1.8180	0.6970	66.912
Mean	0.2515	0.1818	0.0697	6.6912

* Source: Product Listing Policy - Intellectual Property Policy and Infringement Claims - Privacy Policy - Terms of Use Copyright 1999-2012 Alibaba.com Hong Kong Limited and licensors.

Table (4): Sawing wastes volumes and corresponding income of summer quarter-sawn boards.

Tree	Technical Round Wood (m ³)	Lumbers (m ³)	Sawing Wastes (m ³)	Income as Wood Chips (\$)
1	0.1923	0.0674	0.1249	11.990
2	0.2610	0.1666	0.0944	9.062
3	0.2132	0.1288	0.0843	8.093
4	0.2501	0.1217	0.1284	12.326
5	0.3049	0.1525	0.1524	14.630
6	0.1604	0.0851	0.0753	7.229
7	0.2620	0.1856	0.0764	7.334
8	0.2223	0.1726	0.0497	4.771
9	0.1723	0.0851	0.0872	8.371
10	0.4165	0.1820	0.2345	22.512
Total	2.4550	1.3474	1.1076	106.33
Mean	0.2455	0.1347	0.1108	10.633

Since the target of any stockholder is attaining maximum profit, these results supported flat sawing techniques. This is not in line with some literatures; that's may because of drying techniques probable is the reason.

Table (5): Stacked wood, sawing waste volumes and corresponding income of winter.

ree	Stem Over bark Volume (m ³)	Tech. Round Wood (m ³)	Lumbers (m ³)	Stacked Wood (m ³)	Sawing Wastes (m ³)	Total Wastes (m ³)	Income (\$)
1	0.875	0.484	0.2865	0.391	0.1975	0.5885	56.49
2	0.500	0.394	0.3095	0.106	0.0845	0.1905	18.29
3	1.034	0.879	0.5709	0.155	0.3081	0.4631	44.46
4	0.440	0.311	0.2654	0.129	0.0456	0.1746	16.76
5	0.620	0.316	0.2324	0.304	0.0834	0.3874	37.19
6	0.790	0.449	0.3226	0.341	0.1264	0.4674	44.87
7	0.743	0.514	0.4097	0.229	0.1043	0.3333	31.99
8	0.703	0.594	0.5119	0.109	0.0821	0.1911	18.35
9	0.880	0.393	0.2675	0.487	0.1255	0.6125	58.80

10	0.670	0.413	0.2594	0.257	0.1536	0.4106	39.42
11	0.810	0.372	0.2504	0.438	0.1216	0.5596	53.72
12	0.580	0.385	0.2985	0.195	0.0865	0.2815	27.03
Total	8.645	5.504	3.9938	3.1409	1.5191	4.6600	447.36
Mean	0.720	0.458	0.3328	0.2617	0.1266	0.3883	37.28

Income of waste wood by (QS) was (\$106.33), it was higher than in (FS) because of bigger volume. The trend was different with sawn board. Income was about one half the income of flat sawing (Tab. 6). Volume of winter stacked wood (3.1409 m³) was not far from that of summer, and

so was the corresponding income (Tabs. 1, 5). Waste wood ratio, in addition to sawing technique, is dependable upon stem form and uniformity. That might be the reason for obtaining lower quantity of sawing wastes than expected since all winter boards were quarter sawn.

Table (6): Volume of sawn boards and wastes with corresponding income of harvested *E. camaldulensis* trees.

Sawing	Lumbers (m ³)		Wastes (m ³)			Income (\$)	
	volume (m ³)	Income (\$)	Stacked Wood (m ³)	Sawing wastes (m ³)	Total Wastes (m ³)		
Summer	3.1656	1299.7	3.0230	1.8035	4.8265	463.34	1763.1
Flat	1.8181	850.9	-	0.6970	-	66.9	917.8*
Quarter	1.3474	448.7	-	1.1076	-	106.3	555.0*
Winter	3.9938	1415.5	3.1409	1.5191	4.6600	447.36	1862.9

Total summer income of lumbers plus total wastes was \$ 1763.1 (Table 6), while that of winter was \$ 1862.9. When calculating the total income of each sawing method separately the advantage was for flat sawing. Income per volume unit of wastes in winter was 37.3 \$/ tree (Tab. 5) where all sawing was quarter. In summer it was little higher (46.3 \$/ tree) (Tab. 1) where half of the volume was flat and the other was quarter sawn. Total income of summer quarter sawing was (448.7 + 106.3 = 555 \$), i.e. 55.5\$/tree, while summer flat sawing insured a total income of

(849.5 + 66.9 = 916.4 \$), that's 91.6\$/tree. These results assured that when stockholder in Kurdistan region deciding to utilize *E. camaldulensis* for lumber production, he has to apply flat sawing beside other recommendations for achieving best income.

Consistent to the results, it can be conducted that wood of Eucalyptus during processing operation can be utilized for lumber and wood chips industries under the suitability of Kurdistan region circumstances.

*Income of two components (lumbers + sawing wastes only).

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پوخته

ژ بو ته خمینکرنا داهاتین پتر کو دشیان دا هه یه بدهستخوڤه ب ئینین ب وه بهرئینانا بهرماکین دارین قه دین تمام پشته داهینانا قورمین داری، ۲۲ دارین یوکالیبتوس ین خودان خهمله کا باش هاتنه بکارئینان بو قئ قه کولینن. داهات هاته حسیبکرن بریکا ده رئیخستنا قه بارئ ده پان وقه بارئ بهرماکین داهینانن بهری و پشته پروسن. دوو جورین شیوازین داهینانا ده پا هاتنه بکارئینان. ئه نجاما دیارکر کو قه بارئ (stacked wood) هندی دوو بهرامبهری قه بارئ بهرماکین داهینانن بون. برینا وهرزئ هاهینن داهاته کی باشته پاراست ژ برینا وهرزئ زفستانن. سه ره رای کو برینا چارئیکی داهاته کی مه زنترژ بهرماکان ب دهست خوڤه ئینا و برینا راست ب رهنگه کی ئاشکرا داهاتین گشته ین بلند ب دهست خوڤه ئینان، ژ بهرکو قه باره یه کی مه زن ژ ده پان بقی ریکن به رهه مئینا بو.

CHARACTERISTICS AND SOME TECHNOLOGICAL PROPERTIES OF *Juglans regia* L. TREES GROWN IN DUHOK PROVINCE.

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ABSTRACT

Juglans regia L. is an oldest native species and cultivated throughout Kurdistan region/Iraq. The sample trees were harvested from Duhok province. Samples were taken at breast height from different ages of trees. In this research, physical, anatomical properties of the wood were investigated, and some morphological properties of its wood also evaluated including the percentage of Heartwood (HWP) (31.49 %), Sapwood (SWP) (65.51 %), Bark percentage (BP) (21.74 %) and Annual Ring Width (ARW) (4.01cm). The values of physical properties were: moisture content for HWP and SWP were (43.85, 59.50%), were for all studied trees were (52.89 %), whereas specific gravity for HWP and SWP were (0.701, 0.606) and for all studied trees was (0.671). While basic density was (0.578g/cm³). Volumetric shrinkage and volumetric swelling were (12.56, 14.44 %), fiber saturation point (21.91%), cell wall (44.781%) and porosity (55.48 %). The values of anatomical properties were: fiber length (1.585 mm), fiber diameter at the mid-point of the fiber (34.00 μm), fiber double cell wall thickness (16.12 μm) and fiber lumen diameter (7.88 μm), vessel length (0.545mm), vessel diameter at the mid-point of the vessel (179.806 μm), vessel lumen diameter (134.136 μm), slenderness ratio (69.85), runkel ratio (2.339). Due to moderate specific gravity and other physical properties, walnut wood is suitable for structural application. Also could be the walnut fibers are a promising fibrous raw material for paper production.

KEY WORDS: *Juglans regia* L., Technological properties, Wood variation.

INTRODUCTION

Juglans regia L. is commonly called Persian walnut, English walnut or common walnut (Lukas van Zyl 2009). *Juglans regia* is native species to temperate regions in mountainous Eastern Europe and central Asia (Leslie and McGranahan, 1998), and cultivated throughout Kurdistan, and rarely, in the foothill region, often in large landscape (Shahbaz, 2010). Walnut is deciduous tree growing up to 25–35m in height, and growing best in rich, deep and moist soil with full sun and long summers (Chittendon, 1956 and Bean, 1981). One of the main properties of the walnut is the multiple uses for producing both nuts and timber, which considered one of the most high quality timbers over the world (Abuin *et al.*, 2002).

Walnut wood is heavy, hard, strong, stable, durable, dark, close grained, seasons and polishes well, shock-resistant, flexible (Polunin and Stainton, 1984; Manandhar, 2002). Due to its strength and durability, walnut sawn wood is used

in high class, decorative construction and furniture (Hart, 1991).

Many factors are responsible for the variability in wood, which include specific gravity, density (Kiaei, 2013), and the variability of wood anatomical properties has an effect on the efficient use of wood for different application. Anatomical properties vary from tree to tree, within species and between species and variation often being strongly genetically influenced (Zobel and Van-Buijtenen, 1989). Heartwood and Sapwood have varying properties, and their proportion within the stem has a significant effect to the end user of wood products. Heartwood formation is a regular occurrence in tree stems, and may have many different properties from sapwood, including hardness and natural decay resistance (Taylor *et al.*, 2002).

Since information on morphological, physical and anatomical properties of *Juglans regia* L. wood grown in Kurdistan is scarce, therefore this study was carried out to investigate the potential

of this species as a raw material to be used for various purposes.

MATERIALS AND METHODS

Samples

Ten trees of walnut were selected randomly from Kezo area located 10Km North-East of Duhok city according to their quality of stem, crown and devoid from fungi and insect diseases. The age of trees were between 19-33 years-old, with a diameter at breast height (DBH) ranged from 17.1 to 31.15cm while the heights of trees is about 7.75 to 12.3 m (Table 1). The trees were harvested and cut; Disk (5 cm thick) was taken at DBH from each log and placed in plastic bags for further laboratory studies.

Morphological properties

The boundaries of heartwood (HWP) and sapwood (SWP) were very clear due to their distinct color and their length was calculated from the total disk length without bark by verneer digital and their ratios were determined as a geometric circle corresponding percentages was calculated by simple mathematical calculus, while the bark percentage was determined as the difference between total disk area and disk area without bark (Moya and Munoz, 2010) which presented in table (2).

Physical properties

To determine the physical properties of wood, The lumber was cut in parallel to grain directions from the logs in sawmill to 5 specimens with the dimensions of 20 × 20 × 30mm, according to ASTM D143-94 American system, 50 samples were used to study the following; annual ring growth width, moisture content %, oven-dry specific gravity, basic density, volumetric shrinkage, volumetric swelling, cell wall (%), porosity (%) and fiber saturation point (%).

Moisture content (MC) was measured according to the following equation (Akyildiz and Kol, 2010).

$MC = (M_g - M_0) / M_0$ (%). (M_g) green weight of the wood samples (g) after cutting and (M_0) dry weight of wood samples after dried in oven dried at 105±2°C, until a constant weight of wood.

The specific gravity (Sp.gr) was determined by using the following equation:

$Sp.gr = M_0 / V_0$. Where the (M_0) is the oven-dry weight of the samples and (V_0) is the dry volume of the samples.

The basic density (D_b) was calculated by the gravimetric method: (Haygreen and Bowyer, 1996).

$D_b = M_0 / V_g$ (g /cm³). M_0 is the oven-dry weight of the samples (g) and V_g is the green volume of the samples (cm³).

Volumetric shrinkage (ν) was determined by equation:

$$\nu = (V_s - V_0) / V_s$$
 (%)

Volumetric swelling (ν) was determined by the following equation:

$$\nu = (V_s - V_0) / V_0$$
 (%). (V_s) is saturated volume and V_0 is oven-dry volume.

Fiber saturation point (FSP) was determined by using the following equation (Korkut and Guller, 2008).

$FSP = \nu / D_b$ (%). (ν) is the volumetric shrinkage (%) and D_b is basic density (g/cm³).

The Percentage of the cell wall (V_c) and percentage of the porosity (V_H) were determined by using the following equations: (Korkut and Guller, 2008).

$V_c = D_0 / D_c \times 100$ (%). $V_H = 100 - V_c$ (%). D_0 is oven dry density (g /cm³) and D_c is oven dry density of the cell wall (1.5 g /cm³).

Anatomical properties

To determine anatomical properties, the part of each disk assigned for fiber and vessel dimensions was cut into small sticks and then subjected to a maceration process using Franklin solution (Franklin, 1946). The sticks of each specimen were placed in a test tube and immersed with a mixture of 1:1 glacial acetic acid and hydrogen peroxide was macerated. A sample of fibers and vessels was removed from the maceration and spread over a glass slide. Thirty measurements of fiber length (L), fiber diameter at the mid-point of the fiber (d), and fiber double cell wall thickness (p), fiber lumen width (c). Slenderness and runkel ratios were determined (Slenderness ratio = L/d, Runkle ratio = 2p/c). Also twenty measurements of vessel length, vessel width in the mid-point and vessel lumen were recorded for each tree, using Olympus microscope of eye piece 10X and objectives 10X and 40X for each measuring.

Table (1): Tree age, height, diameter at DBH and wood disc diameter without bark for the studied *Juglans regia* L. trees.

Tree NO.	Tree Age (Years)	Tree Height (m)	Tree Diameter at DBH (cm)	Wood Disk Diameter at DBH without Bark (cm)
1	19	10.2	19.25	18.2
2	20	10.8	20.8	19.2
3	21	7.75	17.1	15.6
4	22	9.5	19.1	17.3
5	23	12.3	24.3	21.1
6	24	11.3	22.7	20.4
7	26	11.7	31.15	26.3
8	27	9.2	20.55	17.6
9	31	10.7	30.2	26.1
10	33	11.9	25.85	21.4
Average	24.6	10.535	23.1	20.32
ST.D	4.6476	1.404	4.749	3.582

RESULT AND DISCUSSION

Morphological properties

It appears from Table 2 that there is a variation in the percentages of heartwood and sapwood in all studied trees, the average of HWP and SWP were 34.49 and 65.51%, the results indicated that the values of HWP were low to moderate. From (Figure 1 and 2) it seems that the HWP was

increased with increasing the tree age, while SWP was decreased. Wood properties including density, heartwood and sapwood vary according to tree species, age, height, and within the tree from the pith to the bark (Panshin and de Zeeuw, 1980), and the estimation of HWP helps to define differences in strength, durability and other wood characteristics (Wiemann and Williamson 1989).

Table (2): Morphological properties of *Juglans regia* L. trees.

Tree NO.	Heartwood (cm)	Sapwood (cm)	Heartwood (%)	Sapwood (%)	Bark percentage (%)	Annual Ring Width (mm)
1	2.6	15.6	14.29	85.71	11.87	5.2011
2	3	16.2	15.63	84.38	14.79	4.3715
3	4.8	10.8	30.77	69.23	16.77	4.2095
4	6.1	11.2	35.26	64.74	17.96	4.4018
5	5.5	15.6	26.07	73.93	24.60	4.1178
6	5.3	15.1	25.98	74.02	19.24	3.8071
7	8.8	17.5	33.47	66.53	28.72	3.8577
8	9.4	8.2	53.41	46.59	26.65	3.2704
9	10.4	15.7	55.85	44.15	25.31	3.5590
10	11.6	9.8	54.21	45.79	31.47	3.3455
Average	6.75	13.57	34.49	65.51	21.74	4.0141
ST.D	3.113	3.228	15.368	15.369	6.49	0.5784

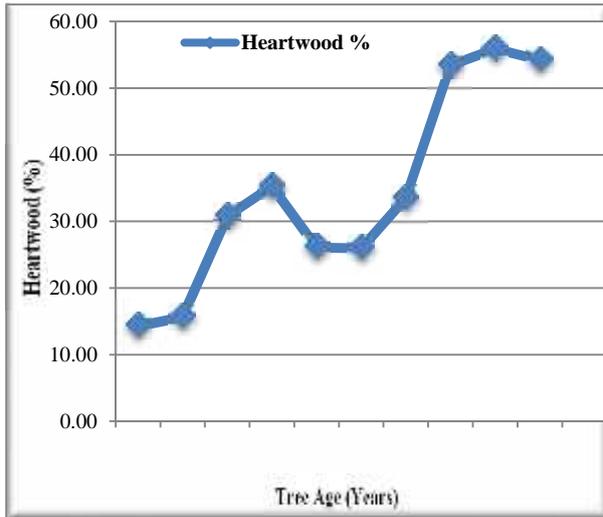


Fig (1): Relationship between percentages of heartwood with tree age.

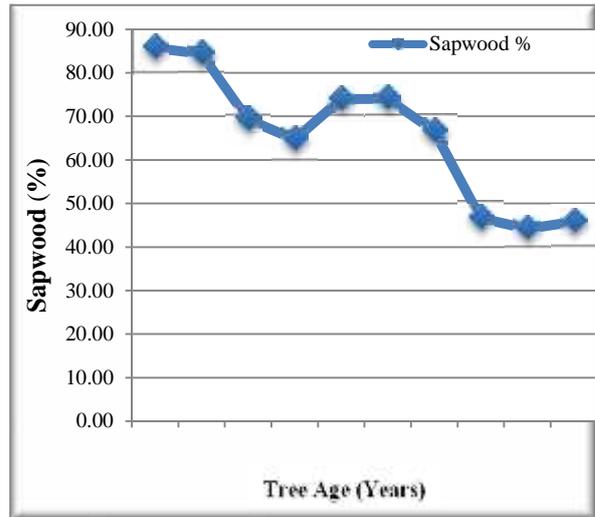


Fig (2): Relationship between percentage of sapwood with tree age.

Bark percentage varied in the cross-sectional area at DBH with an average of 21.74 % (Table2), and increased significantly with increasing the age of trees (Figure 3). Bark thickness are correlated with species, genetic structure, tree age, height, diameter of tree, soil moisture availability and geographical factors (Philip 1994; Sonmez et al. 2007).

The average value of an annual ring width was 4.01 mm (Table 2), which have a distinct border

between the rings. ARW showed a negative correlation with age of trees (Figure 4). The differences in the ring width are known to be susceptible to changes in climatic factors particularly temperature and precipitation, however the tree age greatly affects the fluctuation of ring width (Pasha, 1999; and Dorado Linan et al. 2012).

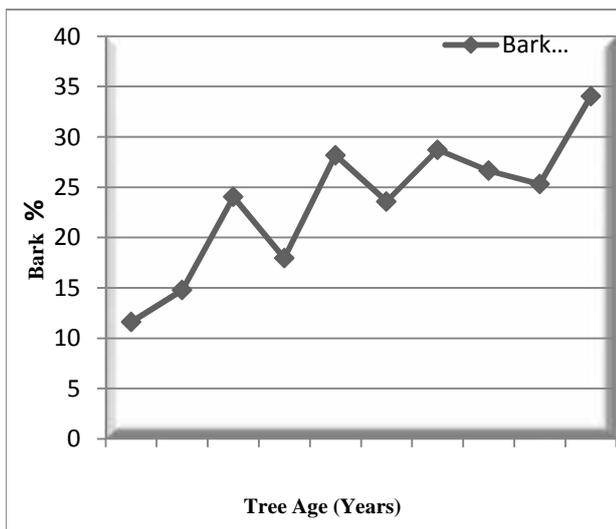


Fig (3): Relationship between bark percentages with tree age.

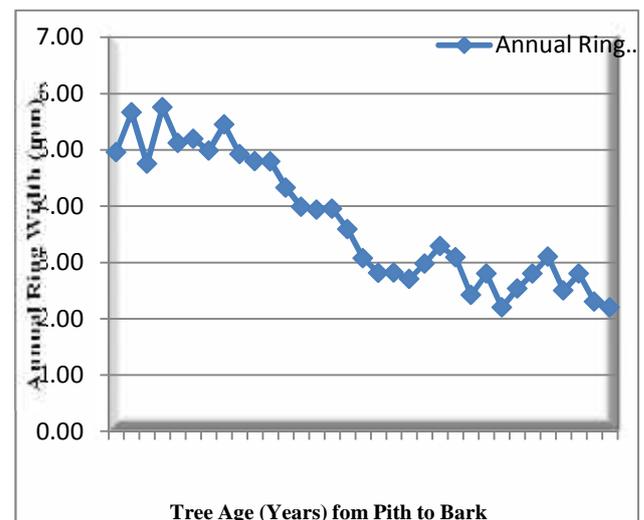


Fig (4): Change of annual ring width from pith to bark.

Physical properties

The average values of moisture content for HWP and SWP at breast height were 43.85, 59.50% (Table 3), and for all studied trees was 52.89, % (Table 4). Most of means refers to present high percentages of moisture content in SWP than HWP. Heartwood is usually drier than sapwood (Forest Products Laboratory, 1999). The average values of specific gravity for HWP and SWP were 0.701, 0.606 (Table 3), and for all studied trees

was 0.67 (Table 4). It appears from (Figures 5 and 6) that a significant relationship between specific gravity with percentages of HWP and SWP. In present study the values of specific gravity of walnut grown in Kurdistan are moderate to heavy wood according to the classifying woods on the basis of specific gravity that classified by (Chowdhury and Ghosh (1958). The present results agree with results of walnut grown in Kashmir Himalaya (Bilal, 2014).

Table (3): Moisture content and oven dry specific gravity for heartwood and sapwood of *Juglans regia* L.

Tree NO.	Moisture Content %		Specific Gravity	
	Heartwood	Sapwood	Heartwood	Sapwood
1.	45.283	73.134	0.685	0.5752
2.	38.095	44.57	0.6818	0.5977
3.	41.304	62.412	0.6853	0.6186
4.	55.156	64.89	0.6767	0.5852
5.	31.82	38.94	0.6767	0.5936
6.	46.31	62.5	0.6748	0.5781
7.	59.729	69.95	0.689	0.5986
8.	30.303	52.31	0.7468	0.6287
9.	56.736	67.262	0.7208	0.6171
10.	33.74	59.13	0.7753	0.6693
Average	43.85	59.5098	0.7012	0.6062
St.D.	10.670	11.0519	0.0348	0.0284

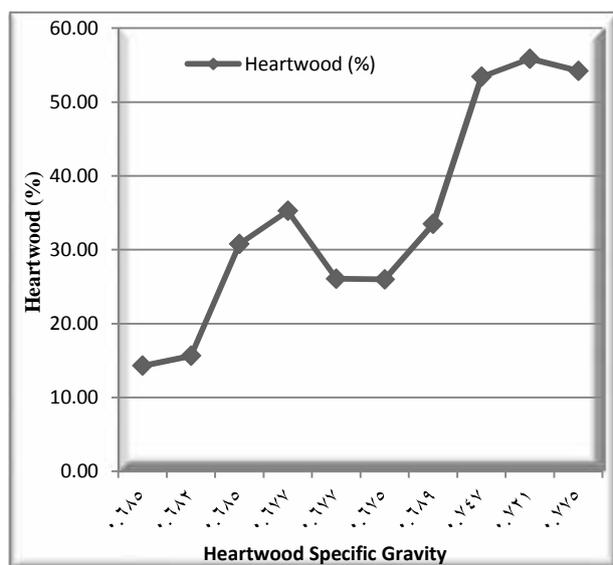


Fig (5): Relationship between oven dry specific gravity with percentages of heartwood.

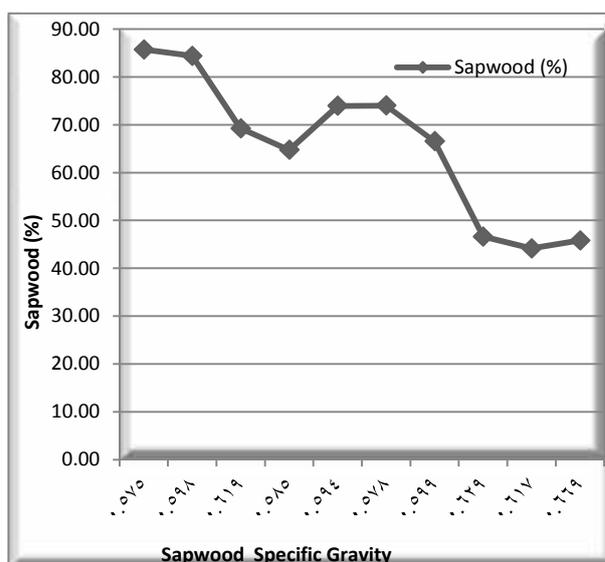


Fig (6): Relationship between oven dry specific gravity with percentages of sapwood.

It appears from Table 4, that the mean value of basic density was 0.578g/cm^3 , Volumetric shrinkage and volumetric swelling were (12.56, 14.44 %) and fiber saturation point (FSP) was 21.91 %. It appeared that *J. regia* shrinks and swells less than other strong species (Gabriel, 2000). On the other hand the walnut has a quite

moderate percentage of the cell wall 44.78%. Therefore it has a moderate percentage of the porosity 55.48%. Porosity and thickness of cell walls causes variation in the density between wood species, within a species, and between earlywood and latewood growth (Forest Products Laboratory, 2010).

Table (4): Descriptive statistics for physical properties studied of *Juglans regia* L. wood.

properties	Mean	Max.	Min.	Standard Deviation (ST.D.)
Annual Ring growth width (cm)	4.013	10.050	1.800	1.4379
Moisture content (%)	52.893	67.625	28.828	6.6271
Specific gravity	0.671	0.789	0.574	0.5010
Basic Density(g/cm^3)	0.578	0.669	0.492	0.0476
Volumetric shrinkage (%)	12.5697	16.506	6.882	2.1103
Volumetric swelling (%)	14.443	19.769	7.391	2.7579
Fiber saturation point (FSP) (%)	21.911	29.136	12.885	3.9686
Cell wall (%)	44.781	52.641	38.292	3.3405
Porosity (%)	55.489	61.707	47.358	3.2720

Anatomical properties

Fiber and vessel dimensions are the most characters which responsible for the variability in wood and they play a key role in determining the suitability of wood as raw material for different uses especially pulp and paper manufacturing. From table (5), the values of anatomical properties were for fiber length 1.58mm, fiber diameter $24.00\ \mu\text{m}$, Fiber double cell wall thickness $16.12\ \mu\text{m}$, and Fiber lumen diameter $7.88\ \mu\text{m}$. Walnut fibers are investigated in different studies that carried out by (Suzuki *et al.*, 1991; Merav, 2003; and Akkemik, and Yaman, 2012). On the other hand the mean value of vessel length was 0.54mm, while vessel diameter and vessel lumen diameter were (179.80 , $134.13\ \mu\text{m}$). The

slenderness ratio and runkel ratio were 69.85, 2.339. The present results are in accordance with results of vessel dimensions reported for walnut wood in Israel and adjacent regions (Fahnet *al.*, 1986), and in Himalaya (Suzuki *et al.*, 1991), also in Turkey (Merev, 1998 and Yaman, 2008).

The standard deviation (ST.D) of different properties studied in the current work indicates a variation exist in the wood properties. This may be attributed to different variable factors, including growth condition, ecological factors and genetic factors (Panshin and de Zeeuw, 1980). More variability in wood characteristics exists within a single tree than trees growing on the same site or between trees growing on different sites (Gartner, 1995)

Table (5): Descriptive statistics for anatomical properties studied of *Juglans regia* wood.

properties	Mean	Max.	Min.	Standard Deviation (ST.D.)
Fiber length (mm)	1.585	2.153	1.057	0.2078
Fiber diameter (μm)	24.003	39.00	11.250	5.5978
Fiber double cell wall thickness (μm)	16.122	31.500	1.875	3.676
Fiber lumen diameter(μm)	7.880	19.875	3.000	3.3023
Vessel length (mm)	0.545	3.730	0.323	0.2515
Vessel diameter(μm)	179.806	326.910	84.612	47.503
Vessel lumen diameter(μm)	134.136	242.298	61.52	39.1706
Slenderness ratio	69.855	133.328	33.834	19.295
Runkel ratio	2.339	6.00	0.200	0.9043

CONCLUSION

From the results presented in the text it can be concluded that the morphological properties are significantly related to the age of trees. Due to walnut moderate specific gravity and density, superior mechanical properties could be expected. Consequently, walnut wood is recommended for structural applications which are requiring high strength. Also according to the anatomical analyses particularly higher values of fiber dimensions authorize to use for pulp and paper production.

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EFFECT OF SOAKING PERIODS IN SULFURIC ACID AND SOWING MEDIA ON GERMINATION OF *Rhus coriaria* L. SEEDS UNDER FIELD CONDITIONS

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ABSTRACT

Sumac (*Rhus coriaria* L.) is a deciduous shrub growing 3 to 6 m. height, belongs to genus *Rhus* and family *Anacardiaceae*. Sumac is a very popular in the Kurdistan region of Iraq with a great ecological, economic and medicinal value. It is well known that the seeds of this species had very low germination percent, because they are undergoing dormancy due to hard seed coat and physiological dormancy as well. So, it was necessary to subject seeds before sowing to some of pre- treatments for breaking dormancy phase and then sowing them in a suitable growing media, to fulfill this purpose, this experiment was conducted in Malta forest nursery- Duhok/Kurdistan region of Iraq, during the period from late February to May, 2014, to investigate the impact of scarification by concentrated sulfuric acid (H₂SO₄) and sowing media on breaking dormancy and increasing seed germination. The experiment comprised studying the effect of two factors: First, soaking seeds in conc. (H₂SO₄) for the periods (0, 1, 2, and 3) hours. Second, three types of sowing media included: river sand, river sand + building sand (1:1) and river sand + building sand + Peat moss (1:1:1) in plastic pots under field condition in a factorial experiment (4*3), using randomized complete block design (RCBD). The results showed that both soaking periods in conc. (H₂SO₄) and sowing media and the interaction between them significantly increased germination of seeds attained (29.6%) with soaking seeds in conc. H₂SO₄ for 3 hours and (20.97%) in sowing media consisting of river sand + building sand (1:1). While the interaction between the two factors revealed synergistic effect and gave the best result of seed germination achieved (40.7%) was found in seeds treated with conc. H₂SO₄ (98%) for 3 hours and seeded in river sand + building sand (1:1).

KEYWORD: *Rhus coriaria* L.; H₂SO₄; Sowing media; seed dormancy

INTRODUCTION

Sumac (*Rhus coriaria* L.) is a deciduous shrub growing 3 to 6 m. height, belongs to genus *Rhus* and family *Anacardiaceae*. Sumac naturally distributes in different areas of the Mediterranean region (Spain, France, Lebanon, Syria, Turkey) including in the mountain areas of the lower Kurdistan region of Iraq at an elevation (600 – 1500) m. altitude, associated with oak species (*Quercus aejilops* and *Quercus infectoria*) and *Pistacia* spp. Annual rainfall varies from (400 – 800) mm (Shahbaz, 2010). Sumac is a species suitable for the reforestation of degraded land in the Mediterranean region. It grows in arid and semi- arid areas and in degraded soils (Mantia and Culluta, 2000). Wood of sumac is soft and light and easy to handle. The leaves and bark are rich in tannin (Grieve, 1984). The leaves contain (20-35%) tannin (Polunin and Huxley, 1987). Tannins are found in all parts of the plant, with high

concentrations, particularly in bark and roots, thus these plant parts are used for tanning leather, moreover, they are part of anti-diarrheic concoction in folk medicine, the fruits have a high food value thus, are used with food as spice (Shahbaz, 2010 and Mohammadi, et al., 2010). The leaves and seeds are used in the treatment of dysentery, haemoptysis and chopra (Chopra, et al., 1986). The main ecological value of sumac is much used for controlling soil erosion due to its vigorous root system which to be wide- spreading thus, preventing soil erosion on mountain sloping faces (Ogle, et al., 2000). It is well known, that this species is difficult to germinate sexually by seeds because seeds of this species have physical dormancy caused by a water impermeable endocarp besides, physiological dormancy as well (Rowe and Blazich, 2008) thus, they are become difficult to germinate so, the seeds are required to some pre-treatments for breaking their dormancy before to be ready for

sowing in the field therefore, it was necessary to develop suitable techniques for breaking dormancy in such seeds to promote seed germination and producing good quality of seedlings in the nursery. Among these techniques, acid scarification of seeds which has proven to play a crucial role for softening seed hard-coat in which help entering moisture to the embryo and modified some physiological processes thereby stimulating germination of seeds. Numerous investigators have indicated the important role of some pre-treatments, including soaking seeds in acid solution for breaking dormancy and promoting germination of seeds those are undergoing dormancy (Norton, 1985; Rasmussen and Wright, 1988; Tipton, 1992; Mantia and Cullotta, 2000; Okunomo and Bosah, 2007; Aboutalebiet al., 2012; Tilki and Bayraktar, 2013; Olatunji, et al., 2013). It is undoubtedly, to ensure the success of plantation process, high quality seedlings are needed. This necessarily needs to choose suitable growing media for enhancing seed germination and growth of seedlings; because the growing media play an important role during the entire cultivation process, they provide physical support, mineral nutrients, air and water to the seedlings. Our nursery practices commonly raise seedlings using sandy loam (river sand) and local soil. Some problems usually associated with these conventional practices such as poor nutritional status, poor aeration and bulk density of the media, which retard the growth of seedlings, particularly their root systems; a consequence is producing seedlings with poor survival and growth in the nursery as well as with poor performance in the field. Many researchers have indicated the important role of choosing suitable growing media for enhancing seed germination and growth of seedlings through their useful advantages mentioned above (Humphrey, 1983; Angeline and Ouma, 2008; Abirami, et al., 2010; Okunomo, 2010; Bali, et al., 2013; Bhardwaj, 2013); therefore the aim of this experiment was to determine the effect of various soaking periods in sulfuric acid and sowing media

on breaking dormancy and germination of *Rhus coriaria* L. seeds under field conditions in Malta forest nursery.

MATERIALS AND METHODS

Experiment site:

The present experiment was carried out during late February to May-2014, in Malta forest nursery- Duhok, General Directorate of Forest and Rangeland, located (565 masl. altitude; 42° , 52', 06" E longitude, and 36° , 52', 28" N latitude). Annual average of (maximum temperature 40.5C°, minimum temperature 4.4C°, precipitations 565mm) (Meteorology station- Duhok).

Seed collection and processing:

Mature fruits of *Rhus coriaria* L. were collected in the early of September 2013, from healthy vigor shrubs, free from insects and diseases, grown in its natural habitat in the mountain area of Sarsing within Duhok province, Kurdistan-Iraq, located (1070 masl. altitude; 43° , 20', 35" E longitude, and 37° , 20', 30" N latitude). The collected fruits were brought to the laboratory of Malta forest nursery, then the fruits were immersed in water for 24 hours to remove fleshy layer by rubbing the fruits by hand on a screen. The clean seeds were placed in glass bottle after drying and stored in refrigerator till sowing time (Scopmeyer, 1974).

Preparation of sowing media:

Three sowing media were prepared by mixing thoroughly river sand with building sand and with the proportion of (1:1) and river sand with building sand and peat-moss with the proportion of (1:1:1) in addition to river sand alone. Some physical and chemical characteristics of sowing media were determined in the Soil laboratory, College of Agriculture according to the standards of Klute (1986) and Page, et al., (1982), table (1). Then the prepared sowing media were transferred to plastic pots, arranged in the nursery according to the experimental design used in this study.

Table (1): Some physical and chemical characteristics of sowing media used in the experiment

Soil characters	Sowing media		
	River sand	River sand + building Sand	River sand + building Sand+ Peatmoss
Clay %	26.5	16.5	19
Silt %	46.6	15.5	16.6
Sand %	27	68	64
Texture class	Loam	Sandy loam	Sandy loam
Bulk density g/m ³	1.36	1.49	1.27
O.C%	0.39	0.1365	2.925
OM%	0.672	0.235	5.043
EC (ds.m ⁻¹)	0.6	0.39	0.52
pH	7.83	8.08	7.95

Treatments and experimental design

Rhus coriaria seeds were divided into four groups, each group contained (100) seeds and soaked in concentrated sulfuric acid (H₂SO₄, 98%) for the periods (1, 2, 3) hours in addition to an untreated group seeds as control treatment. The pre-treated seeds of each soaking period were immediately seeded in plastic pots containing sowing media in the late of February of 2014. The sowing media included (river sand; river sand + building sand (1:1) and river sand + building sand + Peat-moss (1:1:1), in factorial experiment with two factors (4*3) was applied according to randomized complete Block design (RCBD), with a total of (12) combination treatments; each treatment was replicated four times, using 25 seeds for each replication under field condition. During the experiment period, watering process was done as needed. The germination percentages of seeds were accounted after the completely occurring of the germination process according to (ISTA, 1976).

Statistical analysis:

germination percentages were analyzed after their percentile values transformed to arcsine to stabilize any heterogeneous variance and all percentile values were subjected to analysis of variance (ANOVA) using (SAS, 2001) software. Duncan's Multiple Range Test (p<0.05) (Duncan, 1955) was used for the comparison of significant differences between treatment means.

Results and discussion:

From the results, the seeds of sumac showed a high degree of dormancy in this experiment. Germination of seeds responded variably and were clearly influenced by the used pre-treatments to break seeds dormancy. Acid scarification significantly increased seed germination. Generally, all tested duration in sulfuric acid treatments enhanced the germination percentage compared to the control treatment. Sowing media had also the positive effect for enhancing germination of seeds leading a synergistic effect with sulfuric acid.

The statistical analyses by ANOVA table (table 2) indicated that both the periods of soaking seeds in sulfuric acid treatments and sowing media and also the interaction between them had a highly significant effect on germination of *Rhus coriaria* seed. Results of Duncan's Multiple Range Test (p<0.05) for comparison between the effect of soaking periods treatments (table 3) showed that soaking seeds in sulfuric acid significantly increased germination percentage at all tested periods compared to the control treatment. However, the immersed seeds in acid for (3) hours differed significantly over other soaking periods recording highest germination percentage (29.6%) while the lowest percentage (3.93%) was observed in an untreated seeds. No significant differences were observed between the effect of soaking periods 2 hours (17.93%) and 1 hour (14.53%).

This result may be due to the activity of concentrated sulfuric acid in reducing the thickness of the external hard seed-coat and softening it, allowing water to permeate the embryo tissues, causing physiological changes thus, stimulating embryo to germinate (Schopmeyer, 1974; Sedighi, et al. 2009). Since, (3 hours) of the maximum soaking seeds in sulfuric acid revealed the highest germination percentage of seeds compared to (2 hours) or (1 hours) it is likely, by prolonging time of soaking more than (3 hours) to be better for promoting germination percentage of seeds with taken in consideration that, prolonged time of seeds immersion in acid as much as needed may be injurious to the seeds as the acid may rupture vital parts of the embryo. Mantia and Cullotta (2000) reported that Sicilian sumac (*Rhus coriaria*) seeds treated with sulfuric acid for 15 hours gave the highest percentage of seed germination achieved (60%). Rana and Nuatiyal (1989) have observed that treating seeds of *Acacia farnesiana* with sulfuric acid caused increasing in germination, but with increasing time of seed soaking with acid can cause injury to embryo structure and produce more abnormal seedling. It was noticed from the results as well, the germination percentages increased by increasing time of soaking seeds in acid; while Rehman, et al. (1999) they have demonstrated that concentrated sulfuric acid 98% originated germination of *Acacia salicina* seeds which have hard crust and by increasing time of connection with this acid solution caused increasing number of buds.

Our results are in agreement with the findings obtained by numerous studies on different species of sumac (for example, Brinkman, 1974 ; Farmer, et al., 1982 ; Norton, 1985 ; Rasmussen and Wright, 1988 ; Tipton, 1992; Olmez, et al., 2007; Tilki and Bayraktar, 2013), they have reported that soaking of sumac seeds in concentrated sulfuric acid before sowing them in growing media improved significantly germination percentages, indicating that the optimal time of soaking seeds in acid for breaking dormancy varied by varying of plant species.

Regarding the effect of sowing media, it was obviously from the same table (3), that sowing media consisted of river sand + building sand (1:1) was significantly superior on river sand alone medium but it did not differ significantly from the media consisted of river sand + building sand +

peat-moss (1:1:1) on seed germination recorded maximum germination percentage (20.97%) as compared to minimum germination percentage (10.02%) that found in river sand alone. The reason behind this result may be attributed to favorable physical and chemical properties of this medium for providing favorable conditions needed by germination process in terms of low water retention and more aeration permitting more oxygen; in addition, nearly neutral soil pH and high EC which promoted more germination as compared to poor physical and chemical properties of river sand alone in terms high water retention and poor aeration relatively permitting low oxygen, with higher soil PH and lower EC which retarded germination process; in addition, that this medium contains high proportion of silt which make it forming solid layer on soil surface in which restrict coleoptile to appear above soil surface as shown in (table 1). These results are in line with findings obtained by many investigators (Arunakumara, and Subasinghe , 2004 ; Olmez, et al., 2007 ; Hafeez-ur-Rahman , et al., 2007; Angeline and Ouma, 2008 ; Sadeghi, et al., 2009 ; Okunomo, et al., 2009 ; Hassanein, 2010 ; Okunomo, 2010 ; Aboutalebi, et al., 2012 ; Bhardwaj, 2013; Idu, et al., 2003; Olatunji, et al., 2013 ; Salehi, et al., 2014), they have confirmed that growing media in the form of mixture consisting of sandy loam with other materials were more effective than sandy loam alone for promoting seed germination and plant growth traits. In respect of the effect of interaction between two factors According to Duncan's test from the same table, revealed clearly that interaction treatments resulting from combination of acid treatments and growing media have taken the same trends of single factors in respect of their effect on seed germination, so that significantly increased germination percentages more than those observed by the two factors singly achieved (40.7%), (Figure 1) was observed in seeds treated with sulfuric acid for 3 hours and planted in media consisting of river sand + building sand (1:1) with non significant differences with seeds treated with acid for the same soaking time and planted in media consisting of river sand + building sand + peatmoss (1:1:1) compared to least value (3.2%) was recorded in seeds untreated with acid and planted in river sand alone. This means that effect of interaction was synergistic.

Table (2): The effect of source of variance and estimated variance on seed germination of *Rhuscoriaria* L.

Source of variance	d.f.	Germination% (M.S.)
Block	3	25.27
Soaking period in Sulphric acid	3	917.015**
Sowing media	2	289.120**
Soaking period in Sulphric acid × Sowing media	6	60.786*
Error	33	20.224

* significant at probability level (0.05).

** significant at probability level (0.01).

Table (3): Effect of Soaking period in Sulphric acid and Germination media on seed germination of *Rhuscoriaria* L.

Soaking periods in H ₂ SO ₄	G%
0	3.93c
1 hour (H ₂ SO ₄)	14.53b
2 hour (H ₂ SO ₄)	17.93b
3 hour (H ₂ SO ₄)	29.6a
sowing media	
River sand	10.02b
River sand + building sand	20.97a
River sand + building sand + peat-moss	18.5a

- Each number is the average of four replications.

- Means within a column followed by the same letters are not significantly different at (0.05) level, according to Duncan Multiple range test.

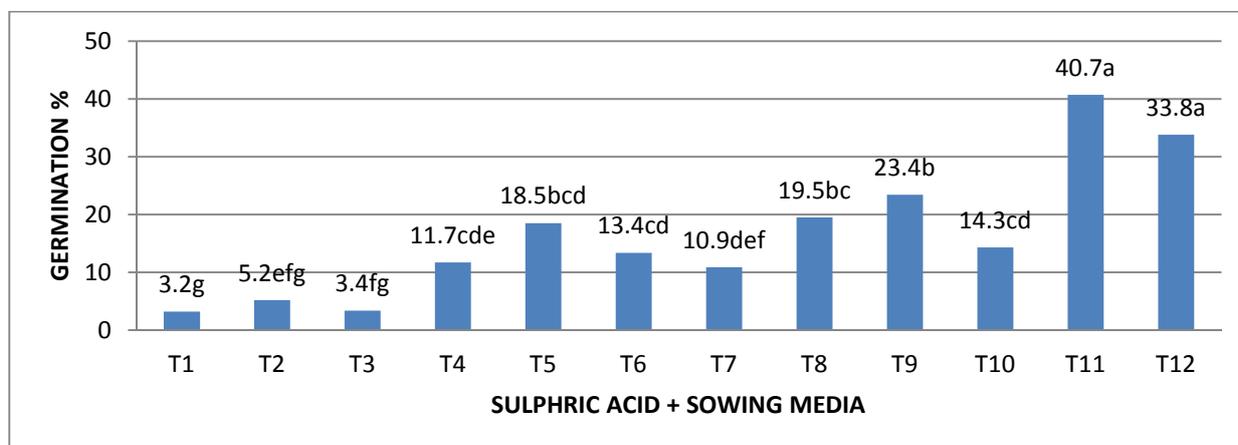


Fig. (1): Interaction of soaking in sulfuric acid and sowing media on germination percentage (%) of *Rhuscoriaria* L. seeds.

Control + river sand= T1

Control + river sand +building sand= T2

Control + river sand +building sand + Peat-moss= T3

1 hour + river sand= T4

1 hour + river sand +building sand= T5

1 hour + river sand +building sand + Peat-moss= T6

2 hour + river sand= T7

2 hour + river sand +building sand= T8

2 hour + river sand +building sand + Peat-moss= T9

3 hour + river sand= T10

3 hour + river sand +building sand= T11

3 hour + river sand +building sand + Peat-moss= T12

CONCLUSION

On the basis of results obtained we can conclude that:

1- Soaking seeds in conc. sulfuric acid for (3) hours or more may be the most effective period of soaking, and using sowing medium consisting of river sand + building sand (1:1) may be the best sowing medium for promoting germination of *Rhus coriaria* L. seeds.

2- The interaction between the two factors (acid treatments and sowing media) showed synergistic effect, so it that produced seed germination more positively than that by individual factors separately.

Recommendation:

1- Since the last period of soaking seeds in sulfuric acid (3 hours) revealed the highest germination percentage of seeds compared to (2 hours) and (1 hours) so, it is likely, by prolonging soaking period more than (3 hours) to be better for promoting germination percentage of seeds.

2- Further studies should be conducted to develop suitable techniques by using other pre-treatments with other growing media for overcoming dormancy and a consequence enhancing seed germination.

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GROWTH RESPONSE OF *Pinus brutia* TEN. AND *Melia azedarach* L. TO VARIOUS GROWING MEDIA UNDER FIELD CONDITIONS

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ABSTRACT

Brutia pine (*Pinus brutia* Ten.) and Umbrella tree (*Melia azedarach* L.) are the most extensively planted in the Iraq, particularly in Kurdistan region. They have high ecological and economic value. Seedlings of brutia pine and umbrella tree are often produced in our nurseries from seeds, by using river sand or clay as growing media. Based on the field observation reported by nurseries staff, that raising of planting stocks by using river sand alone need to some over period and consequently much costs to reach a plantable size, therefore, it was necessary to investigate alternative growing media for producing planting stocks in a short time as possible as and decreasing of production cost. This experiment was carried out during 2014, to determine the impact of various growing media on growth attributes of *Pinus brutia* Ten. and *Melia azedarach* L. seedlings under field conditions in Malta forest nursery - Duhok, Kurdistan region- Iraq. Six different media: river sand, clay, river sand + clay(1:1), river sand + clay(2:1), river sand + clay + peat-moss(1:1:1) and river sand + clay + ash(1:1:1) were investigated in a complete block design(RCBD). The results indicated that all tested growth parameters of both *Pinus brutia* and *Melia azedarach* influenced significantly by growing media. Growing medium consisting of river sand + clay + ash (1:1:1) recorded best results for all tested growth parameters of both species (diameter and length of stem; length and number of roots; shoot and root dry weight), except survival percentage which was better in river sand alone. Based on these results, this medium could be recommended for raising seedlings of these two species in the nurseries.

KEY WORDS: *Pinus brutia*, *Melia azedarach*, growing media, seedling.

INTRODUCTION

Brutia pine (*Pinus brutia* Ten.) is evergreen, coniferous tree species, up to 30 m a height, slow to moderate growing. It belongs to *Pinus* genus and *Pinaceae* family. This tree species naturally distributing in north-eastern of Mediterranean region, principally, Turkey, Syria, Lebanon, Cyprus and eastern Island. It is found to live at elevation from the sea level to 1525 masl. on different soil types, with annual rainfall ranging 300 - 900 mm. and very drought resistant and withstand to frost. It has been proven that *P. brutia* has ability to bioaccumulation lead and copper from soil to its needles leaves (Sulayvaney, 2006). *P. brutia* forms a unique natural pine forest in Kurdistan region of Iraq, particularly in Zawita and Atrosh within Duhok province. This tree species commonly propagates by seeds. The seedlings are widely used for afforestation in Kurdistan region of Iraq on sloppy faces mountains and for road sides planting. The wood

is often used for general constructions, poles, fire wood, charcoal, boxes, and carpentry (Shahbaz, 2010).

Umbrella tree (*Melia azedarach* L.) is a deciduous tree species, up to 12 m. a height, fast-growing, belongs to *Melia* genus and *Meliaceae* family. It is native to Bloshtan, Kashmir, India, south-eastern Asia and northern Australia, wild in Himalaya, cultivated and naturalized in parts in Iran and China, at elevation reached 1800 m a s l., it prefers fertile soil, good drainages (Davidson, 1985). The leaves of tree contain (12 %) protein (Bajrocharya, et al., 1985). Seed oil is used as Anti- sensitivity and used as treatment for rheumatism and dermal (skin) disease and it is active for reducing activity of malaria (Florida, et al., 2002). The wood is used as fuel wood and thin sheet wood (Charm, et al., 2001). Umbrella tree was introduced in Iraq as ornamental trees which are broadly cultivated in parks, urban gardens, and landscape and in road side planting (Shahbaz, 2010).

This tree is commonly propagated by seeds which are undergoing seed coat dormancy (Abdullah, 1985).

It is well known, that the common growing media used for production of different types of seedlings including *Pinus brutia* and *Melia azedarach* in Duhok nurseries is mostly river sand. It was found that raising seedlings by this growing medium need a relatively long period in order to reach a plantable size. Many researchers have tried to find alternative growing media to those materials that traditionally used. They have indicated the importance of choosing the most suitable growing media to be able to provide a favorable growing conditions (e.g. moisture, nutrient elements, aeration) needed by plants for achievement of a successful plant production in nursery practice, (Abdullah and Abdulrahman, 1990 ; Sahin, et al., 2002, 2004 ; Ercisti, et al., 2002, 2005 ; Kuslu, et al., 2005; Agobo and Omaliko, 2006 ; Alexander, et al., 2008 ; Bustamante, et al., 2008 ;). Therefore, this experiment aimed to determine suitable growing media for producing seedlings of *Pinus brutia* and *Melia azedarach* with good quality under field conditions.

MATERIALS AND METHODS

Experiment site:

The present experiment was carried out during the period from March to November-2014, in Malta forest nursery- Directorate of Forests and Rangelands - Duhok, Kurdistan region - Iraq. Located (565 masl. altitude; 42^o, 51', 06" E longitude, and 36^o, 51', 28" N latitude). Annual average of (maximum temperature 40.5C^o, minimum temperature 4.4C^o, precipitations 565 mm) (Meteorology station- Duhok).

Seed collection and processing:

Mature cones of *Pinus brutia* Ten., were collected on 15th August 2013, from healthy vigor trees, free from insects and diseases, grown naturally in natural pine forest- Zawita within Duhok province, Kurdistan region- Iraq; located (890 masl. altitude; 43^o, 20', 35" E longitude, and 37^o, 20', 30" N latitude). The collected pine cones were brought to laboratory of Malta Forest Nursery, and then the seeds were extracted from cones by method of exposing them to sun radiation (Abdullah, 1985). After screening, clean seeds were placed in glass bottle after drying and

stored in refrigerator till sowing time (Schopmeyer, 1974).

Regarding *Melia azedarach*, Mature fruits of *Melia azedarach* were collected at the beginning of February 2014, from healthy vigor trees, cultivated in Malta Forest Nursery-Duhok, Kurdistan region- Iraq; located (565 masl. altitude; 42^o, 51', 06" E longitude, and 36^o, 51', 28" N latitude). The collected fruits were brought to laboratory of Malta Forest Nursery, then the seeds were extracted from pulpy fruits by soaking fruits in water for six hours, then the pulped layer was removed from the seeds by rubbing fruits on softy wire mesh (Abdullah, 1985). Since the seeds of this species are undergoing double dormancy, in order to overcome dormancy phase in seeds, the seeds were soaked in hot water (50 C^o) for 30 minute, after that, the seeds were stratified in refrigerator at temperature (4 C^o) for 45 days from the beginning of 5th February to 23th March 2014 (Al.Khaffaf and Lazar, 2011).

Preparation of growing media:

Six growing media were prepared by mixing thoroughly river sand with clay with the proportion of (1:1); river sand with clay with the proportion of (2:1); river sand with clay and peat-moss with the proportion of (1:1:1); river sand with clay and ash with the proportion of (1:1:1) in addition to river sand and clay alone. Too easily, according to growing media were symbolled as follows:

River Sandy = (S1)

Clay = (S2)

River Sandy + Clay (1:1) = (S3)

River Sandy + Clay (2:1) = (S4)

River Sandy + Clay + Peat moss (1:1:1) = (S5)

River Sandy + Clay + Ash (1:1:1) = (S6)

Some physical and chemical characteristics of growing media used in the experiment were determined in the soil Laboratory, College of Agriculture according to the standards of Klute (1986) and Page, et al., 1982), table (1). Different growing media were distributed to polyethylene bags blacked color (15*15*30) cm for the two types of seeds separately.

Treatments and experimental design

Seeds of both *Pinus brutia* and *Melia azedarach* were divided into six groups separately, each group contained (100) seeds. The seeds of each group were seeded in polyethylene bags filled by one of the growing media used included (river sand; clay; river sand + clay (1:1); river sand + clay (2:1); river sand + clay + Peat-moss

(1:1:1) and river sand + clay + ash (1:1:1) beginning from 25th March to 15th November 2014. The experiment was applied according to randomized complete Block design (RCBD) under field condition with total of (12) treatments; each treatment was replicated four times, using 25 seeds for each replication. During the experiment period, watering and weeding processes were performed as needed. After the seedlings were appeared, plants in polyethylene bags were thinned so as to leave only one plant in each bag. Seedlings were harvested on 15th November, 2014. Survival percentages were

accounted and they were arcsine transformed to stabilize any heterogeneous variance, stem diameter (0.5 cm height from ground surface) (Marianthi, 2006), seedling length, root length, the number of roots per seedling, roots and shoot dry weight were measured.

Statistical analysis:

All collected data were subjected to the analysis of variance (ANOVA) using (SAS, 2001) software. Duncan Multiple Range tests ($p < 0.05$) (Duncan, 1955) was used for the comparison of significant differences between the effect of growing media on the growth parameters.

Table (1): Some physical and chemical characteristic of growing media used in the experiment.

Soil characters	Growing media					
	River Sandy	Clay	River Sandy + clay (1:1)	River Sandy + clay (2:1)	River Sandy + clay + Peatmoss (1:1:1)	River Sandy + clay + Ash (1:1:1)
Clay %	21.5	59	36.5	29.5	34	21.5
Silt %	41.6	31.6	41.6	52.9	39.1	49.1
Sand %	37	9.4	22	18	27	29
Texture class	loam	Clay	Clay loam	Silty clay loam	Clay loam	Loam
Bulk density g/m ³	1.39	1.2	1.28	1.32	1.3	1.22
O.C%	0.312	0.39	0.4225	0.234	9.75	0.4485
OM%	0.538	0.672	0.728	0.403	16.81	0.773
Available NH ₄ + NO ₃ (%)	0.008	0.008	0.008	0.008	0.011	0.008
EC (ds.m ⁻¹)	0.93	0.79	0.66	0.71	0.79	3.46
pH	8.2	7.65	7.94	7.98	8.09	7.8
K (meq/L)	0.29	0.14	0.14	0.18	0.29	7.42
Na (meq/L)	1.69	1.41	1.49	1.53	1.78	6.26
Ca (meq/L)	6	7	5.2	5	5	5.4
Mg (Meq/L)	2.6	1	1.2	1.6	3	1.6
Available P (mg/kg)	2.9	4.26	5.6	5.73	14.93	47.73

RESULTS AND DISCUSSION

The results of the present experiment according to results analyzed by ANOVA table (Table 2) showed that all studied growth parameters of both *Pinus brutia* and *Melia azedarach* seedlings have been influenced significantly by the used growing media. Comparison between the effect of different media on growth parameters according to Duncan multiple range test ($P < 0.05$), (Table 3) showed that the growing media consisting of river sand + clay + ash with the proportion of (1:1:1) produced the best results for all growth parameters of *Pinus brutia* and *Melia azedarach*, followed by river sand alone. (shoot length, stem diameter, root length, root number per plant, shoot dry weight, and root dry weight) achieved (34.4 cm,

5.9 mm, 53.4 cm, 16.55 roots plant⁻¹, 9.4 g and 6.3 g) respectively, except survival percentage which was better in S1 medium with mean value (96.3%), whereas the lowest mean values of these parameters (15.3 cm, 3.3 mm, 38.6 cm, 8.4 roots plant⁻¹, 2.4 g and 1.7 g) respectively were observed in S2 medium including survival percentage with least value (69.6%). Non significant differences were found between the effects of the other media used on the most of the seedlings growth parameters except S2 medium which was found the most unfavorable media in respect of all seedling growth parameters (Table 3). The increase in root number, root length and dry weight of root system of seedlings of *Pinus brutia* and *Melia azedarach* grown in S6 or S1 media may be due to the physical and chemical

properties of these media which enabled them to support and providing a favorable conditions needed by seedlings, through providing best aeration, oxygen, adequate moisture, nutrient element contains ash which is containing an inorganic nutrient element available for absorbing by plant roots easily as shown in (Table 1).

The increase in shoot length, stem diameter and shoot dry weight of seedlings grown in S6 or S1 media, had related with length and root number of roots of seedlings grown in the same growing media. The increased length and root number of seedlings grown in the same media enhanced in more nutrient uptake and water and resulted in more photosynthesis production. Food in the form of photosynthesizes supply plants with the required energy for cell division and cell elongation that lead to producing seedlings with longest shoots and thicker stem diameter. It is evident from the results in (Table 3) that maximum shoot dry weight of seedlings was recorded in seedlings grown in S6 or S1 media, this may be due to longest shoots and biggest stem diameter of seedlings raised in these media, because there is a positive relationship between dry weight of shoot system and the vegetative growth parameters, so that by increasing of vegetative growth parameters, also the dry weight of shoot system increased. Regarding *Melia azedarach*, the high values of these traits achieved (195.4 cm, 15 mm, 47.5cm, 11.4 roots plant⁻¹, 79.0 g and 55.3 g) respectively, compared the lowest values (147.8 cm, 8.6 mm, 40.2 cm, 4.9 roots plant⁻¹, and 24.2 g) respectively, except survival percentage which was the maximum mean value reached (83%), which showed no significant differences found with S2, S3, and S5 media whereas the minimum mean value of this trait (48%) was recorded in S6 medium which was no significant different from S4 medium. Opposing to this, the poor results of growth parameters recorded in S2 medium (clay alone)

the reason may be due to that this medium could not capable to provide a favorable conditions needed by seedlings, being this medium is poor aeration and permeability and has high capacity of water retention in addition, it contains high proportion of silt forming solid layer above soil surface retarding seedling growth. Our results are in conformity with the findings obtained in previous studies conducted by many researchers whom have tried to find an alternative growing media to traditional growing media used regarding the effect of various growing media singly or in combination with other materials on seedling growth of different forest trees species (Sahin, et al., 2004; Sabir, et al., 2004; Ercisti, et al., 2005; Agobo and Omaliko, 2006 ; Abad, et al., 2008 ; Alexander, et al., 2008 ; Bustamante, et al., 2008 ; Soundy, et al., 2008; Akwalulira, et al., 2011). Our results are also in agreement with the results obtained in previous studies conducted by many researchers in Iraq whom have confirmed that growing media consisting of sandy loam and clay with other materials have produced better results than sandy loam alone for raising forest tree seedlings in the nurseries (Al-Tallal and Al-Kinany, 1990 ; Abdullah and Ramathan, 1987 on *Cupressus sempervirens*; Abdullah and Ali, 1987 on *Pinus brutia*; Abdullah and Abdulrahman, 1990 on *Biota orientalis*; Al-Kawaz and Alawi, 1989 on *Prosopi starnarugo* phil ; Al-Kinany and Alwadi, 1989 on *Eucalyptus camaldulensis*). In the present experiment, the observed variance between the two tree species (*Pinus brutia* and *Melia azedarach*) in their growth response to growing media used may be attributed to their physiological conditions or anatomical characteristics in addition to their genetic constitution, owing to that the first one is ever green, coniferous, slow or moderate growing species while the second one is deciduous, fast-growing species.

Table (2): The effect of source of Variance and estimated of variation on survival and growth of *Pinus brutia* and *Melia azedarach* seedlings.

Pinus brutia								
S.O.V.	d.f.	Survival %	Stem length (cm)	Stem diameter (mm)	Root length (cm)	Root number	Shoot Dry weight (g)	Root Dry weight (g)
Block	3	207.60	1.47	0.16	79.18	8.74	0.44	1.98
Growing media	5	1113.26	9000.96**	155.79**	6053.04**	2135.23**	1246.79**	519.11**
Error	15	1328.68	1510.05	34.34	4862.84	1189.57	270.33	152.84
Melia azedarach								
S.O.V.	d.f.	Survival %	Stem length (cm)	Stem diameter (mm)	Root length (cm)	Root number	Shoot Dry weight (g)	Root Dry weight (g)
Block	3	227.60	389.48	0.563	17.87	4.11	36.31	15.62
Growing media	5	1621.11**	60085.94**	1133.64**	1474.77**	1254.23**	85678.64**	40209.65**
Error	15	275.71	82001.23	1411.29	9184.84	1044.21	94587.51	51070.13

* significant at probability level (0.05).

** significant at probability level (0.01).

Table (3): Effect of various growing media on survival and growth of *Pinus brutia* Ten. and *Melia azedarach* L. seedlings.

Pinus brutia							
Growing media	Survival %	Stem length (cm)	Stem diameter (mm)	Root length (cm)	Root number	Dry stem weight (g)	Dry root weight (g)
S1	96.3a	24.7b	4.5b	40.2bc	14.4b	6.0b	3.3b
S2	69.6b	15.3e	3.3d	38.6c	8.4e	2.4f	1.7e
S3	83.9ab	19.3d	4.1c	39.9bc	10.4d	3.9d	2.7c
S4	83.1ab	22.0c	4.2c	41.1b	11.6c	4.7c	2.6cd
S5	77.5b	18.5d	3.9d	40.6bc	8.5e	3.2e	2.3d
S6	80.3ab	34.4a	5.9a	53.4a	16.55a	9.4a	6.3a
Melia azedarach							
Growing media	Survival %	Stem length (cm)	Stem diameter (mm)	Root length (cm)	Root number	Dry stem weight (g)	Dry root weight (g)
S1	83a	190.4a	14.8a	46.7a	11.1a	75.7a	47.0b
S2	82ab	147.8c	8.6c	40.2b	4.9e	24.2d	16.7d
S3	86a	173.1b	11.5b	44.5a	7.1d	46.4c	28.6c
S4	73b	176.0b	12.4b	47.1a	8.4c	57.4b	42.5b
S5	78ab	188.3a	11.9b	45.4a	9.9b	44.4c	29.2c
S6	48c	195.4a	15.1a	47.5a	11.4a	79.0a	55.3a

- Each number is the average of four replications.

- Means within a column followed by the same letters are not significantly different at 0.05 level, according to Duncan multiple range test.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results obtained, the following conclusions and Recommendations Could be made:

1. Since the growing medium consisting of river sand + clay + ash (1:1:1) has shown best results regarding the most of studied growth attributes of both *Pinus brutia* and *Melia azedarach* seedlings, therefore it could be recommended for raising seedlings of these two species in the nurseries.
2. Further researches should be conducted by using other convenient growing media with new techniques for producing seedling with good quality in a short time as possible as in the nurseries.
3. Avoid use of clay alone as growing media for raising seedlings.

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QUANTIFYING CARBON SEQUESTRATION BY TWO URBAN TREES IN DUHOK PROVINCE

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ABSTRACT

Currently, the increasing amount of Carbon dioxide in the atmosphere is one of the most factors affecting the global warming in the world. In this circumstance, trees act as a sink for carbon dioxide by fixing carbon during photosynthesis. On growing expanse of urban areas, understanding the total carbon effect can aid in preparing annual inventories of greenhouse gas emission and helping in urban planning. Therefore, the main aims of this study are to quantify the carbon stored by two urban tree species (*Eucalyptus camaldulensis* and *Cupressus sempervirens* var. *horizontalis*) frequently planted in urban areas of Duhok city and other cities of the Kurdistan Region. In this research project, the results showed a variation between *Eucalyptus camaldulensis* and *Cupressus sempervirens* for the ratio dry/green biomass, the net carbon sequestration and CO₂ storage annually. The main results of our study were the quantification of annual carbon content for commonest urban tree species planted in Duhok city: They are for Rever Red Gum was (~ 38 kg) and for Mediterranean Cypress species was (~ 17.2 kg). Furthermore, the mean ratio of total dry to green biomass was 50.34 and mean percentage of moisture was 49.67 % for *E. camaldulensis*; while, the mean ratio of total dry/fresh biomass was 56.18 and water percentage was 43.81 for *Cupressus sempervirens*. Therefore, the results of our study could be considered as a first step toward quantifying the potential carbon offsetting of urban trees and then developing a region-specific approach that Kurdistan cities can use to estimate carbon dioxide sequestration using the available framework of tree inventories, specific allometric equations at regional scale.

KEYWORDS: Carbon storage, *Eucalyptus*, *Cupressus*, urban tree, Kurdistan Region

1. INTRODUCTION

Carbon sequestration means the description of long-term storage of CO₂ and other forms of carbon to either defer, reduce global warming and prevent dangerous climate change (Sedjo et al., 2012). It has been suggested as a method to slow the atmospheric accumulation of greenhouse gases, which are released by burning fossil fuels (Hodrien and Chris, 2008). The continued increase in its concentration in the atmosphere is believed to be accelerated by human activities such as burning of fossil fuels and deforestation (IPCC, 2007). For example, the increases in carbon dioxide concentrations is directly related to rapid increasing population growth and anthropogenic activities such as increasing energy use and high emissions from vehicular traffic (Sharma et al., 2010; and Uherek et al., 2014). Consequently, the increasing of population growth and urbanization in the modern

world are a major cause of CO₂ emission in atmosphere and other greenhouse gases that are affecting the global climate (Schwendenmann, and Mitchell, 2014).

Carbon dioxide is naturally stored from the atmosphere through (chemical, biological or physical processes). Focus on terrestrial ecosystem sequestration, which is a biological process through photosynthesis plants uptake carbon dioxide from atmosphere and release oxygen. Due to the important roles of plants in carbon sequestration: The first and so far the largest international agreement to stabilize Greenhouses gas (GHG) concentrations allows the use of carbon sequestration through afforestation and reforestation as a form of GHG offset activities (e.g. forest, crop, and grazing-land management). Consequent to that and the realization of the role of trees as an important means to capture and store atmospheric CO₂ in vegetation, soils, and biomass products (see, e.g.

Malhi et al., 2008). In increasing urbanization world, it is becoming important to better understand the carbon dynamics on urban ecosystems (Gratani and Varone, 2013; and Uherek et al., 2014) in one hand, and then decreasing CO₂ emissions in cities via plantation urban trees and green spaces (see e.g. Díaz-Porrás et al., 2014). In this topic, several studies have demonstrated the major role of urban trees in particular decreasing the total amount of humans carbon dioxide (CO₂) emissions (Nowak et al., 2013; and Zhao et al., 2010).

A forest plays an important role in the ecosystem that is estimated and diverse to regulate global warming and assist in the required balance between oxygen and carbon dioxide where in forests are significant parts of the global carbon cycle (Ross, 2007). On growing expanse of urban areas, understanding the local and/or national carbon effect can aid in preparing annual inventories of greenhouse gas emission and helping in urban planning (see e.g. Russo et al. 2014; Schwendenmann and Mitchell, 2014; and Nowak et al. 2013). In the past decade, numerous cities have analyzed carbon storage and sequestration of the trees and forests (Escobedo et al., 2010; Poudyal et al., 2010; and Timilsina et al., 2014). However, little information exists, in best of our knowledge, on the processes of carbon stocks by tree species in Kurdistan Region (but see Mizori, 2010). Therefore, the main aims of this study are to quantify the carbon stored by two urban tree species frequently planted in urban areas of Duhok city. They are *Eucalyptus camaldulensis* and *Cupressus sempervirens* var. *horizontalis*, both species are common and widely planting in most cities of Kurdistan Region. This evaluation can be used to help assess the actual role of urban forests in reducing atmospheric CO₂ and support planning of Kurdistan Region carbon offset schemes in the future. They will led researchers working through experiments to determine the best trees species, which contribute this process and then recommend increasing green cover area, as (Robert, 2005) suggested practices for increase carbon sequestration on forestland such as urban forestry practices.

2. MATERIALS AND METHODS

2.1 Species study:

As part of the project, only two urban tree species frequently planted in urban areas of Duhok

Province were have been selected due to legal problems; They are *Eucalyptus camaldulensis* Dehnh. and *Cupressus sempervirens* var. *horizontalis* (Mill.) Gord.

2.1.1 *Eucalyptus camaldulensis* Dehnh.:

River Red Gum is an evergreen tree species native to Australia planted frequently in urban areas. Consequently, it is now one of the most widespread and familiar introduced species around the world. In its natural range, it found along water courses, rivers, regular flooding places and deep rich alluvial soils. However, it can tolerate a wide range of soil types and climates (Holliday and Hill 1974; and Huxley, 1992) such as poor soils in semiarid regions. In Kurdistan region, it prefers a sunny location and well-drained, moisture soils in urban area. For example, it is often used in Duhok cities as a green shelter belt and roadside plantations e.g. roadside of Zaxo-Duhok and Domiz-Duhok. It has also been planted as an ornamental tree species in public garden and parks of Duhok Province. Knowing that its cultivation on the mountainside is greatly declined due to its high mortality rate under winter frost conditions (T° less than - 7°) (Shahbaz, 2010). About *Eucalyptus*'s wood uses, it is often used for pulp and paper, railway ties, plywood industry, particle-boards industry, furniture, shuttering and scaffoldings, firewood, sports goods industry, construction material etc. Further, straightness and its natural preservatives, tallness, pole timber and general purpose timber. housing, pulp, fuel, charcoal, and pallets (Little and Skolmen 1989; Mohammad, 2013).

2.1.2 *Cupressus sempervirens* var. *horizontalis* (Mill.) Gord.:

Mediterranean Cypress is an evergreen coniferous tree species native to the eastern Mediterranean region (from Cyprus, Greece, Turkey, Lebanon, Jordan and Syria) (Townsend and Guest, 1966). It has been widely planted as an ornamental tree species in both its native range and throughout similar climate to Mediterranean region (hot, dry summer and mild rainy winter) such as California S. Africa and S. Australia. (Shahbaz 2010) considered it as an introduced species in Kurdistan region of Iraq since the early decades of the last century, according to age test of old trees planted in urban areas. Mediterranean Cyper species tolerate a wide range of climate conditions and soil types; It's good success in sunny places of urban area due its tolerant to atmospheric gases, wind dust and little

maintenance after plantation. Actually, both pyramidal and horizontal varieties of Mediterranean Cypress are one of the most characteristic features of the Kurdistan urban area such as roadsides, streets, avenues, entryways, graveyards and public parks. Beside of its urban plantations, it is frequently grown for their very durable, easily worked, and scented wood (Shahbaz, 2010). Moreover shoots and leaves of the plant may be used for the yield of an essential oil (Townsend and Guest, 1966).

2.2 Field Procedure and Sample Preparation:

In literature reviews, most studies used allometric equations to calculate the whole tree dry weight biomass and carbon sequestered at regional and/or national scale (e.g. Nowak, 1994; and Nowak et al., 2008).

These equations are based on the diameter (D) and height (H) of the tree (Total green weight = $0.25 D^2 H$) to predict the estimate weight of a tree (Alexander, 1986). However, this estimate is not a true value, but could be seen as an average value: based on tree species in the United States of America and depending on environmental conditions where a tree grows. Therefore, in this research project a special method had been adopted depending on field data for calculating carbon sequestered in urban tree species. The application procedure was as follows: Two individual trees from both species (*Eucalyptus camaldulensis* and *Cupressus sempervirens* var. *horizontalis*) were selected randomly in Duhok province at college of agriculture and forestry with elevation of 475m. In fact, we collected data from

Mediterranean Cypress trees found in the nursery of the College of Agriculture, where tree species watering approximately weekly. Due to the legal instructions of the governorate of Duhok Province a limited number of selected individuals were taken. All trees were felling down by the chainsaw and main logs had been delimbed and then branches, twigs and leaves were separated. Knowing that extracting mechanically root from the ground is often not an option to derive tree carbon stocks, particularly in urban areas. According to (Alexander, 1986) roots represent 0.2 from the aboveground dry weight of tree, therefore we multiply the aboveground weight of the tree by 1.2.

Three samples from branches, twigs and leaves were randomly taken in plastic sacks to avoid loss of moisture. The main logs had been bucked to lengths of meters and one sample by each meter had been taken in plastic sack. The total green weights of all parts of trees (logs, branches, twigs and leaves) were taken directly in the field by an electronic scale (with a precision of 0.01 g and a capacity of 300 kg). While the weight of all samples was calculated before (green weight) and after (dry weight) drying in oven at 105° for 48 hours in the laboratory of the department of forestry, college of Agriculture, University of Duhok. After that the green weight and dry weight of all parts of trees calculated via collecting the weight of all parts of tree before and after drying separately for each *Eucalyptus* and *Cupressus* (see Tables 1 & 2; Figures 1).

Table (1): Illustrate both green and dry weight of *Eucalyptus* sample in Duhok Province including all tree components.

Date	Sample	H (m)	D (cm)	Stems (kg)		Leaves (kg)		Twigs (kg)		Branches (kg)		Roots (kg)		Total Wet weight (kg)	Total Dry weight (kg)
				Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry		
11/12/2015	1	14.5	26.2	422.3	200.3	104.9	51.4	31.8	16.2	58.9	28.9	123.6	60.22	741.5	357.02
11/12/2015	2	12.5	20.0	203.2	110.7	67.09	31.5	21.9	11.3	36.2	18.8	65.69	34.49	394.08	206.79

*Roots weight determined according to the method of (Alexander, 1986).

Table (2): Illustrate both green and dry weight of *Cupressus* sample in Duhok Province including all tree components.

Date	Sample	H (m)	D (cm)	Stems (kg)		Leaves (kg)		Twigs (kg)		Branches (kg)		Roots (kg)		Total Wet weight (kg)	Total Dry weight (kg)
				Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry		
21/12/2015	1	7.55	26.01	195.3	125.5	141.7	72.3	20.4	12.3	94.6	58.3	90.4	53.7	542.4	321.1
21/12/2015	2	7.12	17.5	116.1	62.97	118.3	60.3	18.5	10.4	37.5	20.2	58.1	30.8	348.5	184.67

*Roots weight determined according to the method of (Alexander, 1986).



Fig. (1): Stages of field procedure and sample preparation. (a) Tree selecting for felling. (b) Felling the tree by using chainsaw. (c) Measuring the height, diameter, and age for each tree of *Eucalyptus* and *Cupressus*. (d) Cutting up tree to useable pieces. (e) Weighting branches. (f) Removing of limbs (leaves, branches, twigs). (g) Taking samples. (h) Wet weight measuring. (i) Measuring the dry weight.

2.3 Quantifying carbon sequestration:

Richard (1992) indicates that the average carbon content in a tree is generally 50% of the total dry biomass. Therefore, we estimated the weight of carbon sequestered in a tree via multiplying the total dry weight of each individual tree by 0.5.

Furthermore, to calculate the weight of carbon dioxide sequestered in the tree, we multiply the weight of carbon by 3.6663 (because the atomic weight of CO₂ is 43.99915 and this of C is 12.001115). In order to obtain the weight of CO₂ sequestered in the tree per year, we divide the weight of carbon dioxide sequestered in the tree by the age of the tree. To estimate the monetary value associated with urban tree carbon storage and sequestration, carbon values are multiplied by \$78.5 per tonne of carbon based on the estimated social costs of carbon in 2010 with a 3% discount rate (Interagency Working Group, 2010).

3. RESULTS & DISCUSSION

Urban tree's carbon sequestrations in Duhok city are a function of the total amount of each urban tree species. Therefore, the first steps towards estimating the rate of carbon storage at regional and/or national scale, is quantified in the field the carbon sequestration capacity of each species. In this research project, the results show a variation between *Eucalyptus camaldulensis* and *Cupressus sempervirens* var. *horizontalis* for the

ratio dry/green biomass, the net carbon sequestration and CO₂ storage annually. From the results, it's important to know which kind of species trees is capable to sequester more quantity of CO₂, and work to increase plantation as possible of that species in the urban areas of Duhok city to reduce air pollution with other reasons that affect the Duhok governorate as well as take in account which location need to planting.

3.1 Carbon sequestration by *E. camaldulensis* versus *C. sempervirens*:

River Red Gum is one of fastest growing evergreen tree species occurring in moisture soils; the table (3) represents the results of biomass and carbon sequestration by *E. camaldulensis*: It shows that the mean ratio of total dry to green biomass was 50.34 and mean percentage of moisture was 49.66 %. Our results indicated that the half of its green biomass is water. This high percentage of moisture in *Eucalyptus* woods.

In addition, may be due to both the chemical and physical prosperities of its woods. Furthermore, *Eucalyptus* species require a lot of underground water and they well grow in along water courses habitats. They often used for drying saturated moisture, soil due its capacity to pump out underground water to the surrounding environment. In addition, the mean of annual carbon dioxide sequestered was 37.97 kg, which equal to a price of approximately 3 \$ per year per individual tree as shown in (Table 3).

Table (3): Moisture content and total carbon sequestered in *Eucalyptus* tress.

Samples	H (m)	D (cm)	Annual rings	Total Wet (kg)	Total Dry (kg)	Dry/Wet	% water	Carbon	CO ₂ Sequestration	Price (\$)	Annually CO ₂	Annually Price (\$)
1	14.5	26.25	14	741.74	357.2	48.16	51.85	178.6	654.81	51.41	46.77	3.67
2	12.5	20.05	13	394.15	206.97	52.52	47.49	103.4	379.4	29.79	29.18	2.29
Mean						50.34	49.67	141.05	517.1	40.59	37.97	2.98

Cupressus sempervirens is one of coniferous evergreen modrate growing species. The results in table (4) indicate that the mean ratio of total dry/fresh biomass was 56.19 and water percentage was 43.81. The highest percentage of water in *Cupressus* species in this study may be due to the environment condition where they grow.. Furthermore, the mean of annual Carbon dioxide

sequestered was 17.2 kg, which equal to a price of approximately 1.35 \$ per year per individual tree. Although, *E. camaldulensis* containing a high percentage of water (~ 50%) comparing to *C. sempervirens* tree species (~44%), it remains more efficient for annual carbon sequestration (~ 38 kg) compared to Mediterranean Cypress species (~ 17.2 kg). In previous study in similar topics in

Duhok Province, Mizori (2010) showed that the average annual carbon sequestered by *Pinus brutia* and *Quercus aegilops* were 11.36 kg and 9.21kg, respectively. Consequently, *E. camaldulensis* has a high efficient capacity of the

annual amount of carbon sequestered. Consequently, it is more preferable to planting fast growing species in urban area due to their capacity for carbon storage such as *Eucalyptus sp.* and *Platanus sp.*

Table (4): Moisture content and total carbon sequester in *Cupressus* tress.

Samples	H (m)	D (cm)	Annual rings	Total Wet (kg)	Total Dry (kg)	Dry/Wet	% water	Carbon	CO ₂ Sequestration	Price (\$)	Annually CO ₂	Annually Price (\$)
1	7.55	26.01	23	542.4	321.9	59.35	40.64	160.95	590.05	46.32	25.656	2.01
2	7.12	17.5	20	348.37	184.7	53.02	46.97	92.35	338.58	26.58	16.929	1.33
Mean						56.18	43.81	126.65	464.34	36.45	21.293	1.67

The field technique procedure adopted in this research allowed to present the carbon allocation strategy between all parts of tree: Significant differences were found in the dry weight biomass and carbon sequestration of all tree parts (Figure 2). Carbon storage concentration by River Red Gum were 55%, 17%, 15%, 8%, 5% in stem, root, leaves, branches and twigs respectively. The main stems of *Eucalyptus* tree species tending to have the highest carbon concentration (about 55%) compared to the crown tissue (branches + twigs + leaves =28%). This allocation strategy may be related to the morphological characteristic and

wood densities of *Eucalyptus* species. Knowing that it's a fast growing species with a high up to 20 m tall (Townsend & Guest, 1966; Shahbaz, 2010). In this study, the field data show that its height achieved about one meter tall per year. Stem-wood, carbon concentrations measured in *E. camaldulensis* in this study was close to the result reported for the New Zealand native tree species (45.2–47.0%) and angiosperms from across the globe were (47.7 ± 0.3%) (Thomas & Martin 2012).

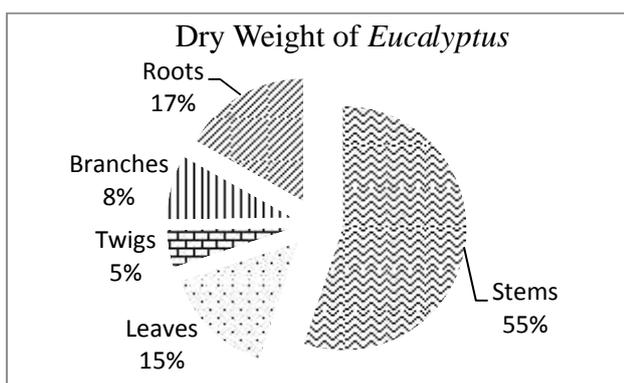


Fig. (2): Carbon allocation strategy between all parts of *Eucalyptus* tree

Concerning *C. sempervirens*, it adopted a different carbon accumulation allocation strategy on a per-tree basis (Figure 3): Carbon sequestration concentrations were 37%, 26%, 17%, 16%, 4% in stem, leaves, root, branches and twigs respectively. Knowing that only the carbon

storage in the crown was 46%. The higher carbon concentration in crown tissue is explained by the high proportion of foliage (26%). For some evergreen tree species, the crown has been reported to have higher carbon concentrations compared with stem wood and roots (e.g. Bert &

Danjon 2006; and Melloet al. 2012). In this circumstance, the field data measured in this research project highlighted the difference carbon sequestration allocation strategies among tree

species according to the physical chemical characteristics of wood and morphological traits (e.g. Crown size versus main stem).

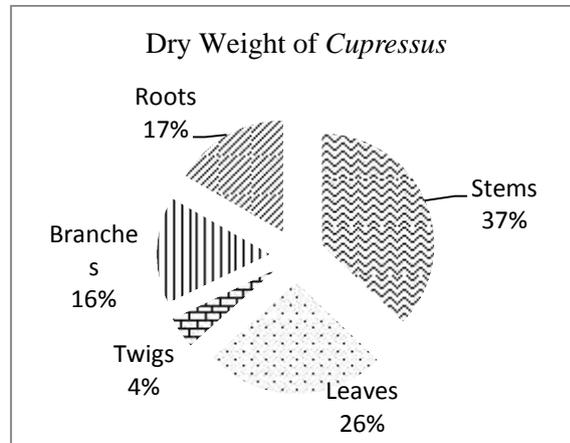


Fig.(3): Carbon allocation strategy between all parts of *Cupressus* tree

2.3 Carbon sequestration by urban tree species in Duhok city:

Urban tree species planted in cities have many functions and values (reducing noise, ornamental purposes, local climate mitigation, air and soil purification...etc.) contributing significantly to human health and environmental quality (Gomez-Baggethun et al. 2013). Unfortunately, in Kurdistan region, relatively little is known about the amount of pollution removed, notably the carbon dioxide sequestered, by urban tree species (Mizori, 2010).

Recently, different models have been used in most developing and industrial countries to estimate the carbon sequestration by urban trees in order to improve urban forest policies, planning and management (see Nowak et al. 2013). For example, a framework that integrates available tree survey data with existing regional-specific allometric equations had been used to quantify the role of urban trees in offsetting CO₂ in European cities (Russo et al. 2014). In addition, carbon storage by urban tree species in the United States (28 cities) was quantified to assess the magnitude and the role of urban forests in relation to climate change and improving human health (Nowak et al. 2013).

The main results of our study were the quantification of annual carbon content for commonest urban tree species planted in Duhok city; They are for Rever Red Gum was (~ 38 kg) and for Mediterranean Cypress species was (~

17.2 kg). In addition, Mizori (2010) quantified the carbon sequestered by some tree species in Duhok Province; He reported that the average annual carbon sequestered by *Pinus brutia* was (11.36 kg) and *Quercus aegilops* was (9.21kg). Therefore, the results of our study with the previous study carried out by Mizori (2010), are considered as a first step toward quantifying the potential carbon offsetting of urban trees and then developing a region-specific approach that Kurdistan cities can use to estimate carbon dioxide sequestration using the available framework of tree inventories, specific allometric equations at regional scale (Duhok city *versus* Kurdistan region). These future frameworks for measurement of CO₂ sequestration could easily be integrated into future urban green space policies and urban planning management. However, the amount of carbon accumulated in individual trees differed considerably among tree species (Capioli et al. 2010; Russo et al. 2014; and Nowak et al. 2013). In this circumstance, additional researches are needed therefore in topics of urban carbon sequestration to develop site-specific urban tree biomass equations specific to Duhok and Kurdistan cities.

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ESTIMATING OF DIAMETER AT BREAST HEIGHT FOR SCATTERED *Pinus brutia* TEN. TREES USING REMOTE SENSING TECHNIQUES, IN ZAWITA SUB-DISTRICT, DUHOK, KURDISTAN REGION- IRAQ

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ABSTRACT

Pinus brutia Ten. is the most important coniferous tree species grow naturally in some mountains of Iraqi Kurdistan Region. It is well adapted to both climatically and soil conditions. The diameter at breast height (DBH) is the significant character which has a major effect on both volume, and height of the tree, and indirectly with the site index. The purpose of this study was to utilize remote sensing techniques in estimating the DBH. This is performed by developing models between the collected DBH measurements from the field and the extracted tree crown area from high resolution satellite imagery (WorldView-2). Five models were developed and the selection of the best model was based on coefficient of determination (R^2), Root Mean Square Error (RMSE), Bias, and Accuracy criteria. Accordingly, the model $DBH = 1.2768 TCA - 14.381$ was the most appropriate model to estimate the DBH for *Pinus brutia* Ten. in this study.

KEYWORDS: Remote sensing, WorldView-2 Satellite imagery, DBH, *Pinus brutia* Ten..

INTRODUCTION

Pinus brutia Ten. grows naturally in some mountainous regions in Kurdistan of Iraq. It covers about 2250ha, as evaluated by the directorate general of forests located in Zawita, Atrosh and Bilkeif localities (Clonaru and Getan 1976).

It is well known that the breast height diameter (DBH) of a tree is the most important parameter used in both forest mensuration, and forest management (Husch et al. 2003). It has a significant relationship to the volume of a tree. There is even a strong relationship between DBH and total height of the tree. This is used to determine the site index of the forest, which can be considered as a measure of site productivity.

The tree DBH is a significant variable used in construction of volume tables (Husch et al. 2003). The volume tables/ volume equations are the main tools in numerous fields of forestry such as making management planes, determination of both growth and yield, as well as studying the efficiency of silvicultural activities.

The tree crown (TC) is defined as that part of tree which bears both branches and foliage (Helms 1998). The Photosynthesis process occurs with TC

and especial with the leaves and the produced material reaches to all parts of the tree. The absorbed water and dissolved minerals reach the leaves through the trunk of the tree (Kramer and Kozlowski 1979).

The genetics and environment are the two main factors which have a significant effect on the shape of a TC (Zimmermann et al. 1971). In an open space, free from competition, the trees tend to have a large canopy, and produce a large diameter but with a short height.

The crown diameter (CD)/ tree crown area (TCA) can be used for prediction of the DBH. Also, in contrast the DBH can be used in predicting the CD/ TCA, depending on the purpose of the study and the available facilities (Lockhart et al. 2005). Hall et al. (1989), and Gering and May (1995) found that there is a strong significant relationship between CD and DBH.

Such a measurement can be achieved in traditional way, using field measurement. In the recent years, however, there have been revolutionary developments in modern techniques as a remote sensing. These tools can be used in different fields of land use including forestry. With such techniques, forest canopy can be estimated and determined for a large area with less

efforts and cost. It has been proved as sufficient and efficient techniques in forest inventory (Kosaka et al. 2005; Pu and Landry 2012; Mustafa et al. 2015). For instance, Mustafa et al. (2015) estimated the TCA with its classification using a very high spatial satellite imagery.

The objective of this study is to utilize remote sensing imagery with its techniques to estimate DBH of *Pinus brutia* Ten. trees in the Zawita sub-district, Kurdistan region-Iraq. This can be implemented by measuring the TCA of *Pinus brutia* Ten. Trees and use this parameter as an explanatory variable to estimate DBH being the dependent variable.

MATERIALS AND METHODS

Study Area

The site of this study is located in Zawita and Bade localities within the Zawita sub-district, Duhok Governorate, Kurdistan Region-Iraq, between latitudes 36°54'59" – 36°53'19" N and longitudes 43°04'46" – 43°09'04" E (Fig.1). These sites are located at about 17 km north Duhok center, Fig. 1 (d). The study area has a high variation as topography with Max. of 1440m and min. 720 m above sea level.

The annual precipitation is 550.19mm, and the temperature is between -1°C and 38°C during the year (Directorate of Meteorology 2014).

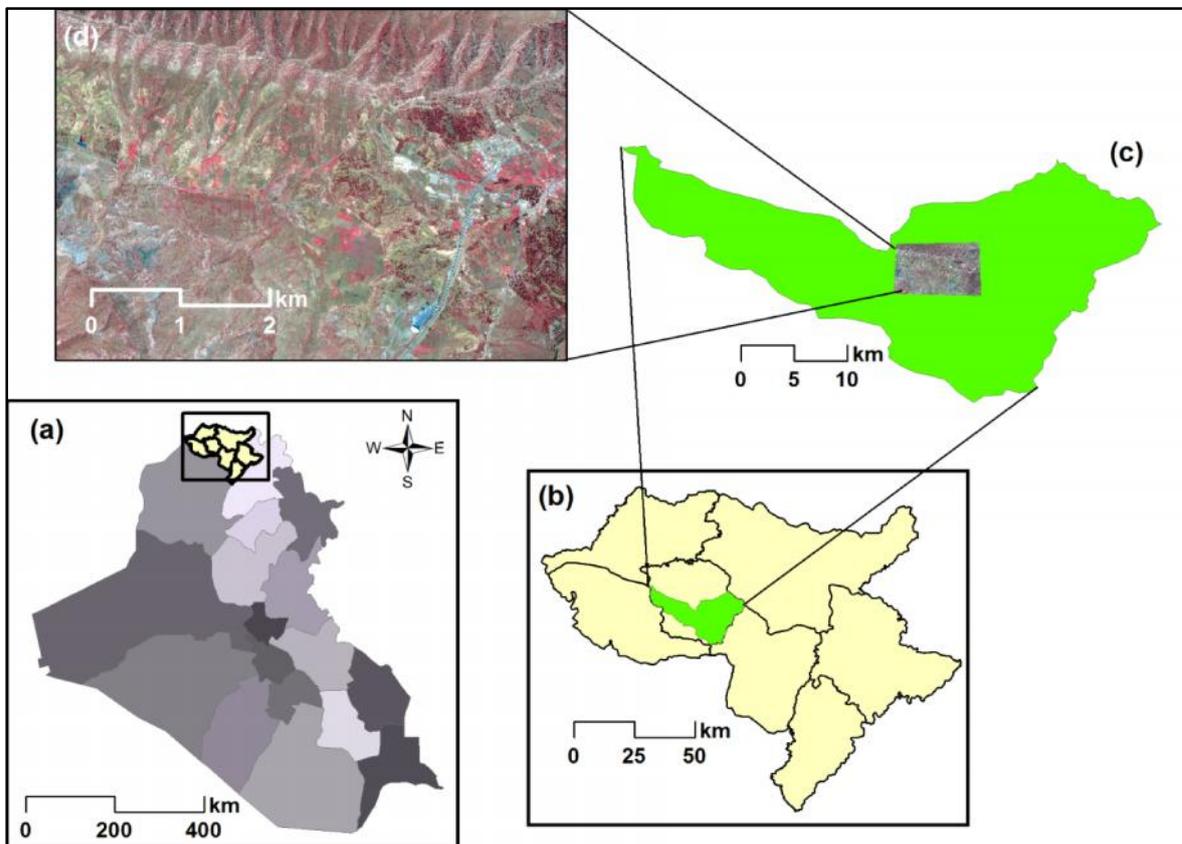


Fig.(1):(a) Map of Iraq,(b)Map of DuhokGovernorate,(c)Map of Zawita sub-district,(d)satellite image of the study site.

Satellite Imagery

The satellite image that used in this study was the WorldView-2 (WV2) imagery. It has eight multispectral spectral bands (MS) and one panchromatic band (Pan). The spatial resolution of the MS bands is 2.0 m while the spatial resolution of the Pan band is 0.5 m at Ground Sampling Distance (GSD) nadir (Table 1). Its swath width at nadir is 16.4 km with altitude of 770 km (DigitalGlobe 2009).

The WV2 scene that covers the study area was cloud-free image acquired in June of 2011 and provided by the Digital Globe agency.

Field Data

The field survey was conducted on December 2015, and includes collection of data as samples. The very high resolution WorldView-2 were brought to the field to directly locate and determine tree crown on the image for a later use

of determining training and validation samples (Fig. 2). The criteria used for selection of trees were in such a way that it was possible to find out the same tree in the forest and with clear crown canopy in the satellite imagery. In total 84 samples were collected from three different locations as shown in Fig. 2 (b-d) of which 64 samples used for training and 20 samples for validation. The field data included the measurements of DBH using ordinary caliper, and ranged between 13.0 and 81.0 cm. The age of trees was measured using increment borer, which ranged between 16 and 66 year. Moreover, the average annual diameter growth was calculated and found to be 0.23 cm. This is performed in order to estimate the DBH measurements at the same date of the image acquisition. Accordingly, these values were deducted from each DBH measurements to represent DBH measurement of 2011. These data

and constituted as the raw data extracted data from WV2 imagery to be used for further process and analysis of developing the prediction model.

Table (1): Spectral resolution of WV2 imagery (DigitalGlobe 2009).

Band	Color	Spectral rang (nm)	Spatial resolution (m)
1	Coastal blue	400–450	2.0
2	Blue	450–510	2.0
3	Green	510–580	2.0
4	Yellow	585–625	2.0
5	Red	630–690	2.0
6	Red-Edge	705–745	2.0
7	NIR-1	770–895	2.0
8	NIR-2	860–1040	2.0
	Pan	460–800	0.5

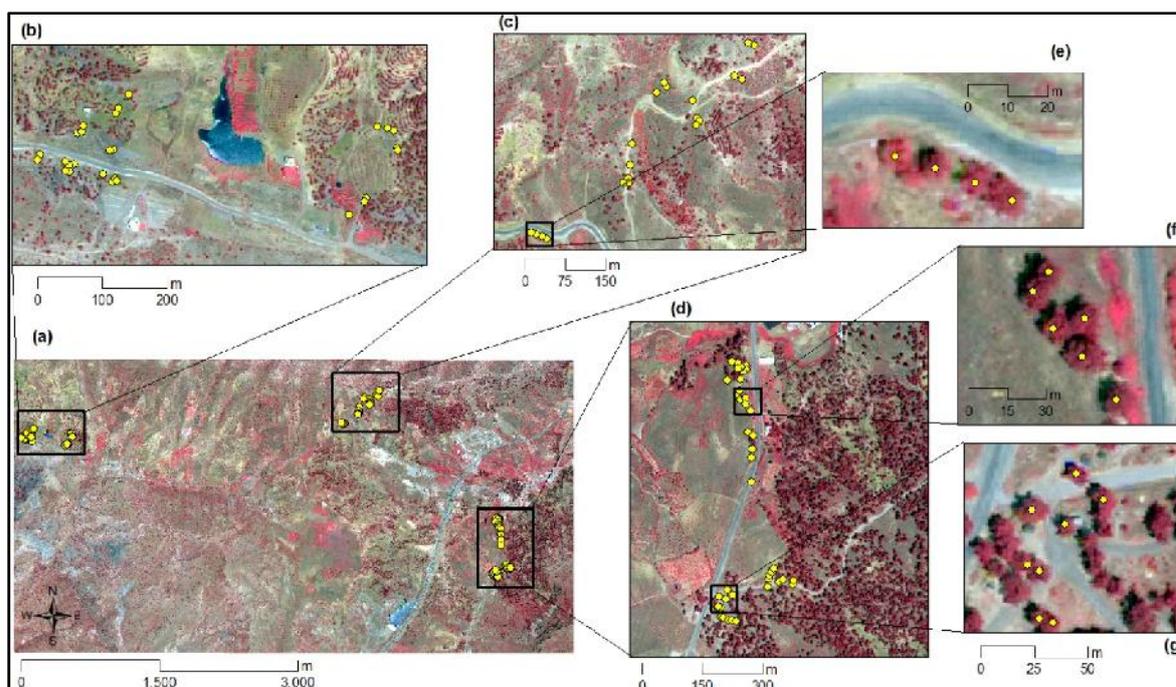


Fig. (2): Yellow points refer to the field work samples (a) Study site, (b) Location A (Bade), (c) Location B (Bade), (d) Location C (Zawita), Zoom in part of some samples shown in (e), (f), and (g).

Image Pre-Processing

All processing and analysis of the satellite imagery was carried out using ENVI (v. 5.3, ITT Visual Solutions). An overview of the methodology steps is shown in Fig. 3. The following steps included in the pre-processing stage.

Radiometric and atmospheric correction: According to (Jensen 2005) the WV2 imagery was

radio metrically calibrated using the Empirical Line Calibration. Next, the image was atmospherically corrected using ENVI's atmospheric correction module FLAASH (Fast Line-of-sight Atmospheric Analysis of Spectral Hypercubes). All spectral bands images (except panchromatic band) were layer stacked to form a single image file. Topographic correction was not

implemented as this image was already terrain corrected by the provider (DigitalGlobe 2009).

Image fusion (Pan-sharpening-PS): It is a useful process to increase the spatial resolution of satellite images (Kosaka et al. 2005). The multispectral bands (2.0 m) were fused (image fusion method) with the panchromatic band (0.5 m) to create Pan-sharpened 0.5 m resolution for multispectral bands of WV-2 images. This process was achieved by using Gram-Schmidt pan-sharpening method, as it has been recommended by (Pu and Landry 2012).

Image Processing

Here we focused on identification and extraction of TC from WV2 imagery. This can be achieved by implementing the following steps:

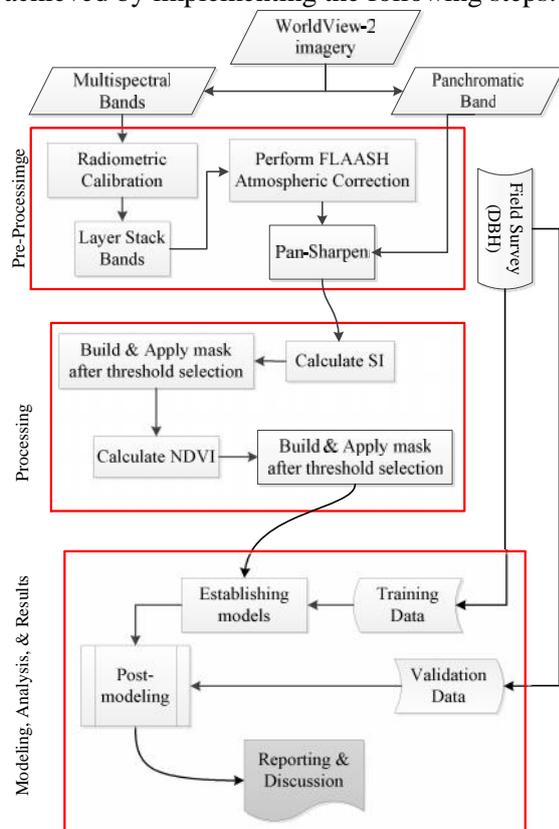


Fig. 3: A work flow sketch showing the research methodologies.

Shadow index (SI): Shadows might consider one of the major corrupted issues in the process of TC identification. For instance, the trees shadow may represent one of the recognized patterns in the imagery, which affects the task of the TC identification. Therefore, SI Equation that was adopted by Mustafa and Habeeb (2014) is used here.

$$SI = \sqrt{(255 - Red)(255 - NIR)} \quad (1)$$

where NIR and Red are the near infrared (band no. 7) and the Red-reflectance (band no. 5) bands, respectively. The value SI is between 0 and 255. Next, the shadow areas were masked out of the image.

Normalized Difference Vegetation Index (NDVI): This index is used to remove the ground as water, building, roads, soil, and any other non-vegetation objects. This is achieved first by applying the following Equation (García and Caselles 1991):

$$NDVI = \frac{NIR - Red}{NIR + Red} \quad (2)$$

where NIR and Red are the near infrared (band no. 7) and Red-reflectance (band no. 5) bands, respectively. Further, non-vegetation areas were masked out from the images, so that the remaining objects on the image were only trees.

Modeling

A relationship was investigated between DBH measurements of *Pinus brutia* Ten. trees with the extracted TC area (TCA) from WV2 imagery. In the developed relationship (model), the independent variable was TCA and the dependent variable was DBH. Different models were tested and accordingly five regression models were developed along with some measures of precision. These measures of precision were then used to select the best model which fits the data. The criteria used for doing such a task were:

$$R^2 = 1 - \frac{\sum(y_i - \hat{y}_i)^2}{\sum(y_i - \bar{y})^2} \quad (3)$$

$$RMSE = \sqrt{\frac{1}{n} \sum(y_i - \hat{y}_i)^2} \quad (4)$$

$$Bias = \frac{\sum(y_i - \hat{y}_i)}{n} \quad (5)$$

$$Accuracy = \frac{\sum |y_i - \hat{y}_i|}{n} \quad (6)$$

Where y_i , \hat{y}_i , and \bar{y} are the actual, estimated, and mean value of DBH, respectively. The number of observations in the sample is represented as n .

The above mentioned criteria were used for both tasks, development of the models and validation purposes.

RESULTS AND DISCUSSION

Tree Crown identification and mapping

The presented result is based on the processes that have been explained in previous section. Fig. 4 (a) is the coarse resolution image (multispectral image) but with good spectral resolution. While Fig. 4 (b) represents the high spatial resolution with poor spectral resolution (panchromatic image). Hence, Fig. 4 (c) is the result of pan-sharpening process which contains both properties (good spatial and spectral resolution). This is important because it enables us to identify the boundary of the image objects, as tree crown objects.

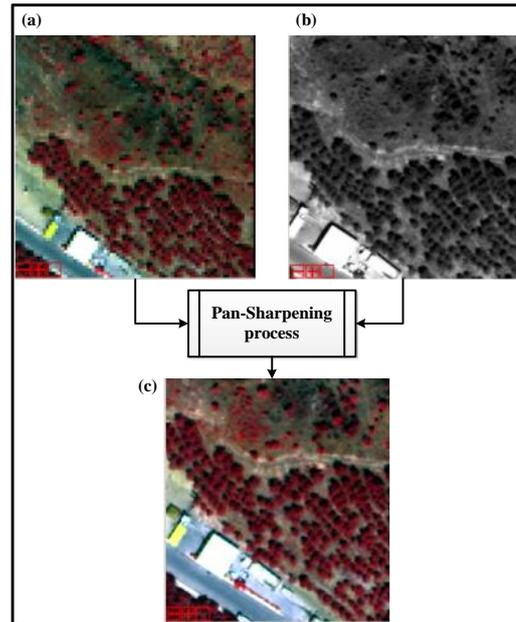


Fig. (4): A portion of the study area image showing the results of the PS process. (a) MS image; (b) Pan image; (c) PS image.

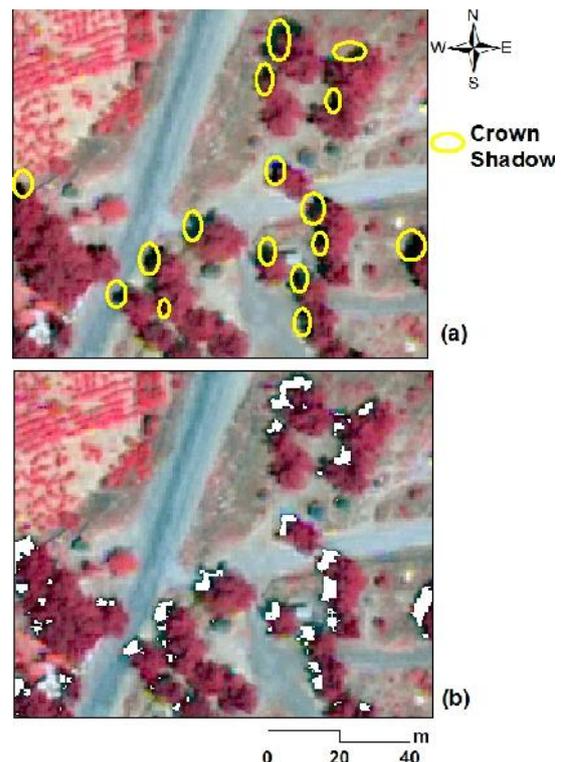


Fig. (5): A portion of the study area image showing the results of the SI process. (a) image after PS process; (b) image without shadow.

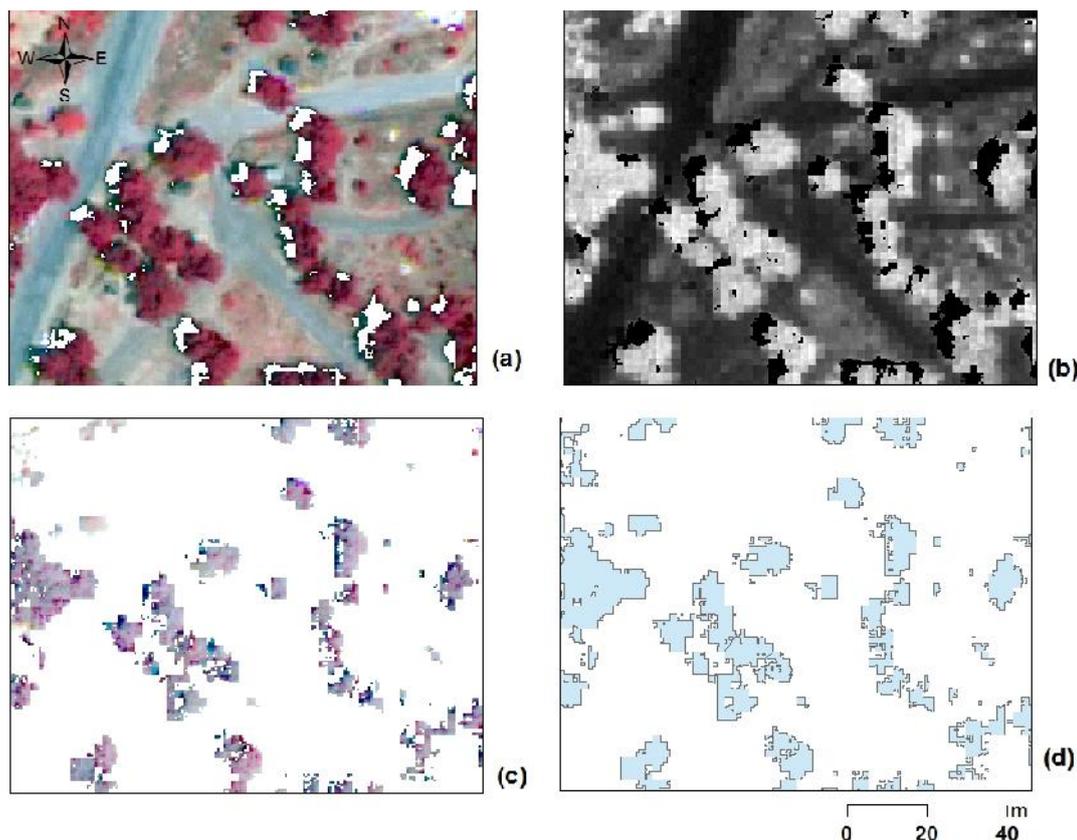


Fig. (6): A portion of the study area image showing the results of the NDVI process. (a) image without shadow; (b) NDVI image, (c) final image with vegetation canopy, (d) converted final image to vector.

The SI image is created by implementing Equation (1) to pan-sharpened image. Next, the shadow area is masked out after a threshold value was experimentally determined and an image is created without shadow, Fig. 5 (b). It should be pointed out that not only the shadow of the tree crowns was removed. However, the shadow of other image objects (as shadow of rocks, buildings, etc.), was removed as well, which had no a major influence on the target of this study.

As a result of Equation (2), the NDVI image was created (Fig. 6 (b)). It appears in grey color with the range between -1 and 1. The very white color represents the vegetation objects while the black color represents non-vegetation objects. The vegetation objects (TC) were masked out based on a selected threshold in an experimental way. As a final process, an image was produced with vegetation canopy (TC) only (Fig. 6 (c)).

Following the workflow steps given in Fig. 3, the final image was converted to vector in order to calculate TCA (Fig. 6(d)). Next, the relationship was tested between TCA and the DBH values for

those trees that were measured and collected from the selected sample of trees.

Model development

Several models have been established namely: linear, exponential, logarithmic, polynomial, and power. These models have been shown along with some measures of precision in Table 2.

It is well known that the precision of equations increases as R-Squared increases. Accordingly, the fourth model (polynomial) is considered to be the best one. However, as shown it contains two independent variables that considered being more complicated in application and in use than first model (linear). The R-Squared difference between the first - and the fourth model is only 0.002, which can be negligible as compared with the additional complicity of the model. Therefore, the first model is selected as far as R-Square is concerned.

Furthermore, the first model is superior to the rest of the models based on RMSE and accuracy as measures of precision. The other strength point of selected model is the simplicity in application comparably to other models.

Table (2): Statistical properties of the models for *Pinus brutia* Ten. trees.

NO.	Models	R ²	RMSE	Bias	Accuracy
1	DBH = 1.2768 TCA - 16.73	0.845	20.93	14.37	18.84
2	DBH = 3.5753 TCA - 16.73	0.753	105.6	-9.38	42.35
3	DBH = 45.414 TCA - 128.23	0.784	35.67	34.36	25.20
4	DBH = 0.0039 TCA + 0.9355 TCA - 10.732	0.847	21.07	12.94	18.93
5	DBH = 0.0354 TCA + 0.9355 TCA - 10.732	0.813	26.34	10.49	21.34

It should be mentioned that the developed models were created based on the extracted TCA from WV2 imagery and field work. However, the acquisition date of WV2 imagery was on June 2011, while the field work was conducted on December 2015. Therefore, a bias has been introduced in the developed regression model, and hence a correction factor (as been explained

methodology section) has been made in order to deduct the growth which had occurred in trees diameter within the last four years.

Based on above mention point, new DBH were estimated and the relationships were investigated again with the extracted TCA. Table 3 shows models that have been developed with these new datasets.

Table (3): Statistical properties of the models for *Pinus brutia* Ten.trees after DBH calibration.

NO.	Models	R ²	RMSE	Bias	Accuracy
1	DBH = 1.2768 TCA - 14.381	0.845	19.43	12.02	17.19
2	DBH = 3.9002 TCA - 14.381	0.747	116.69	-14.04	44.25
3	DBH = 42.527 TCA - 115.36	0.779	31.47	20.75	21.74
4	DBH = 0.0039 TCA + 0.95TCA - 8.9969	0.847	20.06	10.70	17.55
5	DBH = 0.0577 TCA + 0.95TCA - 8.9969	0.814	25.13	8.88	19.99

As it can be seen, that the value of R-Squared is almost the same for most of the models, and still the first model is superior to other models, if the simplicity of the mentioned model is taken into consideration. The same conclusion can be drawn when considering bias and accuracy to check the performance of these different models in estimating the DBH.

It might be worth to mention that the polynomial model is better than the rest models based on bias, because it has the lowest value.

One more last point needs to be reported here regarding the precision of the result of this study (R-Squared = 0.845). The precision of the selected model counts to be acceptable as comparing these results with the results of other researchers such as the one that conducted by (Lockhart et al. 2005). The R-Squared in their study ranged from (0.34 to 0.68).

models based on the field measurements and extracted data from remote sensing imagery. Accordingly, the study concludes:

The linear model was the most appropriate model which fits the datasets and used to estimate the DBH.

R-Squared of the developed models ranged from (0.753 to 0.857), and from (0.747 to 0.847), for the original dataset and the modified dataset, respectively.

This approach is more suitable for scattered trees than dense forests. This is due to the fact that the crown canopies cannot be distinguished through satellite images.

The shadow formed by the trees creates problems in estimating the TCA; however, this issue was manipulated using SI equation.

This study could be developed and applied for other tree species.

CONCLUSION

In this study the DBH of *Pinus brutia* Ten. trees in Zawita sub-district, Kurdistan region-Iraq were estimated. This is performed by developing

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A QUANTITATIVE STUDY OF GROSS RAINFALL, THROUGHFALL, STEMFLOW AND INTERCEPTION LOSS IN NATURAL AND ARTIFICIAL STANDS OF ZAWITA PINE (*Pinus brutia* Ten.)

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ABSTRACT

The pine forests (*Pinus brutia* Ten.) in Zawita sub-watershed were selected for the study during the water-year 2010-2011. The study area is located about 17 km northeast of Duhok city, Iraq Kurdistan Region. Two forest stands were pointed , area for each one was 900 m². One for the natural pine forest (N) with the age and basal area of 59 year and 19.63 m/ ha. Respectively , and the other for the artificial pine plantation(A) for the age and basal area of 28 year and 12.2 m/ha. respectively. Throughfall(Th), Stemflow(Sf) and Interception loss(Ic) for each forest stands were checked for correlation with gross rainfall(Pg). The cumulative (Pg) depth of 63 rainfall events for each stands were 652.1mm and 574.95mm. Mean (Pg) per event was 15.2mm and ranging from 1.95mm to 92.5mm for (N) stand and for (A) stand was 13.4mm and ranging from 1.8mm to 80.8mm respectively. The storm intensity for both of (N) and (A) stands were ranged from 0.72 to 80.0 mm/hr. and from 0.60 to 78.4 mm/hr. respectively. The accumulative and constituted for both of (Th), (Sf) and(Ic) in (N) and (A) stands were (452.4mm and 443.7mm; 69.4% and 77.2%), (1.59 mm and 3.0 mm; 0.24% and 0.52%) and (198.1 mm- 128.3 mm ; 30.4% and 22.3%) respectively. Results showed that daily (Th) and (Sf) for (N) and (A) stands were strongly correlated with (Pg), with r(0.99 and 0.99) and r(0.92 and 0.93) respectively, while (Ic) were moderately correlated with (Pg) with r(0.64 and 0.50) respectively.

KEYWORDS: Gross rainfall, throughfall, stemflow and Zawita pine forests .

1.INTRODUCTION

Precipitation is diverged into three components before reaching the forest floor and it has a very significant effect on water balance and the nutrients cycle in forest ecosystem. The following equation illustrates that:

$$P_g = I_c + T_h + S_f$$

Where P_g , I_c , T_h and S_f ; are gross precipitation, interception loss, throughfall and stemflow respectively. Gross precipitation is the precipitation which falls onto a watershed, measured above the tree canopy or in an open area (Williams, 2004). A part of precipitation that is retained by the plant canopy and its subsequent return to the atmosphere through evaporation that does not reach the forest floor mis called interception loss (Gupta and Usharani, 2009). The amount of precipitation that intercepted depends on precipitation amount, intensity, type of precipitation (Aylee, 2006), tree species, canopy density (Chang, 2006 and

Tate, 1995), relative humidity, temperature and wind speed (Rutter *et al.*, 1971). Since canopy interception loss cannot be measured directly, therefore the interception was assumed to be the difference between gross precipitation and the sum of throughfall and stemflow (Carlyle-Moses and Price, 1999).

Throughfall is the portion of precipitation that reaches the forest floor by passing directly through the gaps or dripping from leaves and twigs of the tree canopy (Gupta and Usharani, 2009). Throughfall is affected by various factors such as the season, stand density, stand age, tree species (Kittredge, 1948), precipitation amount, storm frequency, precipitation intensity (Ovington, 1954 and Rutter, 1963), canopy structure and density of the tree crown (Reynolds and Henderson, 1967; Germer *et al.*, 2006). Stemflow is the portion of precipitation that reaches the forest floor by flowing down the stem (Ziegler *et al.*, 2009). The affecting factors on stemflow volume are precipitation intensity, crown morphology, stem

morphology (Steinbuck, 2002), tree species, variation in bark texture, tree form, age, tree diameter and tree height (Kimmins, 1997, Crockford and Richardson, 2000).

Many studies deal with the measurement of interception loss, throughfall and stemflow of rain in forest ecosystems and their results are different. The studies by Swank and Reynolds (1987) and Perez-Suarez *et al.* (2008) are well known. Few other studies and researches on both quantity and quality of water loss on the forest trees species in Iraq and Kurdistan Region have been carried out such as: Ibrahim (1987), Jabbori and Ibrahim (1989) and Salim (2008). Since the quantity and quality of throughfall and stemflow have not been studied in an appropriate manner for natural forest and artificial plantation of *Pinus brutia* and little is known, therefore the current study aims to achieve the following objectives:

- 1- To evaluate the quantity of the interception loss, throughfall and stemflow in both of the natural pine forest and artificial pine plantation.
- 2- To estimate the throughfall, stemflow and interception loss depending on rainfall for the open area using the regression equations.

2. MATERIALS AND METHODS

2.1. Site Description

The study was carried out in Zawita-Swaratoka watershed area. The area is located about 17 km northeast of Duhok city in Kurdistan Region of Iraq. The study area located within Zawita sub-watershed, which is a part of natural pine forest. The other part of the natural pine forest is in the Atrush area which is considered as the lower part of Zawita-Swaratoka watershed. The study started during the water-year 2010-2011 in Zawita Pine (*Pinus brutia* Ten.) which is composed of the natural pine forest about 830 hectare (Gulcur and Kettenah, 1972) and artificial pine plantation about 200 hectare (Reports of Zawita Forests and Horticulture Office, 2010). Two stands were selected surrounded by Iron fences for the purpose of the present study. One of them for the natural pine forest which is located in the northern aspect of the mountain (latitude 36° 53' N, longitude 43° 08' E) and at elevation 960 m above sea level. The total basal area was 19.63 m²/ha, mean tree height and diameter at breast height (DBH) were 14 m and 40.5 cm, respectively, and the average age of the tree at breast height was 59 years (ranged between 32-109 year) and the other is the artificial pine plantation which is located in the southern

aspect of the mountain (latitude 36° 54' N, longitude 43° 07' E) and at elevation 971 m above sea level. Pine plantations planted in Zawita mountainous are distributed on contour lines. The distance between trees is about 3 m, while the distance between rows is about 4 m. The total basal area was 12.2 m²/ha., mean tree height, diameter and the average age of the trees at breast height (DBH) were 10 m, 19.58 cm and 28 year, respectively. Each of the stand area equal to 900 m². The terrain is mountainous which is mostly steep to very steep. Flat or gentle slopes are rare, in which most of them distributed as small patches in valley bottom, except in the northern part where the topography is gentle or flat. The soils of the Zawita-Swaratoka watershed consist of rough broken and stony land of the mountain region, belong to groups of lithosols, Rendzina and Brown soils (Buringh, 1960). The soil of Zawita belongs to reddish brown soils groups with loamy surface soil and sandy loam in sub-soil. Exposed red areas common in this watershed are marls of circus formation rock in Zawita where pine trees still grow. It was observed during the field study that the soils of the watershed are heavy textured, mostly clayey and clayey loam. Gulcur and Kettenah (1972) noted that the pH varies between 7.7 to 8.3, due to high calcium content. The area mainly belongs to the forest region, in which the Oak trees are predominant with *Quercus infectoria*, *Qercus aegilops* and *Quercus libani*. *Pinus brutia* is located around Zawita and adjacent hills in the north. *Juniperus oxycedrus*, *Pistacia khinjuk* and *Crataegus spp.* are also present with some other tree species. According to Koppen climate classification, the climate of the study area is similar to the Mediterranean climate conditions. Mediterranean or Dry Summer Subtropical Climate Csa (Lands border the Mediterranean Sea) is a type locality for this climate (Critchfield, 1974). The climate is characterized by warm to hot, dry summer and mild to cool, wet winter.

2.2. FIELD MEASUREMENTS

2.2.1. Gross Rainfall (Pg)

Gross rainfall was measured in an opening area located approximately 80 m from the center of the two experimental stands and having the same altitude with them (Baloutsos, 2009). In the present study four manual rain gauges (locally made) were selected. Each consists of plastic funnels 17.9 cm diameter connected to 5 Liter plastic containers and one standard recorder rain

gauge type (CASELLA) (8 inch) was installed for studying the distribution of rainfall in time. Recording rain gauge was read on a daily basis for measurement of both duration and intensity of rainfall. Rainfall was usually measured within 24 hour of each rain event at 06 GMT (A.M). The arithmetic mean of them was estimated and considered as the actual true value of the opening area.

2.2.2. Throughfall (Th)

Throughfall was collected using the same type of rain gauges used for measuring gross rainfall

during the study period for each stand. Eighteen manual rain gauges were numbered and randomly distributed under the tree canopies of each study stand. Throughfall amount of each rainfall event was calculated via the collected throughfall from all 36 manual gauges for both stands. The volume of water that has been collected in the collector depends on the orifice surface area of the collector. Therefore, to get the throughfall in depth value, it is necessary to divide the collected water volume with the orifice surface area of collector (Aylee, 2006).

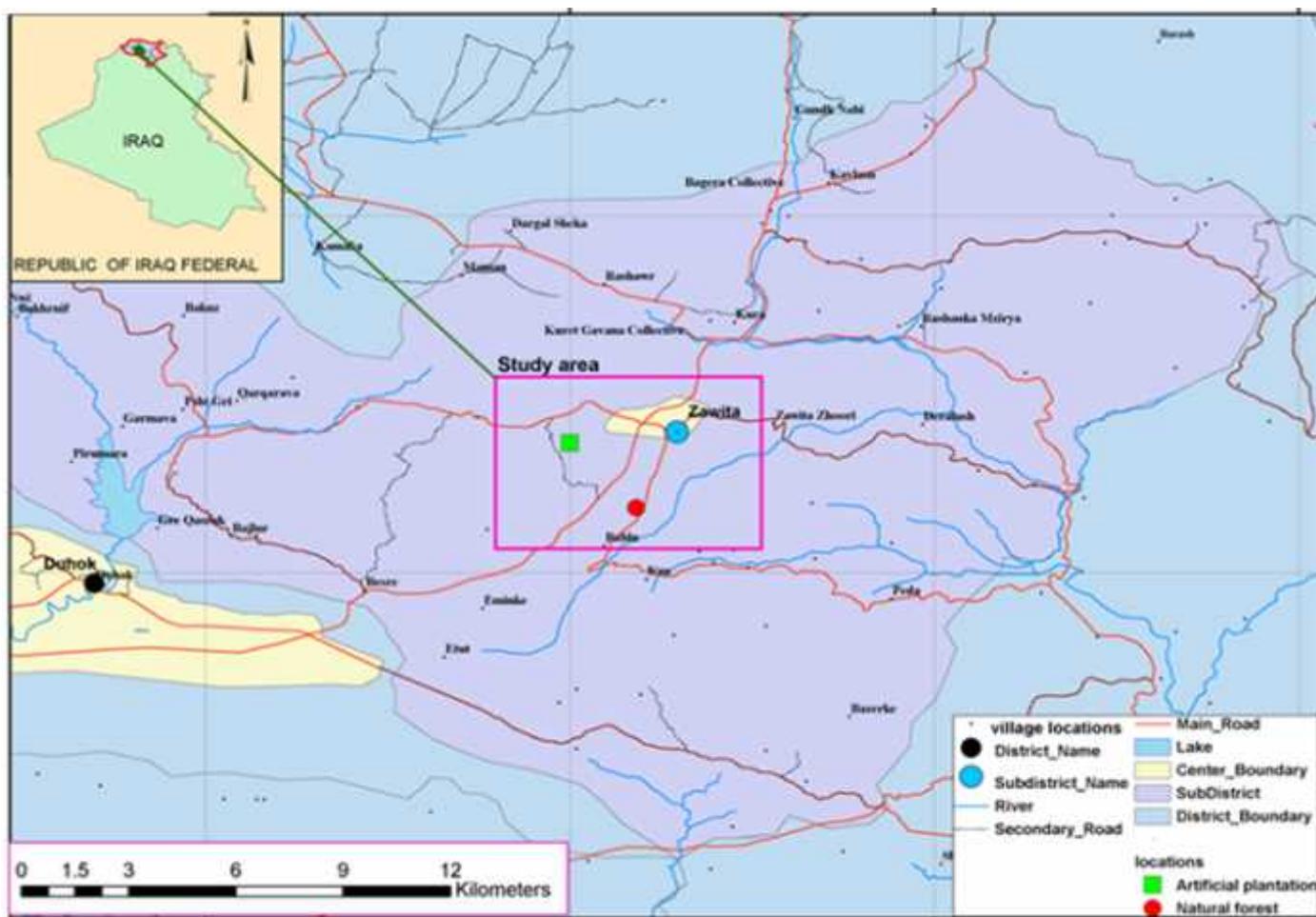


Fig. (1): Location map of the study area (Kurdistan map, 2010)

2.2.3. STEMFLOW (SF)

In each stand, six pine trees were selected for steam flow measurement (Ahmadi *et al.*, 2009) using open rubber collars, spiraled around the stem of each tree (spiral-type) at the level of the

breast height (DBH) and attached with nails and sealed with silicon sealant after smoothing the bark surface which was filled between tree stem and the rubber collar to avoid any leakage from

the collars during the study period, and connected to 20-Liter plastic containers. Stemflow was sampled randomly in 6 locations at each stand.

Stemflow volume was converted to (mm) depending on tree crown area (Bentley, 2007).

2.2.4. Interception Loss (I_c)

The interception loss at each stand was calculated using the standard formula (Majid *et al.*, 1979): Gross rainfall = interception loss + throughfall + stemflow

3. RESULTS AND DISCUSSION

3.1. Hydrology Study

3.1.1. Gross Rainfall (Pg)

Sixty-three rainfall events occurred during the study period, from 10 December 2010 to 29 May 2011. The sums of these events were 709.84 mm and 596.75 mm for natural pine forest and artificial pine plantation respectively. Only events number 43 and 34 produced measurable throughfall and stemflow for natural pine forest, while the events 43 and 36 produced measurable throughfall and stemflow for the artificial pine plantation with total rainfall for the above mentioned events were 652.1 mm and 574.95 mm, respectively.

Table (1): Total monthly of the gross rainfall (mm) and storm intensity (mm/hr) for the study period (Natural pine forest).

Months	Gross rainfall (mm)				Storm intensity mean (mm/hr)		
	Monthly total	Ratio of monthly to annual	Maximum value/day	Minimum value/day	Maximum intensity	Minimum intensity	Mean
December	107.6	16.50	44.29	2.24	4.4	0.95	2.79
January	116.08	23.93	65.98	1.95	30.0	0.72	6.99
February	115.11	17.65	45.13	1.33	13.3	1.00	4.73
March	43.3	6.64	20.10	1.36	32.37	1.80	7.56
April	197.44	30.38	92.46	1.60	80.0	0.86	10.99
May	32.57	4.99	9.92	1.74	19.49	2.40	10.84

Mean gross rainfall per event was 15.17 mm, with high coefficient of variation 118.21 % ranging from 1.33 to 92.46 mm for the natural pine forest and for the artificial pine plantation was 13.37 mm, with high coefficient of variation 118.04 % ranging from 1.75 to 80.81 mm respectively (Table 1 and 2). In addition, monthly gross rainfall ranged between 32.57mm

in May and 197.44 mm in April for the natural pine forest and 35.05 mm in May to 174.04 mm in April for the artificial pine plantation. The storm intensity ranged from 0.72 to 80.0 mm/hr with an average intensity of 7.32 mm/hr for the natural pine forest and from 0.60 to 78.43 mm/hr with an average intensity of 6.895 mm/hr for the artificial pine plantation (Table 1 and 2).

Table (2): Total monthly of the gross rainfall (mm) and storm intensity (mm/hr) for the study period (Artificial pine plantation)

Months	Gross rainfall (mm)				Storm intensity mean (mm/hr)		
	Monthly total	Rate of monthly to annual	Maximum value/day	Minimum value/day	Maximum intensity	Minimum intensity	Mean
December	96.11	16.72	41.77	1.81	3.08	0.66	1.45
January	139.43	24.25	62.00	3.40	29.53	0.62	6.82
February	88.1	15.38	32.32	2.70	11.0	0.75	4.15
March	41.92	7.29	13.92	3.14	22.50	2.40	6.04
April	174.04	30.27	83.61	1.75	78.43	0.60	13.34
May	35.05	6.10	12.92	2.29	20.0	2.43	12.55

3.1.2. Throughfall (Th)

The total throughfall in both the natural pine forest and artificial pine plantation were 452.37 and 443.66 mm respectively, and constituted 69.37% and 77.16% of the gross rainfall (Table 3). The average throughfall values measured in the present study were higher than that derived from

other pine forests. As examples, throughfall was estimated as 59% of the gross rainfall for *Pinus pinea* plantation in Nineveh, northern Iraq (Jabori and Ibrahim, 1989). It is most likely that the differences in throughfall values in the present study were probably due to differences in the rainfall intensity.

Table (3): Measured Gross rainfall, Throughfall stems flow and Interception Loss

Treatments	Natural pine forest	Artificial pine plantation
Measured gross rainfall (P_g) mm	652.1	574.95
Measured throughfall (T_h) mm	452.37	443.66
Measured stemflow (S_i) mm	1.59	3.01
Derived Interception (I_c) mm	198.13	128.28
Throughfall (% of gross rainfall) T_h/P_g	69.37	77.16
Stemflow (% of gross rainfall) S_i/P_g	0.24	0.52
Interception (% of gross rainfall) I_c/P_g	30.38	22.31

The lower percentage for the natural pine forest in the present study is expected to be due to their thick canopy structure that is capable of storing larger rain water before throughfall can be initiated.

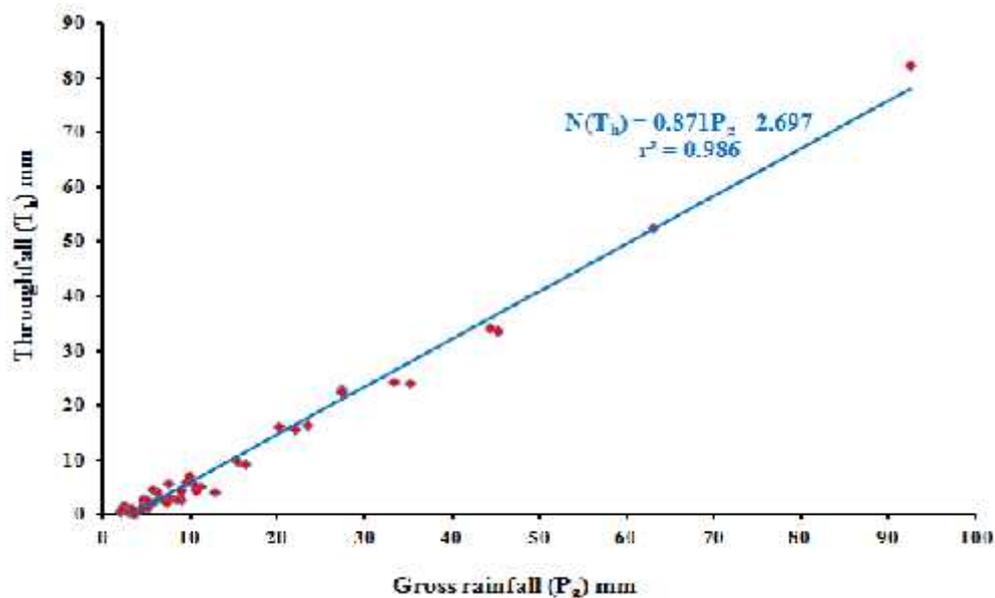


Figure (1): Relationship between gross rainfall and throughfall in natural pine forest.

Conversely, the artificial pine plantation is basically less dense and quite uniform canopy structure compared with the natural pine forest. Monthly throughfall ranged from 24.04 mm or 3.69% to 133.07 mm or 20.41% of the gross rainfall for the natural pine forest, while the values for artificial pine plantation were ranged from 29.19 mm or 5.08% to 133.59 mm 23.24% of the gross rainfall. The highest throughfall was recorded in April for the natural pine forest and artificial pine plantation with 133.07 mm and 133.59 mm respectively which was the wettest month, and the lowest values 24.04 mm and 29.19 mm in the drier month of May.

Daily throughfall for the natural pine forest and artificial pine plantation were strongly correlated

with daily gross rainfall where increased and decreased with increasing and decreasing gross rainfall and with high r^2 (0.986 and 0.987) respectively (Figure 1 and 2).

The amount of rainfall required to saturate the canopy before throughfall starts is termed as canopy storage capacity (Gash and Morton, 1978). The value can be determined by regressing throughfall against daily rainfall. A canopy storage capacity of 3.1 mm and 1.97 mm were derived from the intercept values on the throughfall axis when rainfall is equal to zero in the natural pine forest and artificial pine plantation respectively (Figure 1 and 2).

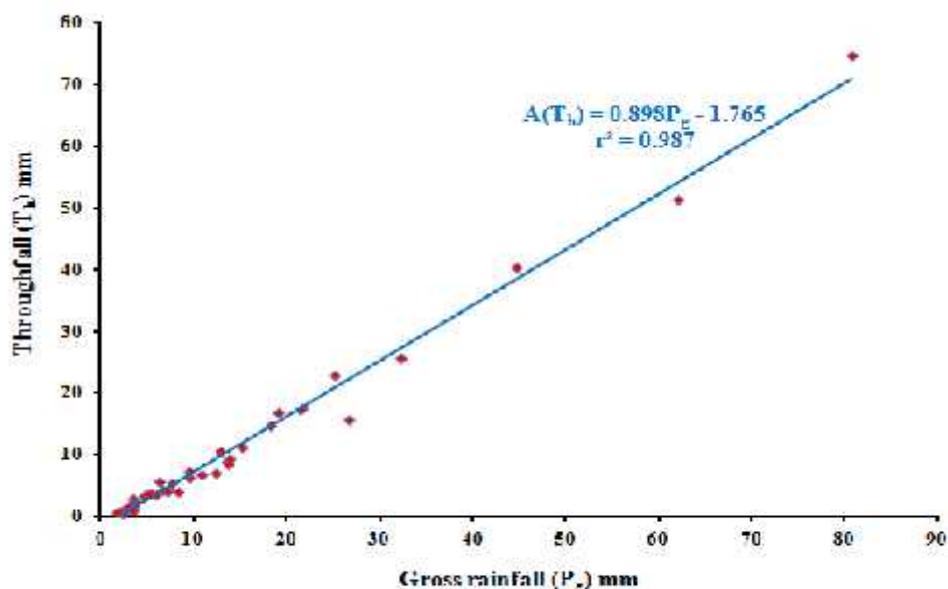


Figure (2): Relationship between gross rainfall and throughfall in artificial pine plantation.

Estimated values of canopy storage capacity vary with the density and the structure of the canopy and the leaf area (Yusop *et al.*, 2003).

3.1.3. Stemflow (Sf)

In the present study it was observed that the stemflow constituted a small percentage of gross rainfall 0.24% as an average or 1.59 mm in the natural pine forest and 0.52% as an average or 3.01 mm in the artificial pine plantation (Table 3).

These values are close to those values obtained by Silva and Rodriguez (2001) when they found that the percentage of stemflow was 0.6% of the gross rainfall for the *Pinus pseudostrobus* L. plantation of north east Mexico, and 0.34% of the gross rainfall for the *Pinus brutia* which was found by Salim (2008) in Aqra area. In general, stemflow in the natural

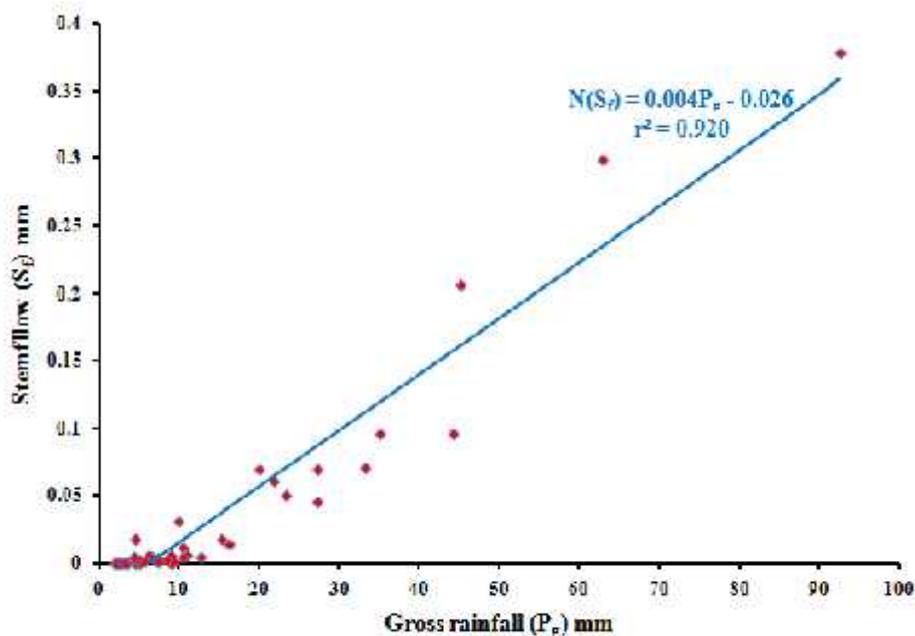


Figure (3): Relationship between gross rainfall and stemflow in natural pine forest.

pine forest is lower than in the artificial pine plantation due to the increasing in trees age and height, the bark roughness, and interception storage capacity (Johnson, 1990). Monthly stemflow for the natural pine forest and the artificial pine plantation were ranged from 0.04 mm or 0.006% to 0.49 mm (0.075%) and from 0.12 mm or 0.02% to 0.78 mm or 0.14% of the gross rainfall respectively. The maximum monthly

stemflow (0.49 and 0.78 mm) were recorded in April for the natural pine forest and artificial pine plantation respectively, while the lowest values (0.04 and 0.12 mm) were occurred in May for natural and artificial forest respectively. Daily stemflow for the natural pine forest and artificial pine plantation were strongly correlated with daily gross rainfall with r^2 values of 0.920 and 0.927 respectively (Figures 3 and 4).

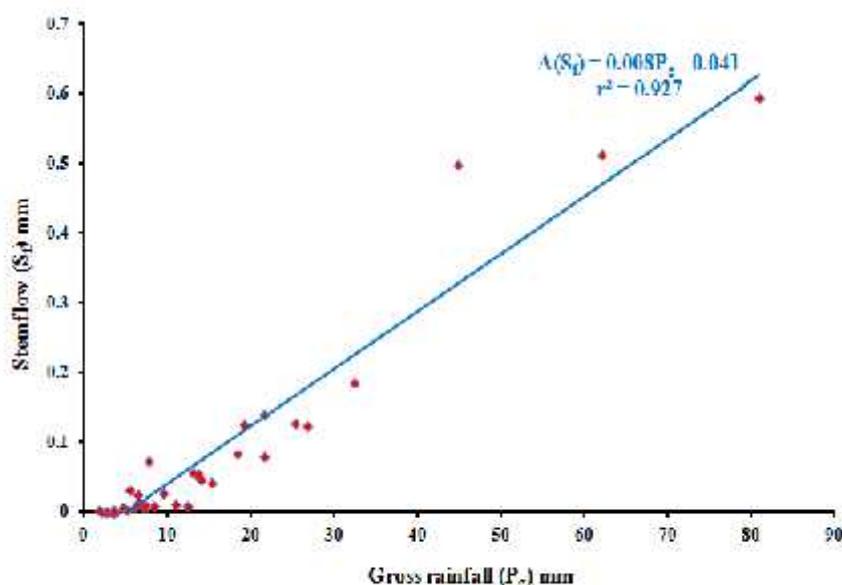


Figure (4): Relationship between gross rainfall and stemflow in artificial pine plantation.

Similar to the throughfall, stemflow can only be generated after gross rainfall has exceeded a certain amount. For stemflow, this is represented by trunk storage capacity (S_t) which can be estimated from a linear function of stemflow on incident gross rainfall (Gash and Morton, 1978). Trunk storage capacities of 0.026 mm for the natural pine forest and 0.041 mm for the artificial pine plantation were found, that is the extended stemflow value when gross rainfall is set to zero.

3.1.4. INTERCEPTION LOSS (IC)

The difference between the sum of throughfall and stemflow from the gross rainfall represents the

interception loss or the portion of rain water that is returned back to the atmosphere immediately after the rain has ceased. Interception loss was 198.13 mm or 30.38% of gross rainfall for the natural pine forest and 128.28 mm or 22.31% of gross rainfall for the artificial pine plantation respectively (Table 3). In general, interception loss in the natural pine forest is more than in the artificial pine plantation due to the large size of canopy cover and density for the natural pine forest compared with artificial pine plantation. Average percentages of the interception loss measured in the present study are lower than

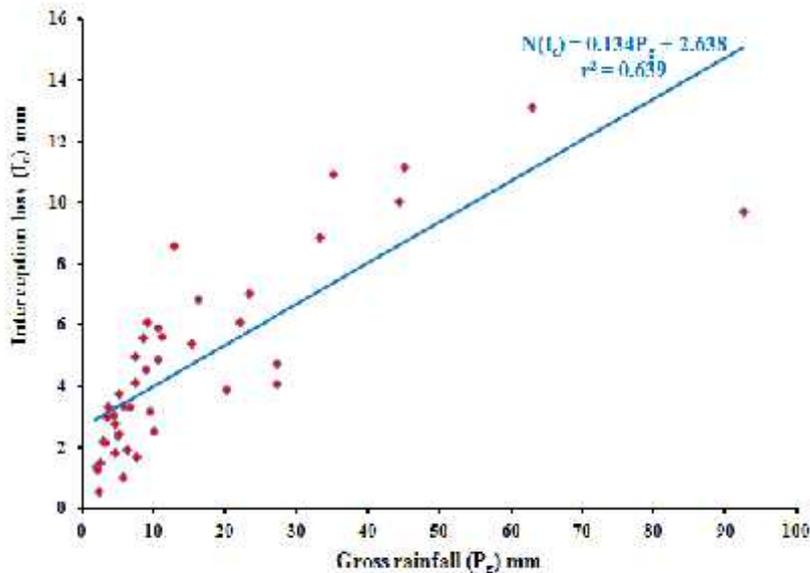


Figure (5): Relationship between gross rainfall and interception loss in natural pine forest.

the percentages which were reported by other researchers. As an example, in northern Iraq, Jabbori and Ibrahim (1989) reported that the percentage of interception loss in *Pinus pinea* plantation in Nineveh was 40% of the annual gross rainfall. According to Swank and Reynolds (1987), the interception loss was 33% of the annual gross rainfall in white pine forest *Pinus strobus* L. plantation located in Coweeta of United states. The lower percentages of interception loss in the present study could be attributed to the high

intensity of the rain storms. Monthly interception loss ranged from 8.49 mm to 63.88 mm of the gross rainfall for the natural pine forest. The highest interception loss was recorded in April which was the wettest month and the lowest in drier month of May. While for the artificial pine plantation, monthly interception loss ranged from 5.74 mm to 39.67 mm of the gross rainfall. The highest and the lowest months from the interception loss of view were in April and May respectively.

The relationships between daily interception loss for the natural pine forest and the artificial pine plantation were tested against daily gross rainfall using linear regression equations.

Interception losses were only moderately correlated with gross rainfall with r^2 values of 0.639 and 0.499 respectively.

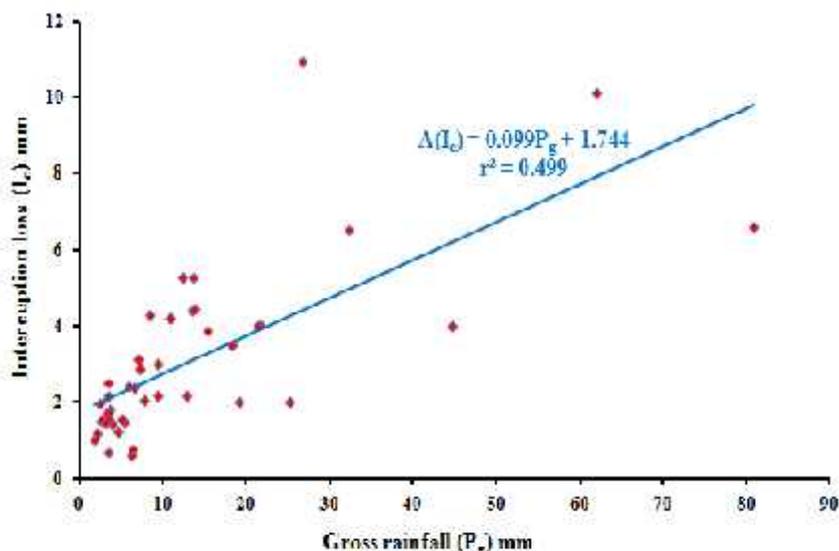


Figure (6): Relationship between gross rainfall and interception loss in artificial pine plantation.

CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions:

1. The percentage of the rainfall partitioning resulting in throughfall and stemflow in both of the natural pine forest and artificial pine plantation were 69.37%, 0.24% and 77.16%, 0.52%, respectively, which refers to superiority of the artificial pine plantation on natural pine forest in terms of the throughfall and stemflow.
2. The interception loss by the natural pine forest canopy and artificial pine plantation canopy were 30.38% and 22.31% of the gross rainfall measured in adjacent open area, which refers to the superiority of the natural pine forest on artificial pine plantation in terms of interception loss.

B. Recommendations:

1. Study of the amount of interception loss, throughfall and stemflow for the type of oak especially cemeteries forest, to contain types of oak, mature trees and different densities.

2. Emphasis in future studies on the nutrients cycle in forest ecosystem in Iraqi Kurdistan Region.
3. Taking into account the amount of interception loss in all studies for calculation of water balance of forests rivers basins.

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قه کولینهک لسه بر و جورئ ئاقا ب ههروه چووئ، بارانین ناقدنا ژوبی و قیداچووئ لسه قورمئ دارستانین سروشتی و کیلگه هین دهستکرد ل دارستانا کاژین زاویته (pinus brutia Ten.)

پوخته

ژ نهیلا زاویته یا دووهم هاته ههلبزارتن بو قئ قه کولینئ ل سالا _ هاته کرن، دهقهر ب دوووریا کم دکه قیته باکورئ روژهلانئ دهوکن ل هه ریتما کوردستانا عیراقئ. دوو پارچه زهقی رووبه رئ هه ر ئیک ژوان دگه هشته (م) هاتنه ههلبزارتن. ئیک دارستانه کا خورسکی بو ب ژینئ سال و رووبه رئ بنکه . م /هکتارو یا دووئ پارچه کا دهستکرد ب ژینئ سال و رووبه رئ بنکه . م /هکتار بوو.

ریتا بارانین تهقان ل ههردوو پارچین دارستانئ گه هشته . ملم و . ملم. تیکراییا بارانین (Pg) لهه ر ته قه کی گه هشته . ملم ل ژیرینجئ . ملم تا . ملم یا پارچا سروشتی و یا پارچا دهستکرد دگه هشته . ملم و درینجئ . ملم تا . ملم لدویف ئیک. هیزا تهقا بارانئ یا ههردوو پارچا یا سروشتی و دهستکرد درینجئ . تا . ملم/دهمژمیر و ژ . تا . ملم/دهمژمیر لدویف ئیک.

ههروه سا کوئ گشتی و خوریا بارانین ناقدناچووئ و قیداچوونا قورمئ و یا قه مایی بو ههردوو پارچین سروشتی و دهستکرد گه هشته (. ملم و . ملم ، . ملم و . ملم)، (. ملم و . ملم ، . ملم و . ملم) و (. ملم تا . ملم ، . ملم و . ملم) لدویف ئیک. دئه نجامیت قه کولینئ دا دیاردییت کو په یوه دنیا بهیزا ههئ دناقبهرا هه ر ئیک ژ بارانین روزانه یین ناقدناچووئ و ییداچوونا قورمئ دگه ل بارانا (Pg) کو گه هشتیه (. _ .) (. _ .) لدویف ئیک و په یوه ندییه کا ناقجئ یا ههئ دناقبهرا بارانا قه مایی و (Pg) گه هشتیه (. .) لدویف ئیک.

دراسة كمية الامطار الكلية و النافذة و الجارية على الساق و المحتجزة في
الغابات الطبيعية و المشاجر الاصطناعية لصنوبر زاوية (Pinus brutia Ten.)

الخلاصة

اختيرت غابات الصنوبر (Pinus brutia Ten.) في حوض زاويته الثانوي لهذه الدراسة خلال السنة المائية ٢٠١٠-٢٠١١، و تقع المنطقة على بعد ١٧ كم شمال شرق مدينة دهوك في اقليم كردستان العراق. تم اختيار قطعتين مساحة كل واحدة منهما ٩٠٠ متر مربع، احدهما من غابة طبيعية و بمعدل عمر و مساحة قاعدة ٥٩ سنة و 19.٦٣ متر مربع/هكتار على التوالي و الثانية كانت من مشجر اصطناعي و بمعدل عمر و مساحة قاعدة ٢٨ سنة و ١٢.٢ متر مربع/هكتار على التوالي.

تم مقارنة الامطار النافذة (Th) و الجارية على الساق (Sf) و الامطار المحتجزة (Ic) بالامطار الكلية للمنطقة المفتوحة (Pg)، حيث كان مجموع الامطار الكلية لـ ٣٦ زخة مطرية لكل قطعة ٦٥٢.١ ملم و ٥٧٤.٤٥ ملم، في حين كان معدل امطار المنطقة المفتوحة للزخة 1٥.٢ ملم و يتباين من ١.٩٥ الى ٩٢.٥ ملم للغاية الطبيعية و للغاية الاصطناعية كانت ١٣.٤ ملم كان ١٣.٤ ملم و يتباين من ١.٨ ملم الى ٨٠.٨ ملم على التوالي، بينما كانت شدة الزخة المطرية لكل من المنطقتين الطبيعية و الاصطناعية قد تراوحت من ٠.٧٢ الى ٨٠.٠ ملم/ساعة و من ٠.٦٠ الى ٧٨.٤ ملم/ساعة على التوالي. مجموع ونسب كل من الامطار النافذة و جريان الساق و الامطار المحتجزة لقطعة الغابة الطبيعية و المشجر الاصطناعي كانت ٤٥٢.٤ ملم و ٤٣٧.٧ ملم ، ٦٩.٤% و ٧٧.٢%* و (١.٥٩ ملم و ٣.٠ ملم ، ٠.٢٤% و ٠.٥٢%) و (١٩٨.١ ملم الى ١٢٨.٣ ملم ، ٣٠.٤% و ٢٢.٣%) على التوالي.

كما ان النتائج اظهرت ايضا من وجود علاقة قوية جدا بين كل من الامطار اليومية النافذة و الجارية على الساق مع الامطار الكلية للمنطقة المفتوحة و التي بلغت (٠.٩٩-٠.٩٩) و (٠.٩٢-٠.٩٣) على التوالي، بينما للامطار المحتجزة كانت العلاقة معتدلة مع الامطار الكلية للمنطقة المفتوحة و التي بلغت (٠.٦٤ و ٠.٥) على التوالي.

ANALYSIS OF GENETIC DIVERSITY FOR SOME GENOTYPES OF SQUASH USING RAPD TECHNIQUE

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ABSTRACT

Five PCR based RAPD markers were used in this study to detect genetic variability during the successive growing seasons of 2014. under the molecular level among the seven squash genotypes (Eskandarani, Coppi, Saja, Beyaz, Zucchini Ginyoveze, Zucchini tondo di piacen za and Zucchini romanesco). The seven varieties were clustered in two main groups; The first group included two cultivars Zucchini tondo di piacen za (P₆) and Zucchini romanesco (P₇) these Varietys were the best in yield traits, these traits were fruit firmness (F.F.g/cm²); fruit length (F.L./cm); fruit shape index (F.Sh.I.); Fruit diameter (F.D./cm); fruit weight (F.W./g); number of fruits per plant (No.F./P.) ; First picking date (F.P.D.) and Yield plant for (Y.P./g). While, the second group divided into sub group the first one include the variety Zucchini Ginyoveze (P₅) and the other sub group divided into sub sub group the first one include the variety Coppi (P₂) and the other include the varieties Eskandarani (P₁) , Beyaz (P₄) and Saja (P₃). The Varietys P₂ and P₅ were the best in vegetative traits , the vegetative traits included number of leaves per plant (No.L./P.), chlorophyll (a) and (b) content (mg.g-1.fw), leaf area(L.A./cm²), and plant height(P.H./cm) while P₁, P₃ and P₄ were the best Variety in earliness traits, the earliness studied traits were: number of node for the first female flowering (No.N.F.F.F.), date of the first female flower (D.F.F.F.), date of the first male flower (D.F.M.F.), Number of fruits per plot for the first seven pickings (NF7P/Plot) and weight of fruits for the first seven pickings per plant (WF7P/g).

DNA (RAPD) used to identify the polymorphisms and the relationships between seven genotypes, using five primers, and concluded that information depend on polymorphism using RAPD markers is useful in the assessment of genetic diversity and genetic relationships and could be useful in the breeding programs.

KEY WORDS: Squash, Rapd, Genotypes, Genetic Diversity

INTRODUCTION

Summer squash (*Cucurbita pepo* L.) is one of the greater necessary Cucurbitaceous crops. This importance comes from utilizing it as a food for human, in addition to many medicinal functions. Genetic diversity using RAPD marker on seven cultivars of squash. PCR was performed according to Williams *et al.* (1990).

Maria Ferriol *et al.*(2003). Study *Cucurbita maxima* Duch. is poorly characterised. Nineteen accessions of this species and 8 related *Cucurbita* accessions were included in a genetic diversity analysis. For this purpose, Random Amplified Polymorphic DNA markers (RAPDs), which analyse neutral variability, and Sequence-Based Amplified Polymorphism (SBAPs), which preferentially amplify coding regions of the genome, were used. While the UPGMA cluster

and the principal coordinate's analysis obtained using RAPDs did not group the different accessions according either to fruit morphological criteria or to passport data (origin and agro-climatic conditions), Gwanama, *et al.* (2000) Random amplified polymorphic DNA (RAPD) analysis provides a quick and reliable method for resolving genetic relationships. Although *Cucurbita moschata* Duch, also known as tropical pumpkin, is one of the most important vegetable crops in Africa, being adapted to a wide range of climatic and soil conditions, it is a scientifically neglected species. El-Adl, *et al.*(2012) they study to Molecular Genetic Evaluation of Seven Varieties of Summer Squash the Varietys were discriminated by their leaves fingerprints as obtained through protein electrophoresis technique and RAPD-PCR technique using five random primers. Protein electrophoresis successfully

generated reproducible polymorphic banding patterns. The generated profiles revealed high levels of polymorphism among the studied Varietys. Data of the analysis recorded a sum of 18 bands. These bands were identified as 11 polymorphic bands and 7 monomorphic ones in all studied Varietys. Five 10-mer arbitrary primers of twenty-one of each RAPD successfully generated reproducible polymorphic products. The results generated from protein and RAPD profiles were pooled together to elucidate the genetic relationships among the seven examined Varietys. **Heikal, et al. (2008)** two PCR molecular marker techniques; random amplified polymorphic DNA (RAPD) and intersimple sequence repeats (ISSR) were employed to identify the polymorphisms and the relationships between 14 genotypes, which belong to three different Cucurbita species (*C. pepo*, *C. moschata* and *C. maxima*). In RAPD analysis, six random primers revealed a total of 463 fragments, in which 405 (87.5%) were polymorphic. Thirty-one out of 463 RAPD-PCR fragments were found to be useful as genotype specific markers. The highest number of RAPD markers was scored for Cm5 genotype (5 markers). **Deena, S. et al. (2002)** random amplified polymorphic DNA (RAPD) data were collected from 37 wild or weedy populations and 16 cultivars, which together represented all intraspecific taxa of *C. pepo*. Twenty-six primers yielded 70 scorable and variable markers. The presence/absence of bands for these markers produced a data matrix which was analyzed using cluster analysis. The analysis confirmed the relationships among intraspecific taxa that had been revealed, in part, in previous genetic analyses. Also supported were findings of varying degrees of gene flow from cultivars into free-living populations. Some of the RAPD variation in subsp. *ovifera* var. *ozarkana* populations was found to be correlated with the distribution of the drainage systems along which these populations are dispersed. Finally, the RAPD results support the idea that transgenic gene flow experiments with free-living populations should consider using representatives from each of the three free-living taxa, as well as from genetically or ecologically distinct populations within these taxa. The purpose of the present investigation was to study the molecular genetic evaluation of seven squash Varietys namely: Eskandarani; Coppi; Saja; Beyaz; Zucchini Ginyoveze; Zucchini tondo di piacen za and Zucchini romanesco under

Egyptian condition. The relationship between these Varietys would be determined.

MATERIALS AND METHODS

Conducted these experimental in Dokki Station, Vegetables Breeding Department, Horticulture Research Institute (HRI) Research Center (ARC), Ministry of Agriculture, Egypt. This study conducted on seven varieties of squash were: Eskandarani (1); Coppi (2); Saja (3); Beyaz (4); Zucchini Ginyoveze (5); Zucchini tondo di piacen za (6) and Zucchini romanesco (7), Five RAPD primer were successful to discriminate among .

DNA isolation procedure:

Total genomic DNA were isolated from young leaves according to (**Murray and Thompson, 1980**), using DNeasy plant Mini Kit (QIAGEN). PCR reactions for RAPD markers were carried out in 30- μ l volume tubes according to **Williams et al. (1990)**. 30 μ l volume containing 2.0 μ l total genomic DNA, 16.80 μ l H₂O, 3.00 μ l dNTPs (2.5 mM), 3.00 μ l MgCl₂ (25 mM), 3.00 μ l Buffer (10 x), 2.00 μ l Primer (10 pmol) and 0.20 μ l Taq DNA polymerase (5U/ μ l). Amplification was performed in an automated thermal cycle (model Techno 512) programmed for one cycle at 94° C for 4 min followed by 45 cycles of 1 min at 94° C, 1 min at 37° C, and 2 min at 72° C. the reaction was finally stored at 72° C for 10 min. The PCR products were analyzed directly on 1.5 % agarose gels in 0.5x TAE buffer, visualized by staining with ethidium bromide and the run was performed for about 30 min at 80 V in mini submarine gel BioRad . The similarity matrices were done using Gel works ID advanced software UVP-England Program. The relationships among genotypes as revealed by dendrogram was generated with the unweighted pair group method with arithmetic mean (UPGMA) using MVSP program (version 3.1). Genetic similarity estimates were determined using Nei & Li's coefficient's (**Nei & Li 1979**).

RESULTS AND DISCUSSION

Molecular analysis:

DNA fingerprinting is an indispensable tool towards tracing of lineages in plant lines. Unlike the morphological and biochemical markers that could be much influenced with environmental factor and growth practices, DAN markers could portray genomic sequences composition thus

enabling to detect genetic differences carried by different individuals (Xiao *et al.* 1996 and Ovesna *et al.* 2002).

Five primers generated polymorphic alleles (OP-B07, OP-B11, OP-C04, OP-C15 and OP-Q18) among the studied genotypes and showed different levels of polymorphism. The detected polymorphism reflects the amount of diversity among the tested genotypes and thus the possibility of genetic improvement using such a

set of genotypes in breeding programs since genetic diversity is the prerequisite for successful such programs. Based on the banding sizes and patterns, a UPGMA dendrogram was generated to elucidate the genetic relationships between the tested genotypes. The banding patterns are presented in **Figures (1)**. The obtained results clearly showed a significant amount of polymorphism among the tested genotypes presented in **Table 1**.

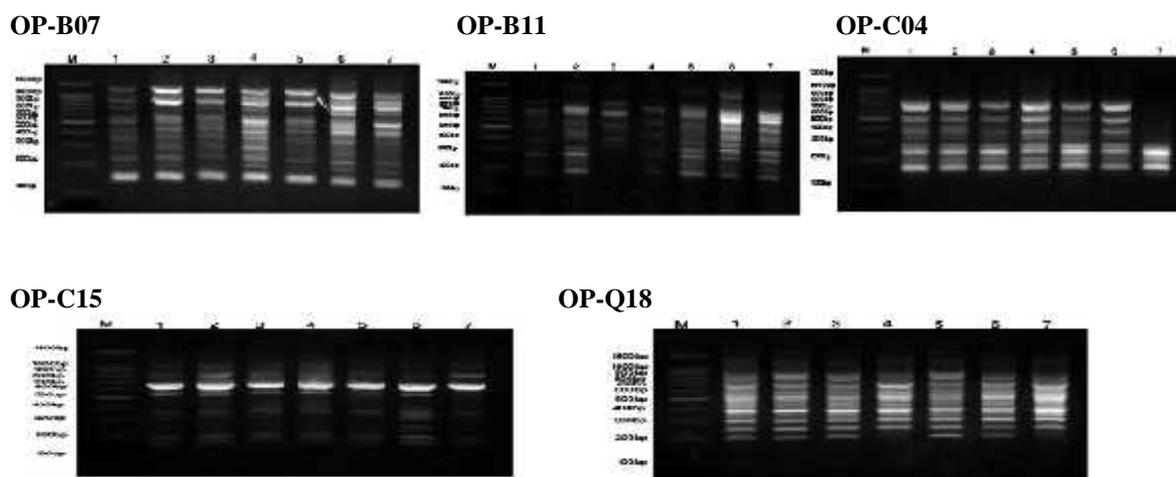


Fig. (1): RAPD-PCR amplification products of seven Varietal cultivars produced using primer, Lane M is DNA ladder and lanes 1 to 7 represent seven Varietal cultivars.

Table (1): List of RAPD primers, the number of amplified products, the number of polymorphic and monomorphic bands and percentage of polymorphism obtained by analyzing seven varieties of squash.

Primers	Primer sequence (5' 3')	Mol. Wt range (bp)	Monomorphic bands	polymorphic bands	Uniqe bands		Polymorphism (%)	
					+	-		
1	OP-B07	5'GAAACGGGTG 3'	150:1165	8	2	-	-	20.0%
2	OP-B11	5'GTAGACCCGT 3'	155:1130	6	5	-	1	50.0%
3	OP-C04	5'GTAGACCCGT 3'	150:680	4	1	-	4	55.6%
4	OP-C15	5'GACGGATCAG 3'	160:1080	6	1	2	1	40.0%
5	OP-Q18	5'AGGCTGGGTG 3'	220:1270	10	1	1	-	16.7%

The results in Table1 indicated that the presence and absence of bands were associated with molecular weight (MW) ranging from about 150 to 1165 bp, 155 to 1130 bp, 150 to 680 bp, 160 to 1080 bp, 220 to 1270 bp for OP-B07, OP-B11, OP-C04, OP-C15 and OP-Q18 respectively.

Data of these primers recorded of **34** monomorphic bands, and polymorphic **10** bands were identified in all Varieties under study. The polymorphic bands were scored as **9** unique bands. These unique bands were used to discriminate between the seven squash

Varieties. The constructed dendrogram tree divided the studied Varieties into two major groups.

Polymorphism levels differed from one primer to the other. Primer (**OP-Q18**) exhibited low polymorphism 16.7%. While, primer OP-C04 showed high polymorphism 55.6%. On the other hand, primers OP-B07 20%, OP-B11 50% and OP-C15 40% exhibited moderate levels of polymorphism which is useful in selected Varieties of squash identification.

The results in **Figure 1** and **Table 1** showed that the primer **OP-B07** demonstrated two polymorphic bands (fragments) with sizes of 751 bp for Varieties Beyaz, Zucchini tondo di piacenza and Zucchini romanesco and one band in Variety Coppi and Saja with sizes of 180 bp. While the Varieties Eskandarani and Zucchini Ginyoveze showed two fragments 751 bp and 180bp.

The seven squash genotypes were characterized by 5 RAPD markers (**3** positive and **6** negative). There were some specific fragments discriminated each parent from the others as follows:-

Primer **OP-B11** showed **one** specific fragment as negative marker. On the other hand, Primer **OP-C04** showed **four** specific fragments as negative, but the primer **OP-C15** showed **one** specific fragment as negative and **two** positive markers, finally about the Primer **OP-Q18** showed **one** specific fragment as positive marker.

For the primer **OP-B11**, showed demonstrated five polymorphic bands (fragments) with sizes of RAPD-PCR amplified products were obtained as shown in **Figure 1**. Varieties Zucchini tondo di piacenza and Zucchini romanesco showed the same pattern without tracing of polymorphism in their DNA. While the other five patterns were demonstrated by the other genotypes. Variety Eskandarani had four polymorphic loci at bands of 1130, 630, 215 and 180 bp. Genotype Coppi had three polymorphic loci at bands of 900, 630 and 180 bp. Genotype Saja had five polymorphic loci at bands of 1130, 630, 260, 215 and 180 bp. Genotype Beyaz had five polymorphic loci at bands of 1130, 900, 630, 215 and 180 bp. Genotype Zucchini Ginyoveze exhibited two polymorphic loci at bands 900 and 215 bp.

Figure 1 showed the primer **OP-C04**, demonstrated one polymorphic band (fragment) with sizes of RAPD-PCR amplified products were obtained. Varieties Eskandarani, Coppi, Beyaz and Zucchini tondo di piacenza showed the same

pattern without tracing of polymorphism in their DNA. Varieties Saja and Zucchini Ginyoveze gave the same pattern. The latter pattern was demonstrated by genomic DNA of variety Zucchini romanesco. Varieties Saja and Zucchini Ginyoveze had one polymorphic locus with 600 bp. Variety Zucchini romanesco showed five polymorphic loci at bands of 680, 600, 495, 375 and 325 bp.

For the primer **OP-C15**, showed that the demonstrated one polymorphic band (fragment) with sizes of RAPD-PCR amplified products were obtained as shown in **Figure 1**. Varieties Eskandarani, Saja and Beyaz showed the same pattern. Similarly, Varieties Coppi and Zucchini Ginyoveze displayed the same pattern. The latter three patterns were showed by Varieties Eskandarani, Saja and Beyaz showed three polymorphic sites with bands of 475, 295 and 240 bp. Whereas, Varieties Coppi and Zucchini Ginyoveze displayed two polymorphic loci at bands of 295 and 240 bp each Variety Zucchini tondo di piacenza had one polymorphic locus at band of 475bp. While, Variety Zucchini romanesco had four polymorphic loci at bands of 530, 475, 295 and 240 bp.

For the primer **OP-Q18**, showed that the demonstrated one polymorphic band (fragment) with sizes **Figure 1** recorded of RAPD-PCR amplified products were obtained. genotypes **Eskandarani, Coppi, Saja, Beyaz and Zucchini Ginyoveze** exhibited the same pattern. However, the other two patterns were displayed by genotypes **Zucchini tondo di piacenza** and **Zucchini romanesco**. genotype **Zucchini tondo di piacenza** had two polymorphic loci at bands of 1270 and 1080 bp. Variety **Zucchini romanesco** exhibited only one polymorphic locus at band of 1080 bp. Conversely, none of the remaining genotypes had polymorphic loci upon this primer.

Genetic relationships among the studied Squash genotype

The DNA bands generated by each primer were counted and their molecular sizes were compared with those of the DNA markers. The bands scored from DNA profiles generated by each primer were pooled together. Then the presence or absence of each DNA band was treated as a binary character in a data matrix (coded 1 and 0 respectively) to calculate genetic similarity and to construct dendrogram tree among the studied seven cultivars. Calculation was achieved using Dice similarity coefficients, **Dice**

(1945) as implemented in the computer program SPSS-10. The scored 0, 1 data were evaluated in the similarity matrix analysis.

Genetic similarity among the seven tested cultivars of Squash plant were illustrated in **Table 2**. The highest genetic distances observed between the cultivars pairs were in this order: 0.851, 0.860, 0.864, 0.867, 0.882, 0.889, 0.894, 0.903, 0.905, 0.907, 0.907, 0.911, 0.923, 0.933, 0.935, 0.936, 0.945, 0.955, 0.957, 0.966 and 0.966 for the cultivars(Eskandarani Zucchini romanesco), (Saja Zucchini romanesco), (Beyaz Zucchini romanesco), (Coppi Zucchini romanesco), (Saja Zucchini tondo di piacen za), (Zucchini Ginyoveze Zucchini romanesco), (Eskandarani Zucchini tondo di piacen za), (Zucchini tondo di piacen za Zucchini

romanesco),(Beyaz Zucchini tondo di piacen za),(Coppi Zucchini tondo di piacen za),(Zucchini Ginyoveze Zucchini tondo di piacen za), (Saja Zucchini Ginyoveze), (Eskandarani Zucchini Ginyoveze), (Coppi Saja), (Beyaz Zucchini Ginyoveze), (Coppi Zucchini Ginyoveze), (Eskandarani Coppi), (Saja Beyaz), (Coppi Beyaz), (Eskandarani Saja) and (Eskandarani Beyaz), respectively. As rule of thumb, the highest genetic distance is between two cultivars, the lowest similarity is between these two cultivars. This in turn reflects the geographic origin between the two cultivars of quest (**Degani et al., 2001**). Thus, the cultivars (Eskandarani) and (Zucchini romanesco) were distally related.

Table(2): Similarity indices among the seven tested cultivars of Squash plant using RAPD primers.

Traits	Eskandarani	Coppi	Saja	Beyaz	Zucchini Ginyoveze	Zucchini tondo di piacen za
Eskandarani	1.000					
Coppi	0.945	1.000				
Saja	0.966	0.933	1.000			
Beyaz	0.966	0.957	0.955	1.000		
Zucchini Ginyoveze	0.923	0.936	0.911	0.935	1.000	
Zucchini tondo di piacen za	0.894	0.907	0.882	0.905	0.907	1.000
Zucchini romanesco	0.851	0.867	0.860	0.864	0.889	0.903

Genetic similarity and cluster analysis based on RAPD markers:

The RAPD data were used to estimate the genetic similarity among the seven squash Varietys by using UPGMA computer analysis **figure 2**. The seven varieties were clustered in two main groups; the first group included two cultivars **Zucchini tondo di piacen za (P₆)** and **Zucchini romanesco (P₇)** these Varietys were the best in yield traits, the parental variety (**P₆**) had desirable negative highly significant estimates of GCA effects for (D.F.F.F.) and (D.F.M.F.). In the same time, the parental variety (**P₇**) had desirable negative highly significant estimates of GCA effects for (No.N.F.F.F.). While, the second group divided into sub group the first one include the variety Zucchini Ginyoveze (**P₅**) and the other sub group divided into sub sub group the first one

include the variety Coppi (**P₂**) and the other include the varieties Eskandarani (**P₁**), Beyaz (**P₄**) and Saja (**P₃**). The Varietys **P₂** and **P₅** were the best in vegetative traits, the parental variety Coppi (**P₂**) was the highest (best) parent for leaf area (L.A./cm²) and plant height (P.H./cm) and the parental variety Zucchini Ginyoveze(**P₅**) was the highest (best) parent for number of leaves per plant (No.L./P.). while **P₁** and **P₃** were the best Variety in earliness traits. The (**P₁**) parental varieties had desirable negative highly significant estimates of GCA effects for date of the first male flower (D.F.M.F.) also the parent (**P₃**) had desirable negative highly significant estimates of GCA effects for number of first female flowering node (No.N.F.F.F.) and date of the first female flower (D.F.F.F.).

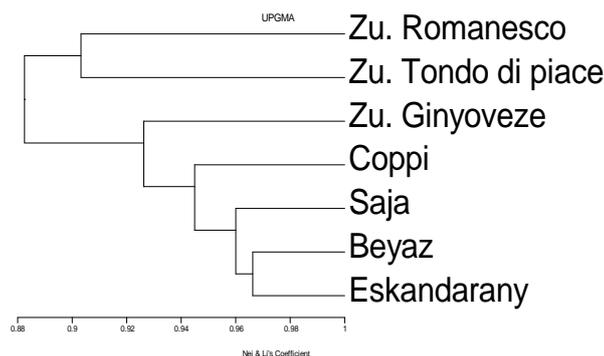


FIG. (2): Dendrogram representing the genetic relationships among the seven tested genotypes based on RAPD markers.

Finally, an excellent RAPD primer is the one which has high discriminating power to determine the polymorphic loci among different cultivars of the same species or different cultivars of different species. Analysis of data deduced that the primers OP-B11 and OP-C04 were somehow efficient regarding discriminating the seven Varietal cultivars genetically. However, the other primers were less efficient. OP-B11 and OP-C04 resulted in generation of 6 and 5 different patterns among the tested cultivars, respectively. Present data would suggest the use of decanucleotide arbitrary primers OP-B11 and OP-C04 as DNA markers in genetic diversity studies of Squash plant. This would be of a prime importance particularly in evaluating and selecting the appropriate offspring cultivars resulting from the breeding process.

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شلوڤه كرنا جياوازيا جيني يا هندهك كه رهستين جيني ل كولندي بكارئنانا تكنولوجيا جياوازيا دريژاهييت قه ديت

زېده كړي

پوخته

پينج ماركه ريت PCR ب ته كنিকা RAPD هاتنه بكارئنان دقې قه كوليني دا ژبو تاقيكرنا جياوازيا جيني لسره حهفت جوريت كولندي كوسه [الاسكندراني (بابي نيكې), كوبي (بابي دووي), سجا (بابي سيني), بياز (بابي چاري), زوكينو جينو فيزي (بابي پينجي), زوكينو تونو ديبياسينزا (بابي شه شي), زوكينو رومانيسكو (بابي حهفتي)] ل وه رزي

چاندنی 2014، نه نجامیت هه کولینی دیار کر کو نه و مارکه ریت هاتینه بکار ئینان شیان جیوازییا دیار بکه ن دناقهه را که ره ستین جینی کو بقی رهنگی بوون: (OP-B07), (OP-B11), (OP-Q18), (OP-C15), (OP-C04). لسه ره هر هفت جوریت کولندی و شلوغه کرنا ئیشی (العنقودی) بو نه نجامان دیار کر کو مارکه را جوریت کولندا جودا کرن لدویف سالوخه تین زه قین کو ساخله تین شینوونی بخووه دکرت (هژمارا به لگا، ریژا کلوروفیلی (a) ریژا کلوروفیلی (b) پانیا سه ری به لگی، دریزا هیا ده رامه تی) و سالوخه تین زویکرنی (ژمارا گریکا ئیکتی کو کولیکه کا می د هه لگرت، هژمارا روژا هه تا هه بونا ئیکه مین کولیکا می، هژمارا روژا هه تا هه بونا ئیکه مین کولیکا می، هژمارا کولندا د هه ر هفت چینی ت ئیکتی دا، کیشا کولندا د هه ر هفت چینی ت ئیکتی دا) و سالوخه تین به ره می و پیکهاتی ت وی (یلا ره قاتی کولندا، دریزا هیا کولندی، ریبه ری سه روبه ری کولندی، پانیا کولندی، کیشا کولندی، هژمارا کولندا، هژمارا روژا بو ئیکه مین چینی، به ره می هه ر ده رامه ته کی). بو نموونه، بابیت شه شی و هفتی د ئیک کووم دا بوون و دسه رکه فتی بوون د سالوخه تین به ره می دا، و بابیت دووی و پینجی د ئیک کووم دا بوون و دسه رکه فتی بوون د سالوخه تین شینوونی دا، و ل دو ماهین بابیت ئیکتی و سیی و چاری لگه ل ئیک بوون د کوومه کی دا و د سالوخه تین زویکرنی دا. هه ر وه سا نه نجامان شیانی ت مارکه ریت RAPD دیار کرن لسه به یداکرنا جیوازیی ت نه لیلی و جینی دناقهه را که ره ستین جینی دا، بابی ئیکتی (P1) یی جیواز تر بو ل ده می بکار ئینانا پرایمه ری (OP-B07) و بابی سیی (P3) و بابی چاری (P4) د جیواز تر بوون ل ده می بکار ئینانا پرایمه ری (OP-B11) و بابی هفتی (P7) ل پرایمه ری (OP-C15), (OP-C04) و بابی شه شی (P6) ل پرایمه ری (OP-Q18).

تحلیل التنوع الوراثي لبعض التراكيب الوراثية في الكوسا باستخدام تقنية تباين اطوال القطع المكثرة عشوائيا

الخلاصة

تم الإستفادة من المعلمات الجزيئية في دراسة درجة التشابه بين التراكيب الأبوية بإستخدام خمسة من الدلائل الوراثية الـ RAPD خلال سنة 2014 وتم إستخدام سبعة أصناف من قرع الكوسه هي [الأسكندرانى (الأب الأول), كوى (الأب الثانى), سجا (الأب الثالث), بياز (الأب الرابع), زوكينو جينو فيزى (الأب الخامس), زوكينو توندو ديباسينزا (الأب السادس), زوكينو رومانيسكو (الأب السابع)]. ووجدت أن هذه الدلائل كانت لها القدره على إظهار إختلافات بين التراكيب الوراثية المستخدمه وهذه المعلمات كانت

(OP-B07), (OP-B11), (OP-Q18), (OP-C15), (OP-C04). على سبعة اصناف من الكوسه أوضح التحليل العنقودى باستخدام المعلمات الوراثية RAPD وتكنيك PCR أن المعلمات المستخدمه كان لها القدره على التمييز بين التراكيب المستخدمه حسب صفاتها الحقلية والتي تتضمن الصفات الخضرية (عدد الأوراق / نبات - محتوى الأوراق من كلورفيل (a) - محتوى الأوراق من كلورفيل (b) - مساحه سطح الورقه - طول النبات) و صفات التبكير (رقم أول عقده تحمل زهره مؤنثه - عدد الأيام حتى تفتح أول زهره مؤنثه - عدد الأيام حتى تفتح أول زهره مذكره - عدد الثمار خلال السبع جمعات الأولى - وزن الثمار خلال السبع جمعات الأولى) و صفات المحصول ومكوناته (قياس درجة صلابه الثمار - طول الثمره - دليل شكل الثمره - قطر الثمره - متوسط وزن الثمره - عدد الثمار/ نبات - عدد الايام حتى اول جمعة - محصول الثمار لكل نبات) فمثلا الأباء السادس والسابع كانوا فى مجموعه واحده و متميزين فى صفات المحصول أما الأصناف الثانى والخامس أخذوا مجموعه واحده وتميزوا فى الصفات الخضرية وأخيرا كانت الأصناف الأول والثالث والرابع معا فى مجموعه واحده وتميزوا فى صفات التبكير.

أوضحت النتائج أن قدره دلائل RAPD على إظهار الاختلافات الأليليه والتباين الوراثي بين التراكيب الوراثية المستخدمه، حيث كان الأب الأول (P1) أكثر إختلافا عند إستخدام البرايمر (OP-B07)، والأب الثالث (P3) والأب الرابع (P4) أكثر إختلافا عند إستخدام البرايمر (OP-B11)، والأب السابع (P7) أكثر إختلافا عند إستخدام البرايمر (OP-C04), (OP-C15)، وأما الأب السادس (P6) فهو أكثر إختلافا عند إستخدام البرايمر (OP-Q18).

NON-DESTRUCTIVE METHOD FOR PREDICTION LEAF AREA AND CHLOROPHYLL CONTENT FOR SOME HORTICULTURAL PLANTS CULTIVATED IN ERBIL CITY

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Abstract

This study was conducted in Erbil Governorate, Iraq Kurdistan region at August 2014 on ten horticultural species including *Acer negundo*, *Buxus sempervirens*, *Carissa macrocarpa*, *Dombeyawallichii*, *Durantarepens* L., *Ficus nitida*, *Lantana cammara*, *Ligustrum* sp., *Morus alba* and *Pittosporum tobira*, by using simple and multiple regression analyses for determining more accurate prediction model (high coefficient of determination and less MSE) for calculate leaf area and chlorophyll content depending on leaf length, width and their combinations as independent variables. The results showed that simple linear regression models that were used for predicating the leaf area regarding to all independent variables were extremely significant ($p < 0.000$) for all studied species except the relation between leaf length and leaf area for *Ligustrum* sp. species. Multiple linear regressions that using length and width as independent variables were more accurate for *Buxus sempervirens*, *Durantarepens* L., *Ficus nitida*, *Ligustrum* sp., *Morus alba* and *Pittosporum tobira*, compared to other species. The results also showed that multiple linear regression model that used for predicting the leaf chlorophyll content, each of *Carissa macrocarpa*, *Durantarepens* L., *Ficus nitida*, *Lantana cammara* and *Pittosporum tobira* record high significant relationships as compared to other species where records non-significant relations. The selected models enabled the researcher to estimate accurately, leaf area and chlorophyll content for some horticultural species without leaf destruction or using expensive tools.

KEY WORD: leaf area, chlorophyll content, horticultural plants

INTRODUCTION

Plant leaf area is an essential component to estimate plant growth through its incidence on crop physiology mechanisms, and determinant of light interception and consequently of transpiration, photosynthesis, evapotranspiration and plant productivity studies (Rosati *et al.*, 2001, Bhatt and Chanda, 2003 and Blanco and Folegatti, 2005). Increased leaf area is essential for energy transference and dry matter accumulation processes in plant canopies. It is also useful in the analysis of canopy architecture (Mohammad *et al.*, 2011). Measurement of leaf area (LA) is divided to destructive and non-destructive methods. Usually destructive way is almost used by means of leaf area meter; this instrument is expensive and very sensitive for calibration. While the Non-destructive way is very

simple and need expensive instrument like portable scanning plan meter (Daughtry, 1990), but it is used for plants with a few small leaves (Nyakwende *et al.*, 1997). The measurement of LA, expressed per tree or as Leaf Area Index (LAI), can be a time consuming process and requires sophisticated electronic instruments, which are expensive especially for developing countries (Bhatt and Chanda, 2003). Moreover, destructive methods may cause inconvenient for some investigations (Chirinoset *et al.*, 1997). Therefore, alternatives to estimate LA on the field may be provided by practical and non-destructive methods (Gutierrez and Lavín, 2000). For example, a rapid and non-destructive method to estimate LA is the use of equations that needs leaf dimensions (length and width) as inputs. Accurate non-destructive measurements permit repeated sampling of the same plants over time and have

the advantage that biological variation can be avoided. Especially when using unique plants, for example in genetically segregating populations, non-destructive measurements are of great value. A common approach for non-destructive leaf area estimation is to develop ratios and regression estimators by using easily measured leaf parameters such as length and width (Schwarz and Klaring, 2001).

Various combinations of measurements and various models relating length and width to area have been utilized in, for example, grapevine (Gutierrez y Lavín, 2000; Williams and Martinson, 2003), common bean (Bhatt and Chanda, 2003), pepper (De-Swart *et al.*, 2004), radish (Salerno *et al.*, 2005), cucumber (Choet *et al.*, 2007), cauliflower and cabbage (Olfat *et al.*, 2010), *Bergenia purpurascens* (Zhang and Liu, 2010) and Al-Barzinji (2013). Such equations allow growers and researchers to estimate LA in relation to other factors like crop load, drought stress, insect damage (Williams and Martinson, 2003), and many physiological studies as it mention above.

Another important factor which effects on growth and productivity of plants is photosynthetic efficiency, and the photosynthetic rate of the entire plant canopy depends on the photosynthesis of individual leaves. Leaf photosynthesis can be influenced by many plant factors such as leaf position and age, as well as environmental factors such as light, temperature, nutrition, water availability and photosynthetic pigments (Shelley and Bell, 2000 and Aighevi and Ekanayake, 2004). The chlorophyll content is an important experimental parameter in agronomy and plant biology research, amount of chlorophyll shows alteration depending on many factors such as light (Johnston and Onwueme, 1998), leaf position (Gondet *et al.*, 2012), plant age, when Hgazaabdet *et al.* (2009) found that the leaf area of

purple yam (*Dioscorea alata* L.) and readings of chlorophyll meter increased with plant age.

The objective of this study was to develop accurate, simple, nondestructive and time saving models for estimation leaf area and chlorophyll content for ten plant species.

MATERIALS AND METHODS

Sampling of leaves of ten horticultural plants was conducted in August 2014 at Mnara Park which is located in Erbil city, Iraq-Kurdistan 44°33' E, 36°11' N and 413 m of altitude, (for scientific names and leaves shape see Table 1 in Results and Discussion and Figure 1). Three individual plants from each species were selected and leaves from 4 branches (one branch for each site of North, South, East and West) per tree were chosen as samples (leaves number were 60 for each species).

The measurement parameters comprise of leaf area (LA), length (L), width (W), by using the leaf area meter (AM 300, ADC BIOSCIENTIFIC LIMITED- UK), and chlorophyll content (Ch.) by using SPAD chlorophyll meter (SPAD-502, Japan).

Simple and multiple linear regression equations, using alternatively the length (L), width (W) and their products (L+W) and (LW) as independent variables, and chlorophyll content as dependent variable, while the leaf area was either dependent and independent variables. These calculations were performed on each species individually, the best and more accurate predicted equation for the leaf area (LA) and chlorophyll content (Ch.) was the equation with high coefficient of determination (r^2 or R^2) and less mean square of error (MSE).

A data analysis was done by using SPSS program. ANOVA analysis was carried out to detect differences between slopes obtained from these types of regressions (Reza, 2006).

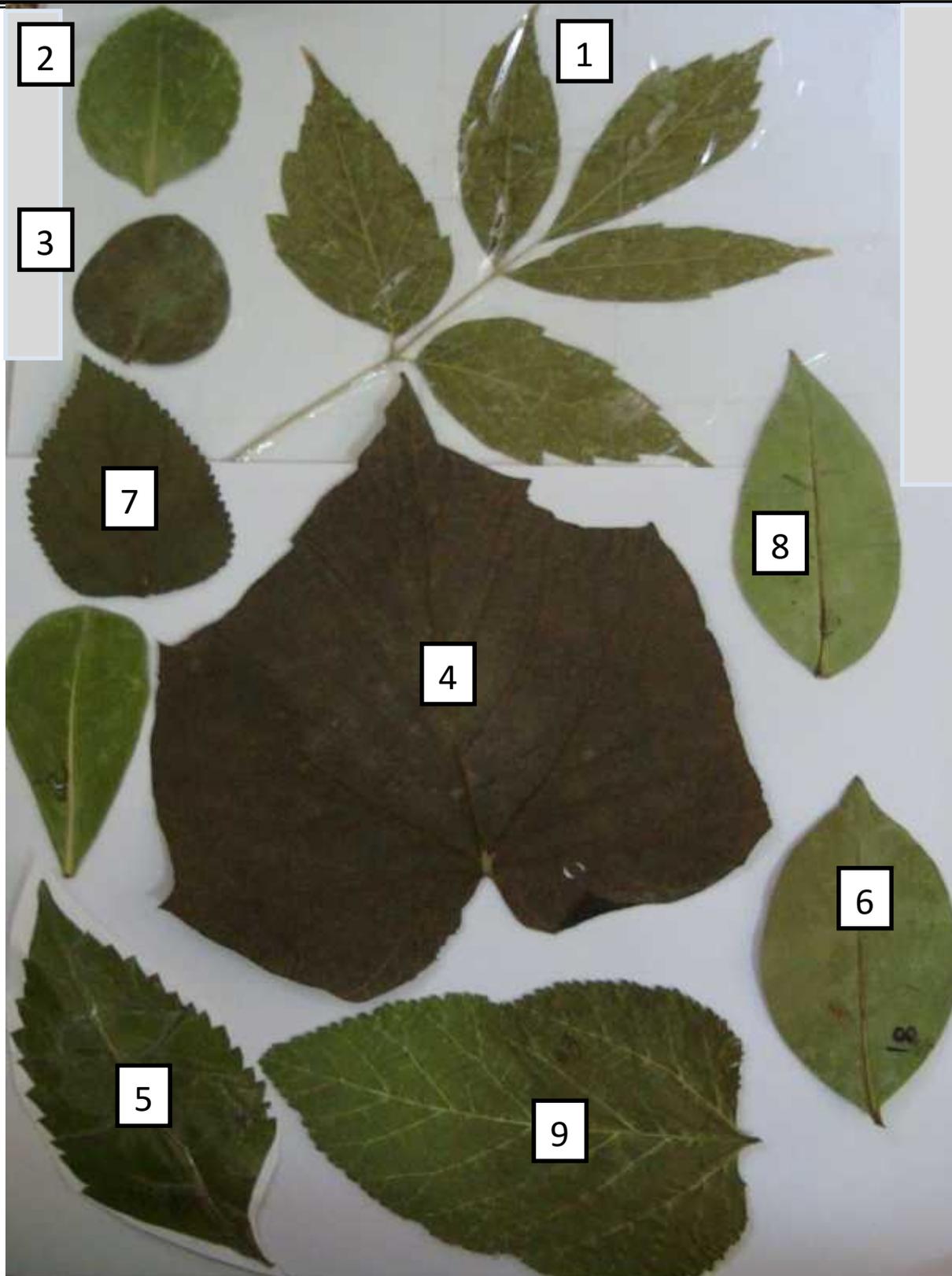


Fig. (1). Plant species used in the study: 1. *Acer negundo* 2. *Buxus sempervirens* 3. *Carissa macrocarpa*
4. *Dombeyawallichii* 5. *Durantarepens* L. 6. *Ficus nitida* 7. *Lantana cammara* 8. *Ligustrum* sp.
9. *Morus alba* 10. *Pittosporum tobira*

RESULTS AND DISCUSSION

Simple and multiple linear regressions for predicting leaf area

Table (1) shows simple linear regression models that used for predicate the leaf area regarding to leaf width (W), square width (W^2), length (L), square length (L^2), sum of width and length (W+L) and product of width and length (WL). The results showed that the equation depends leaf length was the more accurate for *Acer negundo* species, which had the strongest relationship with LA, manifested in high coefficients of determination (r^2) and low mean square of error (MSE). Each of *Dombeyawallichii*, *Ficusnitida* and *Ligustrum* sp. species depends leaf width for giving the most accurate equations, whereas, equations depend leaf width by length (WL) was the more accurate for each of *Buxussempervirens*, *Carissa macrocarpa*, *Durantarepens* L., *Lantana cammara*, *Morus alba* and *Pittosporumtobira* respectively, although all relations were high significant ($p < 0.000$) except the relation between leaf length and leaf area for *Ligustrum* sp. species.

When the models were changed from simple to multiple linear regression by using length and width as independent variables as it shown in Table (2), the results showed that leaf area predication became more accurate for *Buxussempervirens*, *Durantarepens* L., *Ficusnitida*, *Ligustrum* sp., *Morus alba* and *Pittosporumtobira* respectively, compared to other species. Leaf area and leaf dimensions values of the ten species were fitted to a simple and multiple linear regression equation separately.

Simple and multiple linear regressions for predicting leaf chlorophyll content

Table (3) shows simple linear regression models that used for predicated leaf chlorophyll content regarding to leaf area (LA), width (W), square width (W^2), length (L), square length (L^2), sum of width and length (W+L) and product of width and length (WL) as independent variables.

The results showed that equations depending on leaf area were the more accurate prediction for *Durantarepens* L., *Ficusnitida* and *Lantanacammaracompared* to other models. *Pittosporumtobira* had high significant relationship where depend WL as independent variable followed by W+L, LA then W respectively. Both of *Buxussempervirens* and *Morusalbahad* only one significant relationship where leaf width for the

first species and leaf length for the second species were used. The rest species had non-significant relationships for all independent variables used in the study.

Table (4) shows the multiple linear regression model that used for prediction the leaf chlorophyll content for the studied species, each of *Carissa macrocarpa*, *Durantarepens* L., *Ficusnitida*, *Lantana cammara* and *Pittosporumtobira* record high significant relationships, whereas the other species had non-significant relations where this model is used. Like the leaf area equations, the chlorophyll predicate equations also increased there prediction where multiple linear regression where used such as in *Carissa macrocarpa* and *Ficusnitida*, whereas it decrease the prediction in *Durantarepens* L., *Lantana cammara* and *Pittosporumtobira* respectively. The small size and shapes of the previous species may play a role in finding high significant relation between studied variables (Figure 1).

Regarding the equations that used only one leaf dimension, like W or L and has same accuracy, it's more easier using these models for prediction leaf area or chlorophyll content. Kumar and Sharma (2010) found that linear model ($LA = -3.44 + 0.729 LW$) which depending (LW) as independent variable gave more accurate estimation for *Salvia sclarea* L. leaf area compared to other models. Many other researchers also reported that leaf area can be estimated by linear measurement such as leaf width and leaf length in some of plants such as Cristoforiet al. (2007), Mendoza-de Gyves, (2007), Peksen (2007) and Rivera et al. (2007) for developing simple models and non-destructive for plant leaves for estimating plant leaf area by using simple linear regression measurement. Also each of Lakshmanan and Pugazhendi (2013) found that the best fitting equations for oleander was $LA = -22.562 + 21.209W$ and $LA = -22.226 + 2.978L$ with $r^2 = 0.847$ and 0.893 respectively.

For all models of regression used in this study, single variable equations would be preferred sometimes because they avoid problems of co-linearity between L and W, and require measurement of only one leaf dimension. Hence, leaf length and width may be substituted for leaf area calculation but use of the multiple linear regression equation would be better, as can be seen from their correlation (r) values (Table 1 and 2).

There were close relationships between leaf area and chlorophyll content with leaf dimensions of width, length and there compatibles.

CONCLUSIONS

From the results of this work it can be concluded that the prediction of leaf area of the following species *Acer negundo*, *Buxus sempervirens*, *Carissa macrocarpa*, *Dombeyawallichii*, *Durantarepens* L., *Ficus nitida*, *Lantana cammara*, *Ligustrum* sp., *Morus alba* and *Pittosporum tobira* through

measuring width or length of leaves or both of them, whereas prediction of chlorophyll content is true for *Carissa macrocarpa*, *Durantarepens* L., *Ficus nitida*, *Lantana cammara* and *Pittosporum tobira* respectively. Because leaf width and length can be easily measured in the field, these models will enable researchers to make non-destructive measurements or repeated measurements on the same leaves. Such model can accurately estimate leaf area of large quantities of these plants in many experimental conditions, without the use of any expensive instruments.

Table (1). Simple linear regression used for estimating leaf area for ten plant species in respect to leaf length, width and some of their compatibles.

Species	Equation No.	Regression equation	Coefficient of Determination (r^2)	Coefficient of Correlation (r)	Mean Square Error (MSE)	Standard Error (SE)	P value
<i>Acer negundo</i>	1	LA= 6.79 +5.37 W	0.36	0.60	951.59	30.84	0.000
	2	LA= -24.78 +5.45 L	0.52	0.72	709.85	26.64	0.000
	3	LA= -21.97+3.00(W+L)	0.48	0.70	761.41	27.59	0.000
	4	LA=42.26+0.14 (WL)	0.46	0.68	792.87	28.16	0.000
<i>Buxus sempervirens</i>	5	LA= -4.20+4.73W	0.63	0.79	4.19	2.04	0.000
	6	LA= 0.80+2.31 L	0.60	0.77	4.54	2.13	0.000
	7	LA= -6.64+ 2.25(W+L)	0.88	0.94	1.33	1.15	0.000
	8	LA= 2.41+ 0.57(WL)	0.91	0.95	1.03	1.01	0.000
<i>Carissa macrocarpa</i>	9	LA= -7.50+5.06W	0.75	0.87	1.86	1.36	0.000
	10	LA= -6.83+4.49 L	0.81	0.90	1.47	1.21	0.000
	11	LA= -10.99+ 2.92(W+L)	0.96	0.98	3.18	0.56	0.000
	12	LA= -1.59+ 0.78(WL)	0.96	0.98	2.70	0.52	0.000
<i>Dombeyawallichii</i>	13	LA= -68.67 +17.91 W	0.78	0.88	675.99	25.99	0.000
	14	LA= 22.83 +12.37 L	0.40	0.63	1845.21	52.97	0.000
	15	LA= -57.06+ 8.62(W+L)	0.66	0.81	1062.89	32.60	0.000
	16	LA=98.63+0.46 (WL)	0.58	0.76	1292.50	35.95	0.000
<i>Durantarepens</i> L	17	LA= -26.45+11.08 W	0.85	0.92	7.13	2.68	0.000
	18	LA= -6.25+3.40 L	0.74	0.86	12.21	3.51	0.000
	19	LA= -15.27+ 2.97(W+L)	0.87	0.92	6.07	2.47	0.000
	20	LA= -0.22+ 0.61(WL)	0.93	0.97	3.13	1.77	0.000
<i>Ficus nitida</i>	21	LA= -14.24+8.92 W	0.94	0.97	3.53	1.87	0.000
	22	LA= -5.29+3.45 L	0.56	0.75	26.69	5.17	0.000
	23	LA= -12.89+ 2.95(W+L)	0.79	0.89	12.65	3.55	0.000
	24	LA= 2.61+ 0.60(WL)	0.86	0.93	8.61	2.93	0.000
<i>Lantana cammara</i>	25	LA= -9.40+6.66W	0.73	0.85	11.87	3.45	0.000
	26	LA= -15.04+5.27 L	0.59	0.77	17.59	4.19	0.000
	27	LA= -21.17+3.64(W+L)	0.81	0.90	8.39	2.89	0.000
	28	LA=2.07+ 0.58(WL)	0.82	0.90	8.00	2.83	0.000
<i>Ligustrum</i> sp.	29	LA= -2.56 +6.23 W	0.63	0.79	8.23	2.87	0.000
	30	LA= 15.97 +1.09 L	0.05	0.22	21.13	4.59	0.099

	31	LA= -11.15+2.76(W+L)	0.40	0.63	13.35	3.65	0.000
	32	LA=2.66+0.58 (WL)	0.62	0.79	8.32	2.88	0.000
<i>Morus alba</i>	33	LA= -41.89+13.45W	0.73	0.85	39.92	6.31	0.000
	34	LA= -5.74+5.77 L	0.61	0.78	57.32	7.57	0.000
	35	LA= -37.72+5.09(W+L)	0.81	0.90	27.46	5.24	0.000
	36	LA=7.74+ 0.58(WL)	0.86	0.93	20.66	4.54	0.000
<i>Pittosporum tobira</i>	37	LA= -5.00+5.55W	0.64	0.80	7.52	2.74	0.000
	38	LA= -2.96+2.50 L	0.58	0.76	8.69	2.94	0.000
	39	LA= -7.92+2.42(W+L)	0.84	0.92	3.35	1.83	0.000
	40	LA= 1.88+ 0.62(WL)	0.88	0.94	2.44	1.56	0.000

Table (2). Multiple linear regression used for estimating leaf area for ten plant species in respect to leaf length, width and some of their compatibles.

Species	Equation No.	Regression equation	Coefficient of Determination (R ²)	Coefficient of Correlation (R)	Mean Square Error (MSE)	Standard Error (SE)	P value
<i>Acer negundo</i>	41	LA= -25.19+0.17W+5.32L	0.52	0.72	723.579	26.90	0.000
<i>Buxus sempervirens</i>	42	LA= -9.11+ 3.67 W+1.75L	0.94	0.97	0.66	0.81	0.000
<i>Carissa macrocarpa</i>	43	LA= -10.99+ 2.93W+2.91L	0.96	0.98	3.24	0.57	0.000
<i>Dombeyawallichii</i>	44	LA= -64.64+18.76W-1.10L	0.78	0.88	698.44	26.43	0.000
<i>Durantarepens L</i>	45	LA= -24.89+ 7.54W+1.73L	0.95	0.98	2.35	1.53	0.000
<i>Ficus nitida</i>	46	LA= -115.94+ 7.83W+0.80L	0.97	0.98	2.55	1.59	0.000
<i>Lantana cammara</i>	47	LA= -19.77+ 4.75W+2.69L	0.82	0.91	7.88	2.81	0.000
<i>Ligustrum sp.</i>	48	LA= -14.90+ 6.33 W+ 1.34L	0.70	0.84	6.79	2.60	0.000
<i>Morus alba</i>	49	LA= -52.92+19.63W+3.38L	0.88	0.94	18.08	4.25	0.000
<i>Pittosporum tobira</i>	50	LA= -10.65+ 4.23W+1.82L	0.91	0.95	1.97	1.40	0.000

Table (3). Simple linear regression used for estimating chlorophyll content for ten plant species of plants in respect to leaf area, length, width and of their compatibles.

Species	Equation No.	Regression equation	Coefficient of Determination (r ²)	Coefficient of Correlation (r)	Mean Square Error (MSE)	Standard Error (SE)	P value
1. <i>Acer negundo</i>	51	Ch.= 34.39+0.00 LA	0.03	0.17	11.52	3.30	0.200
	52	Ch.= 32.64 +0.018 W	0.05	0.22	11.31	3.36	0.100
	53	Ch.= 32.95 +0.013 L	0.03	0.18	11.47	3.39	0.170
	54	Ch.= 32.47+0.008(W+L)	0.04	0.21	11.35	3.36	0.120
	55	Ch.=34.13+0.00 (WL)	0.05	0.22	11.32	3.36	0.110
<i>Buxus sempervirens</i>	56	Ch.= 59.96+0.004 LA	0.06	0.24	32.62	5.71	0.060
	57	Ch.= 55.89 +0.27 W	0.07	0.26	32.40	5.69	0.047
	58	Ch.= 62.43 +0.06 L	0.01	0.11	34.31	5.85	0.420
	59	Ch.= 58.57+0.08(W+L)	0.04	0.19	33.47	5.78	0.150
	60	Ch.=61.38+0.002 (WL)	0.04	0.21	33.15	5.75	0.106
3. <i>Carissa macrocarpa</i>	61	Ch.= 64.64+ -9.20 LA	0.000	0.001	14.08	3.75	0.990
	62	Ch.= 59.25 +0.16 W	0.040	0.19	13.53	3.68	0.130
	63	Ch.= 68.84 + -0.11 L	0.030	0.17	13.69	3.69	0.200
	64	Ch.=64.57+0.001 (W+L)	0.000	0.002	14.08	3.75	0.990

	65	Ch.=64.18+0.00 (WL)	0.001	0.03	14.06	3.75	0.810
<i>Dombeyawallichii</i>	66	Ch.= 37.65 +4.84 LA	0.007	0.08	9.93	3.15	0.667
	67	Ch.= 34.70 +0.03 W	0.04	0.21	9.55	3.09	0.275
	68	Ch.= 33.01 +0.03 L	0.10	0.31	9.01	3.00	0.101
	69	Ch.= 33.10+0.01 (W+L)	0.08	0.28	9.20	3.03	0.142
	70	Ch.=36.05+9.92 (WL)	0.08	0.28	9.18	3.03	0.139
<i>Durantarepens L</i>	71	Ch.= 39.69 +0.004 LA	0.26	0.51	18.99	4.38	0.000
	72	Ch.= 30.22 +0.41 W	0.21	0.45	20.36	4.54	0.000
	73	Ch.= 37.52 +0.13 L	0.18	0.43	20.94	4.60	0.001
	74	Ch.= 34.21+0.11(W+L)	0.21	0.46	20.13	4.51	0.000
	75	Ch.=39.78+0.002 (WL)	0.23	0.48	19.68	4.46	0.000
6. <i>Ficusnitida</i>	76	Ch.= 42.89 +0.01 LA	0.63	0.79	36.95	36.95	0.000
	77	Ch.= 28.11 +0.91 W	0.61	0.78	39.33	39.33	0.000
	78	Ch.= 33.99 +0.40 L	0.46	0.68	53.69	53.69	0.000
	79	Ch.= 26.90+0.33(W+L)	0.59	0.77	40.62	40.62	0.000
	80	Ch.=44.51+0.006 (WL)	0.61	0.78	39.25	39.25	0.000
<i>Lantana cammara</i>	81	Ch.= 35.44 +0.004 LA	0.28	0.53	17.20	17.20	0.000
	82	Ch.= 31.94 +0.26 W	0.20	0.45	19.24	19.24	0.000
	83	Ch.= 29.83 +0.20 L	0.16	0.40	20.15	20.15	0.001
	84	Ch.= 27.40+0.14(W+L)	0.22	0.47	18.74	18.74	0.000
	85	Ch.=36.22+0.002 (WL)	0.23	0.48	18.40	18.40	0.000
3. <i>Ligustrum sp.</i>	86	Ch.= 59.11 +0.001 LA	0.002	0.004	59.62	59.62	0.761
	87	Ch.= 60.22 +0.01 W	0.00	0.01	59.71	59.71	0.940
	88	Ch.= 60.56 +0.003 L	0.00	0.003	59.71	59.71	0.981
	89	Ch.= 60.00+0.006(W+L)	0.00	0.008	59.71	59.71	0.950
	90	Ch.=59.85+0.00 (WL)	0.00	0.02	59.69	59.69	0.881
9. <i>Morus alba</i>	91	Ch.= 35.18+0.00 LA	0.04	0.19	7.30	7.30	0.183
	92	Ch.= 34.74 +0.034 W	0.01	0.10	7.51	7.51	0.060
	93	Ch.= 31.90+0.05 L	0.07	0.27	7.02	7.02	0.036
	94	Ch.= 31.23+0.03 (W+L)	0.06	0.24	7.13	7.13	0.063
	95	Ch.=34.63+0.00 (WL)	0.04	0.20	7.26	7.26	0.120
10. <i>Pittosporum tobira</i>	96	Ch.= 39.14 +0.006 LA	0.13	0.37	44.22	6.65	0.004
	97	Ch.= 35.95 +0.33 W	0.09	0.30	46.45	6.82	0.020
	98	Ch.= 37.45 +0.172 L	0.11	0.33	45.44	6.74	0.010
	99	Ch.= 32.89+0.16(W+L)	0.15	0.38	43.65	6.61	0.003
	100	Ch.=39.02+0.004 (WL)	0.17	0.41	42.66	6.33	0.001

Table (4). Multiple linear regression used for estimating chlorophyll content for ten plant species in respect to leaf area, length, width and of their compatibles.

Species	Equation No.	Regression equation	Coefficient of Determination (R ²)	Coefficient of Correlation (R)	Mean Square Error (MSE)	Standard Error (SE)	P value
<i>Acer negundo</i>	101	Ch.= 32.57+0.39W+0.94L	0.05	0.22	11.53	3.39	0.270
<i>Buxus sempervirens</i>	102	Ch.= 55.44+ 0.26 W+0.16L	0.07	0.20	32.94	5.73	0.139
<i>Carissa macrocarpa</i>	103	Ch.= 63.19+ 3.98W- 3.29L	0.18	0.42	11.76	3.42	0.004
<i>Dombeyawallichii</i>	104	Ch.= 33.28 -0.06W+ 0.39L	0.10	0.32	9.36	3.05	0.265
<i>Durantarepens L</i>	105	Ch.= 30.71+ 2.69W+0.69L	0.23	0.48	20.25	4.5	0.000
<i>Ficus nitida</i>	106	Ch.= 24.63+ 0.69W+0.17L	0.65	0.81	35.63	5.97	0.000
<i>Lantana cammar</i>	107	Ch.= 27.97+ 0.19W+0.10L	0.22	0.47	18.96	4.35	0.001
<i>Ligustrum sp.</i>	108	Ch.= 59.92 +0.01 W+ 0.003L	0.00	0.01	60.75	7.79	0.975
<i>Morus alba</i>	109	Ch.=33.06 -0.03W+0.05L	0.08	0.28	7.12	2.67	0.102
<i>Pittosporum tobira</i>	110	Ch.= 31.78+ 0.23W+0.13L	0.15	0.39	44.18	6.64	0.010

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PERFORMANCE OF GENETIC PARAMETERS FOR F₂ HYBRID IN PEAS (*Pisum sativum* L.)

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ABSTRACT

The experiment was carried out in the field of the Horticulture and Landscape Design Department , College of Agriculture and Forestry , Mosul University , during growing fall season 2013-2014 . The aim was to study the performance of genetic parameters for F₂ hybrids in peas . Using 13 hybrid F₂ of peas plant by using Randomized Complete Block Design (R.C.B.D.) with three replication . The results indicated that the Anova analysis showed Mean square were significantly for the number of days flowering for 50% of plant , number of flowers per plant , the percentage of flowering set , number of pods per plant , number of seeds per pod , 100 seeds weight , seeds yield per plant , biological yield and total seeds yield per unit area . The hybrid F₂ (6x7) gave a significantly higher in all traits compared with the others hybrids . The ² genotypic and Phenotypic were higher for all traits except the number of branches per plant , pod length , pod weight . The Heritability ($h^2_{b,s}$) was higher in all traits, there was the high expected genetic advance (Ega) for the percentage of flowers set , pod length , seed yield per plant , biological yield . The results show a higher positive significant genotypic and phenotypic correlation coefficients between the total seeds yield per area with the number of lowers per plant , 100 seeds weight , number of seeds per pod , seeds yield per plant and biological yield.

KEY WORDS : Hybride F₂ , genetic parameters , correlations , peas .

INTRODUCTION

Pea (*Pisum sativum* L.) is an important plant in human and animal nutrition because of its high protein level (23 – 33%) (Cousin and *et al.*, 1985). It is a major cool season legume crop for human consumption , as dry seeds or as vegetable .Peas was also one of the first domesticated crops in the Old World and one of first genetic research materials .It has a prominent place among vegetables due to its high nutritive value , particularly proteins and other health building substances like carbohydrates vitamin A. vitamin C. calcium and phosphorus (Sharma , 2010). Understanding of the relationship between the traits , for the selection of the important traits , is the utmost importance . In fact the basic relationships between the traits are expressed by this analysis . The correlation coefficients the set of the independent variables on a dependent variable., and their importance is calculated . Several researches of the relationships and traits effect of plants have been reported of peas were identified , there was significant correlation

between the seed yield with the number of pods per plant , number of seeds per pod and 1000 seed weight (Avcı and Ceyahan, 2006, Togay *et al.*, 2008, Nisar and Ghafoor , 2009 , Saeed *et al.*, 2009 , Andrea *et al.*, 2009 , Dhama *et al.*, 2010 ,Abo-Toraby *et al.*, 2011 , Sharma *et al.*, 2013. Rasai *et al.*, (2011) , in his study found the traits correlation showed that the traits grains per pod , pods per plant and harvest index have a positive correlation with the grain yield. Salehi *et al.*, (2011) found in his study there was significant correlation between the numbers of grain per pod , the number of pods per plant and pod length with the grain yield of the common bean .Lavanya *et al.*, (2010) found in his study there was high GCV and PCV estimates recorded for number of pods per plant , seed yield per plant and 100 seed weight , heritability estimates were found high for all traits except for days to maturity , high expected genetic advance coupled with high heritability estimated were recorded for number of pods per plant and 100 seed weight , seed yield per plant had significant and positive association with plant height , biological yield and number of

Pods per plant. In a previous paper Ghobary (2010), related that was a high significant positive correlation between seeds yield with number of pods per plant, pod length, and 100 seeds weight. Akansha *et al.*, (2011) found through their study it was a positive significant correlation between number of grains yield per plant with the number of pods per plant, height of plant, number of branches per plant and 100 seeds weight. Azmat *et al.*, (2011) found in their study it was a positive significant correlation between traits yield and with number of seeds per pod, 100 seeds weight, and length, diameter of pod. Alhamdany (2014) in his study found that there was the higher phenotypic and genotypic correlation between dry pods yield and seeds yield. Borah (2009) rapidist in his study it is a high variation of phenotypic and genotypic for the pods per plant. In a previous papers Singh *et al.* (2011), Bihari and Kumar (2012), Kosev *et al.*, (2012) related to the high variation in genotypic and phenotypic in the number of pods per plant, 100 seeds weight, number of branches per plant.

The aim of this study was to performance of genetic parameters for F₂ hybrid in peas under Ninevah conduction.

MATERIAL AND METHODS

Thirteen F₂ hybrids of peas which was comes from seven inbred lines G.S.C.22763(1), P.S.305301572(2), Thomas Laxton (3), Solara (4), Petit Provael (5), Duna Pea(6), and English 97), were cross in all possible combination (full diallel cross), during growing season of 2009/2010. After self-fertilizing of the F₁ hybrid during 2010/2011 at the field of vegetable crops department of horticulture and landscape design, college of agriculture and forestry, Mosul university. Were grown in Randomized Complete Block Design with three replication. Seeds of 13 (F₂ hybrids) were planting at 24/10/2013 for performance of genetic parameters for F₂ hybrids, the unit plot size consisted of 2 rows (3x1.6 m) each row contained 12 plants. Agricultural practices were performed as recommended (Matlob *et al.*, 1989). The data was recorded on 8 plants randomly selected for each (plot) genotypes (F₂ hybrid) and the traits were: number of branches per plant, 50% flowering of plants, number of flowers per plant, % of flowering set, number of pods per plant, pod length (cm), pod weight (gm), number of seeds per pod, 100 seeds

weight (gm), total seeds yield per plant (gm/plant), biological yield (gm/plant), and total seeds yield per unite (kg/donum). The data was analysis to Dewey and Lu (1959). Phenotypic and genotypic coefficients of variation were estimated by following the procedure given by Burton (1952),
 $GCV = \frac{\sigma^2_g}{\bar{g}} \times 100$
 $PCV = \frac{\sigma^2_p}{\bar{P}} \times 100$
Heritability in broad sense (h^2) by Burton and Devane (1953), if ($h^2_{b.s.}$) = or > to 40% was low, ($h^2_{b.s.}$) = 40-60 was medium, more than 60% was higher, and genetic advance *i.e.* the expected genetic gain by using the procedure given by Johnson *et al.*, (1955).

$$E.G.A = [(K h^2_{b.s.} \sigma^2_p) / \bar{P}] \times 100$$

The correlation coefficients were estimated following method by Al-Jibouri *et al.*, (1958)

RESULTS AND DISCUSSION

The analysis of variance (Table 1) showed significant difference for most of the traits under study except the number of branches per plant, pod length and weight, which indicates the presence of variation for all the traits among the population. Maximum variability was recorded for total yield, following by biological yield, seeds yield per plant, number of flowers per plant, number of pods per plant, percentage of flowering set, weight of 100 seed, and the number of days for 50% flowering.

High genetic variability for different quantitative traits in pea was also reported earlier by Ranjan *et al.*, (2006), Singh and Singh (2006), Sofi *et al.*, (2006) for trait of seed yield, Nawab *et al.*, (2008) for 100 seed weight, Borah (2009), for the number of pods per plant, Dhama *et al.*, for biological yield, Sing *et al.*, (2011) for date of flowering, number of pods per plant, 100 seed weight and total seeds yield, Kosev *et al.*, (2012) for the number of seed per pod, and Al-hamdany (2014) for number of branches per plant, date of flowering, biological yield, and seeds yield per plant.

Table (2) showed the mean value of the traits of F₂ hybrid *i.e.*: number of branches per plant, days of 50% flowering, number of flowers per plant, percentage of flowering set, pods per plant, pod length, pod weight, number of seeds per pod, 100 seeds weight, seeds yield per plant, biological yield, and total seeds yield, it was indicated that hybrid F₂ (6x7) gave a high number of branches per plant which differ with all F₂

hybrids of peas flowered the F₂ hybrid (3x1), while the F₂ Hybrid (6x3) gave a less days of 50% flowering flowered the F₂ hybrid (5x3), they were earlier in this trait, while the F₂ hybrid gave a high days in flowering which means that it is very later genotype in flowering. This indicated that the difference between the F₂ hybrid was different for the photoperiod which is controlled for a multiple gene as Ppd

(Arumingtyas and Musfet, 1994). These results are similar to the findings (Singh *et al.*, 2011; Punia *et al.*, 2011; Gatti *et al.*, 2011; Esho, 2012; and Al-hamdany, 2014). The F₂ hybrid gave (6x7) gave a high number of flowers per plant flowered the F₂ hybrids (5x7, 6x3), while the F₂ hybrids (5x2, 7x1) gave a little number in this trait. The high percentage of flowering set comes from F₂ hybrid (6x5) flowered by the F₂ hybrid (5x7), while the F₂ hybrid (7x1) gave a less percentage of its. The same results come as some researchers (Nisar and Ghafoor, 2009; Saeed *et al.*, 2009; Ram *et al.*, 2010; Singh *et al.*, 2011). Whoever, for the trait of number of pods per plant, the F₂ hybrid (6x5) gave a high number of pod per plant flowered by the F₂ hybrid (5x2) which gave a less number of its, in the other hand the F₂ hybrid (6x7) gave a high number of seeds per pod, 100 seed weight and a high total seeds per plant compared with the most F₂ hybrids under the study, these results are similar to the findings of (AL-Kumar and Esho, 2009; Dhama *et al.*, 2010; Gatti *et al.*, 2011; AL-shakargy, 2011; Kosev, 2012; Sharma *et al.*, 2013; and Al-hamdany 2014). The F₂ hybrids (6x7, 5x2) gave a high biological yield different with all F₂ Hybrids, it means that these two hybrids gave a high number of branches per plant and a high total seeds yield per plant which effected directly on this trait, The same result founded from Dhama *et al.*, (2010); Esho, (2012); and Al-hamdany, (2014). In table (2) indicated that a high total seeds yield per unit area comes from the F₂ hybrids (1x5, 6x7, 5x7) which were 877.12, 860.29 and 815.92 kg/donum respectively. This results are similar to the findings of Dhama *et al.* (2010); Azmat *et al.*, (2011); Punia *et al.*, (2011); Kosev *et al.*, (2012).

Genetic parameters which include the mean value and standard deviation, the range, genotypic variance (σ^2_g), phenotypic variance (σ^2_p) genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability ($h^2_{b.s.}$), and expected genetic advance (Ega) were estimated for all 12 traits under study

are presented in table (3). Analysis of variance showed significant variance among the F₂ hybrids for most the characters. The highest (σ^2_g), (σ^2_p) was observed biological yield followed by total seeds yield per plant, while (GCV), (PCV) was observed in total seed yield per unit area followed by biological yield and total seeds per plant, which indicated that possibility of selection would be effective based the phenotypic expression. The ($h^2_{b.s.}$) was higher in most traits, the genetic advance was maximum for pod length, percentage of flowering set, seeds yield per plant and biological yield. The study investigation shows percentage flowering set, pod length, seed yield per plant, biological yield, and total seed yield per unit area had high heritability as well as high genetic advance and therefore effective selection may be made for these traits and suggested that these traits could be controlled by additive genetic effect and can therefore be used for improvement through phenotypic selection. When heritability of trait is medium to high, selection based on individual level of performance allows a relatively rapid rate of improvement. Higher heritability is known to be important in selection of superior genotypes based on phenotypic performance. Allard, (1960); Singh and Chaudhary, (1985); Togay, (2008); Al-Kumar and Esho, (2009); AL-Shakargy, (2010); Singh *et al.*, (2011); Rasaei *et al.*, (2011); Akansha *et al.*, (2011); Sharma *et al.*, (2013); and AL-hamdany, (2014) reported that the high (σ^2_g), (σ^2_p), (GCV), (PCV) ($h^2_{b.s.}$) with ega for percentage of flowering set, pod length, seeds yield per plant, biological yield, and total seeds yield per unit area in peas.

From the correlation studies (Table 4) it is evident that the traits number of branches per plant, number of days flowering exhibited significant and positive association with number of lowering, pod number per plant and biological yield. Further, character days to flowering 50%, exhibited significant positive phenotypic correlation with biological yield, number of seed per pod, number of pod per plant and number of flowers per plant, and significant positive genotypic correlation with number of seeds per pod and percentage of flowering set. This results same with reported earlier by Lavanya *et al.*, (2010); Abo-Toraby *et al.*, (2011); Singh *et al.*, (2011); Rasaei *et al.*, (2011).

The trait number of pods per plant was significant positive phenotypes correlation with

biological yield , pod length , and negative correlation with seeds yield per plant , the same result indicate from Al-shakargy (2011) ; Rasaei *et al.* (2011); and Sharma *et al.*, (2013). Further , character 100 seeds weight exhibited significant and positive phenotypes and genotypes correlation with total seeds yield , biological yield and

seeds yield per plant ,AL-Kumar and esho (2009); Singh *et al.*, (2011); Azmat *et al.*, (2011); Akansha *et al.* , (2011); Rasaei *et al.*, (2011); Sharma *et al.*, (2013) , and Al-hamdany (2014) .

Observed that correlation provides measure of genetic association between traits which helps to identify important traits for selection program . To meet the need of the farmers and consumer performance , genetic parameters , correlation and genetic advance , inheritance , studies is necessary to focus on genetic variability of local breeder to increase production through genetic improvement for the purposes of storability , processing and consumer quality in peas plant .

Table (1): Anova table analysis for the traits of peas F2 hybrids.

S.O.V	df	Mean square											
		No. of branches/plant	Days for 50% flowering	No. of flowers /plant	Flowering set(%)	No. of Pods /plant	Pod length (cm)	Pod weight (gm)	Seeds/pod	100 seeds weight (gm)	Seeds yield/plant (gm)	Biological yield (gm)	Total seeds yield/donum
Block	2	1.385	32.666	169.626	81.676	169.626	0.213	0.133	0.310	82.587	795.884	7050.512	2866.366
Genotype (F2Hybrids)	12	0.334	21.092**	90.127*	62.378**	90.127*	0.476	0.223	1.214**	57.370**	804.273**	7977.964**	7977.964**
Error	24	0.004	1.613	10.535	3.240	10.535	0.114	0.024	0.058	6.961	37.373	253.462	253.462

*, ** significant different at 5% , 1% level.

Table (2) : Mean value for traits of peas F2 hybrids .

Hybrids	No.of branches/plant	Days for 50% flowering	No. of flowers /plant	Flowering set(%)	No. of Pods /plant	Pod length (cm)	Pod weight (gm)	Seeds/ pod	100 seeds weight (gm)	Seeds yield/plant (gm)	Biological yield (gm)	Total seeds yield (kg/donum)
3x1	5.71	94.85	73.62	90.20	68.05	8.47	2.67	8.33	88.96	88.96	303.49	688.80
6x1	4.61	98.43	75.28	81.42	60.18	8.61	2.51	8.74	117.22	117.22	320.65	758.45
7x1	4.89	97.39	68.38	77.44	61.44	8.74	2.66	7.65	94.98	94.98	375.46	792.87
5x2	5.51	95.87	60.64	89.21	55.83	9.61	2.21	8.10	69.80	69.80	418.27	775.02
5x3	5.15	91.31	72.03	88.31	65.11	9.17	2.24	8.17	78.71	78.71	297.45	643.76
6x3	5.36	89.94	78.45	82.05	61.38	8.50	2.14	8.72	102.17	102.17	334.25	623.86
6x4	5.22	96.82	74.20	87.29	63.00	8.09	2.15	7.44	106.61	106.61	417.26	673.81
1x5	4.99	96.26	70.98	88.89	61.94	9.29	2.09	9.07	84.29	84.29	309.60	877.12
3x5	4.92	99.26	74.69	84.59	66.93	8.95	1.98	8.86	73.89	73.89	287.20	711.57
6x5	5.36	97.16	70.16	93.38	68.38	8.91	2.36	8.90	87.32	87.32	397.42	701.71
4x6	5.42	94.97	72.97	90.12	69.83	8.64	2.90	9.50	83.77	83.77	361.98	620.83
5x7	4.99	97.29	80.29	91.03	75.31	9.12	2.50	8.80	89.99	89.99	309.12	815.92
6x7	5.73	94.51	82.08	90.09	77.00	8.87	2.57	9.51	125.15	125.15	430.11	860.29
L.S.D. at 5%	0.986	3.101	5.617	7.880	3.937	1.765	0.945	0.662	9.567	9.567	22.451	37.673
L.S.D at 1%	1.876	4.105	7.435	10.436	5.209	2.342	1.547	0.877	12.664	12.664	29.746	49.869

Table (3) :Estimates of means and standard deviation , the range , genetic parameters of peas F2 hybrids .

F2 Hybrids	Means and Sta. Devi.	Range	² G	² P	GCV	PCV	H²_{b.s.}	Ega
No.of branches/plant	5.22 ± 0.392	5.73 – 4.89	0.110	0.114	2.110	2.289	96.490	10.610
Days for 50% flowering	95.70 ± 1.905	89.94 – 98.43	6.493	8.106	6.785	8.470	80.10	40.51
No. of flowers /plant	73.37 ± 4.341	60.64 – 82.08	26.531	37.066	36.162	50.521	71.58	10.18
Flowering set(%)	87.23 ± 0.154	77.44 – 93.38	19.712	22.952	22.598	26.311	85.89	35.19
Pods /plant	65.72 ±4.679	55.83 – 77.00	23.664	30.846	36.006	46.934	76.73	13.02
Pod length (cm)	8.84 ±0.186	8.09 – 9.61	0.121	0.234	1.363	2.649	51.47	40.88
Pod weight (gm)	2.34 ± 0.122	1.98 – 2.66	0.066	0.090	2.838	3.882	73.10	17.93
Seeds/ pod	8.6 ±0.186	7.44 – 9.51	0.385	0.443	4.481	5.155	86.94	11.43
100 seeds weight (gm)	27.05 ± 3.029	21.07 – 35.11	16.803	23.764	62.121	87.857	70.71	22.66
Seeds yield/plant (gm)	92.52 ± 9.403	69.80 – 125.15	255.633	293.006	279.291	316.684	87.25	27.44
Biological yield (gm)	317.85 ± 27.989	297.20 – 430.11	2574.813	2828.295	810.083	889.826	91.04	25.89
Total seeds yield (kg/donum)	673.09 ±56.437	620.83 – 877.12	7124.738	7502.479	1058.507	1113.234	94.96	20.78

Table (4): Phenotypic(rp) , genotypic(rg) correlation coefficient among different traits in peas F2 hybrids .

Traits	Corr. Coeff.	Total seeds yield (kg/donum)	Biological yield (gm)	Seeds yield/plant (gm)	Seeds/ pod	Pod length (cm)	No. of Pods /plant	Flowering set (%)	No. of flowers /plant	Days for 50% flowering plant
No.of branches/plant	rp	0.190	0.270	0.289	0.066	0.003	0.321*	- 0.174	0.464**	0.223
	rg	0.168	0.420*	0.217	0.040	0.005	0.195	0.129	0.233	0.140
Days for 50% flowering	rp	- 0.160	0.228	- 0.192	0.558**	0.156	0.285	0.155	0.391*	
	rg	0.129	- 0.169	0.167	0.719**	0.038	0.143	0.990**	0.179	
No. of flowers /plant	rp	0.343 *	0.487**	0.522**	- 0.119	0.333*	0.579**	0.328*		
	rg	0.261	0.341*	0.337*	0.145**	0.763**	0.075	0.288		
Flowering set(%)	rp	0.270	0.383*	0.395*	0.944**	- 0.262	0.456*			
	rg	0.375 *	-0.294	0.290	0.125	0.056**	0.334*			
Pods /plant	rp	0.313 *	0.761**	-0.477**	- 0.109	0.304*				
	rg	0.411 *	0.247	0.778**	0.120	- 0.302*				
Pod length (cm)	rp	- 0.272	0.387*	0.415**	0.036					
	rg	0.294	- 0.177	0.556**	0.143					
100 seeds weight (gm)	rp	0.375 *	0.532**	0.571**						
	rg	0.524**	0.316*	0.992**						
Seeds/pod	rp	0.422**	0.390*	0.418*						
	rg	0.346*	0.208	0.652**						
Seeds yield/plant (gm)	rp	0.548**	0.910**							
	rg	0.665**	0.881**							
Biological yield (gm)	rp	0.461*								
	rg	0.428*								

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EFFECT OF SPRAYING ROSELLE EXTRACT (*Hibiscus subdriffo* L.) AND VITAMIN ON GROWTH PARAMETERS OF CARNATIONS (*Dianthus caryophyllus* L.)

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ABSTRACT

An experiment was conducted at the nursery of Agriculture Faculty/ University of Kufa during the growing season 2013 – 2014, to study the effect of spraying with Roselle extract and vitamin C on growth parameters of Carnation plant. Results showed that spraying Roselle extract concentration at 10g.L⁻¹ and vitamin C concentration at 30mg. L⁻¹ significantly increased the growth parameters (number of leaves to 75.87 leave.plant⁻¹ and branches 9.87 branch.plant⁻¹, total content of chlorophyll to 74.67 mg.100g⁻¹ fresh weight and total soluble carbohydrates to 5.23 mg.g⁻¹ dray weight) flowering parameters (number of flowers to 12.67 flower.plant⁻¹, petals to 30.35 petals. Flower⁻¹, flower diameter of flower to 4.03cm, floret length stalk to 59.16cm, floret diameter stalk to 0.41mm and day to flowering to 120.22 day), compared with control which gave the least values (44.23 leave.plant⁻¹, 3.00 branch.plant⁻¹, 62.57 mg.100g⁻¹ fresh weight, 3.23mg.g⁻¹ dry weight, 4.33 flower. Plant⁻¹, 16.53 petals. Flower⁻¹, 1.73cm, 35.20cm, 0.13mm, 0.16g and the longest day to flowering 147.69 day).

KEYWORD: Roselle extract, vitamin C, Carnation, extract

INTRODUCTION

Carnation plant is belongs to Caryophyllaceae family, it is a herbaceous perennial plant with many colors such as white, red, yellow (Galbally and Galbally, 1997). Native is Mediterranean region, it is very distribution in the public and private gardens for the beauty of their flowers, and it reached aromatic smell, also it is planted in the pots and (Al-Batal, 2005).

Scientific research has indicated that there are many plant extracts have affected of encouraging the vegetative and flowering growth parameters of the plant. Roselle extracts *Hibiscus subdriffo* L. as a herbaceous plant. It is yellow flowering, calyces color was red or green (Ismail *et. al* 2008). calyces leaves contained proteins, fats, carbohydrates, ashes, Carotene, Thiamine, Riboflavin, Ascorbic acid and nutrient elements (Phosphorus, Potassium, Calcium, Magnesium, Iron and sulfur) (Mahadevan *et. al* 2009).

Vitamin C is an organic compound chemical structure is C₆H₈O₆ (NLM). Little information are available about the role of vitamins in plant. Price (1966) reported that ascorbic acid (V. C) increases

nucleic acid content, especially RNA. It also influenced of the synthesis of enzymes, nucleic acids and protein, in addition it acts as coenzyme in metabolic changes. Robinson (1973) reported that vitamin C act as co-enzymes in the enzymatic reactions by which carbohydrates, fats and proteins are metabolized and involved in photosynthesis and respiration. Abd El-Halim (1995) reported that foliar application of ascorbic acid on tomato plants significantly increased growth parameters (stem length, number of branches, leaves, flowers and fruit set as well as dry weight of shoot per plant) in comparison with control plants.

Al-Jabir (2010) found that spraying ascorbic acid to fenugreek plant *Trigonella foenum graecum* L. at a concentration 150 mg.L⁻¹ gave the highest rate of plant height, number of leaves, fresh and dry weight, total soluble carbohydrates in leaves and the number of flowers as well as decreased the number of days until opening the total flowers compared with the control, which gave the lowest values besides Hengawy and Ezz El-Din (2010) mentioned that spraying vitamin C at a concentration 75 mg. L⁻¹ on fenugreek plants increased fresh and dry weight of shoots, number

of flowers and branches of plant, also Al- Zurfi and Jodey (2013) revealed that had a significant increasing when spray common marigold plant *Calendula officinalis* L. with vitamin C at a concentration of 60gm.L⁻¹ in the number of flowers and petals and diameter of the flower compared to the control treatment which gave the lowest vales.

For this importance of Carnation plant an experiment was conducted to show the effect of spraying Roselle extract and vitamin C on the growth and flowering parameters of plant.

MATERIALS AND METHODS

An experiment was conducted at Faculty of Agriculture nursery / University of Kufa during the growing season 2013 -2014, to release the

effect of spraying Roselle extract and vitamin C in the growth parameters of plant. Seeds were planted seed Spinach and production by Semiltas-Fito company on 10/15/2013. Seedling were planted in pots after the emergence of four true leaves planted in pots diameter of 15cm and height of 20cm containing (4Kg) salty clay soil, which is composed of (4.8% Clay, 18.5% Silt and 76.7% sand) as shown in Table 1 . All treatments include three pots.

An experiment was adopted in Randomized Complete Block Design (R.C.B.D) with three replicates in two factors; First three concentrations of Roselle extract (0, 5 and 10) g.L⁻¹ ; the second three concentrations of vitamin C (0, 15 and 30) mg . L⁻¹. Spraying be done twice time the first was sprayed after two weeks and second after two weeks from the first sprayer

Table (1): The chemical properties of the experimental soil.

Chemical properties	Units	Values
PH	----	6.35
Electric Conductivity (Ec)	Ds.M ⁻¹	1.83
N	mg.Kg ⁻¹	30.2
Ca ⁺⁺	mm.L ⁻¹	22.8
K ⁺	mm.L ⁻¹	1.85
Mg ⁺⁺	mm.L ⁻¹	15.8
Orange matter	g.kg ⁻¹	8.3

Means were analyzed and compared by Least significant difference test (L.S.D) at probability 0.05 (Al- Rawi and Khalaf-Alla, 2000). All the operations service was conducted like weed control irrigation when needed for all experimental units. At the end of the experiment on 01\14\2014, the following parameters were measured:

Number of leaves (leaf. plant⁻¹), Number of Branches (branh.plant⁻¹), the longest root length (cm), Total chlorophyll content in leaves(mg.100g fresh weight):according to (Goodwin, 1976), Leaves content of total soluble carbohydrate (mg.g⁻¹ dry weight): estimated according to (Dubois *et. al.* 1956). Number of flower (flower.plant⁻¹), Number of petals (petal. flower⁻¹), Flower diameter (cm): Flower stalk diameters (mm):

Number of day to flowering (day): number were calculated until opening the first floret bud of 50% flowers.

RESULTS

1-Vegetative Growth parameters:

The data in Table (2) shown that the significant increases the number of leaves and branches, length of the longest root, total chlorophyll content and total soluble carbohydrates of leaves that reaching 61.44 leaf. plant⁻¹, 6. 21 branch.plant⁻¹,20.67cm and 68.44 mg.100g⁻¹ fresh weight and 4.34mg.g⁻¹ dry weight when spraying Roselle extract concentration at 10gm.L⁻¹ compared with control treatment which gave the lowest values (54.11 leaf. plant⁻¹, 4.33 branch. plant⁻¹,17.98cm, 65.43mg.100g fresh weight⁻¹ and 3.76 mg.g⁻¹) respectively. Also spraying vitamin C concentration at 30 mg. L⁻¹ increased significantly of the number of leaves and branches,length of the longest root, total chlorophyll content and total soluble carbohydrates in leaves to 69.24 leaf. plant⁻¹,7.25 branche.plant⁻¹ ,23.52cm⁻¹, 71.25 mg.100g fresh

weight⁻¹ and 4.80mg.g dry weight⁻¹ compared to the plant spraying with distilled water (control), which gave the lowest values (46.55 leaf. plant⁻¹, 3.42 branch.plant⁻¹, 15.65cm, 63.34mg.100mg fresh weight⁻¹ and 3.33 mg. g dry weight⁻¹) respectively. (Table, 2) show that the spraying Roselle extract concentration at 10mg. L⁻¹ combine with vitamin C concentration at 30 mg. L⁻¹ increased significantly number of leaves and

branches, length of the longest root, total chlorophyll content to and total soluble carbohydrates in leaves to 75.87 leaf. plant⁻¹, 9.87 branch. plant⁻¹, 25.93cm, 74.67 mg.100g fresh weight⁻¹ and 5.23 mg. g dry weight⁻¹ compared to the control which gave the lowest values (44.23 leaf. plant⁻¹, 3.00 branch. plant⁻¹, 14.70, 62.57 mg. g100 fresh weight⁻¹ and 3.23 mg. g dry weight⁻¹) respectively.

Table (2): Effect of Roselle extract and Vitamin C spraying and their interaction on growth parameters of Carnation plant.

Treatments		No. of leaves (leaf.plant ⁻¹)	No. of branches (branch .plant ⁻¹)	Length of the longest root (cm)	Chlorophyll (mg.100 g ⁻¹ fresh weight)	Carbohydrates (mg. g ⁻¹ dry weight)	
Roselle extract (g.L⁻¹)	0	54.11	4.33	17.98	65.43	3.76	
	5	57.43	5.00	18.84	66.69	3.96	
	10	61.44	6.21	20.67	68.44	4.34	
L.S.D. 0.0		1.01	0.27	0.62	0.44	0.11	
Vitamin C (mg.L⁻¹)	0	46.55	3.42	15.56	63.34	3.33	
	15	56.71	4.84	18.42	66.03	3.94	
	30	69.24	7.25	23.52	71.25	4.80	
L.S.D. 0.05		0.91	0.46	0.51	0.65	0.11	
Roselle extract * Vitamin C	0	0	44.23	3.00	14.70	62.57	3.23
		15	46.66	3.65	15.63	63.55	3.30
		30	49.65	4.12	16.36	63.91	3.46
	5	0	53.61	4.64	17.50	65.07	3.56
		15	56.32	5.00	18.03	65.83	3.93
		30	60.65	5.33	19.73	67.19	4.33
	10	0	64.87	5.66	21.76	68.81	4.50
		15	68.65	6.62	22.86	70.70	4.66
		30	75.87	9.87	25.93	74.67	5.23
	L.S.D. 0.05		1.58	0.80	0.89	1.14	0.20

1- Flowering parameters:

Results in Table (3) shown that an significant obtained increased when spraying Roselle extract concentration at 10gm.L⁻¹ in the number of flowers, and petals, flower diameter and the length and diameter of the flower stalk that reaching to 8.77 flower. plant⁻¹, 23.42 petal. flower⁻¹, 3.10cm, 48.66cm and 0.29mm, . As well as reducing the number of days until opening the first floral bud to 129.44 day compared to control that gave the lowest values (6.22 flower. Plant⁻¹, 19.88 petal. flower⁻¹, 2.47cm, 42.94cm and 0.22mm) also increasing the number of days until opening the first floral bud to 136.88 Day respectively.

A significant increasing obtained when spraying vitamin C concentration at 30mg. L⁻¹ in the number of flowers and petals, flower diameter, length of the flower stalk and diameters flower stalk, that gave 10.43 flower. plant⁻¹, 26.46 petals. flower⁻¹, 3.53cm, 55.40cm and 0.53mm and reducing the number of days until opening the first floral bud to 124.44 day compared to the control treatment which gave the lowest values (5.00 flower. plant⁻¹, 17.35

petals. flower⁻¹, 2.02cm, 37.61cm and 0.15mm and 143.22) day respectively (Table 3).

Table (3) show that the interaction between Roselle extract concentration at 10gm. L⁻¹ and

vitamin C concentration at 30gm. L⁻¹ gave a significant increase in the number of flowers and petals, flower diameter, length and diameters of flower stalk i.e. (12.67 flower. plant⁻¹, 30.35 petal.flower⁻¹, 4.03cm 59.66cm and 0.41mm besides reduced the number of days until opening

the first floral bud to 120.22 day compared to the control treatment which gave the lowest values (4.33 flower. plant⁻¹, 16.35 petal. flower⁻¹, 1.73cm ,35.20cm and 0.13mm and respectively, and the highest number of days until opening the first floral bud to 143.22 Day.

Table (3): Effect of Roselle extract and Vitamin C spraying and their interaction on flowering parameters of Carnation plant.

Treatment		Number of flower (flower. plant ⁻¹)	Number of petals (petal. Flower ¹)	Flower diameter s (cm)	Length of flower stalk (cm)	Diameters of flower stalk (mm)	Number of day until opening the flower bud (day)	
Roselle extract (g.L ⁻¹)	0	6.22	19.88	2.47	42.94	0.22	136.88	
	5	7.65	21.13	2.67	45.84	0.23	133.34	
	10	8.77	23.42	3.10	48.66	0.29	129.44	
L.S.D(0.05)		0.671	0.092	0.053	1.803	0.018	1.521	
Vitamin C (mg.L ⁻¹)	0	5.00	17.35	2.02	37.61	0.15	143.22	
	15	7.12	20.62	2.70	44.44	0.24	132.32	
	30	10.43	26.46	3.53	55.40	0.35	124.44	
L.S.D(0.05)		0.466	0.571	0.142	0.881	0.019	1.334	
Roselle extract × Vitamin C	0	0	4.33	16.53	1.73	35.20	0.13	147.69
		15	5.23	17.36	1.96	38.03	0.14	143.87
		30	5.26	18.76	2.36	39.60	0.19	139.54
	5	0	6.43	19.67	2.50	41.96	0.22	134.66
		15	7.36	20.98	2.71	44.13	0.23	132.54
		30	8.11	21.69	2.92	47.23	0.28	129.31
	10	0	8.87	23.45	3.21	51.63	0.31	128.33
		15	9.56	25.23	3.36	55.36	0.32	125.43
		30	12.67	30.35	4.03	59.16	0.41	120.22
	L.S.D(0.05)		0.808	0.990	0.247	1.527	0.033	2.310

DISCUSSION

Table (2) show that spraying Roselle extract increasing growth parameters (number of leaves and branches, the longest root length and total chlorophyll content and total soluble carbohydrates) in leaves, this increases due to the role of Roselle extract which contains elements such as potassium and calcium, that works to increase the effectiveness of enzymes that responsible on constructing proteins, amino acids, as well as potassium that effect on activating enzymes, proteins and plays as an important role in regulation of the osmotic pressure inside plant cells, which helps to increase water absorption and regulation closing and opening of the stomata in the leaves. (Al-Sahaf, 1989), as well as its role in stimulating the formation chlorophyll as it

important in photosynthesis and the formation of sugars and energy compounded "ATP" and encourage division of mersitemic tissue and manufacturing of carbohydrates(Devlin and Witham,1992). In addition it's encourage root growth, as well as the magnesium element has an important role in sugars manufacturing and chlorophyll . Also phosphorus encouragement and development the growth of the root (Al-Naimi, 1985), therefore, they lead to all increases the growth parameters.

The role of vitamin C in the increase of the growth parameters due to their role in encouraging cell division (Smirnoff and Wheeler, 2000), as well as his role in the photosynthesis and protection chloroplasts from antioxidant factors (Oertli, 1987). Also its role in activated root growth and improving the absorption of nutrients

which work to improve plant growth (Hanafy, 1996). Price (1966) reported that ascorbic acid (vit.C) increases nucleic acid content, especially RNA. It also influenced the synthesis of enzymes, nucleic acids and protein; in addition it acts as coenzyme in metabolic changes. Robinson (1973) reported that vitamin C act as co-enzymes in the enzymatic reactions by which carbohydrates, fats and proteins are metabolized and involved in photosynthesis and respiration, at the end improve the growth indicators. These results match the findings Al-Jabir (2010) on fenugreek plant. Spraying Roselle extract increasing the number of flowers and petals, length and diameter of the flower stalk and reduce the number of days until opening the first floral bud (table 2). that due to the role of Roselle extract which contains many nutrients such as phosphorus, which stimulates the metabolism of the plant such as photosynthesis and the liberalization of the energy required for many critical operations in the plant, including cell division and cell elongation, formation of amino acids and proteins that are important in the formation of the energy compound "ATP" and the formation of anther organic compounds(Al-Sahaf, 1989). An addition to encourage cell division and formation of the protein, nucleic acids and chlorophyll (Wanas, 2002), which it increase the composition of the biological material and carbohydrates in the plant because activated photosynthesis and increase the transfer of nutrients inside the plant, which it is reflected on improvement growth parameters (Table 2) and thus improving flower parameters.

The role of vitamin C in the increase of flowering growth parameters due to his role in an increasing manufacturing materials resulting from the photosynthesis process that transfer to the mersitamic tissues cell division (Horemans, *et al.*, 2000). also it appears to link flowering time, developmental senescence, programmed cell death and responses to pathogens (Barth *et al* 2004 and Pavet *et al* 2005). Furthermore, it affects nutritional cycle's activity in higher plants and plays an important role in the electron transport system (Liu *et al*, 1997). As well as Price (1966) reported that ascorbic acid (vit.C) increases nucleic acid content, especially RNA. It also influenced the synthesis of enzymes, nucleic acids and protein, in addition it acts as coenzyme in metabolic changes which works ultimately to increase the flowering growth indicators.

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ANATOMY OF PETIOLE LEAVES OF FOUR RADISH (*Raphanus sativus* L. VAR. SATIVUS) CULTIVARS GROWN IN CONTROLLED CABINETS UNDER VARYING TEMPERATURES AND IRRIGATION LEVELS

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ABSTRACT

Topsi, Famox F1, Corox F1 and Altox F1 radish cultivars were grown in controlled 20 and 12°C cabinets and they were subjected to 0, 33, 66 and 100% depletion of peat moss available water capacity (AWC). The objective of this experiment was to determine the performances of cuticle, epidermis, hypodermis, cortex, vascular bundles and vessels of four radish cultivars in response to varying temperatures and irrigation levels. The obtained results revealed that radish grown in 12°C cabinet substantially improved thickness of cuticle (25.2%), epidermis (22.25) and hypodermis (16.8%), as compared to that of radish grown in 20°C. In contrast the deeper petiole tissues, parenchyma cortex thickness, vascular bundle number and vessel number per bundle were highly increased by 3.15, 13.56 and 14.4%, respectively, in radish grown in 20°C cabinet, as compared to that of 12°C. Cuticle thickness results manifested that the best cuticle thickness was concomitant to radish irrigated at 0% AWC depletion which profoundly exceeded that of 33% AWC depletion (47.54%), 66% AWC depletion (1.6%) and 100% AWC depletion (20%). Cortex parenchyma exhibited significant gradual reductions in thickness, as the water reduced, and thus 0% AWC was superior over 33% AWC, 66% AWC and 100%, by 36.25, 76.07 and 168%, respectively. Cuticle thickness showed significant reduction of 14.1% in Topsi radish cultivar only, as compared to Famox F1. However, differences between other cultivars were not detected. The highest hypodermis thickness (90.625 µm) was accompanied to Famox F1 which, apparently surpasses other cultivars by 18.12, 50.26 and 32.1%, respectively for Topsi, Corox F1 and Altox F1. The highest vascular bundles were detected in Topsi 4.25 which significantly exceeded Famox F1 21.4%, Corox F1 9.7% and Altox F1 13%. Therefore, cultivars can be ordered as follows: their cortex thickness and vessel numbers Altox > Famox > Corox > Topsi. Interaction results are in results and discussion section.

KEYWORDS: Radish, temperatures, irrigation, anatomy, cuticle, epidermis, hypodermis, cortex, vascular bundles, vessels

INTRODUCTION

Plant cell development consists of two interrelated processes: growth and differentiation. Growth can be described as a three-step model: cell cycle (new cells are formed), cell elongation, and cessation of cell enlargement (cell maturation). In (step 2) the juvenile cell vacuoles, takes up water, and expands by irreversible extension of the growth-limiting primary walls (Pietruszka *et al.*, 2007). The growth process of plant cell is based on irreversible extension of the whole organism as a result of the increase in the quantity and size of cells, the mass of protoplast, and the cell walls (Fogg 1975; Kutschera 2000).

Growth of any plant organ can be split into three basic phases: the initial phase of slow

growth, the intense growth phase and, eventually, the final phase of slow growth. Such regularity can be represented by a sigmoid curve that characterizes the course of individual cell growth, the growth of plant organs, and the growth of the plant as a whole. The external factors that fundamentally affect plant growth are temperature, light, water and soil factors, pH, and atmosphere composition. A rise in temperature gradually increases the intensity of growth (which is also due to acceleration of chemical reactions by raising the temperature). However, after the optimum temperature has been exceeded a rapid decrease in the intensity of plant growth begins caused by dysfunction of the plasmalemma (Pietruszka *et al.*, 2007). Therefore, leaf elongation rate was closely related to meristems temperature, with a common relationship in the

field and in the growth chamber. Cell division and cell elongation occurred in the first 20 and 60 mm after the ligule, respectively, at all temperatures. Similar quantitative responses to temperature were observed for local cell division and local tissue expansion rates (common x intercept and normalized slope), and both responses were spatially uniform over the whole expanding zone (common time courses in thermal time). As a consequence, faster cell elongation matched faster cell division rate and faster elongation was compensated for by faster cell displacement, resulting in temperature invariant profiles of cell length and of proportion of dividing cells. Cell-to-cell communication, therefore, was not necessary to account for coordination (Ben-Haj-Salah and Tardieu, 1995).

It was found that cell length and the length of the division zone were also greater in the *slender* mutant than in the wild type, and growing the plants at reduced temperature (5 °C) shortened cell lengths only in the wild type. The *slender* barley mutant had a higher mitotic index than the barley wild type, although in neither genotype was change in the mitotic index observed following growth at reduced temperature. Cell doubling time, on the other hand, was reduced by growth at reduced temperature in the wild type but not in the *slender mutant*. Thus, the data suggest very different growth responses to low temperature in the two genotypes. The results are discussed in terms of the ability of plants to sense their environment and optimize their metabolism for future growth (Harrison *et al.*, 1998). The decrease of xylem conductivity due to vessel embolism can directly contribute to reduce water flow across the shoot (Schultz and Matthews, 1988) and at the same time it can induce stomatal closure, which in turn avoids further embolisms and limits transpiration (Sperry and Pockman, 1993). Water stress induces a decrease in the average diameter of grapevine vessels and a decrease of xylem hydraulic. Water stressed plants had lower shoot growth and total transectional xylem area, which can both affect hydraulic conductivity, however, hydraulic conductivity was also lower when expressed per unit xylem cross sectional area (k_s) and per unit leaf area (k_l). These results suggest that the decrease in vessel transectional area due to a diminished growth as a response to water stress was the main factor affecting conductivity. Relative differences in vessel transectional areas dependent on the square of the vessel radius

between irrigated and water stressed plants were similar at all node positions tested, relative differences in k_h dependent on the fourth power of the vessel radius were larger in basal internodes, where vessel transectional areas are (Lovisolo and Schubert, 1998). A negative effect of water stress on vessel size was hypothesized by Zimmermann and Milburn (1982) and is implied in the observation that in periods of drought, wood xylem rings develop less than when water is available. The objective of this investigation was to determine the influences of growing four radish cultivars in 20°C and 12°C cabinets under varying irrigation level, where radish was irrigated whenever 0% AWC (field capacity, 33% AWC, 66% AWC and 100% AWC (wilt) were depleted.

Materials and Methods

This experiment was conducted in controlled growth cabinets at Institute Fur Gartenbauliche Produckions Systeme, Biologie, Liebniz Universitat, Hannover, Germany. The objective of this trail was to evaluate the responses of four radish (*Raphanus sativus* L. var. sativus) cultivars namely Topsi, Famox F1, Corox F1 and Alttox F1 to two varying (12 and 20 oC) temperatures and four varying water availabilities (0, 33, 66 and 100% depletion from the available water capacity AWC).

Untreated seeds of the evaluated cultivars were produced Verschliessung in 2013-2014, EG-Norm Standardsaatgnt DE 08-9387st. These cultivars can perform storage root of 2.5-2.75 mm diameter. Lots number of Topsi RA0002CTP (T) was 01972-007, Famox F1 RA4798CTP (F) was 00013-001, Corox F1 was 07110-000 (C) and Alttox F1 (A) was 00212-007.

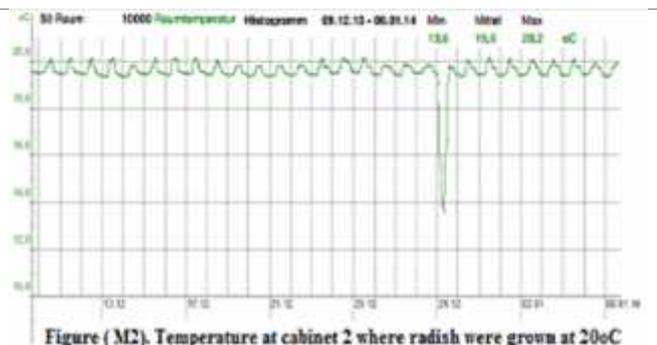
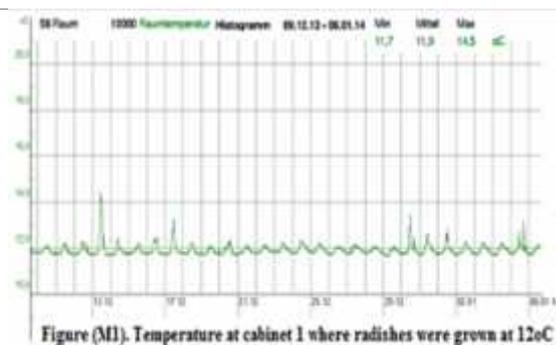
Experimental Design

Split Split plot with in Factorial Complete Randomized Block Design (S S F-CRBD) was chosen for this trail where Factor (A) was represented by cabinet temperature of 20 0C (a1) and cabinet temperature 12 oC (a2). Factor (B) was represented by four water availabilities, sustain peat moss moisture at and below field capacity 0 AWC% depletion (b1), 33% AWC depletion (b2), 66% AWC depletion (b3) and wilting point, 100% AWC depletion (b4). Factor (C) was represented by four radish cultivars namely Topsi (c1), Famox F1 (c2), Corox F1 (c3) and Alttox F1 (c4). Therefore, 32 treatments were included in this trail each was replicated four times with 18 plants for a replicate.

Cultural practices

Experiment was conducted in two cabinets radish cultivars in the first cabinet (figure, M1) were subjected to controlled temperature 12^oC, while the second (figure, M2) radish cultivars were exposed to controlled temperature 20^oC. Therefore, 176 plastic trays dedicated to 128 trays

for investigation, besides 48 guard trays, each tray contains 18 cells of 5.4749732831g dry peat moss. Trays were filled with peat moss and were taken to the controlled cabinets (Figures, M1, and M2) then trays were set according to the above proposed statistical design.



Trays were brought up to field capacity on December 9th 2013, and then one seed was sown in each cell. 15 days from sowing undesired plants were replaced by transplants from guard trays to maintain uniformity and then these transplants were substituted by seedling grown in separate plastic plates. Immediately, after transplanting plants were brought to field capacity and irrigation schedule was commenced according to AWC% depletion adopting weighing methods with 2 decimal electrical balances. A compound fertilizer type 2 Mega special composed of Macro nutrients NPK (Mg), 16-6-26(3,4) Magnesium and possesses micro nutrients precisely 0.02% B, 0.04% water soluble CU, 0.04% EDTA Cu, 0.1% water soluble Fe, 0.1% EDTA and EDHHA Fe, 0.05% water soluble Mn, 0.05% EDTA Mn, 0.01% water soluble Mo and 0.01% water soluble Zn, 0.01% EDTA Zn, EDTA with pH 3, 11 and EDHHA with pH 1 and 10. Plants were fertilized four times on 11, 20, 28 and 32 days after sowing by dissolving 5g.l⁻¹ in irrigation water. Finally, Radish leaves petioles were sliced mounted on glass slides and they were examined under light microscope using graded slides and lenses.

RESULTS AND DISCUSSION

A. Temperatures

The obtained results (table, R1) revealed that radish grown in 12^oC cabinet substantially

improved thickness of cuticle 25.2%, epidermis 22.25 and hypodermis 16.8%, as compared to these traits in radish grown in 20^oC. Similar results were found in irrigated and droughted faba bean (Abdel and Al-Hamadany, 2010). These results suggested that 12^oC tended to urge the commencement of acquired systematic resistance. Since these three outer tissues constitute the protective dermal tissue in leaf petioles. Plant usually urges their defense cell metabolisms through oxidant homeostasis to harden tissues more in order to achieve well established stature capable to match adversity of ambient environment. High bulk density and shorter leaf length produced at 12^oC confirmed this interpretation.

In plants, ROS are unavoidable by-products of biochemical pathways, such as glycolysis and photosynthesis. As a result, plants have evolved enzymatic and non-enzymatic antioxidant mechanisms to eliminate ROS and avoid oxidative destruction (Apel and Hirt, 2004). On the other hand, ROS production is necessary for cell elongation (root hairs, appressoria growth) and plant-microorganism interactions. It is therefore necessary for the plant to possess very complex and well-tuned ROS producing and scavenging systems capable of maintaining ROS homeostasis in the cells (Nanda *et al.*, 2010).

In contrast the deeper petiole tissues, parenchyma cortex thickness, vascular bundle

number and vessel number per bundle were highly increased by 3.15, 13.56 and 14.4%, respectively, in radish grown in 20°C cabinet, as compared to that of 12°C. These results can be referred to the higher cell growth rates under 20°C in relation to 12°C, which resulted in larger leaf and thicker leaf petioles. Quagliotti (1967) stated that as the temperature increases above the optimum a decline in assimilates occur that is exceptionally rapid in C₃-plants such as carrots and leads to low yields as extreme temperature jeopardizes the translocation of assimilate to the harvestable portion. However, vegetative growth of carrots increase at temperatures of 20 and 26°C but final plant size was larger at 14°C indicating that high

temperatures early in the growth stage of carrots favour vegetative growth, although carrots are a cool season crop. Temperatures impacts on growth proceed through functional enzymes and the most affected enzyme is ribulose biphosphate carboxylase exogenase (RUBISCO). Many investigations confirmed that the net assimilation rate (NAR) is one of the most important growth parameters. It describes the net production efficiency of the assimilation apparatus. The RGR is the product of NAR and LAR, where NAR is largely the net result of carbon gain (photosynthesis) and carbon losses (respiration, exudation) expressed per unit leaf area (Poorter and Remkes, 1990).

Table (R1): Thickness (µm) of petioles anatomy components of radish grown in controlled cabinet under varying temperatures.

Temperature	Cuticle	Epidermis	Hypodermis	Cortex	Bundle no.	Vessel number
20 °C	B 4.9609	B 32.422	B 68.516	A 459.1	A 4.188	A 24.188
12 °C	A 6.2109	A 39.648	A 79.609	B 405.7	B 3.688	B 21.141

(*). Figures of unshared characters significantly differ at 0.05 level, Duncan.

B. Irrigation levels

Cuticle thickness results (table, R2) manifested that the best cuticle thickness was concomitant to radish irrigated at 0% AWC depletion which profoundly exceeded that of 33% AWC depletion (47.54%), 66% AWC depletion (1.6%) and 100% AWC depletion (20%). These results confirmed waxes and cutin excreting through ectodesmata superiority of epidermal cells of radish grown under field capacity over other irrigation treatments. This is a paradox phenomenon, it is well established that droughted plants should have a thicker cuticle. This is true under prolonged drought episodes, particularly with xerophytic plants, but under cabinet conditions where, the drought episodes were very shorts, gave no enough time for plants to operate its cuticle building system. It seems that wilted plants commenced to initiates such system this reason why wilted plants showed thicker cuticle than moderately droughted radish 33 and 66% AWC depletion. Similar results in droughted pea grown in greenhouse (Duhoky *et al.*, 2011). It was found that both lignified and suberized cell walls represent a characteristic feature of plant tissues associated with specialized physiological functions. Lignin is a complex and highly variable biopolymer derived from oxidative polymerization of the cinnamyl alcohols *p*-coumaryl, coniferyl,

and sinapyl alcohol (Freudenberg, 1965; Campbell and Sederoff, 1996). The content of *p*-coumaryl, coniferyl, and sinapyl alcohol vary considerably: gymnosperm (softwood) lignin essentially consists of G, dicotyledon angiosperm (hardwood) lignin is composed of G and S, and monocotyledon angiosperm (grass) lignin represents a mixture of H, G, and S (Higuchi *et al.*, 1967; Nimz, 1974; Boudet *et al.*, 1995). In terms of functionality, lignin is reported to provide mechanical stability (Monties, 1989) and to form one of several plant responses toward the defense of pathogens. Epidermis and hypodermis thickness were highly reduced in plants exposed to wilting the reductions were 20.57 and 41.53%, respectively, as compared to field capacity irrigated radish. These results suggested tissue water content is the main factor for cell growth and thereby tissues. Thickness reduction caused by drought can be attributed to the impacts of water scarcity on nutrient absorption and photosynthesis. NO₃-N concentration in roots was significantly influenced by irrigation treatments. Roots from the plots which received infrequent irrigation when soil water potential reached -60 KPa had the highest NO₃-N. Low water potential decreases both NO₃-reductase activity and photosynthesis leading to higher NO₃-N accumulation in tissue (Huffaker *et al.* 1970).

Cortex parenchyma exhibited significant gradual reductions in thickness, as the water reduced thickness were also reduced, and thus 0% AWC was superior over 33% AWC, 66% AWC and 100% by 36.25, 76.07 and 168%, respectively. These results suggested that parenchymatous cells had received inadequate assimilate to facilitate its normal growth owing to low CO₂ concentration that was conducted to the mesophyll tissues through stomata. Stomatal closure is an early plant response to drought, and increases in the cytosolic concentration of free calcium, together with pH changes, are considered to be primary events in the ABA-mediated reduction of stomatal turgor (Schroeder *et al.*, 2001). However, it is likely that calcium, together with phosphorylation processes, plays a more general role in the mechanisms associated with drought stress perception.

Medium drought 66% AWC showed the highest number of vascular bundle, as it significantly bypassed field capacity 9.37%, 33% AWC 29.63% AWC and wilting 9.37%. The highest vessel numbers per bundle were confined

to 33% AWC which substantially exceeded that in field capacity, 66% AWC and wilting by 32.6, 22.57 and 37.86%, respectively. It can be inferred from these results that radish commenced to increase either vessel numbers or bundles when it experienced drought. The observed vascular bundles and vessels diameter were smaller than that of field capacity irrigated radish, this phenomenon can be interpreted to the slow growth rates of differentiated cell. The resulted small vessels may perform conducting water better under water scarcity capillary tubes. On the other hand, the differentiated vascular bundles seems to be in adequate, therefore plants urge it defense system to emit signals for the commencements of parenchyma cell to recall their tetipotencies and then alter them in some locations to dividing cells to create new vascular bundle to meet the adequate required water to blade. These new formed bundles were obvious under microscope exam during measurements, particularly with droughted radish. Similar results were observed in droughted watermelon (Abdel and Bamerny, 2011).



Table (R2): Thickness (µm) of petiole anatomy components of radish grown in controlled cabinet under varying irrigation levels.

Irrigation	Cuticle	Epidermis	Hypodermis	Cortex	Bundle number	Vessel number
0% awc	A 7.0313	A 39.844	A 83.594	A 646.56	B 4.000	C B 21.375
33% awc	C 4.7656	B A 37.031	A 71.875	B 474.53	C 3.375	A 28.344
66% awc	C 4.6875	B A 34.219	A 81.719	C 367.19	A 4.375	B 23.125
100% awc	B 5.8594	B 33.047	B 59.063	D 241.25	B 4.000	C 17.813

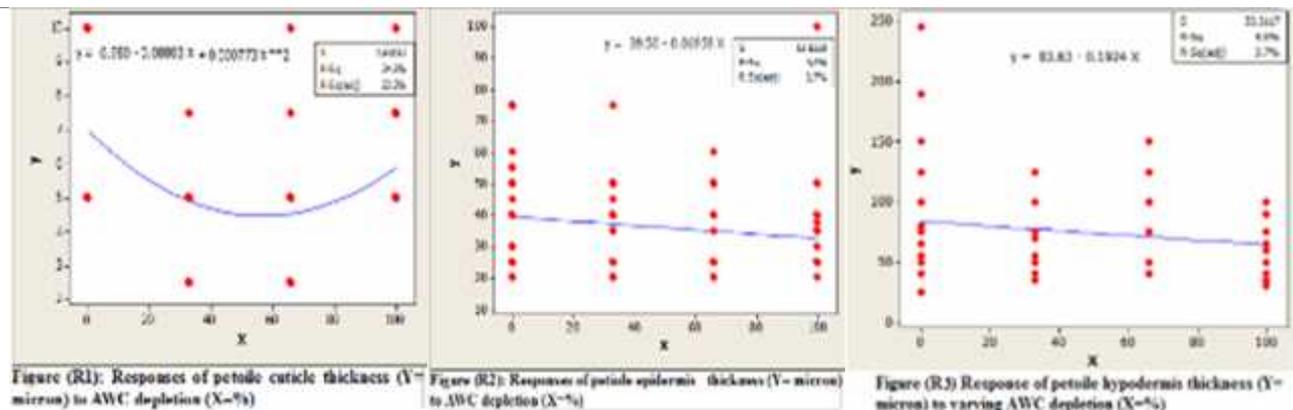
(*). Figures of unshared characters significantly differ at 0.05 level, Duncan.

Regression analysis revealed that cuticle thickness was reduced gradually with increases of AWC depletion from peat moss until it attained 66% AWC depletion then commenced to increase at further AWC depletion, however these increases was lower than that of 0% AWC depletion. Therefore, the response of cuticle

thickness can be forecasted by the following quadratic equation: Cuticle thickness (µm) = 6.98 - 0.8803 AWC% + 0.000773 (AWC%)². These results suggested that moderate drought inhibited the synthesis of waxes and cutin that cuticle is assembled from and when plants experienced severe drought plants made an attempt to

counteract evapotranspiration (Figure, R1). Different trend of regression was exhibited by epidermis response to irrigation levels, where epidermis thickness reductions was concomitant to AWC% depletion of peat moss, this correlation can be predicted by the below linear equation: Epidermis thickness (μm) = 39.5 - 0.06959 AWC% (Figure, R2). Resemble regression trend was manifested in hypodermis thickness (Figure, R3) where thickness is adversely affected by water availabilities reduction and can be estimated from the below linear equation: Hypodermis thickness (μm) = 83.63 - 0.1929 AWC%. These results suggested that reductions in the components of dermal tissues thickness of radish petiole were mainly due to the gradual loss in turgor pressures, since turgor pressure play a vital role in cell wall expansions. Several types of wall polymer rearrangements could plausibly induce wall relaxation and lead to turgor driven wall expansion. These include weakening of non-covalent bonding between polysaccharides (as postulated for expansions), cleavage of the

backbone of major matrix polymers by endoglucanases, pectinases, transglycosylases and hydroxyl radicals, and breakage of cross links between matrix polymers by esterase's (Cosgrove, 1986). It is well known that water shortages negatively affect the enzyme metabolism and interrupted tissues performance. Changes in primary metabolism are a general response to stress in plants. For example, a cDNA-encoding glyceraldehyde-3-phosphate dehydrogenase, isolated from the resurrection plant *C. plantagineum*, shows increased expression during drought and upon ABA treatment. However, increased levels of the enzyme are also associated with other environmental stresses in plants, possibly reflecting increased energy demand. Proteases may also be an important feature of stress metabolism, dispensing with redundant proteins and depolymerizing vacuolar storage polypeptides, thereby releasing amino acids for the massive synthesis of new proteins (Ingram and Bartles, 1996).



Cortex thickness of radish leaf petiole appeared to be overwhelmed by linear regression (Figure, R4), and it can be estimated by the following equation: Cortex thickness (μm) = 630 - 3.972 AWC%. The obtained results showed that the slope of cortex thickness reduction caused by varying irrigation was higher than that of epidermis and hypodermis in other words cortex was more affected than dermal tissues. Higher cortex influence might be due to several reason for instance their lower compaction and larger cells with huge intercellular spaces impart a low cell holding capacity to their received water which made it easy to draw up by dermal tissues to

substitute lost water from dermal tissues under severe drought conditions, these results were confirmed in lentil and mung beans leaves by Abdel and Al-Rawi (2011). Up withdraw water loss can alter the hormonal homeostasis to detain adequate water in dermal tissues cells through inhibiting evapotranspiration and drawing water from beneath tissues to substitute at least some of the lost water. Plant growth and development are regulated by both external environmental factors, such as light quantity and quality, and by a set of endogenous regulators collectively known as the phytohormones. In many instances, these two sets of determinants interact with one another. For

example, phytohormones mediate many of the stress responses that facilitate adaptation to environmental changes. One of the most studied examples of this occurs during periods of drought stress, when the phytohormones abscisic acid mediates stomatal pore closure, resulting in reduced transpiration water loss (Blatt and Thiel, 1993).

Vascular bundle numbers appeared to exhibit slight increases in vascular bundles with the gradual increases of AWC% depletion, however, these increases of slight slope (figure, R5).

Subsequently, the number of vascular bundles can be predicted from the following equation: $\text{Vascular bundle number} = 3.789 + 0.002987 \text{ AWC\%}$. These results recruit the fact that under drought conditions plant urge their defense system to overcome the shortages in water supply to the blade and emphasized the adverse effects of drought on xylem conductivity of water. On the other hand, number of differentiated xylem vessels, (figure, R6), were slightly reduced with the reductions of water availabilities and it can be estimated by the following linear equation: $\text{vessel number} = 25.06 - 0.04281 \text{ AWC\%}$.

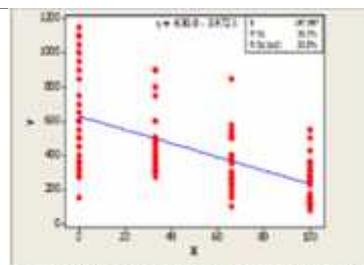


Figure (R4): Responses of petiole cortex thickness (Y=microns) to AWC depletion (X=%)

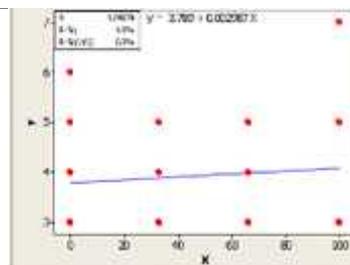


Figure (R5): Response of petiole vascular bundle number (Y) to AWC depletion (X=%)

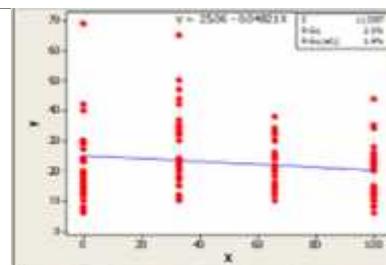


Figure (R6): Responses of petiole performed vessel number (Y) to AWC depletion (X=%)

C. Cultivar responses

Cuticle thickness showed significant reduction of 14.1% in Topsis radish cultivar only, as compared to Famox F1 (table, R3). However, differences between other cultivars were not detected. The highest hypodermis thickness (90.625 μm) was accompanied to Famox F1 which apparently surpasses other cultivars by 18.12, 50.26 and 32.1%, respectively for Topsis, Corox F1 and Alttox F1. The highest vascular bundles were detected in Topsis 4.25 which significantly exceeded Famox F1 21.4%, Corox F1 9.7% and Alttox F1 13%. Cultivar differences were found in lentil, mung beans and vetch (Abdel and Al-Rawi, 2011). It seems that Topsis radish cultivars suffer drought earlier than other cultivars, since it possessed higher vascular bundles besides it lower vessels number. Therefore, cultivars can be ordered as follow their cortex thickness and vessel numbers $\text{Alttox} > \text{Famox} > \text{Corox}$ and Topsis. These differences can be attributed to the capability of individual cultivars in gene expressions and translations of these genes to enzymes under stresses adversity, such capability usually is conserved in the cultivar during seed production in other words which techniques have been applied to maintain and improve the acquired gene diversity.



Photo (R5). Famox F1 vascular bundles and vessels



Photo (R6). Famox F1 vessels with 400x

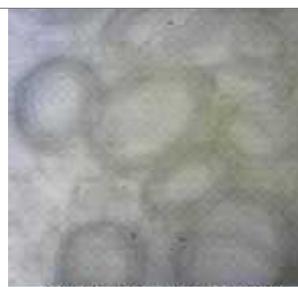


Photo (R7). Corox F1 vessels with 400x



Photo (R8). Corox F1 vessel with 200x

Table (R3): Thickness (μM) of petiole anatomy components of four radish cultivars grown in controlled cabinet.

Cultivars	Cuticle	Epidermis	Hypodermis	Cortex	Bundleno.	Vessel no.
Topsi	B 5.3125	A 36.406	B 76.719	A 386.72	A 4.250	A 21.594
Famox F1	A 6.0938	A 36.797	A 90.625	A 448.75	D 3.500	A 23.563
Corox F1	B A 5.3906	A 33.594	C 60.313	A 445.31	C 3.875	A 20.688
Alttox F1	B A 5.5469	A 37.344	C B 68.594	A 448.75	B 4.125	A 24.813

(*). Figures of unshared characters significantly differ at 0.05 level, Duncan.

D. Cultivar responses to irrigation

Dermal tissue thickness assembled by cuticle, epidermis and hypodermis thickness showed superiority in radish grown in 12°C cabinet and irrigated at 0%AWC, since it gave the thickest cuticle 8.7 μm , epidermis 51.25 μm and hypodermis 107.5 μm , as compared to other temperature irrigation treatments (table, R4). These results suggested that dermal thickness were substantially influenced by 12°C rather than their influenced by varying irrigation levels and 20°C, where the lowest thickness were observed in 20°C, regardless to irrigation levels. Temperatures influences cell membrane fluidity which highly affected cellular membrane enzymes and thereby reflected of cell enlargements. It is well established that that crops of cool growing season possesses higher ratio of unsaturated fatty to saturated one to improve fluidity of membrane to cope with cool environments. Plant cell membranes respond to temperature lowering very rapidly by changes in the lipid composition and content, e.g. by an increase in the ratio of unsaturated to saturated FAs (Kreps, 1981). In wintering cereals, desaturation of previously synthesized FAs of membrane lipids occurs as soon as in 15–30 min after cooling (Novitskaya *et al.*, 1990). During low temperature acclimation of frost tolerant plants, lipids enriched in linolenic acid are synthesized. Such accumulation of unsaturated FAs at temperature lowering prevents membrane lipid transition from liquid crystalline phase into the solid gel (Trunova, 2007). An enhanced unsaturation of lipid FAs in chilling sensitive tobacco plants achieved by insertion the gene encoding FA desaturase resulted in their improved cold tolerance (Orlova, *et al.*, 2003).

Cortex thickness took the other aspects where, in general thicknesses were higher in 20°C grown radish regardless to irrigation levels. However, the thickest cortex was confined to 12°C grown radish irrigated by 0%AWC. These results can be referred to high growth rates and low compaction of parenchymatous cortex cell, the high

percentages of pithiness incidences emerged under 20°C emphasized the poor stature of cortex. Bhale (2004) mentioned that high temperatures may cause heat damage or injury to plant tissue that may influence the texture and structure. The texture of root crops is mainly determined by the structural composition of cellular tissues. Carrot firmness may be increased in response to low, non-freezing temperatures (4°C) without the variation in root water status (Gomez and Sjöholm, 2001). Temperature's influence on firmness depends more on the overall tissue structure (genetic) and the stage of development of the produce (Johnson *et al.*, 2001).

Temperatures had slight effects on vascular bundle and vessel numbers as that imposed by irrigation levels. It seems that radish experienced drought revealed higher potency to increases both vascular bundles and vessels number per bundle. These results suggested that under drought conditions vascular bundles, where their vessels were performed poorly, because of the lack of water and assimilates. Drought reduces cell growth by cell turgor pressure reductions. In addition to that water deficits occur not only during drought and under conditions of high salt concentrations but also during cold conditions. They probably also cause the decrease of turgor pressure at the cellular level. A change in the osmotic potential across a plasma membrane, caused by the decrease of turgor pressure, might be a major trigger of the water stress response at the molecular level. Osmosensors of yeasts have been extensively studied, and cloning of Osmosensors involved in the signal perception of water stress in plants is in progress based on the knowledge of Osmosensors in yeast (Wurgler-Murphy and Saito, 1977). Subsequently, plants need to operate its defense system to substitute the poor stature and small vessels by increasing the numbers of both vascular bundles and their vessels to meet the required water supply and water conductivity. Under water scarcity the plant growth hormonal homeostasis is shifted to the

favour of growth retardants such as ABA, phytic acid, dihydropasic and *p*-cumarin, which finally blocks the GA₃ synthesis pathways (Goodwin and Mercer, 1985; Taiz and Zeiger, 2002). ABA was found to be of multi functions, particularly in gene expressions, when it accumulated in droughted plants. The role of ABA in water stress signal transduction has been analyzed with ABA insensitive mutants in various species. Of these, maize VP1 and *Arabidopsis* *abil*, *abi2*, and *abi3* have been extensively characterized and their genes cloned. Among them, ABII and AB12 gene products function mainly in vegetative tissues and also participate to some extent in seed

development (Shinozaki and Yamaguchi-Shinozaki, 1997). Because of the wilt phenotypes of *abil* and *abi2* mutants, ABII and AB12 are thought to have important roles in ABA-dependent signal transduction pathways during water stress (Giraudat *et al.*, 1994). The *ABII* and *ABI2* genes have been cloned and shown to encode proteins that are related to type 2C protein Ser/Thr phosphatases (PP2Cs) (Leung *et al.*, 1997; Meyer *et al.*, 1994). The *ABII* gene product functions in stomata closure, and the *abil* plant accordingly has a wilt phenotype (Armstrong *et al.*, 1995).

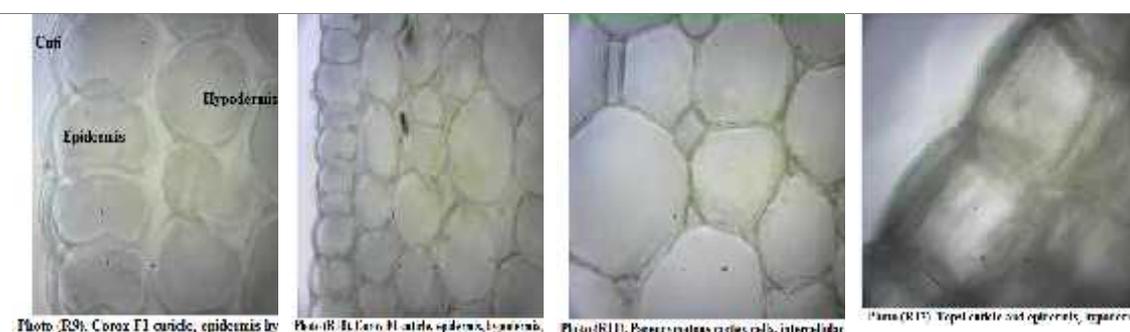


Table (R4): Thickness (μm) of petiole anatomy components of radish grown in controlled cabinet under varying temperatures and irrigation levels

T: Irrig	Cuticle	Epidermis	Hypodermis	Cortex	Bundle no.	Vessel no.
20/0%	C B 5.3125	C 28.438	C 59.688	B 529.69	B 4.500	B A 24
20/33%	C B 5	C B 35.313	C B 65.313	B 574.06	D 3.500	A 28.313
20/66%	D 3.9063	C B 37.500	A 98.438	C B 473.44	C 3.750	A 26.500
20/100%	C B 5.6250	C 28.438	C 50.625	D 259.06	A 5	B 17.938
12/0%	A 8.7500	A 51.250	A 107.500	A 763.44	D 3.500	B 18.750
12/33%	C D 4.5313	B 38.750	B 78.438	C 375.00	E 3.250	A 28.375
12/66%	C B 5.4688	C B 30.938	C B 65.000	D 260.94	A 5	B 19.750
12/100%	B 6.0938	C B 37.656	C B 67.500	D 223.44	F 3	B 17.688

. (*). Figures of unshared characters significantly differ at 0.05 level, Duncan

E. Cultivar responses to temperatures

The obtained results (table, R5 and Figures, R7,8,9) revealed that 12°C temperature substantially bypassed 20°C in cuticle thickness in all evaluated cultivars, particularly, Famox F1 which exceeded that of the same cultivars grown in 20°C cabinet by 32.56%, followed by Topsi. Whereas, Corox F1 and Altox F1 gave close results by which they exceeded their values obtained from 20 °C. Same superiority trends of 12°C over 20°C. Resemble potency was observed in the responses of radish cultivars grown in 12°C over that of 20°C in term of epidermis thickness

particularly, Altox F1 in which its value at 12°C exceeded that at 20°C by 27.4 %, followed by Topsi and Corox 21.97% and the lowest difference between 12 and 20°C were observed in Famox F1 5.43%. Famox F1, Corox F1 and Altox F1 cultivar responses to temperature in term of hypodermis also support their superiority to grow in 12°C rather than 20°C, particularly Altox F1 which exceeded its value in 20°C by 40%. However, Topsi gave diverge results, as its hypodermis in 20°C exceeded its value under 12°C by 40%. These results suggested that dermal tissue performance is established better under 12°C and

the best performance can be dedicated to Altox F1. The worst was confined to Topsi. The thickest cuticle which was highest in Topsi manifested that defense system was urged earlier in comparison to other cultivars in other words this cultivar could not manage drought overcoming and then send its drought signals earlier, and thus this cultivar can be accused for its low temperature resistance, as compared to other radish cultivars, particularly, Altox F1. It is worthy to mention that highest thickness in epidermis and cortex confirmed the cool temperature resistance which was absent in Topsi under 12°C besides its value under 20°C exceed that of 12°C by 40%. Low temperature strengthens dermal tissues through reducing the cell growth rates which spare enough time for cell performance, particularly, cell wall and reducing the intercellular spaces, plants take this aspect to avoid the initiation of ice crystals in its intercellular spaces which further draw the tonoplast water and cytoplasmic and finally augmented and rupture the cell and whole tissue. It was stated that in *Chara corallina* cells and wheat roots turgor at given water potential declined with temperature but increased in leaves of *Lolium* and *Poa spp.*, and maize roots (Proseus *et al.*, 2000). Hence, it is very unlikely that the temperature affects strength via tissue water status. On the other hand, it has been shown that in the biennial carrots stiffness (Herppich *et al.*, 2001b) and strength (Gomez and Sjöholm, 2001) may change in response to low, non-freezing temperatures (4°C) without a variation in water status (Herppich *et al.*, 2001a) due to cold acclimation processes altering cell wall properties (Gomez *et al.*, 2003). Hence, temperature may species- or tissues type-specifically affect strength by changing cell walls chemical and/or physical properties. Such changes certainly occur during tuber development in the rapidly growing annual radishes also indicated by the different temporal dynamic of strength and stiffness. Pronounced developmental effects on tissue strength have been found during the ripening of pears (De Belie *et al.*, 2000). Hence, temperature effects on produce texture highly depend on overall tissue structure, the stage of development (Johnson *et al.*, 2001) and the duration of the temperature treatment.

Cultivar responses to temperature in cortex thickness (table, R5 and R10) manifested that Topsi grown at 20°C exceeded that of 12°C by 46% which confirm that Topsi favored the high temperature, as compared to other radish cultivars,

particularly Famox F1 which showed higher cortex thickness at 12°C. Vascular bundles were increased substantially in Altox F1 and Famox F1 grown in 20°C cabinet by 19.87% and 34%, as compared to 12°C, however, differences between Topsi and Famox were not detected under both temperatures (table, R5 and Figure, R11). The highest vessels number per bundle 25.875 was observed in Altox grown at 12°C. Corox F1 and Topsi appeared to increase their vessel substantially in 20°C cabinet rather than 12°C on contrast as they exceeded the 12°C by 47 and 36%, respectively. On contrast, Altox F1 and Famox F1 preferred their vessels increases to be performed in 20°C (table, R5 and figure, 12). Increase in vascular bundles and in vessel number seem to be occurred under unfavorable conditions and also in less evaluate cultivars, from microscope exam, vascular bundle were small and containing narrow vessels in leaf petiole of possessing higher number of vascular bundle. In other words such type of differentiation is usually adopted under low cell growth rates where, stresses are imposed, in order to supply enough water that required by blade. Increases in cells sizes and thereby tissues thickness that observed in Topsi cultivars might be referred to the role of high temperatures on hormonal manipulations and shifting them to growth promoters. Mutations in the GA and ABA biosynthetic pathways also did not confer defects in hypocotyl elongation in response to high temperature. The *det2-1* brassinosteroid mutant displayed a moderate defect in temperature-induced hypocotyl elongation similar to some of the less severe auxin pathway mutants. Brassinosteroid are known to have a role in hypocotyl elongation on both light- and dark-grown seedlings (Kauschmann *et al.*, 1996). Thus, it is possible that some functional interactions occur between auxin and brassinosteroid that are required for temperature induced hypocotyl elongation. Alternatively, because the *det2-1* mutation confers a much more severe dwarf phenotype than any of the auxin pathway mutants examined, the reduced temperature-induced elongation of *det2* mutants may simply be a reflection of a general cell expansion defect. The increase in free IAA levels observed when plants are grown at 29°C suggests that temperature may directly regulate auxin levels to achieve this growth response in *Arabidopsis* seedlings. Because the level of IAA conjugates also is elevated in these plants, regulation

presumably occurs at the level of IAA synthesis. An alternative possibility is that temperature negatively regulates IAA catabolism. It is possible that, the increase in IAA levels is a secondary

effect of growth at high temperature rather than the actual mediator of the response (Gray *et al.*, 1998).

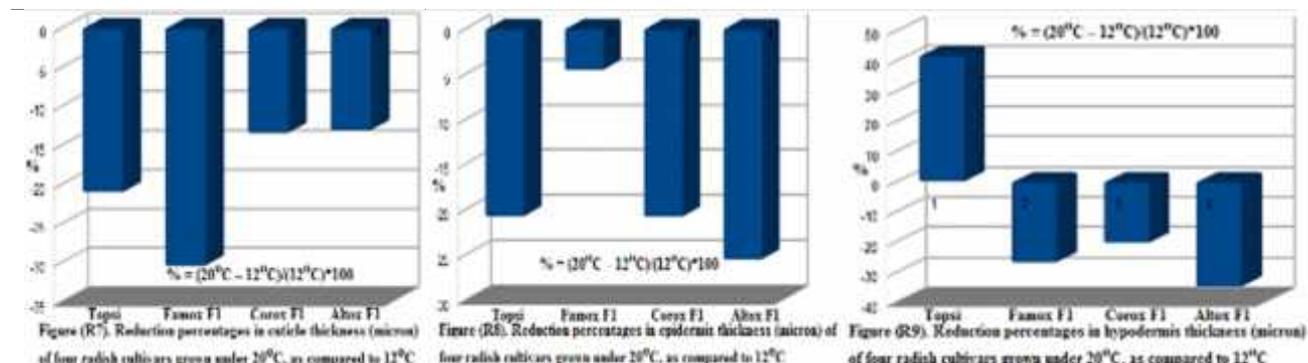
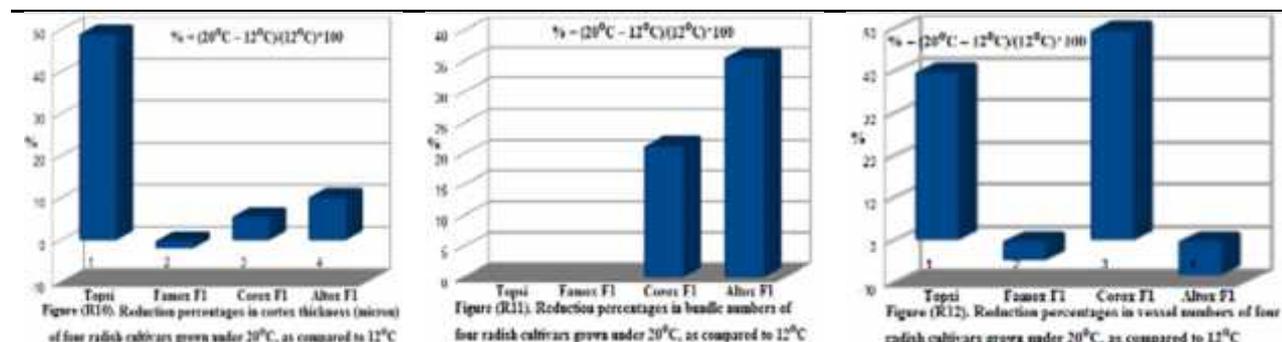


Table (R5): Thickness (μm) of petiole anatomy components of four radish cultivars grown in controlled cabinet under varying temperatures.

Temp:Cv	Cuticle	Epidermis	Hypodermis	Cortex	Bundle number	Vessel number
20 T	C4.6875	BC32.188	AB 90	A463.13	B4.25	AB 25.188
20 F	BC5	A-C35.938	B-D 76.563	A444.38	C3.5	A-C 23
20 C	BC5	C29.688	E 53.438	A457.81	B4.25	AB 24.813
20 A	BC5.156	BC31.875	E 54.063	A470.94	A4.75	AB 23.75
12 T	B5.9375	AB40.625	DE 63.438	B 310.31	B4.25	BC 18
12 F	A7.1875	A-C37.656	A 104.688	A453.13	C3.5	AB 24.125
12 C	B5.7813	A-C37.5	C-E67.188	A432.81	C3.5	C16.563
12 A	B5.9375	A 42.813	BC 83.125	A426.56	C3.5	A 25.875

T= Topsi, F= Famox F1, C= Corox F1, A= Altox F1, (*). Figures of unshared characters significantly differ at 0.05 level, Duncan



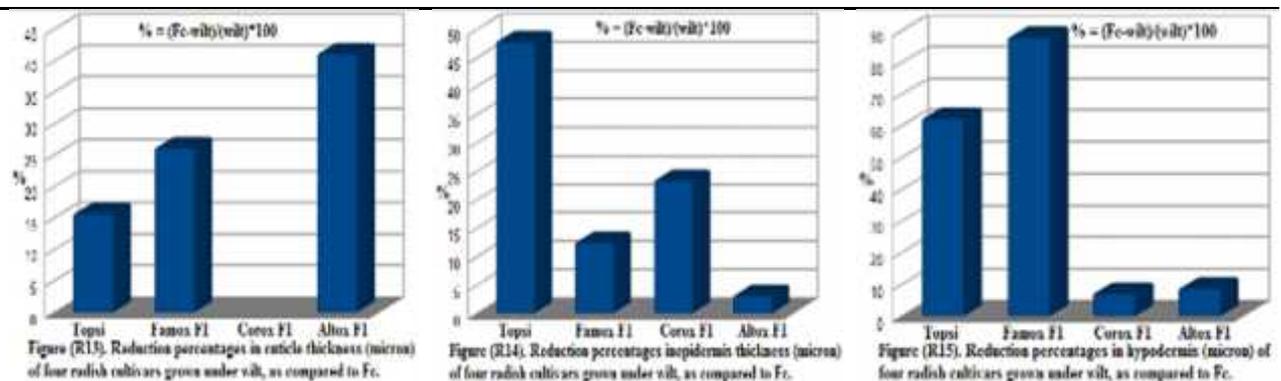
F. Cultivar Responses to irrigation levels

Cuticle thickness in all radish cultivars were found in radish irrigated by Fc. Cuticle thickness increases in Corox F1, Famox F1, Topsi and Altox F1 were 320,180, 105 and 70%, respectively as compared to severe drought. This contradictory results to the general notion that drought should increase cuticle thickness under drought. Drought adaptation required long drought episodes accompanied with low relative humidity, high temperature and high light intensity, besides

genomes. These parameters were not found in growing cabinets. Moreover, the water holding capacity of water for the used peat moss was 57% which can supply roots water for a quite long period (table, R6 and Figure, R16). The highest epidermis thickness 44.375 μm , (table, R6 and figure, R17) was confined to Topsi radish cultivar irrigated with Fc, however, significant differences between this highest epidermis thickness were found only with Topsi irrigated with 33%AWC and with Topsi irrigated 100AWC. Epidermis

thickness in all cultivars except Altox F1 showed thickness increases under Fc in comparison to wilt these increases for Topsis (11%), Famox F1 (15%) and Corox F1 (11%). However, Altox F1 was the only cultivars revealed increases by 30% than Fc in epidermis thickness under wilt, this might reflect its capability to counteract drought in relation to other cultivars. Corox F1 irrigated with Fc highly exceeded that of wilt in hypodermis thickness by 110%. However, significant differences between Fc and wilt were not observed in other cultivars (table, R6 and figure, R18). These results explained the role of varying water availabilities on enzyme functioning which finally resulted in the regulation of cell growth rates and thereby size and morphology of given tissue. It was reported that genes encoding proteins with sequence similarity to proteases, and which are induced by drought, have been isolated from both pea (Guerrero *et al.*, 1990) and *A. thaliana* (Kiyosue *et al.*, 1993; Koizumi *et al.*, 1993). One of the functions of these enzymes could be to degrade proteins irreparably damaged by the effects of drought (Guerrero *et al.*, 1990). During early drought in *A. thaliana*, there is an increase in levels of mRNA encoding ubiquitin

extension protein (Kiyosue *et al.*, 1993), a fusion protein from which active ubiquitin is derived by proteolytic processing. This increase may be significant in terms of protein degradation, because ubiquitin has a role in tagging proteins for destruction. During drought stress, protein residues may be modified by chemical processes such as deamination, isomerization, or oxidation, and it is thus likely that enzymes with functions in protein repair are upregulated in response to drought. Indeed, the response to desiccation in mosses may largely be repairing based (Oliver *et al.*, 1996). An example of such repair processes is the observation that L-isoaspartyl methyltransferases may convert modified L-isoaspartyl residues in damaged proteins back to L-aspartyl residues. Mudgett and Clarke (Mudgett and Klarke, 1994) have argued that such repair mechanisms could be particularly important during desiccation, when protein turnover rates are low. Although *Escherichia coli* mutants lacking the enzyme grow normally in the logarithmic phase when there is high protein turnover, they survive poorly in the stationary phase when turnover is much lower (Li and Klarke, 1992).



The highest cortex thickness (806.25 µm) was confined to Famox F1 irrigated with 0AWC% and the lowest (162.5 µm) was concomitant to Corox F1 wilt (table, R6 and figure, R16). Regardless to cultivars, cortex thickness of radish irrigated with Fc profoundly exceeded that of wilt, particularly with Corox F1 which revealed that drought reduced its cortex thickness by 320 %, on the other hands drought reduction of cortex thickness in Altox F1 approached 70%. Once more, Altox F1 showed its capability in resisting drought. Drought resistance cultivars usually showed potency in reducing the yield gap between their

irrigated and droughted plants. This reduction, in general can be achieved through sustaining reasonable source sink of assimilate production and distribution. Meng *et al.* (1999) reported that net photosynthetic rate (A) had a significant negative correlation with stomatal density due to a marked reduction in (A) induced by severe drought; this is not consistent with the present results. The disparity may be due to the age related leaf traits and soil drought severity. Xu and Zhou (2008) stated that youngest and most fully expanded leaves were used in gas exchange measurement, and the plants that were subjected

to more severe drought were not used because of leaf curliness. In addition, leaf stomatal conductance is closely associated with leaf age, decreasing more in older leaves compared with young leaves under a given stress (Yang *et al.*, 1995). Thus, compared to severe drought, the youngest leaves under moderate drought might favour more gas exchange, demonstrating an adaptation to environmental stress, and leading to high g_s and photosynthetic rate (A). On the other hand, moderate water stress always limits leaf A by both stomatal resistance and carboxylation inhibition (Schulze, 1986; Munne-Bosch *et al.*, 2003). Moreover, stomatal conductance does not always parallel changes in the photosynthetic capacity of tobacco plants (von Caemmerer *et al.*, 2004) and *S. dimidiatum* (Maherali *et al.*, 2002), thus highlighting the complexity in the relationship. However, Zhang *et al.* (2006) reported that the relationship between stomatal density, and g_s and photosynthetic rate (A) is positive under limited irrigation conditions, while Galmes *et al.* (2007) indicated that g_s is related to stomatal density for a wide range of water status.////The observed vascular bundle and vessels number of Altex F1 radish cultivars appeared to be increased under drought by 30 and 15% than that of irrigated, respectively (table, R6 and figures, R17 and 18). These increases can be adopted an interpretation for the superiority of Altex F1 in drought avoidance over other cultivars, particularly Topsi. Is this virtue gained by hormonal homeostasis and osmosis

homeostasis, as it was found that when plant roots are subjected to water stress, Abscisic acid (ABA) accumulation may be initiated by a drought-sensing mechanism located in the roots, where it can be exported, thus reducing water loss by stomatal regulation (Cominelli *et al.*, 2005; Gudesblat *et al.*, 2007). On the other hand, long-term soil drought can also lead to up-regulation of leaf osmotic pressure and lower water potential around the stomata while osmoregulation promotes greater g_s under moderate soil drought. Altex F1 drought resistance might be gained from its capability to facilitate gas exchange through stomata. Xu and Zhou (2008) revealed that a response of g_s to short-term low humidity was not observed, the relationship between g_s and stomatal density was positive under long-term drought. This implies that a stomatal density increase under long-term moderate drought may help to maintain the value of g_s to a certain extent, or even produce an acclimated increase in g_s . Yang *et al.* (2007) reported that the increase in stomatal density is positively correlated photosynthetic rate (A) diagrammatic representation of the effects of drought on stomatal density under the regulations by leaf growth (MD, moderate drought; SD, severe drought). MD may lead to an acclimated increase in stomatal density, but SD may reduce it partly because of guard cell inhibition. This synergy balance or trade-off may occur between the effects of both leaf growth and changes in stomatal density towards the variations in water status.

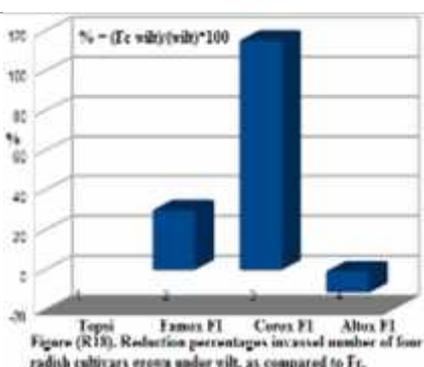
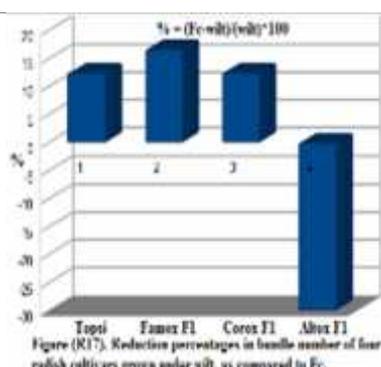
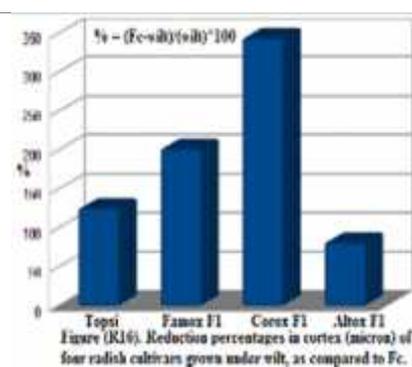


Table (R6): Thickness (μM) of petiole anatomy components of four radish cultivars grown in controlled cabinet under varying irrigation levels.

Temp.	Cuticle	Epidermis	Hypodermis	Cortex	Bundle no	Vessel number
0%T	B A 6.8750	A 44.375	B C D 84.38	D E 439.38	B 4.500	D C 17.375
0%F	A 7.5	B A 36.250	A 118.75	A 806.25	D 3.500	B A C 22.875
0%C	B A C 6.25	B A 39.375	E D 63.13	B A 721.88	B 4.500	B A C 22.125
0%A	A 7.5	B A 39.375	E C D 68.13	B C 618.75	D 3.500	B A C 23.125
33% T	D E 4.3750	B A 40	B E C D 76.88	D C 528.13	D 3.500	A 29.875
33% F	D E C 5	B A 36.875	B C D 83.75	D F E 390.63	E 3	B A 29
33% C	C-E 4.6875	B A 31.875	E D 58.13	D C E 484.38	E 3	B A C 23.875
33% A	D E C 5	B A 39.375	E C D 68.75	D C E 495	C 4	A 30.625
66% T	E 4.0625	B A 31.250	B C 93.75	D F E 384.38	A 5	B A C 21.750
66% F	A-D5.94	B A 41.875	B A 96.88	G F E 331.25	B 4.500	B A C 24.875
66% C	D E 4.3750	B A 31.250	E D 61.25	D F E 412.50	C 4	B A C 26.500
66% A	D E 4.3750	B A 32.500	B E C D 75	G F E 340.63	C 4	B D C 19.375
100%T	BDAC5.94	B 30	E 51.88	G H 195	C 4	D C 17.375
100%F	BDAC5.94	B A 32.188	E D 63.13	F- H 266.88	E 3	D C 17.500
100%C	B A C 6.25	B A 31.875	E D 58.75	H 162.50	C 4	D 10.250
100%A	B-E 5.3125	B A 38.125	E D 62.50	G F E 340.63	A 5	B A C 26.125

T= Topsis, F= Famox F1, C= Corox F1, A= Alttox F1, (*). Figures of unshared characters significantly differ at 0.05 level, Duncan

G. Cultivar responses to varying temperatures and irrigation levels

The obtained results (table, R7) revealed that the highest cuticle ($10\mu\text{m}$), epidermis ($62\mu\text{m}$), hypodermis ($171.25\mu\text{m}$), cortex ($1075\mu\text{m}$), bundle number (7) and vessel number per bundle (37.5) these were respectively detected in the triple combinations of Famox 0AWC 12°C , Topsis 0AWC 12°C , Famox 0AWC 12°C , Corox 0AWC 12°C , Alttox 100AWC 20°C and Famox 33AWC 12°C treatments. Radish grown under severe drought gave the highest cuticle thickness, (Famox F1 100AWC 12°C , $6.875\mu\text{m}$), epidermis thickness (Alttox F1 100AWC 12°C $51.25\mu\text{m}$), hypodermis thickness, (Alttox F1 100AWC 12°C , $87.5\mu\text{m}$), Cortex thickness, (Alttox 100AWC 20°C , $362.5\mu\text{m}$), vascular bundle number, (Alttox 100AWC 20°C , 7) and vessel number per bundle, (Alttox F1 100AWC 12°C , 22.75). These results suggested that Alttox F1 was the best drought resistance radish cultivars followed by Corox F1 and Famox F1, however, the worst was Topsis. The superiority might be referred to the capability of any given cultivar to cope with drought circumstance which

appeared on its stature. Only in turgid tissues strength is positively correlated with water potential. At water potentials beyond the wilting range, the slope of this relationship declined. Hence, it is evident that turgor affected tissue strength in both carrots and radishes. Furthermore, turgor governs tissue stiffness (Herppich *et al.*, 2004), which, in turn, affects tissue 'hardness' (De Belie *et al.*, 2000). A high turgor may tightly pack cells thus increasing the mechanical resistance against blade penetration (Hiller and Jeronimidis, 1996). This results in increased tissue strength and not in a weakening due to a cell wall overstretching as found after artificial turgor manipulation by immersion in pure water (Lin and Pitt, 1986). Both texture characteristics are related to the physical and chemical cell wall properties, to cell wall structure and to tissue water status and temperature, and their interactions (Tu *et al.*, 2000; Herppich *et al.*, 2003). On the other hand, the elastic properties are an important determinant of strength, toughness or crispness (Vincent, 1998), thus they assumed to provide an indirect means to nondestructively monitor temperature effects on the overall mechanical properties.

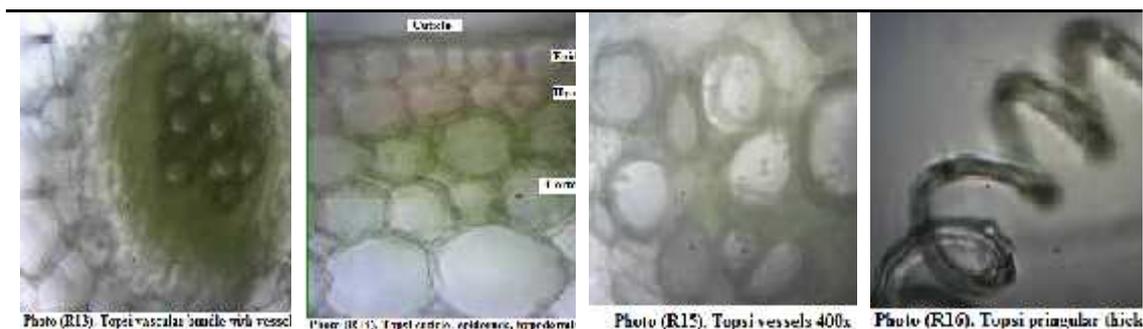


Table (R7): Thickness (μM) of petiole anatomy components of four radish cultivars grown in controlled cabinet under varying temperatures and irrigation levels

Temp:Irrig:Cvs	Cuticle	Epidermis	Hypodermis	Cortex	Bundlenumber	Vessel no.
20 0% T	D-G5	EF26.25	D-H75	B-F550	D4	B-G20.25
20 0% F	D-G5	C-F32.5	D-H66.25	B-G537.5	D4	B-G18.5
20 0% C	D-G5	F25	GH43.75	B-H468.8	B6	A-E28.5
20 0% A	C-E6.25	D-F30	F-H53.75	B-E562.5	D4	A-E28.75
20 33% T	D-G5	B-F41.25	C-F87.5	BC650	E3	A37.5
20 33% F	D-G5	B-F35	D-H67.5	B-I437.5	E3	B-G20.5
20 33% C	D-G5	D-F30	E-H56.25	BC625	E3	A-C31
20 33% A	D-G5	B-F35	F-H50	B-D583.8	C5	A-F24.25
20 66% T	G3.125	D-F31.25	B131.25	B-H475	C5	A-F25.5
20 66% F	D-G5	A-E46.25	BC118.75	B-H481.3	D4	A-D30.25
20 66% C	FG3.75	B-F35	D-H68.75	B-E562.5	E3	A-D28.25
20 66% A	FG3.75	B-F37.5	D-H75	D-K375	E3	B-G22
20 100% T	C-f5.63	D-F30	D-H66.25	JK177.5	C5	C-G17.5
20 100% F	D-G5	D-F30	F-H53.75	E-K321.3	E3	B-G22.75
20 100% C	C-E6.25	D-F28.75	GH45	JK175	C5	FG11.5
20 100% A	C-F5.63	F25	H37.5	D-K362.5	A7	B-G20
12 0% T	AB8.75	A62.5	C-E93.75	E-K328.8	C5	E-G14.5
12 0% F	A10	B-F40	A171.25	A1075	E3	A-E27.25
12 0% C	BC7.5	AB53.75	C-G82.5	A975	E3	DG15.75
12 0% A	AB8.75	A-D48.75	C-G82.5	B675	E3	C-G17.5
12 33% T	FG3.75	B-F38.75	D-H66.25	C-J406.3	D4	B-G22.25
12 33% F	D-G5	B-F38.75	C-D100	D-K343.8	E3	A37.5
12 33% C	E-G4.38	B-F33.75	E-H60	D-K343.8	E3	C-G16.75
12 33% A	D-G5	A-E43.75	C-F87.5	C-J406.3	E3	A37
12 66% T	D-G5	C-F31.25	E-H56.25	G-K293.8	C5	B-G18
12 66% F	B-D6.88	B-F37.5	D-H75	JK181.3	C5	B-G19.5
12 66% C	D-G5	EF27.5	F-H53.75	H-K262.5	C5	A-F24.75
12 66% A	D-G5	EF27.5	D-H75	F-K306.3	C5	C-F16.75
12 100% T	C-E6.25	D-F30	H37.5	I-K212.5	E3	C-G17.25
12 100% F	B-D6.88	B-F34.38	D-H72.5	I-K212.5	E3	FG12.25
12 100% C	C-E6.25	B-F35	D-H72.5	K150	E3	G9
12 100% A	D-G5	A-C51.25	C-F87.5	E-K318.8	E3	AB32.25

T= Topsi, F= Famox F1, C= Corox F1, A= Alttox F1, (*). Figures of unshared characters significantly differ at 0.05 level, Duncan

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COMPARATIVE THE DIFFERENT SOLVENTS AND SPAD CHLOROPHYLL METER FOR DETERMINATION SOME PHOTOSYNTHESIS PIGMENTS OF BEAN AND COWPEA PLANTS

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ABSTRACT

In this work, some photosynthetic pigments with acetone, methanol and diethyl ether were extracted spectrophotometrically, in addition to SPAD chlorophyll meter from bean (*Phaseolus vulgaris* L.) var. Biotack and cowpea (*Vignasinensis* Savi) var. California black eye leaves in vegetative, flowering and podding growth stages cultivated in Koya city, Erbil- Iraq. Results show that concentration of chlorophyll a in bean and cowpea leaves increased significantly when acetone used in the extraction process followed by methanol and the lowest was obtained when the diethyl ether was used, whereas methanol was the best solvent for extracting chlorophyll b. The concentration of chlorophyll a and b increased significantly in the flowering stage compared to vegetative and podding stages in bean plants and compared to vegetative growth in cowpea plants, whereas there were non-significant differences in total carotenoids with changing growth stage. Results also showed that there were non-significant differences in SPAD readings between different growth stages in both of bean and cowpea plants. SPAD readings correlated high significantly with chlorophylls a and b concentrations, when acetone used as solvent in cowpea plants.

KEYWORDS: bean, extraction solvents, cowpea, photosynthesis pigments, SPAD

INTRODUCTION

Chlorophyll pigments of the chloroplasts are responsible for the efficient capture of the solar energy in photosynthesis process. Chlorophylls a and b are the two most abundant chlorophylls. Carotenoids, the accessory pigments which assist in photosynthetic light harvest, and they prevented chlorophyll and thylakoid membrane from the damage of absorbed energy by photooxidation. The Carotenoids include majorly the red colored β -carotene and yellow colored xanthophyll. The foliar pigments content are varies depending on species. Chlorophylls and carotenoids can be isolated from green leaves by acetone, ether or other organic solvents. Chlorophyll a dissolves very well in petroleum ether while chlorophyll b in methyl alcohol. Different chlorophylls and carotenoids have a characteristic absorption spectrum, absorbing certain wavelengths of light more efficiently than the others. The absorbance properties of pigments facilitate the qualitative and quantitative analysis of them (Vechetel and Ruppel, 1992, Verma, 2008, Srivastava, 2010 and Nayek, *et al.*, 2014).

There is a trade-off between choosing the best solvent for efficient quantitative extraction of

chlorophylls and use of a solvent best suited for spectrophotometric assay. Acetone gives very sharp chlorophyll absorption peaks, but acetone is volatile, highly inflammable, it is narcotic in high concentrations and is a skin irritant, also plastic spectrophotometer cuvettes cannot be used for acetone based chlorophyll assays. Methanol is less volatile and flammable than acetone but is notoriously toxic. It cannot be used with plastic cuvettes. Diethyl ether is a very popular solvent for chlorophylls for research purposes, particularly for preparing pure pigments. It is extremely volatile, flammable, explosive and narcotic. The explosion hazard in particular restricts its use (Porra, *et al.*, 1989, Scheer, 1991, Ritchie, 2006 and Nayek, *et al.*, 2014).

Many studies were done on the effect of type of the solvent on the extracted pigments in different plants, for example Manuela, *et al.* (2012) found that for tomatoes, cherry tomatoes, pepper and cucumber vegetables crops the best extraction solvents for simultaneously determination of chlorophyll a and b and carotene were methanol and acetone. For cherry tomatoes and tomatoes the best extraction solvent was methanol for chlorophyll a and acetone for carotene. For peppers the best extraction solvent was acetone

and for cucumbers it was methanol. Variation coefficients were high, both between vegetable species and between tested varieties or hybrids. Kumar, *et al.* (2010) observed that ethyl acetate showed higher significance during the extraction process when compared to ethanol and acetone for some algal species.

The Soil-Plant Analyses Development (SPAD) unit of Minolta Camera Co. has developed the SPAD-502 chlorophyll meter (Minolta Camera Co., Japan), a convenient, and nondestructive lightweight device used to calculate the amount of chlorophyll present in plant leaves (Minolta, 1989). Calibration of SPAD measurements by spectrophotometric chlorophyll analysis. A nearlinear relationship was found between spectrophotometrically determined total chlorophyll content on fresh mass basis and SPAD values measured by a chlorophyll meter for bean seedling (Ineta, *et al.*, 2007).

The aim of this study is compares the use of three different solvents viz. acetone, methanol and, diethyl ether for determining chemical extraction capabilities of chlorophyll a, chlorophyll b and total carotenoids from bean and cowpea leaves in three different growth stages, it also aims to find the relationship between the chemical method for pigments extracting and the reading of SPAD chlorophyll meter instrument.

MATERIALS AND METHODS

Sample collection

Bean (*Phaseolus vulgaris* L.) var. Biotack and cowpea (*Vignasinensis* Savi) var. California black eye seeds were planted at 23 April in summer season 2015 in the Faculty of Science and Health, Koya University, Erbil-Iraq (44°38 E, 36 °4N and 517 m of altitude). Fifth leaf of a three separated plants were harvested from each species in three different growth stages, vegetative, flowering and podding.

The chlorophylls content were determined for each leaf separately by SPAD chlorophyll meter (SPAD-502, Japan) before the chemical extracting of pigments.

Chemical Extraction Process

The preweighed samples of the two species were put separately in aqueous solutions of acetone (80%), methanol (99%) and diethyl ether (99%). The extraction ratio was 1:50. The samples were grained using mortar and pestle and then the sample was filtered using filter paper. The supernatant was separated and concentration of chlorophyll a and b and total carotenoids were determined by using spectrophotometer (721-2000 SPECTROPHOTOMETER, China) with equations represented in table 1 (Lichtentaler and Wellburn, 1983).

Table (1): Equations used for measure chlorophyll a, b and total carotenoids by different extractant solvents in spectrophotometer.

Solvents	Equations
Acetone	$Chl_a = 11.75A_{662} - 2.35 A_{645}$
	$Chl_b = 18.61A_{645} - 3.96 A_{662}$
	$Car = 1000 A_{470} - 2.27 Chl_a - 81.4 Ch_b / 227$
Methanol	$Chl_a = 15.65A_{666} - 7.34 A_{653}$
	$Chl_b = 27.05A_{653} - 11.21 A_{666}$
	$Car = 1000 A_{470} - 2.86 Chl_a - 129.2 Ch_b / 245$
Diethyl ether	$Chl_a = 10.05A_{662} - 0.776 A_{644}$
	$Chl_b = 16.37 A_{644} - 3.14 A_{662}$
	$Car = 1000 A_{470} - 1.28 Chl_a - 56.7 Ch_b / 230$

Where:

Ch_{1a} chlorophyll a [mg/l]

Ch_{1b} chlorophyll b [mg/l]

Car = Total Carotenoids [mg/l]

A₆₆₂ absorbance at wavelength 662 nm

A₆₄₅ absorbance at wavelength 645 nm

A₄₇₀ absorbance at wavelength 470 nm

A₆₆₆ absorbance at wavelength 666 nm

A₆₅₃ absorbance at wavelength 653 nm

A₆₄₄ absorbance at wavelength 644 nm

For converting the concentrations from mg/l to mg/100 g fresh weight, each value multiplied by (extraction volume/ (sample weight*1000)).

Statistical Analysis

The treatments of all experiments replicate three times, and the comparisons between means

were made by using Least Significant different (LSD) test at 5% level (Reza, 2006). Correlation coefficient between SPAD reading and chemical method for pigment estimation were determined too. The statistical analysis was carried out by using SPSS program.

RESULTS AND DISCUSSION

In this study, chemical extraction by three different solvents and SPAD instrument were used to determine some photosynthetic pigments from fresh materials of bean and cowpea leaves on three different growth stages. Concentration of chlorophyll a, b and total carotenoids showed variations according to plant material used and to the solvent used in the chemical extraction in addition to the stage of growth.

Results in tables (2 and 3) shows that concentration of chlorophyll a in bean leaves increased significantly when acetone used in the extraction process followed by methanol and the lowest obtained when the diethyl ether was used, whereas, in cowpea there were no significant differences between acetone and methanol solvents, which they gave the highest values of chlorophyll a compared to diethyl ether solvent. This result is disagree with Nayek *et al.* (2014) who found that diethyl ether is the best solvent for extracting chlorophylls in some ferns. When methanol was used as solvent, chlorophyll b concentration increased in bean and cowpea leaves non-significantly compare to acetone and significantly compare to diethyl ether solvent, this result agree with Verma (2008), whom state that chlorophyll b dissolves very well in methyl alcohol. This different in chlorophyll a and b solubility is due to chlorophyll b differ from chlorophyll a only in one functional group (i.e -CHO) bounded to the porphyrin ring, and is more soluble than chlorophyll-a in polar solvents because of its carbonyl group (Lichtenthaler and Wellburn, 1983).

The acetone solvent enabled extracting significantly more total carotenoids compared to diethyl ether solvent, this result agrees with Manuela *et al.* (2012) whom cleared that acetone extraction recorded the best results in all analyzed vegetables: tomatoes, peppers and cucumbers carotene extracting. When performing methanol extraction, the content of total carotenoids was a negative values when the formulas were applied, therefore it consider as zero. Thus the selection of

the method and the solvent to be used in the studies in connection with pigments according to the plant species will be more useful (Sükranet *al.*, 1998).

The concentration of chlorophyll a and b increased significantly in the flowering stage compared to vegetative and podding stages in bean plants and compared to vegetative growth in cowpea plants, whereas there were non-significant differences in total carotenoids with changing the age of bean and cowpea plants (Table 2 and 3).

Bean plants records high concentration of chlorophyll a, b and total carotenoids when acetone solvent was used in the extraction process in the flowering stage (Table 2). Cowpea plant leaves record variation in the pigments concentration between different solvents and growth stages (Table 3). The values of chlorophyll a increased significantly by using acetone as extraction solvent in the flowering stage, whereas the lowest were record when diethyl ether was used in podding stage growth. Extracted chlorophyll b was increased significantly when methanol was used in the podding stage growth, whereas it decreased when each of acetone and diethyl ether solvents were used in podding stage growth. Total carotenoids increased significantly when diethyl ether was used in vegetative growth stage followed by using acetone in podding and flowering stages, whereas there were no total carotenoids where recorded when methanol solvent used for the extraction process.

Results in table 4 shows that although of the non-significant differences in SPAD meter readings between different growth stages in both of bean and cowpea plants, the flowering stage gave the highest values as it appear in the chemical method.

There were positive correlations between SPAD meter readings and chlorophyll concentrations determined by chemical method with different solvents for bean and cowpea plants (Table 5 and 6), this might be due to sampling method, because SPAD meter readings were taken from same leaves used for chemical chlorophyll extraction. SPAD meter readings correlated high significantly with chlorophylls a and b concentration, when acetone used as a solvent in cowpea plants (Table 6). This might be due to effectiveness of acetone in extracting chlorophylls compare to other solvents, especially diethyl ether for vegetables crops (Manuela *et al.* 2012), and attributed to inherent physiological characteristics

of cowpea which may contains other types of chlorophylls which reflects in the high value of SPAD meter reading (Table 4). This positive results found in previous studies of bean seedling (Inetaet *al.*, 2007), and other crops like St. Augustinegrass (*Stenotaphrum secundatum* (Walt.)

Kuntze, where SPAD meter readings were positively correlated with chlorophyll concentrations $r^2 = 0.79$ (Ian and Grady, 2000), and with extractable chlorophyll for eleven food crop species ($r^2 > 0.90$) (Marquard, and Tipton, 1987).

Table (2): Chlorophyll a, b and total carotenoids concentration for bean (*Phaseolus vulgaris* L.) extracted by different solvent in different growth stages.

Treatments	Chlorophyll a	Chlorophyll b	Total Carotenoids
	(mg/100 g fresh weight)		
Solvents			
Acetone	3.14 a	2.67 a	0.42 a
Methanol	2.49 b	2.95 a	0.00 c
Diethyl ether	1.06 c	1.76 b	0.29 b
Growth stage			
Vegetative	2.39 b	2.16 b	0.23 a
Flowering	2.81 a	3.11 a	0.25 a
Podding	2.03 c	2.14 b	0.24 a
Interaction			
Acetone x Vegetative	2.86 b	2.78 b	0.24 c
Acetone x Flowering	4.02 a	3.70 a	0.53 a
Acetone x Podding	2.54 bc	1.61 c	0.50 ab
Methanol x Vegetative	2.80 b	3.18 ab	0.00 d
Methanol x Flowering	2.58 bc	2.91 b	0.00 d
Methanol x Podding	2.10 cd	2.75 b	0.00 d
Diethyl ether x Vegetative	1.52 d	0.52 d	0.44 b
Diethyl ether x Flowering	1.83 d	2.75 b	0.23 c
Diethyl ether x Podding	1.60 d	2.05 c	0.21 c
Mean	2.41	2.47	0.24
S.E.	0.051	0.049	0.008

Means followed by the same letters within column are not significantly different at $p = 0.05$ according to the least significant differences (LSD) test.

Table (3): Chlorophyll a, b and total carotenoids concentration for cowpea (*Vignasinensis* Savi) extracted by different solvent in different growth stages.

Treatments	Chlorophyll a	Chlorophyll b	Total Carotenoids
	(mg/100 g fresh weight)		
Solvents			
Acetone	3.03 a	2.79 a	0.41 a
Methanol	2.88 a	3.20 a	0.00 c
Diethyl ether	1.69 b	1.74 b	0.34 b
Growth stage			
Vegetative	2.37 b	2.05 b	0.25 a
Flowering	2.74 a	2.86 a	0.24 a
Podding	2.49 ab	2.82 a	0.26 a
Interaction			
Acetone x Vegetative	2.78 b	2.80 bc	0.24 b
Acetone x Flowering	3.66 a	3.38 ab	0.49 a
Acetone x Podding	2.65 bc	2.18 c	0.50 a
Methanol x Vegetative	2.46 bcd	2.57 bc	0.00 c

Methanol x Flowering	2.90 ab	2.95 abc	0.00 c
Methanol x Podding	3.27 ab	4.07 a	0.00 c
Diethyl ether x Vegetative	1.87 cde	0.77 d	0.52 a
Diethyl ether x Flowering	1.66 de	2.24 bc	0.24 b
Diethyl ether x Podding	1.55 e	2.21 c	0.27 b
Mean	2.53	2.58	0.25
S.E.	0.071	0.097	0.011

Means followed by the same letters within column are not significantly different at $p = 0.05$ according to the least significant differences (LSD) test.

Table (4): Chlorophyll meter SPAD reading in different growth stages for bean and cowpea plants

Growth stage	Bean	Cowpea
Vegetative	46.17 a	65.60 a
Flowering	50.83 a	72.33 a
Podding	42.33 a	65.17 a
Mean	46.44	67.70
S.E.	2.88	3.26

Means followed by the same letters within column are not significantly different at $p = 0.05$ according to the least significant differences (LSD) test.

Table (5): Correlation relationship at $p = 0.05$ between chlorophyll meter SPAD reading and different pigments extracted by different solvents for bean plants.

SPAD reading	Acetone			Methanol		Diethyl Ether		
	Ch. A	Ch.b	Car.	Ch. a	Ch.b	Ch. a	Ch.b	Car.
	0.39	0.40	0.08	0.31	0.21	0.52	0.21	0.07 N.S.
	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	

Table (6): Correlation relationship at $p = 0.05$ between chlorophyll meter SPAD reading and different pigments extracted by different solvents for cowpea plants.

SPAD reading	Acetone			Methanol		Diethyl Ether		
	Ch. A	Ch.b	Car.	Ch. A	Ch.b	Ch. a	Ch.b	Car.
	0.80	0.82	0.03	0.39	0.20	0.53	0.25	0.09
	**	**	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

CONCLUSIONS

Results from this experiment clearly indicate that extraction of photosynthetic pigments by different solvents depends on chemical nature of the pigments (chlorophyll a, chlorophyll b and carotenoids). Investigation reveals for each of bean and cowpea plants, acetone was the best extracting solvent for chlorophyll a and total carotenoids, whereas methanol for chlorophyll b. No significant differences observed in the SPAD chlorophyll meter reading between different growth stage for both of bean and cowpea plants. Further experiments is needed to assess the effect of solvents dilution for obtain the highest concentrations of pigments.

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INFLUENCE OF GA₃ AND LIQUORICE ROOT EXTRACT ON SOME STORAGE CHARACTERISTICS OF PEAR FRUITS (*Pyrus communis* L.) cv. Le-CONTE

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ABSTRACT

The present study was carried out on fruits of Le-Cont pear trees (*Pyrus communis* L.) in the research center of Agriculture Collage/ Duhok University / Kurdistan Region-Iraq, during growing season of 2013, to investigate the effect of GA₃ (0, 75 and 150 mg l⁻¹) and liquorice root extract (0, 7.5 and 15 g l⁻¹) on fruit storage behavior of Le-Conte pear fruits. The results showed that the fruit dipped in 150 mg l⁻¹ GA₃ (after a storage period of 51 day at 0±1°C.) caused a significant increase in fruit firmness and ascorbic acid. On the other hand, the fruit dipped in 15 g l⁻¹ liquorice root extract was significantly increased titratable acidity after storage period. Whereas TSS and total sugars were increased in control treatment. Concerning the post-harvest disorders, also there were significant effects of GA₃ and liquorice root extract in decreasing each of core breakdown and superficial scald percentage after storage period especially at 75 mg l⁻¹ GA₃ and 15 g l⁻¹ liquorice root extract respectively.

KEYWORDS: Pear, GA₃, liquorice root extract.

INTRODUCTION

The Le-Conte pear (*Pyrus communis* L.) is a cultivar named by John Eatton Le-Conte, who introduced it to Georgia in 1856. A well known old pear cultivar is Le-Conte - which is thought to be a hybrid between the Chinese Sand pear and a European pear, with parentage similar to Kieffer pear, which it immensely likens in both tree and fruit. The tree is medium in size, a vigorous grower and a yearly bearer, the fruits are a beautiful bell shape and pink-blushed golden color, Le-Conte pear fruits has a soft melting texture. It will ripen on the trees or can be picked when the ground color lightens slightly for long period storage (Adicks, 1978).

Plant growth regulators are used to improve fruit size and quality, extend the storage period and to increase the profitability in some fruits (Lawes and Woolley, 2001 and Greene, 2003). Gibberellins are beginning synthesized just after flowering and their synthesis shows a correlation with fruit growth (Palavan-Unsal, 1993). Gibberellins play an important role in fruits set and development (Zhang, *et al.*, 2008). Due to their role in fruit development, gibberellins are widely used to enhance fruit size (Ozga and Reinecke, 2003). The gibberellins slow fruit

climacteric respiration, ethylene synthesis and fruit softening (Ben-Arie, *et al.*, 1989). Among the wide range of gibberellins, the most widely used ones are GA₃ and GA₄ (Hedden, 1999).

Recently the plant extracts were used to improve the vegetative growth and the yield of many crops through its influences in different physiological activities in the plants. Liquorice is the root of *Glycyrrhiza glabra* from which a sweet flavor liquid can be extracted. The liquorice plants are herbaceous perennial leguminous to southern Europe, India, and parts of Asia. Much of the sweetness in liquorice comes from glycyrrhizin and some sugars, which has a sweet taste, 30–50 times the sweetness of sugar. The glabrene and glabridin are found in the roots of liquorice and they are phytoestrogens. Also liquorice extract contains some nutrients like K, P, Mg, Na, Mn, Fe, Zn, Cu and Co (Somjen *et al.*, 2004).

Al-Gawary (2002) found that the liquorice root extract has the similar influence of GA₃ or act by the similar way. The liquorice root extract induce cell division and cell elongation due to GA₃ content so that it increased the vegetative growth and induced flowering and fruit set and also liquorice root extract contains carbohydrates which are used by the growing plant and the liquorice root

extract increased plant content of auxins (Mossa, *et al.*, 2002 and Al-Alawy, 2004).

The aim of the study was to find out the influence of GA₃ and liquorice root extract on storage quality of pear fruits cv. Le-Conte.

Materials and Methods

This study was carried out during 2013 growing season on pear fruits (*Pyrus communis* L.) cv. Le-Conte, grown at orchard of horticulture/ College of Agriculture / Duhok University. The selected trees were 20 years old, uniform in size and growth as possible, and received all required service operations through growing season.

The fruits of pear were harvested manually at optimal commercial date on 6 October 2013 and transported in plastic boxes to the Research Center of Agriculture College, then the fruits were placed directly in cold room (1°C) for pre-cooling treatment, after that, sound fruits were selected uniformly in size, shape and color.

The fruits of Le-Conte cv. were dipped in three GA₃ concentrations (0, 75 and 150 mg l⁻¹) at 20°C for 7 minutes. Other sound fruits of Le-Conte were dipped in three levels of liquorice root extract (0, 7.5 and 15 g l⁻¹) then the fruits of all treatments were left to dry on clean thick cloth piece, and then the fruits of each treatment were put in perforated polyethylene bags, closed tightly. In addition four replications for each treatment with 12 fruits / replicate were put for weight loss and physiological disorders, and then stored in cold room at 0 ± 1°C and 85-90 % RH for stored for 51 days.

The pear fruits parameters were taken after 51 days of cold storage. All fruit quality characteristics were done on 12 fruits.

1. Firmness (Lb/cm²): Measured by using hand penetrometer with a plunger of 7.8mm (5/16 inch) in diameter (Kitinoja and Kader, 2002).

2. Total soluble solids (TSS) %: Were determined by table refractometer (A.O.A.C, 2000).

3. Total sugars (%): Was estimated by using the techniques of Seyoun (2002) after which the absorbance was determined by Jenway model 6100 spectrophotometer at 450nm (Joslyn, 1970).

4. Ascorbic acid (V.C mg/100ml juice): Was determined by 2, 6- di-chloro-phenol indo-phenol (A.O.A.C, 2000).

5. Titratable Acidity (TA %): Expressed as percent of malic acid, was obtained by titrating 10 ml of juice with 0.1N NaOH (A.O.A.C, 2000).

6. Physiological injuries (Core breakdown and Superficial scald) %: Was determined as percentage after the end of storage period by the equation (number of infected fruits/total number of fruits)*100 (Abd-Elghany *et al.*, 2012).

Statistical analysis: Data were evaluated statistically analyzed as Complete Randomized Design (C.R.D.). The data were analyzed by SAS program (2002). Duncan's test at 0.05 level has been used for means comparing (Duncan, 1955). An arcsine square-root transformation was performed on percent data.

RESULTS

Firmness (Lb/cm²) It was observed from Table (1) that pear fruits dipped in all concentrations of GA₃ and levels of liquorice was significantly superior on control treatment, especially fruit dipping in 150 mg GA₃ l⁻¹ which gave the highest fruit firmness (25.62 Lb./cm²) as compared with non treated fruits, which had the lowest fruit firmness (16.1 Lb./cm²). Whereas, there were no significant differences among all concentrations GA₃ and liquorice levels.

Total soluble solid (TSS%) Table (1) indicates that the fruit total soluble solid percentage after storage period was significantly high when the fruit were non dipped in GA₃ in comparison with 150 mg l⁻¹ GA₃ and 15 g l⁻¹ liquorice root extract. So it can be seen that the highest TSS was showed in fruits of control (16.6 %). Whereas the lowest value was obtained in liquorice root extract treatment (14.68 %).

Table (1): Influence of GA₃ and liquorice root extract on pear fruit firmness (lb.), TSS% and total sugars (g/100ml juice).

Treatments	Parameters		
	Firmness (lb/cm ²)	TSS %	Total sugars(g/100ml juice)
Control	16.1 b	16.6 a	14.39 a
GA ₃ 75 mg l ⁻¹	23.31 a	15.26 ab	13.14 ab
GA ₃ 150 mg l ⁻¹	25.62 a	14.93 b	12.84 b
Liquorice 7.5 gl ⁻¹	24.48 a	15.04 ab	12.93 ab
Liquorice 15 gl ⁻¹	25.44 a	14.68 b	12.61 b

* The same letter with columns indicates that there is no significant difference by DMRT (p = 0.05)

Total sugars (g/100 ml juice)

With regard to total sugars, untreated fruits were significantly more total sugars (14.39 g/100 ml juice) as compared with the least total sugars in juice which resulted when fruit dipped in liquorice root extract 15 gl⁻¹ and 150 mg l⁻¹ GA₃ respectively (Table 1).

Ascorbic acid (V.C mg/100ml juice)

It is clear from the results in the table (2) that ascorbic acid of pear fruits when dipped in 150 mg l⁻¹ was higher significantly (0.317 mg/100 ml juice) as compared with lower ascorbic acid (0.217 mg/100 ml juice) in the fruits of control treatment.

Table(2): Influence of GA₃ and liquorice root extract on pear fruit ascorbic acid (mg/100 ml juice) and titratable acidity (%).

Treatments	Parameters	
	Ascorbic acid (mg/100 ml juice)	Titratable acidity (%)
Control	0.217 b	0.237 c
GA ₃ 75 mg l ⁻¹	0.283 ab	0.268 bc
GA ₃ 150 mg l ⁻¹	0.317 a	0.297 ab
Liquorice 7.5 gl ⁻¹	0.283 ab	0.262 bc
Liquorice 15gl ⁻¹	0.267 ab	0.333 a

Titratable Acidity (TA %)

Liquorice root extract (15 gl⁻¹) treatment had significant effect on TA (%) of LeCont pear fruits which gave the highest value of TA (0.333 %) as compared to lowest value of TA (0.237%) which obtained in control fruits (Table 2).

Core breakdown (%)

From table (3) it can be shown that all concentrations of GA₃ and Liquorices root extract was significantly superior on control treatment, in decreasing the core breakdown as compared with fruits of control.

Table (3): Influence of GA₃ and liquorice root extract on pear fruit core breakdown(%) and superficial scald (%).

Treatments	Parameters	
	Core breakdown (%)	Superficial scald (%)
Control	61.82 b	28.65 b
GA ₃ 75 mg l ⁻¹	33.85 a	15.00 a
GA ₃ 150 mg l ⁻¹	21.13 a	18.05 a
Liquorice 7.5 gl ⁻¹	27.82 a	28.12 b
Liquorice 15gl ⁻¹	18.34 a	16.68 a

Superficial scald (%) It is obvious from table (3) that fruits of untreated and fruit dipped in 7.5 g l⁻¹ liquorice root extract had significantly higher percentage of superficial scald. On other hand we can say that fruits dipped in GA₃ at two concentrations or in 15 g l⁻¹ liquorice root extract was efficient effect in lowering the percentage of superficial scald.

DISCUSSION

The results appeared that the effect of fruit dipped in GA₃ concentrations at (0, 75 and 150 mg l⁻¹) and liquorice root extract levels (0, 7.5 and 15 g l⁻¹) in tables (1 - 3) on pear fruits cv. Le-Conte storage characteristics. It was showed from the (Table 1) that fruit dipped in 75 and 150 mg l⁻¹ GA₃ and in liquorice root extract levels (7.5 and 15 g l⁻¹) recorded significantly higher fruit firmness (Ib) as compared to control, this result might be due to the function of GA₃ in decreasing the activities of pectin methylestrase and polygalacturonases enzymes, thus GA₃ treatment preserve fruit firmness by their inhibitory effects on these enzymes (Andrews and Li, 1995). Al-Gawary (2002) found that the influence of liquorice root extract was the similar impact as the influence of GA₃. Also Al-Marsomy (1999) found that the liquorice root extract has the same effects of GA₃ on all parameters of growth and fruits quality, because it contains mevalonic which is the base of GA synthesis. The effectiveness of GA₃ in preserving fruit firmness might be due to a decrease in different physiological activities associated with the softening of fruit (Rees, 1975). The mechanism ripening retarded by GA₃ has not been clearly elucidated, but it is supposed to act at the gene level, or through modifying the effect of other hormones such as IAA (Osman, 2002). Also GA₃ and ethylene have opposite effects on fruit senescence and ripening (Scott and Leopold, 1967). These results are similar with result reported by El-Fakharany *et al.*, (1995) and Singh and pal (2006) on apple fruits cv. Anna and Red Delicious respectively; Cline and Trough, 2007 and Canli and Orhan (2009) on sweet cherry fruits and Siddiqui *et al.*, (2013) on mango fruits cv. Himsagar; Kirmani *et al.*, (2013) on plum fruits cv. Santa Rosa and Hassan, (2015) on local apple cv. Xank.

It is clear from table (1) that fruit dipped in 150 mg.l⁻¹ GA₃ and fruit dipped in 15 g.l⁻¹ liquorice root extract were significantly less of total soluble

solid and total sugar percentage as compared with control. The decrease in total soluble solid as result of GA₃ treatments might be to delay in fruit ripening (El-Shazly *et al.*, 2013). As well as, sugars are considered the main component of soluble solids in fruits; sugars resulted from the degradation of starch during ripening to sugars (John and Marshal, 1995). The postharvest effect of GA₃ on banana fruit green life show the prolonged green and yellow life because of the delay in the deterioration of cellulose, hemicelluloses, starch and conversion to soluble sugar, since the GA₃ affects both the degradation of synthesis sucrose and complex carbohydrates, as well as to extend shelf-life of fruits (Rosseto *et al.*, 2003). Reduced in total sugar might be due to effect of GA₃ on reduce the rate of respiration, and therefore reduce the transmission rate of starch to sugars (Patil *et al.*, 2014). Similar results were obtained by Hussein *et al.*, (2001) on apple fruits cv. Anna and Dorestt Golden; Lolaei *et al.*, (2013) on strawberry fruits; El-Shazly *et al.*, (2013) on peach fruits cv. Swelling; Hassan, (2015) on local apple cv. Xank and Osman, (2002) on banana.

Fruit dipped in 150 mg l⁻¹ GA₃ and fruit dipped in 15 g l⁻¹ liquorice root extract recorded significantly the higher vitamin C and titratable acidity respectively as compared to control in table (2). This result might due to GA₃ which was a possible cause delay in oxidation of vitamin C by retarding the ripening processes (Jain and Mukherjee, 2001), also GA₃ lower the rate of respiration as well as delay the ripening of fruit by reduction or inhibiting the production of CO₂ (Duguma *et al.*, 2014). This result agreement with reported by Al-Azeerjawi (1998) on orange fruits; Mahajan *et al.*, (2011) on guava fruits cv. Allahabad Safeda and Hassan, (2015) on local apple cv. Xank.

From table (3) we can see there is significant effect of fruits dip in all GA₃ and liquorice root extract concentrations as compared with control in decreasing core breakdown. Also fruit dip in two concentrations of GA₃ and in 15 g l⁻¹ liquorice root extract were significant in decreasing of superficial scald as compared with control and with 7.5 g l⁻¹ liquorice root extract. The damage on the skin of the fruit is caused by conjugated trienes produced after oxidation of -farnesene (Huelin and Coggiola 1970). Also, it has been suggested that the content of natural antioxidants (like -tokopherol) plays an important role in preventing oxidation of -farnesene and consequently scald

development (Meir and Bramlage, 1988). Vasilakakis and Manseka (1995), when working with Delicious fruits, found that late harvested apples, resistant to scald, had increased levels of antioxidants. The same authors working with "G. Smith" found that GA₃, or temperature, as pre-storage treatments, had a positive effect on reduction of scald %. Vasilakakis and Thomai (1999) found that application of GA₃ (3000 mg l⁻¹), as a spray after harvest and then storage at 20 °C for 4 days, before storage at 0 °C, significantly reduced scald by 12%. However, combination of GA₃ (2000 mg l⁻¹) and storage at 20 °C for 4 days resulted in 25% scald reduction, meaning that there was an additive effect. The role of GA₃ on scald incidence needs further investigations.

CONCLUSIONS

According to these results, all treatments of GA₃ and liquorice root extract were superior to control in increasing fruit firmness and decreasing core breakdown. The high concentration of GA₃ and high level of liquorice root extract were better in maintaining TSS and total sugar percentage and increasing ascorbic acid and titratable acidity than control. Also, fruit dipped in all concentrations of GA₃ and all levels of liquorice root extract (except low level) were significantly superior to control in decreasing superficial scald.

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EFFECT OF CALCIUM CARBONATE, CALCIUM CHLORIDE AND STORAGE PERIOD ON SOME FRUIT CHEMICAL CHARACTERISTICS OF TWO APPLE CULTIVARS

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ABSTRACT

Apple Fruits of 'Golden Delicious' and 'Red Delicious' cultivars were harvested by hand from chosen trees at the morning of 22 Sep 2013 in the fully mature stage from a commercial orchard in Bagera, and transferred directly on the same day to the Laboratory of Research Centre - Agriculture College - Duhok University- Duhok Governorate - Kurdistan region- Iraq. Fruits divided to groups depending to the treatments under study. Then fruits dipped for 3 minutes in the solutions of variant source of calcium (CaCO_3 and CaCl_2), at (0, 2, 4% CaCO_3 , and 2, 4% CaCl_2) for each storage period, after that fruit stored at $0\pm 1^\circ\text{C}$ and 85-90%RH in the cold storage. The results appeared that the fruit total acidity% of Golden Delicious superior significantly on Red Delicious fruits, in contrary of that vitamin C, Ca, K and P% were higher in Red Delicious fruits than Golden Delicious but not reached to the significant. Fruit dipped in 4% CaCl_2 had significantly maximum total acidity compared to the other treatments, while other parameters under the study not influenced significantly by dip fruit in all solutions of CaCO_3 and CaCl_2 during storage. In general the interaction among the three factors under the study has more effective on fruit quality parameters than the alone effect of each factor.

KEY WORD; apple, storage period, CaCO_3 and CaCl_2

INTRODUCTION

Apple (*malus domestica* L.) is a popular fruit in Iraq. Generally, commercial and local cultivars are widely and successfully grown in the Kurdistan region -Iraq. Apple has a long storage period and shelf life and its quality deteriorates after harvest delayed. Though postharvest quality of a produce after harvest can be maintenance, it is possible to reduce the rate of quality loss. The rate of deterioration physiological decay of fruit is directly related to the respiration rate (Kader *et al.* 1989). Surface treatments delay physiological decay in fruit tissues, stabilize the fruit surface and prevent degradation that affects the quality of the product, they also rinse the enzymes and substrates released from injured cells during cutting operations from the product surface (Glenn and poovaiah, 1990). Calcium (Ca^{2+}) has been extensively reviewed as both an essential element and its potential role in maintaining postharvest quality of fruit and vegetable crops, the role of calcium in stabilizing cellular membranes and delaying senescence in horticultural crops is well known (Naem *et al.*, 2009). Postharvest calcium

application maintains cell turgor, membrane integrity, tissue firmness and delays membrane lipid catabolism, extending storage life of fresh fruits (Picchioni *et al.*, 1998). Pre and postharvest application of calcium may delay senescence in fruits with no detrimental effect of consumer acceptance (Lester and Grusak, 2007). Applied calcium stabilizes the plant cell wall and protects it from cell wall degrading enzymes (White and Broadley, 2003). Calcium (Ca^{2+}) has been extensively reviewed as both an essential element and its potential role in maintaining postharvest quality of fruit and vegetable crops (Kirkby and Polbeam, 1984) by contributing to the linkages between pectic substances within the cell-wall, the presence of (Ca^{2+}) ions increases the cohesion of cell-walls (Demarty *et al.*, 1984). Saleh, (2003) showed that dip apple fruit in CaCl_2 solution at level 3 and 6% caused significantly increase in Ca% in apple fruits during cold storage. They reported that respiratory rate and ethylene production correlate negatively with Ca content in apples, both at harvest and in extended cold storage. (Recasens *et al.*, 2004). Increasing the Ca content of apples maintains fruit firmness,

decreases the incidence of disorders such as water core, bitter pit, and internal breakdown (Dierend and Rieken, 2007). Studies have demonstrated that the rate of senescence often depends on the calcium status of the tissue and by increasing calcium, various parameters such as respiration, protein, chlorophyll content and membrane fluidity are altered (Poovaiah, 1986). Generally it is accepted that Ca tissue concentrations should exceed 250 mg.g⁻¹ dry weights to control such physiological disorders as breakdown and bitter pit (Meheriuk and Moyls, 1989). To improve quality or decrease decay of fruits significantly, it is necessary to raise the tissue Ca level from 800 to 100 mg.g⁻¹ concentrations, surface injury of the fruit may be caused when the level of Ca is higher than 1000 mg.g⁻¹ (Conway and Sams, 1985). Research has shown postharvest treatments of Ca lead to improve fruit firmness, and ratio of soluble solid concentration to titratable acidity (Kadir, 2005).

The Aim Of Study

It is necessary to conduct search in the effect of calcium on post-harvest management of fruit, which will help in progressing storage life of apple fruit, so the purpose of this study is to study the role of dipping fruit of two apple cultivars in calcium on the quality and storage life of apple fruit during cold storage.

MATERIALS AND METHOD

“Golden Delicious” and “R Delicious” apple trees were 20 years old, the apple trees planted at a distance of (5*5m) received the regular agricultural and horticultural practices that usually carried out in the apple trees orchard. The mature fruits were harvested by hand from chosen tree of the two cultivars at the morning of (22 Sep 2013) by hand and special scissors carefully to avoid the fruits from mechanical injuries in the fully mature stage from a commercial orchard in Bagera, and transferred directly on the same day to the laboratory of Research Center-Agriculture College-Duhok University-Duhok-Kurdistan region-Iraq. After that fruits pre cooled in cold room. Next day sound fruit with uniform size, color and appearance randomly selected. Subsequently fruit were washed with distilled water to remove any dirt, and then divided to groups depending to the treatment under study. Fruits dipped for 3 minutes in the solutions of variant source for calcium (CaCO₃ and CaCl₂), as

a treatment at concentration (0, 2, 4% CaCO₃ and 2, 4% CaCl₂) for each storage period, fruit distributed to 3 replicates /treatment and 15 fruit/replicate. After that fruit were placed in plastic bags according to its treatments, and stored at 0±1°C and 85-90% RH in the cold storage. A sample of randomly selected 10 fruits after 2 months and 4 months was collected from each replication in a treatment for analysis during the storage period;

Data of the following parameters was recorded.

Measurement

Titratable acidity (TA%) and Ascorbic acid content (Vitamin C ml.100ml juice) were determined in clear juice of fruit by using recommended method of A.O.A.C (2000) and fruit Mineral Con. Ca, N, K and P measured depending to (Bhargava and Raphupathi, 1999) in fruit dry weight as below:

Nitrogen (%): it was determined by the Microkjelhadahl method.

Phosphorus (%): it was determined with colorimetric method using Spectrophotometer Pharmacia LKB.

Potassium (%): it was determined by the flame photometer.

Ca (mg.Kg⁻¹): spectrophotometer determined using atomic absorption.

The experiment designed out as factorial experiment, in Randomized Complete Block Design (RCBD) including three factors (2 cvs*2 storage periods*5 Ca Conc.), with three replicated and 15 fruits for each replicate in each storage period (AL-RAWI AND KHALAFALLA, 2000).

Data were tabulated and statistically analyzed with computer using SAS program (SAS, 2002).

The differences between various treatment means were tested with Duncan Multiple Range test at 0.05 levels.

RESULTS AND DISCUSSION

I-Titratable acidity (TA%): It is clearly from table (1) that fruit of Golden Delicious apple superior fruit of Red Delicious significantly on fruit TA%. Dipping fruit of apple in CaCO₃ and CaCl₂ affected significantly on fruit TA% content, the highest total acidity resulted from dip fruit in 4% CaCl₂, this result was significantly different from other treatment except 2% CaCl₂, but total acidity of fruit not affected by storage period.

According to the interaction between cultivars and storage period the result showed that the TA%

of fruit in the interaction between Golden Delicious and both storage period(2and 4)months was significantly higher than the TA of interaction between Red Delicious and (2 or 4) months storage period.

The interaction between Golden Delicious and (2 or 4 % CaCl₂) give significantly the maximum value of fruit TA as compared with other interaction treatments .Highest TA obtained from the interaction of 2 months storage and 4% CaCl₂ .

In the same table the interaction among Golden Delicious cultivars, 2 months and 2% CaCl₂.The increase of TA% in fruit dipped in calcium might Attributed to accumulation of Ca in cell wall which leading to making easy in cross linking of the pectic polymers which leading to increase the strength of cell wall and cell tenacity.Our result was agree with the result reported by (Shirzaden *et al* .,(2011)) when they dipped apple fruit in CaCl₂ solution.

Table (1): Effect of cultivars, Ca source, storage period and their interactions on total acidity (TA %) of apple fruit stored at (0±1)⁰C.

Cultivars(cvs.)	Storage period(SP.) month	Concentration (%)					cvs. * sp.	Mean of cvs.
		CaCO ₃			CaCl ₂			
		0	2	4	2	4		
Red Delicious	2	0.138 G	0.160 d-g	0.147 e-g	0.127 g	0.180 c-f	0.150 b	0.155 b
	4	0.171 c-f	0.169 c-f	0.129 g	0.162 d-g	0.167 c-g	0.16 b	
Golden Delicious	2	0.160 d-g	0.169 c-g	0.167 c-g	0.247 a	0.254 A	0.199 a	0.196 a
	4	0.196 b-d	0.189 b-e	0.140 fg	0.229 ab	0.212 a-c	0.193 a	
cvs.*Con.	Red Delicious	0.154 b-d	0.165 b-d	0.138 d	0.144 cd	0.174 Bc	mean of SP.	
	Golden Delicious	0.178 B	0.179 b	0.153 b-d	0.238 a	0.233 A		
SP.*Con.	2	0.149 De	0.164 b-e	0.157 c-e	0.187 a-c	0.217 A	0.175 a	
	4	0.183 Bc	0.179 b-d	0.134 e	0.196 ab	0.189 Ab	0.176 a	
Mean of Con.		0.166 C	0.172 bc	0.146 d	0.191 ab	0.203 A		

Number with similar letters are statistically not different from one another (p<0.05).

2- Vitamin C(ml.100ml juice):

There were no significant different between the two apple cultivars Red Delicious and Golden Delicious in juice vitamin C during cooled storage.Also vitamin C content not influenced by prolonged of storage period or dip apple fruit in (Ca%) solution (table 2).

Data in the same table conformed that the interaction of Red Delicious .cv plus 2 months storage was significantly better treatment when

compared to other interactions. Nevertheless ,fruit juice vitamin C not affected significantly by the interaction between apple cvs.and Ca% solution through cooled storage.

The highest fruit juice vitamin C was noticed from the interaction between 2 months storage and control, but the lowest fruit juice vitamin C was observed from the interaction between 2 months storage and 4% CaCl₂. Depending to the triple

interaction of the factors under study, we can observed that the maximum fruit juice vitamin C appeared at the interaction among Red Delicious plus 2 months storage plus untreated fruit which

was significantly vary from the interactions among Golden Delicious plus 2 months storage plus 4% CaCl₂ which gave the minimum fruit juice vitamin C.

Table (2): Effect of cultivars, Ca source, storage period and their interactions on Vitamin C (ml . 100 ml juice) of apple fruit stored at (0±1)⁰C.

Cultivars (cvs.)	Storage period(SP.) month	Concentration (%)					cvs.* sp.	Mean of cvs.
		CaCO ₃		CaCl ₂				
		0	2	4	2	4		
Red Delicious	2	1.440 A	1.368 ab	1.369 a	1.296 ab	1.225 a-c	1.340 a	1.253 a
	4	1.152 a-c	1.244 a-c	1.152 a-c	1.224 a-c	1.080 Bc	1.166 b	
Golden Delicious	2	1.296 Ab	1.152 a-c	1.296 ab	1.152 a-c	1.008 C	1.180 b	1.195 a
	4	1.224 a-c	1.152 a-c	1.152 a-c	1.224 a-c	1.296 Ab	1.209 b	
cvs.*Con.	Red Delicious	1.296 A	1.296 a	1.260 a	1.260 a	1.152 A	mean of SP.	
	Golden Delicious	1.260 A	1.152 a	1.224 a	1.188 a	1.152 A		
SP.*Con.	2	1.368 A	1.260 a-c	1.332 ab	1.224 a-c	1.116 C	1.260 a	
	4	1.188 a-c	1.188 a-c	1.152 bc	1.224 a-c	1.188 a-c	1.188 a	
Mean of Con.		1.278 A	1.224 a	1.242 a	1.224 a	1.152 A		

Number with similar letters are statistically not different from one another (p<0.05).

3- Calcium(mg.Kg⁻¹) results clearly showed the apple cultivars, storage period and all Ca solution had no significant effect on Ca% content of fruit dry weight (table 3). Also the interaction between cv. and storage period was not affected significantly on fruit dry weight Ca content. Regarding the interaction of cv. And Ca concentration it was noticed that the higher Ca concentration obtained from Red Delicious and 4% CaCO₃, which was significantly differ from the interaction between Golden Delicious and 4% CaCO₃ only.

From the effect of the interaction between storage period and Ca solution, the maximum value of Ca was recorded by the interaction of 2 months storage and 2% CaCO₃ as compared with most other interaction treatments. In respects with interaction of three studied factors, the interaction of Red Delicious plus 2 months storage plus 2% CaCO₃ resulted higher Ca concentration in fruit dry weight, where as the interaction among Golden Delicious plus 2 months storage plus 4% CaCO₃ gave the lowest concentration of Ca in fruit dry weight.

Table (3): Effect of cultivars, Ca source, storage period and their interactions on Ca(mg.Kg⁻¹) of apple fruit stored at (0±1)⁰C.

Cultivars(cvs.)	Storage period(SP.) month	Concentration (%)					cvs. * sp.	Mean of cvs.
		CaCO ₃			CaCl ₂			
		0	2	4	2	4		
Red Delicious	2	423.8 Cd	1113.90 a	756.9 a-d	965.8 a-c	511.4 b-d	759.4 a	788.0 a
	4	1069.7 Ab	539.3 b-d	1060.0 ab	840.1 a-c	574.2 a-d	816.6 a	
Golden Delicious	2	795.0 a-c	701.7 a-d	178.4 d	831.1 a-c	520.3 b-d	605.3 a	636.9 a
	4	496.5 b-d	748.6 a-d	532.1 b-d	708.5 a-d	857.7 a-c	668.7 a	
Cvs.*Con.	Red Delicious	746.7 A	839.1 a	908.4 a	902.9 a	542.8 Ab	mean of SP.	
	Golden Delicious	645.7 Ab	725.2 ab	355.3 b	769.8 a	689.0 Ab		
SP.*Con.	2	609.4 Cd	920.4 a	467.6 c	898.4 ab	515.8 Bc	682.3 a	
	4	783.1 b-d	643.9 b-d	796.1 a-c	774.3 b-d	716.0 b-d	742.6 a	

Number with similar letters are statistically not different from one another (p<0.05).

4-Nitrogen(N%): It is completely appeared from the table (4) that the apple cultivar, storage period, Ca% solution, interaction between cultivar and storage period, cultivar and Ca% solution and interaction of storage period and Ca% solution dip does not cause any significant effect in N% concentration of fruit dry weight when compared with untreated fruit of each factor alone or with binary interaction between factors under study.

On the other hand the tripartite interaction of the factors affected significantly on fruit N%. The maximum N% observed from the interaction of Red Delicious plus 4 months storage plus 4% CaCO₃, which was higher significantly from the interaction Red Delicious plus 2 months storage plus 4% CaCl₂ only.

Table (4): Effect of cultivars, Ca source, storage period and their interactions on N (%) of apple fruit stored at $(0\pm 1)^{\circ}\text{C}$.

Cultivars(cvs.)	Storage period(SP.) month	Concentration (%)					cvs. * sp.	Mean of cvs.
		CaCO ₃		CaCl ₂				
		0	2	4	2	4		
Red Delicious	2	0.392 ab	0.392 ab	0.336 ab	0.373 ab	0.261 b	0.350 a	0.379 a
	4	0.317 ab	0.354 ab	0.541 a	0.454 ab	0.373 ab	0.408 a	
Golden Delicious	2	0.448 ab	0.410 ab	0.448 ab	0.336 ab	0.429 ab	0.414 a	0.390 a
	4	0.373 ab	0.354 ab	0.429 ab	0.354 ab	0.317 ab	0.365 a	
cvs.*Con.	Red Delicious	0.354 a	0.373 a	0.438 a	0.414 a	0.317 a	mean of SP.	
	Golden Delicious	0.410 a	0.382 a	0.438 a	0.345 a	0.373 a		
SP.*Con.	2	0.420 a	0.401 a	0.392 a	0.354 a	0.345 a	0.382 a	
	4	0.345 a	0.354 a	0.485 a	0.404 a	0.345 a	0.387 a	

Number with similar letters are statistically not different from one another ($p < 0.05$).

5- Potassium (K%): The result recorded in table(5) appeared that the Red Delicious cv. surpass on Golden Delicious cultivar in K% concentration significantly. In addition of that the result in the same table appeared that K% not affected significantly by storage period and all Ca concentration reveals that the interaction between Red Delicious and 4 months storage gave the highest value of K% which was significantly different from other interaction. The maximum value of K% in fruit recorded in the interaction of Red Delicious apple and untreated fruit, while the

lowest value of K% appeared by the interaction between Golden Delicious and 4 months storage. Also data of the same table illustrates that the interaction between 4 months storage and untreated fruit had significantly higher K% only when compared with interaction of 2 months storage and 2% CaCl₂. In the case of triple interaction among the factors under study. It I found that the combination among Red Delicious plus 4 months storage and control was the best interaction compared to the lowest value from the interaction of Golden Delicious, 2 month storage and 4% CaCO₃.

Table (5): Effect of cultivars, Ca source, storage period and their interactions on K (%) of apple fruit stored at $(0\pm 1)^0$ C.

Cultivars(cvs)	Storage period(SP.) month	Concentration (%)					cvs. * sp.	Mean of cvs.
		CaCO ₃		CaCl ₂				
		0	2	4	2	4		
Red Delicious	2	4.278 a-c	4.278 a-c	4.411 ab	3.779 b-d	4.013 a-d	4.152 b	4.318 a
	4	4.709 A	4.477 ab	4.378 a-c	4.478 ab	4.378 a-c	4.484 a	
Golden Delicious	2	3.482 D	3.740 b-d	3.383 d	3.681 b-d	3.947 b-d	3.647 c	3.664 b
	4	3.880 b-d	3.482 d	3.482 d	3.813 b-d	3.746 b-d	3.681 c	
Cvs.*Con.	Red Delicious	4.494 A	4.378 a	4.394 a	4.128 a-c	4.195 ab	mean of SP.	
	Golden Delicious	3.681 Cd	3.611 d	3.433 d	3.747 b-d	3.846 b-d		
SP.*Con.	2	3.880 Ab	4.009 ab	3.897 ab	3.730 b	3.980 ab	3.899 a	
	4	4.295 A	3.980 ab	3.930 ab	4.145 ab	4.062 ab	4.082 a	
Mean of Con.		4.087 A	3.994 a	3.913 a	3.938 a	4.021 a		

Number with similar letters are statistically not different from one another ($p < 0.05$).

6- Phosphor(P%): Table(6) shows that P% concentration in apple fruit dry weight not influenced significantly by the three factors under study each along or bilateral interaction or the triple interactions among the factors. The difference between fruit of Red Delicious and Golden Delicious apple in chemical

parameter as response to treatment (CaCO₃ and CaCl₂ concentration) and strong period might be due to the variance in it is genetic. The result of this study was similar to the result of (Ghafiret *al.*, (2009) in comparison among fruit of four apple cvs.

Table (6): Effect of cultivars, Ca source, storage period and their interactions on P (%) of apple fruit stored at (0±1) °C.

Cultivars(cvs.)	Storage period(SP) month	Concentration (%)					cvs.* sp.	Mean of cvs.
		CaCO ₃			CaCl ₂			
		0	2	4	2	4		
Red Delicious	2	0.367 a	0.526 a	0.394 a	0.301 a	0.639 A	0.445 a	0.452 a
	4	0.620 A	0.395 a	0.432 a	0.376 a	0.470 A	0.458 a	
Golden Delicious	2	0.451 A	0.244 a	0.395 a	0.432 a	0.394 A	0.383 a	0.409 a
	4	0.545 A	0.338 a	0.432 a	0.470 a	0.395 A	0.436 a	
cvs*Con.	Red Delicious	0.493 A	0.460 a	0.413 a	0.338 a	0.554 A	mean of SP.	
	Golden Delicious	0.498 A	0.291 a	0.413 a	0.451 a	0.394 A		
SP.*Con.	2	0.409 A	0.385 a	0.394 a	0.366 a	0.516 A	0.414 a	
	4	0.582 A	0.366 a	0.432 a	0.423 a	0.432 A	0.447 a	
Mean of Con.		0.495 A	0.376 a	0.413 a	0.394 a	0.474 A		

Number with similar letters are statistically not different from one another (p<0.05).

CONCLUSION

Depending to our result that calcium(CaCO₃ and CaCl₂) dips deals the retention of acidity in fruit of both cvs. of apple Red Delicious and Golden Delicious during storage and the effect of the interaction among the three factors under study were more than the effect of each factor alone in vitamin C, Calcium, Nitrogen, and potassium content of apple fruit. Also Red Delicious fruit superior on Golden fruit in vitamin C, Calcium, Potassium, and phosphor concentration of fruit.

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EFFECT OF TIPPING, LATERAL SHOOTS REMOVAL AND SPRAYING OF CYCOCEL ON GROWTH, YIELD AND QUALITY OF GRAPEVINE (*Vitis vinifera* L.) cv. TAIFI

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ABSTRACT

A field experiment was carried out in a private vineyard located at Atrush village, Duhok governorate, Kurdistan region, Iraq, during 2015 growing season to investigate the effect of tipping, lateral shoots removal, spraying of three concentrations (0, 250 and 500 mg.l-1) of CCC and their interaction on growth, yield and quality of ' Taifi' grapes. The results indicated that Tipping and both concentration of CCC significantly decreased shoot length; while removing of lateral shoots significantly increased shoot length. Tipping significantly increased leaf area, total chlorophyll content, number of clusters per vine, yield as well as TSS and total sugars percentage, whereas removing of lateral shoots significantly increased cluster weight, TSS and total sugars percentage. Spraying of CCC also have significant effect since increasing concentration tend to increasing number of clusters, cluster weight, yield and TSS and total sugars percentage. The interaction between the studies factors varied in their effect on the traits, the most important interaction was the interaction of tipping + removal of lateral shoots + spraying of CCC.

KEYWORD: tipping, lateral shoots, CCC, grape, Taifi.

INTRODUCTION

The grapevine is a fruit species of very ancient origins. From the Caucasian area, its cradle of origin, it spread first in the Mediterranean area and later across the world thanks to its marked adaptability to highly diversified soil and climatic conditions (Lacirignola & Digiario, 1997; Al-saidi, 2014). The species has characterized for centuries wide areas where it is used both for direct consumption (above all in the Asian and North African regions) and for wine processing (Al-saidi 2014)

Taifi variety is planted in Duhok, Erbil and Sulaymaniyah governorates, especially in the irrigated areas. It is also planted in rain-fed areas with deep and wet soils. There are several clones of this variety, including Egaimy, Ebraheemi, Omeeri, and Taefee-Koya. It is considered to be a good table grape. The inflorescence of this variety is hermaphroditic and it is a good pollinator for the pistillate varieties (USAID, 2005).

Tipping and lateral shoot removal is to achieve a balance between vegetative growth and crop levels and to achieve maximum interception of light. While avoiding excessive canopy growth

that can shade grape clusters and interior leaves, leading to poor quality grapes and fruitful buds. Leaving too much crop on a grapevine delays maturity, limits vegetative growth, and can lead to reduction in vine size and death of the vine. Leaving too little crop can lead to excessive shoot growth, canopy shading and lower return crop, because shaded buds are less fruitful than buds exposed to sunlight. The overall goal is to achieve an adequate ratio of leaf area to crop level (Hellmann 2004). Tipping shortens the branch and it releases the buds behind it, interrupting apical dominance, the buds are held from opening by the release of a Hormone (auxin) manufactured by the last (terminal) bud, now the remaining bud is free to open and the buds behind this one (May 2004; Guerra 2006).

The excess shoot vigor may be detrimental because most of the metabolites are utilized for continuous vegetative growth. Therefore, it is necessary to reduce the excess vigor of vegetative growth without reducing the shoot number of the vine, which can be achieved with the application of growth retardants like Cycocel. Cycocel plays an important role in reducing the excess vigor in

grapes (Smirnov, 1988, Shikhamany and Reddy, 1989; Ramteke and. Somkumar, 2005).

Hunter (2000) investigated the effect of combinations of shoot positioning, topping, leaf removal and shoot removal treatments on yield and growth compensation of a vertically trellised *Vitis vinifera* L. cv. Sauvignon were spaced 2.75 x 1.5 m. Significant compensatory growth and yield was induced by the removal of lateral shoots. Chougule *et al.*, (2008) investigated the effect of canopy management and Cycocel application on yield and quality attributes, via: weight of bunch, length of berry, diameter of berry and weight of berry. The investigation was laid out on a four-year-old orchard of Thompson Seedless grape in factorial randomized block design. The treatment consist of: three cane densities (30, 35, 40 per vine); three leaf densities (14, 16 and 18 per cane) after October pruning with application of Cycocel at five concentrations (control, 250, 500, 750 and 1000 mg.l⁻¹) at five leaf stage after October pruning. Significantly highest yield, TSS acid ratio with attractive grayish yellow color of berries and significantly minimum acidity was recorded in cane density 35 per vine, leaf density 16 per cane with application of Cycocel 500 mg.l⁻¹ at 5 leaf stage after October. Collins and Dry (2009) studied the effect of shoot topping and (CCC) application on growth, fruit set and other yield components of the grapevine varieties Cabernet Sauvignon, Chardonnay and Tempranillo at two sites over two or three seasons. Treatments were applied before and during the flowering period. Fruit set and yield per vine increased in response to both shoot topping and CCC treatment, especially when CCC was applied 1 week before flowering. So this study is aims to investigate the seasonal canopy management practices, consisting of different combinations tipping, lateral shoots removal and plant growth retardants, were therefore applied in order to determine their effect on growth compensation as well as their impact on yield and related parameters. The study also presented an opportunity to re-evaluate existing canopy composition criteria by quantifying the whole canopy in terms of contribution of different leaf size groups to yield.

MATERIAL AND METHODS

A field trial on 15 years old vines of Taifi grapes was conducted during 2015 growing season. The vines were selected to be as uniform

as possible in vigor and grown in a private vineyard located at Atrush town, Duhok governorate. The vines were planted in clay soil spaced at 2 x 2.5 meters, the vines were trained of "T" trails training system. Winter pruning was done at the second week of March. Vine load was 63 buds (7 fruiting cane x 7 buds plus 7 renewals spurs x 2 buds).

This experiment included three factors, the first was tipping (Tipping and non-tipping), the second was lateral shoot removal (Removal and non-Removal) and the third factor was spraying with three concentration (0, 250 and 500 mg.l⁻¹) of CCC (Chloroethyl trimethylammonium chloride). It was applied twice per season first was two weeks before blooming and month later, Tween-20 was added as wetting agent at 0.1%.

A randomized complete block design with three factors was followed in the experiment. Every treatment consisted of one vine per replicate with three replications, so the numbers of vines used were 36 vines. The vines were sprayed with CCC solutions till run off (1 L/vine). The traditional horticultural practices (winter pruning, irrigation, weed control ...etc.) were applied as usual. Potential effects of tipping, lateral shoot removal and spraying of CCC were evaluated in terms of the change in shoot length, leaf area, number of clusters, cluster weight, yield, total soluble solid and total sugar percentage. All results were analyzed statistically by using SAS programs (2003). Duncan's multiple tests (DMRT) at 5% level of portability was used to compare the treatments means according to Al-Rawi and Kalafalla (2000).

RESULTS AND DISCUSSION

1- Shoot length (cm):

Tipping and Cycocel sprays with both concentrations significantly influence the vigor of Taifi vines, as indicated by reducing shoot length, whereas removing of lateral shoots significantly increased shoot length (Table 1). However, there was significant reduction in main shoot length from 150.07 cm in non-tipping to 127.85 cm in tipping and from 153.03 cm in control to 131.19 cm in Cycocel applied at 500 mg.l⁻¹, while it increased from 134.49 to 143.43 cm with lateral shoot removed. Duple interaction between the study factors also shows significant influences, since the longest shoot length was with the interaction of non-tipping + removal of lateral shoots, non-tipping + 0 CCC and removal + 0

CCC. the triple combination effect among the three study factors also showed significant differences since the highest shoot length was

obtained with the interaction of non-tipping + removal + 0 CCC.

Table (1): Effect of tipping, lateral shoot removal and spraying CCC on shoot length (cm) of grapevine cv. Taifi.

Tipping	Lateral shoots removal	CCC (mg.l ⁻¹)			Tipping * Removal	Main effect of Tipping
		0	250	500		
Non-tipping	Non-removal	163.35 ab	138.22 cde	135.52 cde	145.70 a	150.07 a
	Removal	174.26 a	147.25 bc	141.85 bcd	154.45 a	
Tipping	Non-removal	131.50 cde	118.30 e	120.06 de	123.29 b	127.85 b
	Removal	143.00 bc	126.88	127.34 cde	132.41 b	
Tipping * CCC	non-tipping	168.80 a	142.73 b	138.69 b	Main effect of	
	Tipping	137.25 bc	122.59 c	123.70 c	Removal	
Removal * CCC	Non-removal	147.43 ab	128.26 c	127.79 c	134.49 b	
	Removal	158.63 a	137.06 bc	134.60 bc	143.43 a	
Main effect of CCC		153.03 a	132.66 b	131.19 b		

Means with the same letter are not significantly different according to Duncan multiple ranges test at 5% level.

2- Leaf area (cm²):

It is clear from table 2 that tipping had significant effect on leaf area of vine cv. Taifi, highest leaf area (175.36 cm²) was recorded in tipping vine compared to the lowest leaf area (156.79 cm²) resulted from tipped vine. Whereas both lateral shoot removal and spraying CCC did not significantly influence the leaf area of Taifi vine (Table 2). However, there were significant effects of the duple interaction between tipping, lateral shoot removal and CCC spraying, the

maximum leaf area (180.10, 179.00 and 179.35 cm²) was resulted from the interaction of tipping + removal, tipping + 0 CCC and removal + 0 CCC respectively.

The triple interaction also showed significant influence in the leaf area, the maximum leaf area (184.48 cm²) was obtained from the interaction among tipping, removal and non-sprayed vine compared to the minimum leaf area (150.40 cm²) obtained from the interaction among non-tipped, removal and spraying 500 mg.l⁻¹ CCC.

Table (2): Effect of tipping, lateral shoot removal and spraying of CCC on leaf area (cm²) of grapevine cv. Taifi.

Tipping	Lateral shoots removal	CCC (mg.l ⁻¹)			Tipping * Removal	Main effect of Tipping
		0	250	500		
Non-tipping	Non-removal	154.12 bcd	152.38 cd	154.01bcd	153.50 c	156.79 b
	Removal	174.22 a-d	155.60 bcd	150.40 d	160.07 bc	
Tipping	Non-removal	173.51 a-d	169.84 a-d	168.52 a-d	170.62 ab	175.36 a
	Removal	184.48 a	176.83 abc	179.00 ab	180.10 a	
Tipping * CCC	non-tipping	164.17 ab	153.99 b	152.20 b	Main effect of	
	Tipping	179.00 a	173.33 a	173.76 a	Removal	
Removal * CCC	Non-removal	163.82 ab	161.11 b	161.26 b	162.06 a	
	Removal	179.35 a	166.21 ab	164.70 ab	170.09 a	
Main effect of CCC		171.58 a	163.66 a	162.98 a		

Means with the same letter are not significantly different according to Duncan multiple ranges test at 5% level.

3- Number of clusters per vine (cluster.vine⁻¹):

Tipping, lateral shoot removal and spraying of CCC was significantly influence on No. of clusters per vine (Table 3), since the highest number of clusters were obtained from vines tipped, lateral shoot non-removed and sprayed with 500 mg.l⁻¹ CCC which were 27.89, 28.22 and 28.70 clusters.vine⁻¹ respectively.

For the interaction same table obvious that duple interaction between tipping and non-removal, tipping and spraying 500 mg.l⁻¹ of CCC and non-removal and spraying 500 mg.l⁻¹ of CCC

recorded the top number of clusters per vine (29.77, 29.90 and 31.03 clusters.vine⁻¹) respectively. The triple interaction among the three study factors also affected significantly on the number of clusters per vine, the top number (32.37 clusters.vine⁻¹) was resulted from the interaction of tipping + non-removal + spraying 500 mg.l⁻¹ of CCC compared with the less number (19.31 clusters.vine⁻¹) was resulted from the interaction of non-tipping + removal + 0 CCC.

Table (3): Effect of tipping, lateral shoot removal and spraying of CCC on No. of clusters per vine of grapevine cv. Taifi.

Tipping	Lateral shoots removal	CCC (mg.l ⁻¹)			Tipping * Removal	Main effect of Tipping
		0	250	500		
Non-tipping	Non-removal	24.67 bc	25.67 bc	29.68 ab	26.67 b	24.35 b
	Removal	19.31 d	21.43 cd	25.34 bc	22.03 c	
Tipping	Non-removal	28.00 ab	28.94 ab	32.37 a	29.77 a	27.89 a
	Removal	25.31bc	25.31bc	27.42 ab	26.01 b	
Tipping * CCC	non-tipping	21.99 c	23.55 bc	27.51 a	Main effect of Removal	
	Tipping	26.65 ab	27.13 a	29.90 a		
Removal * CCC	Non-removal	26.33 bc	27.31 b	31.03 a	28.22 a	
	Removal	22.31 d	23.37 cd	26.38 bc	24.02 b	
Main effect of CCC		24.32 b	25.34 b	28.70 a		

Means with the same letter are not significantly different according to Duncan multiple ranges test at 5% level.

4- Cluster weight (g.cluster⁻¹):

The application of tipping had no significant effect on cluster's weight, whereas both lateral shoot removal and spraying of CCC with both concentrations significantly increased cluster weight. Highest cluster's weight (488.05 and 511.65 g.cluster⁻¹) was obtained by the application of lateral shoot removal and spraying vines with 500 mg.l⁻¹ CCC respectively (Table 4). Non-removal of lateral shoots and no treatment of CCC (control) resulted in the lowest cluster's weight (434.35 and 410.06 g.cluster⁻¹) respectively.

The combination effect between the study factors palpable that the highest cluster's weight

(500.57, 516.81 and 533.66 g.cluster⁻¹) were resulted by the duple combination of tipping + shoot removal, non tipping + spraying 500 mg.l⁻¹ CCC and shoot removal + spraying 500 mg.l⁻¹ CCC respectively. Concerning the triple combination among the three study factors, the highest value (546.92 g.cluster⁻¹) was obtained by the triple combination of non-tipping + lateral shoot removal + spraying 500 mg.l⁻¹ CCC compared to the lowest value (344.52 g.cluster⁻¹) was by the combination of non-tipping + non-lateral shoot removal + no treatment with CCC (control).

Table (4): Effect of tipping, lateral shoot removal and spraying CCC on cluster weight (g.cluster⁻¹) of grapevine cv. Taifi.

Tipping	Lateral shoots removal	CCC (mg.l ⁻¹)			Tipping * Removal	Main effect of Tipping
		0	250	500		
Non-tipping	Non-removal	344.52 e	411.85 cde	486.70 abc	414.36 b	444.94 a
	Removal	385.19 de	494.49 abc	546.92 a	475.53 a	
Tipping	Non-removal	446.52 a-d	423.90 b-e	492.58 abc	454.33 ab	477.45 a
	Removal	464.01 a-d	517.30 ab	520.41 ab	500.57 a	
Tipping * CCC	non-tipping	364.85 b	453.17 a	516.81 a	Main effect of	
	Tipping	455.26 a	470.60 a	506.50 a	Removal	
Removal * CCC	Non-removal	395.52 b	417.87 b	489.64 a	434.35 b	
	Removal	424.60 b	505.89 a	533.66 a	488.05 a	
Main effect of CCC		410.06 c	461.88 b	511.65 a		

Means with the same letter are not significantly different according to Duncan multiple ranges test at 5% level.

5- Yield (Kg.vine⁻¹):

Application of tipping and Cycocel sprays with high concentrations was significantly influence the yield of Taifi vines; whereas removing of lateral shoots had no significant influence (Table 5). However, there were significant increases in mean yield from 10.893 in non-tipping to 13.319 Kg.vine⁻¹ in tipping and from 10.037 in control to 14.650 in application of 500 mg.l⁻¹ of Cycocel. The duple Interaction between the study factors also showed significant influences, since the maximum yield (13.546, 15.094 and 15.247 kg.vine⁻¹) were with the interaction of tipping + non-removal of lateral shoots, tipping + 500 mg.l-

1 of Cycocel and non-removal + 500 mg.l⁻¹ CCC respectively, the minimum yield (10.579, 7.954 and 9.576 kg.vine⁻¹) were with the interaction of non-tipping + removal of lateral shoots, non-tipping + 0 CCC and removal of lateral shoots + 0 CCC.

The effect of combination among the three study factors also showed significant differences since the highest yield (15.849 kg.vine⁻¹) was obtained from the combination of tipping + non-removal of lateral shoots + 500 mg.l⁻¹ of Cycocel compared to the lowest yield (7.415) was resulted from the combination of non-tipping + removal of lateral shoots + 0 CCC ..

Table (5): Effect of tipping, lateral shoot removal and spraying CCC on yield (Kg.vine⁻¹) of grapevine cv. Taifi.

Tipping	Lateral shoots removal	CCC (mg.l ⁻¹)			Tipping * Removal	Main effect of Tipping
		0	250	500		
Non-tipping	Non-removal	8.493 de	10.486 cde	14.644 ab	11.208 b	10.893 b
	Removal	7.415 e	10.554 cde	13.768 abc	10.579 b	
Tipping	Non-removal	12.504 abc	12.284 abc	15.849 a	13.546 a	13.319 a
	Removal	11.736 bcd	13.199 abc	14.340 ab	13.091 a	
Tipping * CCC	non-tipping	7.954 d	10.520 c	14.206 ab	Main effect of	
	Tipping	12.120 bc	12.741 abc	15.094 a	Removal	
Removal * CCC	Non-removal	10.499 c	11.385 c	15.247 a	12.377 a	
	Removal	9.576 c	11.876 bc	14.054 ab	11.835 a	
Main effect of CCC		10.037 b	11.630 b	14.650 a		

Means with the same letter are not significantly different according to Duncan multiple ranges test at 5% level.

6- TSS (%):

Table 6 obviously shows that application of tipping, lateral shoot removal and spraying of CCC significantly influence on total soluble solid percentage, since the highest percentage of TSS were obtained from vines tipped, lateral shoot

removed and sprayed with 500 mg.l-1 CCC which were 17.45, 17.41 and 17.92 % respectively.

For the interaction same table obvious that duple interaction between tipping and removal of lateral shoots, tipping and spraying 500 mg.l-1 of CCC and removal of lateral shoots and spraying

500 mg.l⁻¹ of CCC recorded the top values of juice total soluble solid (18.04, 18.20 and 19.02 %) respectively, the triple interaction among the three study factors also affected significantly on the juice total soluble solid, the top number (19.16

%) was resulted from the interaction of tipping + removal of lateral shoots + spraying 500 mg.l⁻¹ of CCC compared with the less number (11.90 %) was resulted from the interaction of non-tipping + non-removal + 0 CCC.

Table (6): Effect of tipping, lateral shoot removal and spraying CCC on TSS of grapevine cv. Taifi.

Tipping	Lateral shoots removal	CCC (mg.l ⁻¹)			Tipping * Removal	Main effect of Tipping
		0	250	500		
Non-tipping	Non-removal	11.90 f	14.27 e	16.41b-e	14.19 b	15.49 b
	Removal	14.73 de	16.76 a-d	18.87 a	16.79 a	
Tipping	Non-removal	15.38 cde	17.95 ab	17.24 abc	16.86 a	17.45 a
	Removal	16.90 a-d	18.06 ab	19.16 a	18.04 a	
Tipping	Non-tipping	13.31 d	15.52 c	17.64 ab	Main effect of	
* CCC	Tipping	16.14 bc	18.00 a	18.20 a	Removal	
Removal	Non-removal	13.64 c	16.11 b	16.82 b	15.52 b	
* CCC	Removal	15.82 b	17.41 b	19.02 a	17.41 a	
Main effect of CCC		14.73 c	16.76 b	17.92 a		

Means with the same letter are not significantly different according to Duncan multiple ranges test at 5% level.

Total sugar (%):

Application of tipping, lateral shoots removal and Cycocel sprays with both concentrations significantly influence the total sugar percentage of Taifi grape (Table 7). However, there were significant increases in mean total sugar percentage from 17.54 in non-tipping to 20.29 % in tipping and from 17.82 non-removal to 20.00 % in removal of lateral shoots and from 16.85 in control to 20.61 % in application of 500 mg.l⁻¹ of Cycocel. The duple Interaction between the study factors also showed significant influences, since the maximum total sugar percentage (21.62, 21.54 and 21.28 %) were with the interaction of tipping + removal of lateral shoots, tipping + 500 mg.l⁻¹

of Cycocel and removal + 500 mg.l⁻¹ of CCC respectively, the minimum total sugar % were with the interaction of non-tipping + non-removal of lateral shoots, non-tipping + 0 CCC and non-removal of lateral shoots + 0 CCC.

The triple combination among the three study factors also showed significant differences since the highest total sugar % (22.49) was obtained from the combination of tipping + removal of lateral shoots + 500 mg.l⁻¹ of Cycocel compared to the lowest total sugar % (13.52) was resulted from the combination of non-tipping + non-removal of lateral shoots + 0 CCC .

Table (7): Effect of tipping, lateral shoot removal and spraying CCC on total sugars (%) of grape cv. Taifi

Tipping	Lateral shoots removal	CCC (mg.l ⁻¹)			Tipping * Removal	Main effect of Tipping
		0	250	500		
Non-tipping	Non-removal	13.52 g	17.27 ef	19.26 cde	16.69 c	17.54 b
	Removal	15.99 f	19.09 cde	20.07 bcd	18.38 b	
Tipping	Non-removal	17.68 def	18.57 cde	20.60 abc	18.95 b	20.29 a
	Removal	20.19 abc	22.20 ab	22.49 a	21.62 a	
Tipping	Non-tipping	14.76 d	18.18 c	19.67 bc	Main effect of	
* CCC	Tipping	18.94 bc	20.38 ab	21.54 a	Removal	
Removal	Non-removal	15.60 c	17.92 b	19.93 a	17.82 b	
* CCC	Removal	18.09 b	20.64 a	21.28 a	20.00 a	
Main effect of CCC		16.85 c	19.28 b	20.61 a		

Means with the same letter are not significantly different according to Duncan multiple ranges test at 5% level.

It is known that photosynthetic activity of leaves as well as export of photo-assimilates increase as a result of improved canopy microclimate and lower source: sink ratio (Hunter *et al.*, 1995; Koblet *et al.*, 1996; Ramteke and Somkumar, 2005), since application of some practice of canopy management such as tipping, lateral shoots removal and spraying with retardant growth regulators have significant effect on improving canopy microclimate. It's clear from table (1) that tipping caused decrease in shoot length due to the remove of the end of the shoots which stopped the continues of shoot growth, whereas tipping significantly improved other characteristics of Taifi grape, the reason of increasing single leaf area may be due to that the tipping increased the growth of remaining leaves (Pisciotta *et al.*, 2005), where removes the impact of apical dominance and thus stimulates the growth of lateral shoots and increases the number of shoots and consequently increases the number of leaves and leaf area (Al-Hawezi, 2008). The increase in yield represent in number of cluster per vine and cluster weight may be due to the increase in leaf area (Table 2) and photosynthetic produces, where the direction of translocation is reversed down to clusters (Abdul-Qader, 2006), seeing as the tipping reduced the competition between the clusters on the tipped shoots, for assimilates in the leaves available to cluster weight developing which in turn reduced abscission of clusters and berries (Barbuhari, 2014). The increase in TSS and total sugar percentage could be due to an increase in available assimilates produced by photosynthesis to the clusters (Barbuhari, 2014), that would have impacted on the distribution of carbohydrates and probably counterbalanced the positive effects of an improved microclimate and related reactions.

The lateral shoot correctly invested assimilates in the expansion of the assimilating surface (Candolfi-Vasconcelos and Castagnoli, 2006). The increase in a shoot length, single leaf area and chlorophylls could be due to a sufficient accumulation of reserves required for the growth of these leaves (Candolfi-Vasconcelos and Koblet, 1990), additionally this overtopping could be attributed to the increasing of leaf surface of main shoot (Candolfi-Vasconcelos and Castagnoli 2001), furthermore making remaining leaves more active photo-synthetically (Hunter and Visser 1989) contributing to the increase of the leaf area

and chlorophyll content of the main shoots (Candolfi-Vasconcelos and Castagnoli 2001).

The spraying of growth retardant (CCC) obvious to decrease shoot length because of its role in retardation of shoot elongation, whereas had significant effect of improving leaf area, No. of clusters per vine, cluster's weight, yield per vine and total soluble solid and total sugar percentage (Table 2-7), these results may attributed to that the Cycocel (CCC) is impediments in plant growth which is about organic aromatic materials which are called (Aromatic organic materials), Its effects can be summarized as working to prevent the synthesis of nucleic acid (RNA) and protein and reduce the elasticity and the flexibility of the cell wall of plant cells, and the production of enzymes for metabolism of carbohydrates and protein, and others because they prevent the disappearance of histones on acid molecules (DNA) leading to prevent the production of enzymes and reduces the permeability of the cell wall and thus lower permeability of water and mineral needed for growth, division of plant cells, the formation of flowers and reduce production auxin encouraging the growth, gibberellins and Cytokinin in the plant (Jundiai, 2003).

CONCLUSION

According to the experimental results of this study, the most important conclusions can be expressed as follows:

1. Both tipping and spraying of Cycocel markedly reduced shoot length whereas removal of lateral shoots significantly increased shoot length. On the other hand, tipping, spraying of Cycocel and removal of lateral shoots significantly improved Leaf area, number of clusters per vine, cluster weight, yield and TSS and total sugar percentage.
2. Moreover tipping was more effective in properties undertaken in this study followed by spraying of Cycocel then removal of lateral shoots.
3. spraying of Cycocel with 500 mg.l⁻¹ noticeably increased properties undertaken in this study except shoot length.

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EVALUATION OF THE GREEN SPACES IN THE UNIVERSITY OF DUHOK (UOD) CAMPUS

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ABSTRACT

This study was performed in 2009 in the University of Duhok (UoD) campus to evaluate the green spaces (quantity and quality) accordance to the international standard criteria by use GIS technology, Satellite images and Survey all green spaces (gardens, yards, and streets) and record its areas, plants numbers and conduct personal to evaluate the degree and rank of each site, Analysis and evaluation (Results) can summarized as the following. Generally the summation of green area in UoD campus for all locations reach 15260 m² and the overall ratio reach 2.48 cm² for each person which was less than the international standard (2m²) but it decreased than the high standard by 2.52m² when compared, in the other side the total of the trees and shrubs reach 581. Although the green spaces in some campus locations were good and their ratio reach 12.41m²/person as in the sport college and they reach 7.17, 2.85, 2.17 m²/person for the Law and Politics, Administer and Economic and Art College respectively and came in the second, third and fourth rank with respectively whereas all other locations were less than the two international standards. Evaluate the green spaces (gardens and plants) by use the international standard for garden and plants judging we found that the best green area was in the Cultural Social Center which get high degree (9 from 10) then the sport and law college with (7) degree while the art and administer with 6 and 5 degree. The least locations which were getting the least degree of evaluated were ranged between 0 and 4 degree.

KEYWORDS: Green Spaces, University of Duhok.

INTRODUCTION

Green space is defined by European Commission as outdoor settings that contain a significant amount of vegetation which playing role in the urban micro-climate and in biodiversity (Hall, 2003; Sutton, 2008). Or as land, water and geological features which have been naturally colonized by plants and animals and which are accessible on foot to large numbers of residents (Gold, 1980; Box and Harrison, 1993; Woolley, 2005). The functions of green and natural open spaces which includes parks, athletic fields, water features, and nature areas used for activities like sports, picnicking, fishing, swimming is an important part of many people's daily lives and serve a number of functions in our community and providing places for active and passive recreation, so as they provides scope for relaxation, refreshment (Macnaghten and Urry, 2000). Also the landscapes and urban greens paces play a vital role in biodiversity, contribute to sheltering, shading and water protection, decreased local air temperatures and fundamental for building strong,

such communities will ensure continued success in attracting and generating investment and improving the quality of life for its residents (Ulrich, 1984; Tyrväinen, 1999; Yeang *et al.*, 2008). Nearby green space has been shown to enrich real estate prices and attract economic activity, as well as having manifold socio-cultural functions (Tyrväinen, 1999). Whilst the presence of plant in and around the office environment has a significant impact upon worker satisfaction which in turn affects productivity (Randall *et al.*, 1992).

Urban green spaces are now widely recognized as major contributors both to the quality of the environment, and to human health and well-being in inner city and suburban areas (Ulrich, 1984; Kaplan *et al.*, 1989). (Ulrich, 1979) show that viewing green space goes beyond aesthetic enjoyment to include enhanced emotional well-being, reduced stress and in certain situations improved health. Also Kaplan *et al.* (1989) show that vegetation and nature reinforce our spontaneous attention, allow our sensory apparatus to relax and infuse us with fresh energy. Watson *et al.* (2003) insure that the difference in surface temperature

between grass and asphalt can easily exceed 25°F and each acre of turf on a sunny summer day may evaporate about 2400 gallons of water also one meter square absorbs 1.5kg CO₂/hour and the rear yard of a typical ¼ acre lot will have the cooling effect of 2 million Btu per day. A recent study at the Sloan Kettering Institute in New York found that women recover from breast cancer surgery quicker if they spend time in a garden, according to a report by the American Horticultural Therapy Association (Frank, 2003). Kaplan *et al.* (1989) found that workers with a view of natural elements such as trees and flowers experienced less job pressure and more satisfied with their jobs and reported fewer ailments and headaches than those who either had no outside view or could only see built elements from their windows. Also Lohr *et al.* (1996) show that lives interior plants may increase worker productivity and reduce stress. In an analysis of the relationship between crime rates and vegetation at inner city public housing developments in Chicago, buildings with high levels of greenery had roughly half as many crimes as buildings with no greenery (Kuo, and Sullivan, 2001).

So because of the a vital role of greens paces in reduce the environmental pollution and global warming affect such as a lack of rain fall and high temperature above normal and sand storms which may be swept the city and in order to create safe and comfortable places, increase (communication)

social relationships and easy access within the UoD campus where the students can get rid of the daily study compression this study was done to focuses on the following:

1. Evaluate the green coverage within University's campus.
2. Input the essential principles to green space design more suitable for UoD campus and its future development.
3. Encourage the university responsibly to renew the bad green space with some modification in its design furthermore complete that yet cannot cultivated .
4. Progress the required recommendation for succeeded and aesthetically new landscape.
5. Encourage analog studies to complete this project.
6. Improve the quality of life providing a sustainable green open space within the University campus.

METHODOLOGY.

CASE STUDY DESCRIPTION.

Duhok University Malta campus (UoD) which is the main site that involves most of the colleges is located in 36⁰ latitude and 42⁰ longitude, and it has an elevation of 500-600 m above sea level. The campus has an area of 3036 km² and boundary length of 8026 m. It has 6150 students and faculty members (Figure, 1).



Fig. (1): Location of UoD malta campus with green area quality evaluation.

CASE STUDY APPROACHES INCLUDE:

1. Satellite images for the UoD campus which Obtained from government directories.
2. Survey all green spaces (gardens, yards, and streets) and record its plant numbers, type, and evaluate the rank of each site by make interview about the availability and suitability of the existence green spaces in the university table (3-1), (3-2).
3. Selection of the appropriate criteria of landscape and plants material judging table(1) to assesses the plant material and green squares, doing by ten professional persons each one gives the point for each judging then obtain the mean point criteria in the UoD (McDaniel, 1979; AlManna, 2000).
4. Evaluate the presence stage of green spaces in University campus so compared with the International Standard criteria for the green spaces quantity (m²/person) then give the suggest for improve and develop this sites. (Abo-Saad and Badr (2003), (Greenspace scotland (2011)).
5. Perform (creation) maps by using GIS technology (GIS 9.2, 2008).
6. Research in related literatures in books and webs about open spaces and landscaping design.

Explanation of judging criteria for Landscape Design.

There are four criteria to judging landscape and five for plant material, as shown in table (1).

1. Function: The landscape plan must be functional because it is an integral part of a design. Each plant should be evaluated according to how

well it fits the climate, topography and site location and the needs of client family.

2. Aesthetics: The landscape plan should possess harmony, unity, balance, color, texture and form without creating confusion and the accent planting provided both to delineate the entrance and create an attractive focal point for the outdoor living area also the planting plan and plant material should complement the building architecture. The shapes and size of plants should soften building lines rather than emphasize them.

3. Presentation: The landscape plan should be simple, easily understood at a glance and the boundaries of the individual planting spaces and yard are well declined.

4. Scale: The planting areas and plant materials used in the design should be in scale with the building and yard.

Explanation of judging criteria for plant material.

1. Size: must be proportional to container and consistent with species or cultivar.

2. Form: plant shape should be symmetrical and conform to the species type.

3. Density: the plant should possess a full, dense branching habit having sufficient foliage to create a typical form .deciduous plant will have a loose, open appearance, while evergreen plants will be denser in appearance.

4. Color: foliage and flowers should be healthy and true. Craf (1985).

5. Condition: the foliage and flowers should have good substance and be free of disease, or physical blemishes. (McDaniel, 1979).

Table (1): There are four criteria to judging landscape and five for plant material:

Landscape Design judging standard						
Judging Criteria	Function	Aesthetics	Scale	Presentation	Total point	
Max Points	39	36	15	10	100	
plant material judging standard						
Judging Criteria	Size	Condition	Density	color	Form	Total point
Max Points	20	20	20	20	20	100

ANALYSIS AND EVALUATION (RESULTS).

1. Quantity evaluation of all location in UoD campus

Survey included all green spaces, yards and streets in the UoD campus which include the obtained green spaces area for each location and numbers then evaluated were done by using the international criteria standards for green space quantity and quality to measure the green space values. Because of the absence of the green spaces standards in Iraq except the ratio of (17%) for the private buildings and (30%) for public buildings as shown in the reference of Municipality of Duhok (2009) we return to our research to select

the ratio of green spaces for each person (2 and 5) m² per table (1).

As shown in Table (2) and the figure (2 and 3) the sport college contains the largest number of tree and shrub (141) and the largest green area 4194 m² (first rank) in the UoD campus with ratio reach 12.41m²/person which is more than the two international standards (2 and 5m²) by 10.41 and 7.41 m² respectively. Low and Politics College came in the second rank with 49 tree and shrubs and 3091 m² of green area with ratio reach 7.17 m²/person which also more than the two international standards (2 and 5m²) by 5.17 and 2.17 m² respectively.

Table (2): Green space criteria (quantities):

location	green area (m ²)	population number	Green area (m ²) /person	comparison with the standard	
				2 m ²	5 m ²
Sport College	4194	338	12.41	10.41	7.41
Law & Politics College	3091	431	7.17	5.17	2.17
Administer & Economic College	2380	835	2.85	0.85	-2.15
Cultural Social Center	1178	475	2.48	0.48	-2.52
Art College	2562	1180	2.17	0.17	-2.83
Dormitory	997	532	1.87	-0.33	-3.33
Engineering College	395	270	1.46	-0.54	-3.54
Sciences College	265	908	0.29	-1.71	-4.71
Basic Education College	198	1180	0.17	-1.83	-4.83
The overall rate	15260	6149	2.48	0.48	-2.52

The third rank was for Administration and Economic College with 119 tree and shrub and 2.85m²/person which increased with 0.48m² than the low standard (2m²) whereas it decreased with 2.52 m² than the high standard (5m²). The fourth rank which reached the low standard ratio was Art College which increased by 0.17m² than the low ratio only and it has 119 tree and shrub.

All other locations in UoD campus such as Dormitory, Engineering, Sciences, and Basic Edu-

cation College were less than the two international standards with green area ratio reach 1.87, 1.46, 0.29, 0.17 m²/person for the fourth locations respectively and the least number of trees and shrubs.

Generally the summation of green area in UoD campus for all locations reach 15260 m² and the overall ratio reach 2.48 cm² which involve the less international standard (2m²) but it decreased than the high standard by 2.52 m²

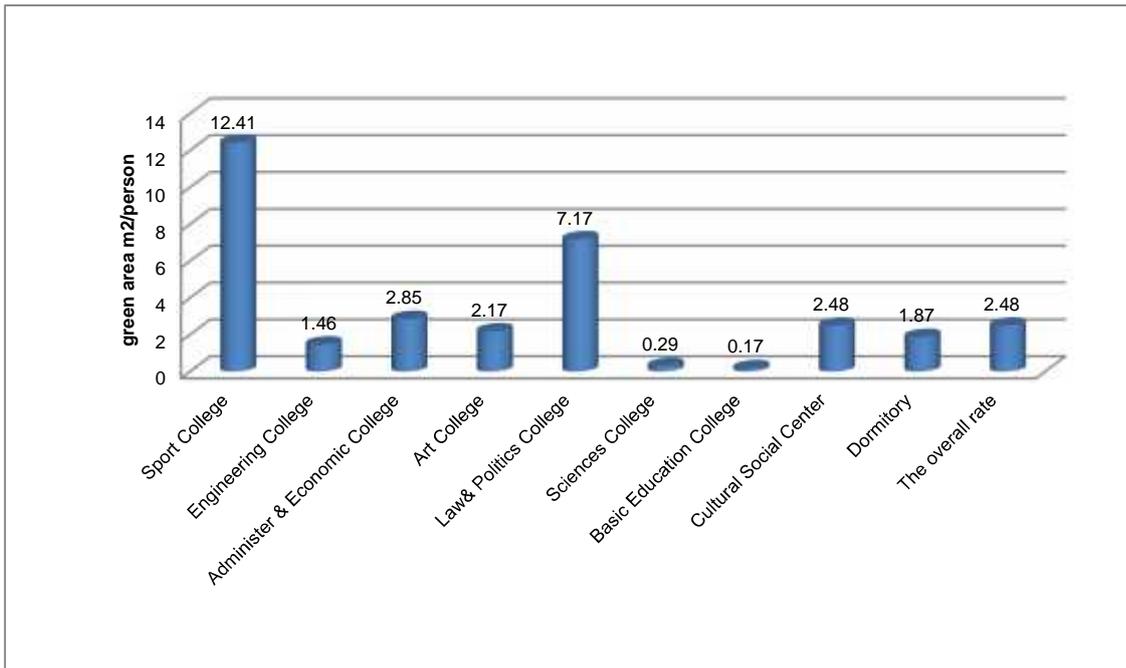


Fig. (2): Green area (m²) per person for some location in Dohuk University campus.

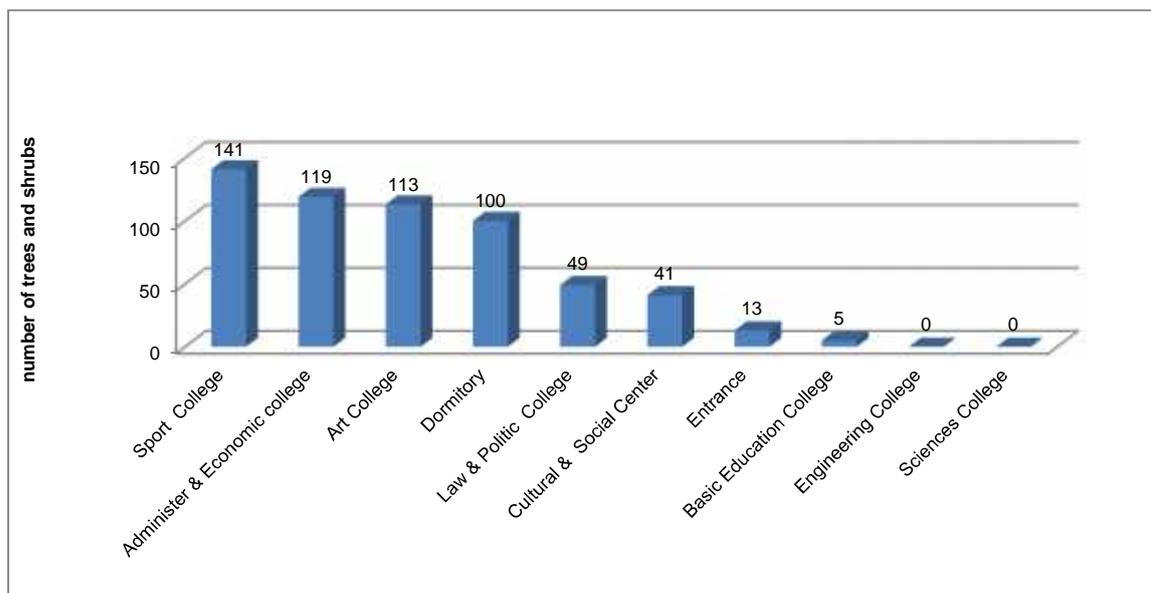


Fig. (3): Number of trees and shrubs for each location in the UoD campus.

1. Quality evaluation of all location in UoD campus

As shown in the figure (4) the best green area (garden) in UoD campus was in the Cultural Social Center which get high degree (9 from 10) via the personal evaluation for ten of professional persons each one gives the point from 10 by use the

judging criteria table (1). The sport and law college were in the second rank with (7) degree while the art and administration were in the third and fourth rank with 6 and 5 degree respectively. The last four locations as shown in the same figure gate the least degree of evaluation ranged between 0 and 4 degree.

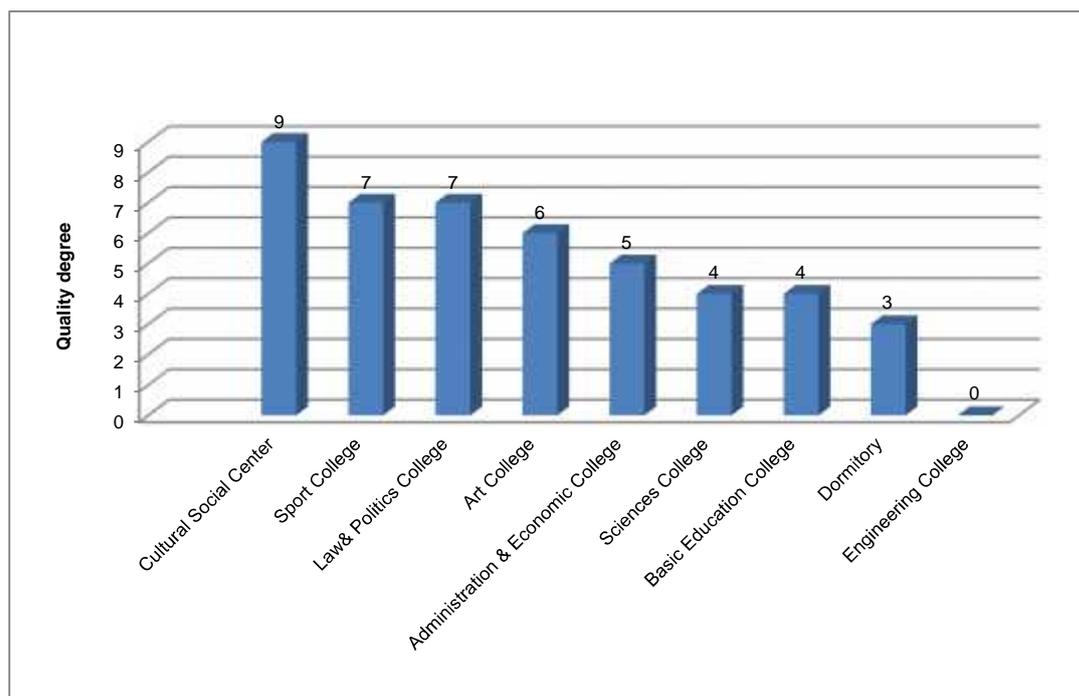


Fig. (4): Quality degree of all location in Uod campus

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EFFECT OF MAGNETIZED WATER WITH SPRAYING (AMINOALEXINE) ON GROWTH AND YIELD OF (*Cucumis Sativus* L.) GROWN IN PLASTIC HOUSE

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ABSTRACT

This study was conducted at the plastic house of Agricultural and experimental research unit "Al-Bender location" Department of plant production/college of Agriculture in Al-Muthanna Uni. during 2012-2013 growing season. The experiment included studying the effect of planting method of cucumber (*Cucumis sativus* L. cv. Rami), magnetic technique on the drip irrigation and spraying with aminoalixene on Vegetative growth, flowering and yield. Randomized Completely Block Design (R.C.B.D) was used with three replicates. The means were compared according to L.S.D test at the level 0.05 probability the results were summarized as follows:

The magnetized water treatments caused significantly increment compared with control treatment in plant height, leaf area, total chlorophyll, number of leaves, dry weight of vegetative growth, setting percentage, fruit weight, number of fruits, early yield, total yield per plastic house and sugar percentage reached (86.5 cm, 34.45dcm², 16.31 mic/cm², 19.91 leaf.plant⁻¹, 29.02 g.plant⁻¹, 30.70day, 68.51%.76.80 g.plant⁻¹, 22.51 fruit.plant⁻¹, 0.630g.plant⁻¹, 669.3kg per plastic hous, 3.26%) respectively. The treatment of aminoalixene (4ml aminoalixene per litter water) caused significantly increase compared with control treatment in height of plant, leaf area, number of leaves, dry weight of vegetative growth, setting yield, fruit weight, number of fruit per plant, yield per plant, early yield, total yield per plastic house and sugar percentage reached 84.5cm, 34.91dcm², 20.73 leaf. Plant, 28.56g. plant⁻¹, 30.80day, 67.67%, 81.13g.plant⁻¹, 21.91fruit.plant⁻¹, 1.786 kg.plant⁻¹, 0.627g.plant⁻¹, 587.3 kg.plant⁻¹, 3.35%, respectively.

INTRODUCTION

The Cucumber (*Cucumis sativus* L.) considered as one of the summer vegetable crops which belongs to the Cucurbitaceae (Cucurbitaceae) family. This family includes 90 genera and 750 species of plants. The original native of this family is South-East Asia regions, in particular India and southern China, as it grows naturally in tropical and subtropical areas. Consumption fruits either fresh or as a pickled (Maqdadi, M. 1989). Moreover, the Cucumber have medical uses such as reducing the skin irritation pain and swelling (Sumathi et al., 2008), also used as stimulus to encourage urine, because it contains a high amount of the K estimated (80-50) mg / 100 g, also reducing high blood pressure (Waseem et al., 2008). The magnetized water process become an affective method, since that the magnetization process affected on water physical properties and including the ability of

water to dissolve the salts which absorbed by the plant, as well as precipitated in water. Kronenberg (2005) revealed that, the irrigation with magnetized water wash the salts from the soil and increases the availability of nutrients by cracking salt crystals which increase penetration of roots in the soil, which in turn increases plant growth (Abdul Qados *et al.*, 2010).

Due to the some problems as obstacles resulted from adding fertilizer which affected on installation of some elements in addition to use of foliar fertilizer spray on the plants can compliment or increases the effectiveness of the added to the soil fertilizer, and because of many problems occur in greenhouses accompanied by cultivation of this crop including irrigation and fertilization problems. So the aim of this study was to determine the effect of magnetization and foliar application and what can be caused by positive effects in increasing the growth and production of yield.

MATERIALS AND METHODS

This research carried out the experiment in the agricultural season 2012 - 2013 in one of the greenhouses area (30 × 9) m at agricultural research , College of Agriculture station University of Muthanna which located in the Al Bandar area. Seeds of Rami hybrid are sown on 14 /9/ 2012 in the plastic house. Water irrigation was magnetized by using a magnetic device homemade Intensity 3500 gauss magnetic intensity measured by a Gauss meter product by Hirst Magnetic Instrument company under serial number 4977GM. In the laboratories of the Ministry of Science and Technology.

Experiment carried out for two variables : the magnetization of water and fertilizer use foliar fertilizer Amino alixin (P2O5 30%, K2SO4 20% and 4% amino acids) with four levels, namely, (0, 2, 3 and 4) ml. l-1 on Rami hybrid plant spraying five times on the shoot for two weeks between

each . Data were recorded on plant height , leaf area ,the chlorophyll pigment ,fresh weight of shoots , total number of fruits and total yield per plant. Randomized completely Block Design (RCBD) with three replicates .Means were compared at the level of 5% probability.

RESULTS AND DISCUSSION

Number Of Leaves

The results in table (1) indicated that, magnetic treatment of water for irrigation affected significantly on number of leaves (19.91, 18.24) leaf. Plant¹ respectively with an increasing percentages reached 9.15 % . Moreover; the results recorded significant differences among spraying treatments and 4 ml.l⁻¹ of amino alixin treatment (F4) gave highest rate reached 20.73 leaf.plant⁻¹ with increment percentages reached 10.14, 12.05 and 13.46% respectively. While there were no significant differences among interactions

Table (1): Effect of magnetized water with spraying (Aminoalixine) on number of leaves.plant-1

magnetized water	spraying (Aminoalixine)				magnetized water
	F1	F2	F3	F4	
W1	17.41	18.14	17.84	19.60	18.24
W2	19.14	18.86	19.81	21.86	19.91
Rare of spraying (Aminoalixine)	18.27	18.50	18.82	20.73	

LSD_(0.05) of spraying (Aminoalixine) = 0.85

LSD_(0.05) of magnetized water = 0.60

LSD_(0.05) of interaction = N.S

Leaf Area (Dcm².Plant⁻¹):

The results in table (2) indicated to a significant differences between the magnetic treatment of water irrigation and (magnetized water) recorded the highest rate of this leaf area reached 34.45 Dcm².plant-1 as compared with control treatment which recorded the lowest rate of 26.50 34.45 Dcm².plant-1 with increment

percentages reached (30%). Moreover; the results recorded significant differences among spraying treatments and (4 ml.l-1 and 3 ml.l-1) amino alixin gave highest rate reached 34.91 and 32.51 Dcm².plant-1 respectively and they were significantly differs from control treatment (F1). While there were no significant differences among interactions.

Table (2): Effect of magnetized water with spraying (Aminoalixine) on Leaf area (Dcm².plant¹).

magnetized water	spraying (Aminoalixine)				magnetized water
	F1	F2	F3	F4	
W1	22.97	26.23	27.64	29.19	26.50
W2	30.35	29.43	37.38	40.64	34.45
Rare of spraying (Aminoalixine)	26.66	27.83	32.51	34.91	

LSD_(0.05) of spraying (Aminoalixine) = 3.18

LSD_(0.05) of magnetized water = 2.25

LSD_(0.05) of interaction = N.S

Shoots fresh weight (gm.plant⁻¹):

The results in table (3) revealed non significant differences in shoot fresh parameter among

cucumber plants treated with different (magnetized water) and amino alixin treatments.

Table (3): Effect of magnetized water with spraying (Aminoalexine) on Shoots fresh weight (gm.plant⁻¹).

magnetized water	spraying (Aminoalexine)				magnetized water
	F1	F2	F3	F4	
W1	95.2	98.4	94.6	103.9	98
W2	96.9	94.4	97.2	95.5	96
Rare of spraying (Aminoalexine)	96.1	96.3	95.9	99.7	

LSD_(0.05) of spraying (Aminoalexine) = 3.18

LSD_(0.05) of magnetized water = 2.25

LSD_(0.05) of interaction = N.S

Shoots Dry Weight (Gm.Plant⁻¹):

The results in table (4) indicated that there are significant differences and magnetized water treatment (W2) was superior to give highest value of Shoots dry weight reached 29.02 gm.plant⁻¹ as compare to 20.81 gm.plant⁻¹ in control treatment (W1) with (39.45)% increment percentage. Furthermore, the results recorded significant

differences among foliar applications treatments (F4 and F3) amino alixin gave highest rate reached 28.56 and 28.38 gm.plant⁻¹ respectively as compared with (20.26) gm.plant⁻¹ in control treatment (F1). While there were no significant differences among the interaction.

Table (4): Effect of magnetized water with spraying (Aminoalexine) on Shoots Dry weight (gm.plant⁻¹).

magnetized water	spraying (Aminoalexine)				magnetized water
	F1	F2	F3	F4	
W1	15.93	19.75	23.65	23.49	20.81
W2	24.60	25.20	33.12	33.18	29.02
Rare of spraying (Aminoalexine)	20.26	22.47	28.38	28.56	

LSD_(0.05) of spraying (Aminoalexine) = 2.29

LSD_(0.05) of magnetized water = 1.62

LSD_(0.05) of interaction = N.S

The irrigation with magnetized water increased positively plant growth parameters such as (leaf area, number of leaves and dry weight) and this may be due to increasing the nutrients availability in the soil which in turn increase the efficiency of transport and absorption of nutrients with water through root cells which in turn increased the protein in tissue content and thus increase the hormones activity that stimulate cell growth, division and elongation and which affected positively on number of leaves and leaf area (Kronenberg, 2005). In addition to the ability of magnetizing for reducing resisting of cell wall for cell elongation through growth processing (Okiely and Orordan, 1998), On the other hand, increasing the oxygen concentration in the magnetized water, play an important role in increasing plant growth by increasing the soluble mineral nutrients, in addition to the magnetized water lead caused reduction of surface tension and formation of small groups associated with each water

molecules as a result of denaturation of hydrogen bonds (Martin, 2003) which make it easy for water penetration through to the cellular membranes and increase the efficiency of the nutrients transfers to the shoots, cell expanded, leaves expanded, elongation and increase of leaf area table (2) and finally increase shoot dry weight.

Moreover; magnetized water has the ability to penetrate cell membranes (Colic et al, 1998) with minerals, and increase cell division and elongation with the emergence of leaf primordial further increasing number of leaves in plant, leading to increase photosynthesis products by increasing the effectiveness of the cell surfaces (Takatchenko, 1995) which leads to increase in the leaf area. The results are agreements with Abdul Qados and Hozayn, 2010 and Racuciu et al. 2008).

The role of Foliar application in improving vegetative growth characters may be due to the

vital role of its elements contain such as phosphor which involves in stimulating cell division process through energy-rich compounds (CTP, GTP, ATP) which is the basis for the processing energy in the living cells, also its involved in coenzymes which responsible for growth namely (FAD, NADP, NADPH) Abu Dahi and Al-Younis (1988).

Potassium also affects many effective enzymes in physiological processes such as respiration, photosynthesis and chlorophyll metabolism by activating enzymes, leading to the promotion of cell division and tissue growth, also its role in meristematic growth and encourage CO₂ fixation and increase the efficiency of photosynthesis and increased shoot system Poni et al (2003) and Carcia et al (2004)

Amino acids are play an important role in increasing the effectiveness of the enzymatic system in plants and thus increasing cell division and cell elongation which is reflected positively

on the vegetative growth such as, plant height, leaf area and number of leaves these results are confirmed by (Hussain *et al.*, 2010) who pointed to an increase in the vegetative growth parameter for vegetable crops treated with foliar application..

The Number Of Days For The Appearance Of First Flower (Day):

The results in a table (5) improve that (W2) treatment affected significantly on early flowering days and reached 30.70 day as compare with 32.09 day in control treatment plants with (4.52%) increment percentage .

Concerning to foliar application treatments, the results also indicated to significant differences and 3 ml of amino alixin gave highest rate reached 30.80 of first flowering day as compare to 31.91 in control treatment (F1) with (3.60%) increment percentage. For the interaction, non significant differences were found between foliar application and magnetized water treatments

Table (5): Effect of magnetized water with spraying (Aminoalexine) on The number of days for the appearance of first flower (Day).

magnetized water	spraying (Aminoalexine)				magnetized water
	F1	F2	F3	F4	
W1	31.77	31.38	32.33	32.88	32.09
W2	30.94	30.22	30.72	30.94	30.70
Rare of spraying (Aminoalexine)	31.35	30.80	31.52	31.91	

LSD_(0.05) of spraying (Aminoalexine) = 0.46

LSD_(0.05) of magnetized water = 0.32

LSD_(0.05) of interaction = N.S

The Percentage Of Flowering Sets (%):

Results in table (6) referred to significant differences between the magnetic treatments on flowering sets % parameter reached 68.51% and 63.41% for W2 and W1 respectively, with an increment percentage reached (8.04%).

Concerning to foliar application treatments, the results also indicated to significant differences and 4 ml of amino alixin treatment (F4) gave highest rate reached 67.67% as compare to F2 and F1

treatments, while non significant differences were found For the interactions between foliar application and magnetized water treatments.

The magnetized water may be conceder as a good transporter for dissolved nutrients which in turn affected positively on improving growth characteristics parameters the results is in line with (Hilal and Hilal, 2000 and Khattab et al., 2000).

Table (6): Effect of magnetized water with spraying (Aminoalexine) on The Percentage of flowering sets (%).

magnetized water	spraying (Aminoalexine)				magnetized water
	F1	F2	F3	F4	
W1	62.24	63.42	63.08	64.90	63.41
W2	66.59	67.88	69.14	70.46	68.51
Rare of spraying (Aminoalexine)	64.41	65.65	66.10	67.67	

LSD_(0.05) of spraying (Aminoalexine) = 1.61

LSD_(0.05) of magnetized water = 1.14

LSD_(0.05) of interaction = N.S

Number Of Fruits. Plant⁻¹:

Results in the table (7) showed significant differences between the magnetic treatments in number of fruits . plant⁻¹ and (W2) treatment gave highest number of fruits reached 22.51 as compare to 18.45 fruit . plant⁻¹ in (W1) treatment respectively, with an increment of (22 %). For the foliar application treatments, the results also

indicated to significant differences and 4 ml of amino alixin treatment (F4) gave highest rate reached 21.91 fruit . plant⁻¹ as compare to F1 treatment which gave 19 0.06 fruit . plant⁻¹, while non significant differences were found For the interactions between foliar application and magnetized water treatments

Table (7): Effect of magnetized water with spraying (Aminoalexine) on Number of fruits. plant-1

magnetized water	spraying (Aminoalexine)				magnetized water
	F1	F2	F3	F4	
W1	16.45	17.78	19.12	20.46	18.45
W2	21.67	22.44	22.57	23.36	22.51
Rare of spraying (Aminoalexine)	19.06	20.11	20.84	21.91	

LSD_(0.05) of spraying (Aminoalexine) = 0.94

LSD_(0.05) of magnetized water = 0.67

LSD_(0.05) of interaction = N.S

Average Of Fruit Weight (Gm.Fruit⁻¹):

From the results in table (8), the (W2) treatment gave highest average of fruit weight 76.80 g. fruit⁻¹ which differ significantly from 74.27 g. fruit⁻¹ in (W1) treatment with (3.40%) of an increment percentage, and from the same table foliar application treatments were affected significantly on the average of fruit weight

parameter and 4 ml of amino alixin treatment (F4) gave highest rate reached 81.13 g. fruit⁻¹ as compare with lowest rate reached 68.60 g. fruit⁻¹ in (F1) treatment with an increment of (18.26 %) percentage. while non significant differences were found For the interactions between foliar application and magnetized water treatments

Table (8): Effect of magnetized water with spraying (Aminoalexine) on Average of fruit weight (gm.fruit⁻¹).

magnetized water	spraying (Aminoalexine)				magnetized water
	F1	F2	F3	F4	
W1	68.60	74.05	76.49	77.97	74.27
W2	68.59	74.68	79.66	84.29	76.80
Rare of spraying (Aminoalexine)	68.60	74.36	78.07	81.13	

LSD_(0.05) of spraying (Aminoalexine) = 2.80

LSD_(0.05) of magnetized water = 1.98

LSD_(0.05) of interaction = N.S

Early Yield (Gm.Plant⁻¹):

The data presented in the table (9) indicate to the significant differences between the magnetic treatments in Early yeild (gm.plant⁻¹) parameter ,the (W2) treatment gave highest average of yield reached 595.2 gm.plant⁻¹ which differ significantly from 570.9 gm.plant⁻¹ in (W1) treatment with (4.3%) of an increment percentage, and from the same table foliar application treatments were affected significantly on the average of early

yeild (gm.plant⁻¹) parameter and 4 ml of amino alixin treatment (F4) gave highest rate reached 627.8 gm.plant⁻¹ as compare with lowest rate reached 547.2 gm.plant⁻¹ in (F1) treatment with an increment of (14.7%) percentage. Moreover, significant differences were not found for the interactions between foliar application and magnetized water treatments .

Table (9): Effect of magnetized water with spraying (Aminoalexine) on early yield (gm.plant⁻¹).

magnetized water	spraying (Aminoalexine)				magnetized water
	F1	F2	F3	F4	
W1	501.8	567.2	614.2	600.5	570.9
W2	592.7	583.7	549.5	655.2	595.2
Rare of spraying (Aminoalexine)	547.2	575.4	581.8	627.8	

LSD_(0.05) of spraying (Aminoalexine) = 55.82

LSD_(0.05) of magnetized water = 23.94

LSD_(0.05) of interaction = N.S

The superiority of (fruit weight, number of fruits, early-yield) parameters in the magnetized water treatment due to the important role of the magnetic treatment technique for balancing of nutrients and thereby increase the biosynthesis of chemical compounds in the photosynthesis process, which led to reduced competition between setting fruits which in turn increase the number of fruits and increase the tissue content of protein dry matter and the flesh of the fruit, which leads to increased fruit weight and total yields. Moreover, the magnetic water have effectiveness on hormonal balance which stimulate growth promoters, flowering and fruit setting which affected positively on increasing early yield percentage. These results are agreement with (Blake, 2000) and (Kronenberg, 2005).

In addition to foliar application contain of K and P elements and their role in improving vegetative growth and increased photosynthesis through the formation of ATP energy which responsible for the transmission of photosynthesis products such as (carbohydrates and proteins), and their transition to the fruit, leading to speed up the flowering, setting and early yields, as the abundance of phosphorus reduces the absorption

of inorganic nitrogen which improve maturity (Tisdle et al., 1997), and increase the potassium (K⁺) availability as its important role in the transmission of sugars from the leaves to the reproductive organs, which encourages in speed the flowering, settings and earlier yield (Al-Sahaf, 1989).

Sugars% In Fruits:

Results in table (10) indicate that (W2) treatment gave highest average of sugars% reached 3.26 % as compared with 2.91% in (W1) treatment with (12.02%) of an increment percentage. And from the same table foliar application treatments were affected significantly on the average of sugars% parameter and 4 ml of amino alixin treatment (F4) gave highest rate reached 3.34% as compare with 2.72 % and 2.98% in (F1) and (F2) treatment respectively.

Further more a significant differences were found For the interactions between foliar application and magnetized water treatments and the combination between (F3+ W2) treatments gave highest rate of sugars% reached 3.58%. compared with (F2+ W1) treatments which gave lowest rate reached 2.59%.

Table (10): Effect of magnetized water with spraying (Aminoalexine) sugars% in fruits.

magnetized water	spraying (Aminoalexine)				magnetized water
	F1	F2	F3	F4	
W1	2.74	2.59	3.05	3.28	2.91
W2	2.70	3.36	3.58	3.41	3.26
Rare of spraying (Aminoalexine)	2.72	2.97	3.31	3.34	

LSD_(0.05) of spraying (Aminoalexine) = 0.25

LSD_(0.05) of magnetized water = 0.17

LSD_(0.05) of interaction = 0.35

These results may be due to increase the proportion of sugars in the cucumber fruit in because of the role of Magnetic water treatment in increasing the availability of nutrients in the soil,

where it becomes a vector for these elements as a result of improved qualities of the physical and chemical water and as a result increase susceptibility roots for water and nutrients which

necessary for the growth of vegetative and fruits and reduce the osmotic pressure in the soil solution which lead to increase metabolism and the effectiveness of growth, development which led to increase the soluble sugars (Pavlov, 1984).

The superiority of the treatment of 4 ml amino alixin treatment probably due to the effectiveness of the elements involved a combination of fertilizer and its impact in increasing the vegetative growth of the plant, which helped to improve plant nutrition and the transfer of sugars from the manufacturing Source (leaves) to the Sink consumption of fruits to growth requirements of which contributed to increase of total sugars content. This agreement with (Ghonaime, 2005).

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EFFECT OF DATE AND KINETIN ON PLUM AND CHERRY GRAFTING SUCCESS ON WILD ALMOND (*Prunus amygdalus*) UNDER SULAIMANI REGION CONDITION.

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ABSTRACT

The study was conducted during the growing season 2014 at Mergapan mountain on northwestern of Sulaimani city, Kurdistan region – Iraq, in order to determine the most appropriate time and kinetin application to achieve the better grafting success. Qadri plum cultivar and sweet cherry were employed as scion and wild almond was used as rootstock. The treatments included two grafting dates (February 20 and March 1) and three concentrations of kinetin (0,5 and 10)mg/L¹. The results revealed that both fruit species grafted on wild almond gave the best results and the most appropriate time for grafting is February 20 especially when kinetin at 5mg/L¹ is used . Also budshoot length of both species on February 20 have been observed to give the higher value.

KEY WORDS: Top-Working, Wild Almond, Qadri Cultivar, Plum, Cherry, Kinetin.

INTRODUCTI

Wild Almond (*Prunus amygdalus* or *Prunus dulcis* var. amara, Baillon) used as rootstock for almond and plum. Cultivars budded on the rootstock produce fruits early. The rootstock is known as the most tolerant species against adverse environmental conditions especially drought due to the nature of the tap root that grows deeply in the soil. Water availability is an important factor affecting plant growth and yield, mainly in arid and semiarid regions, where plants are often subjected to periods of drought (Rouhi *et al.*, 2006). The cultivated almond (*Prunus amygdalus* Batch) belongs to Rosaceae family and typified by a drupe fruit structure. Wild population of almond species representing a wide range of morphological and geographical forms have evolved throughout southeast and central Asia from Turkey and Syria into the Caucas Mountains (Baninasab and Rahemi, 2007). The wild almond (*Prunus amygdalus* or *Prunus dulcis* var. amara, Baillon) has a bitter taste due to high glucoside cyanogenic amygdalin contents recently used as a rootstock for almond, plum and produce fruits more rapidly. Ercisli *et al.*, (2006) observed that the most common rootstocks used by fruit growers in Turkey are wild types of pears, plums and Almonds. These rootstocks are not important only in the increase of productivity but also in vegetative growth management and proper acclimatization of budded trees against environmental conditions. Plum tree is considered a hardy plant and a large number of species and hybrids spread all over the world and adapted to various soils

and climates (Gautier, 1977). Qadri plum cultivar is one of the most important deciduous fruit tree planted under rainfed orchards in Sulaimani governorate for fresh consumption. It is a commercial cultivar with good characters and tolerant to certain diseases and drought. In some countries cherries are grown under rain fed conditions in temperate zones which produce good fruit quality in cool climates. Such area is characterized with good winter rains and dry cool summers (Tareen and Tareen, 2004). Grafting is widely used technique for the production of several horticultural species. The vegetative propagated plants primarily depend upon proper time, season and specific grafting method (Khan *et al.*, 2002). Vegetative propagation techniques are the most effective method to produce scion/rootstock combinations (Hartman and Kester, 2002).

Hama Saleh (2004) studied the effects of budding dates and kinetin concentration on pistachio success percentage and found that they had significant effect on budding success and bud shoot length. Top – working by grafting under rainfed condition is necessary in order to maximize the total orchard area by getting use of the wild rootstocks available under such conditions. The objective of this study are water harvesting through expanding the plum and cherry growing area in mountains under rainfed condition besides the increase of grafting success percentage using top working their vegetative growth through cytokinin usage as well as at different dates

MATERIAL AND METHODS

The study was conducted during the growing season 2014 at Mergapan mountain, locating at northwestern of Sulaimani city, Iraqi Kurdistan region. The commercial cultivars of plum (Qadri) and local sweet cherry cultivar were used as scions grafted on 8-10 years old wild almond (*Prunus amygdalus* var. *amara*, Baillon) trees which had grown from seed. The treatments consisted of two cleft grafting dates (February 20 and March 1) and three concentrations of kinetin (0, 5 and 10) mg/L¹.

On the same day of grafting healthy and well developed bud sticks from the previous year growth were selected from mother trees of both plum and sweet cherry. A gentle slope (about 4 cm long) was done at the base of the scions and treated immediately with three different concentrations of kinetin for 5 seconds. Branches of the rootstocks were headed back just before grafting. The prepared scion was then inserted into clefts. Then both scions and clefts fixed to obtain better union. Grafting union was then covered with wax and bound firmly with polyethylene strips. The strips were removed after 2 months from grafting dates. The experiment was laid out in a factorial randomized complete block design with three replicates using ten grafting branches for each replicate.

The following parameters were measured on November 1, 2014

1. Grafting success percentage (%).

2. Budshoot length (cm).
3. Budshoot diameter (cm).
4. Number of budshoot per scion.
5. Number of leaves per budshoot.
6. Leaves area (cm²) per budshoot.

RESULT AND DISCUSSION

Table(1): Shows that there was significant difference between grafting dates on most studied characteristics the highest value of budshoot length (52.52cm), number of budshoot per scion (2.37) and number of leaves per budshoot (34.18) were observed on grafts of February 20, while with grafting on March 1, budshoot diameters (0.94cm) and leave area per budshoot (22.62cm²) were superior. The concentration of kinetin had significant effects on some parameters. 5 mg/L¹ was superior to the others with regard to grafting success (76.08%), budshoot length(57.36cm), number of budshoot per scion (1.97), budshoot diameter (1.04 cm), number of leaves per budshoot (31.21) and leaves area per budshoot (22.99cm²). The results were in accordance with those obtained by (Hama – Saleh, 2004 and Kako *et al.* 2012). The reason for these may be due to that grafting dates effect on physiological condition of both rootstock and scion such as levels of auxin and cytokinin like substance, besides the ecological factors particularly temperature and relative humidity (Hartmann *et al.* 2002)

Table (1): Effect of dates and kinetin concentration on some growth characteristics of Plum Grafting on wild Almond.

		Plum					
	Treatments	Grafting success (%)	Bud shoots length (cm)	Number of buds shoot	Bud shoots Diameter (cm)	Number of leave per scion	Leaves area (cm ²)
Dates	20 /February	64.32 a	52.52 a	2.37 a	0.72 b	34.18 a	17.05 b
	1/March	63.54 a	40.71 b	1.58 b	0.94 a	23.92 b	22.62 a
Kinetin	0 ppm	56.92 b	43.1 b	1.93 a	0.61 c	30.68 a	16.34 c
	5 ppm	76.08 a	57.36 a	1.97 a	1.04 a	31.21 a	22.99 a
	10 ppm	58.80 b	39.39 c	2.04 a	0.85 b	25.25 b	20.18 b

Numbers with the same letters within a column are not different significantly by DMRT (P = 0.05)

Table (2) declares that the interaction between grafting time and kinetin had a significant effect on most plum parameters. The maximum values of grafting success percent (78.57%), budshoot length (65.60 cm) and number of leaves per budshoot (38.60) were recorded when grafting was carried out on February 20 and treated with 5 mg/L¹ kinetin which was superior to other interactions. These results agree with those obtained by (Pektas *et al.*, 2009 and Vatankhah *et al.*, 2015). This indicates that grafting dates had played

a significant role in the enhancement of grafting success. Similar results were also confirmed by (Boryla and Kaplan, 2012) who found budding time significantly influences the budding compatibility which depends on environmental conditions of the region. This might be due to the presence of cell sap in rootstocks and scions during those dates which is also important for the union between stock and scion. Proper temperature and humidity could also facilitate the grafting union (Ahmad *et al.*, 2012). Grafting failure may be due to envi-

ronmental conditions which led to losses of turgidity and desiccation (Hartman and Kester , 2002). Such process should be done during the time of year when

temperatures are favorable and tissues are active in breaking dormancy (Leakey, 1985)

Table (2): The interaction effect between grafting time and kinetin concentration on grafting success and some growth characteristics of Plum Grafting on wild Almond.

Plum							
Date	Kinetin	Grafting success (%)	Bud shoots length (cm)	Number of buds shoot	Bud shoots Diameter (cm)	Number of leave per scion	Leaves area (cm ²)
20/Ferberuary	0ppm	60.78 bc	46.833 bc	2.50 a	0.553 f	32.527 b	14.200 d
	5 ppm	78.57 a	65.600 a	2.157 b	0.860 c	38.607 a	19.197 c
	10 ppm	53.61 c	45.133 bc	2.45 a	0.753 d	31.387 b	17.573 c
1/March	0 ppm	53.06 c	39.367 bc	1.35 e	0.670 e	28.83 b	18.483 c
	5 ppm	73.58 ab	49.117 b	1.787 c	1.21 a	23.813 c	26.777 a
	10 ppm	63.99 abc	33.653 c	1.620 e	0.940 b	19.11 c	22.610 b

Numbers with the same letters within a column are not different significantly by DMRT (P 0.05).

Table(3) shows significant influence of grafting time (February 20) on all characteristics: grafting success (45.73%), budshoots length (65.98cm), number of budshoot per scion (2.79), budshoot diameter (0.91cm), number of leaves per scion (22.55) and leaves area (20.52 cm²). Also kinetin levels showed significant effect on all characteristics ,5mg/L⁻¹ recorded the highest value of grafting success percentage (49.17), budshoot length (70.78 cm), leaves area per budshoot

(23.32 cm²) .while the control caused significant effect on some parameters like number of budshoot per scion (2.9), budshoot diameter (1.07 cm) and number of leave per scion (26.16). Cytokinin enhance budding success , by inducing cell division and formation of callus tissues (Hartmann *et al.*2002) .Results observed that the both cherry scions and almond rootstocks may contain medium levels of natural kinetin and this reflex in some parameters.

Table (3): Effect of dates and kinetin concentration on some growth characteristics of Cherry grafting on Almond.

Cherry							
treatments		Grafting success (%)	Bud shoots length (cm)	Number of buds shoot	Bud shoots Diameter (cm)	Number of leave per scion	Leaves area (cm ²)
Dates	20/ Ferberuary	45.73 a	65.98 a	2.79 a	0.91 a	22.55 a	20.52 a
	1/ March	42.35 b	62.20 b	2.02 b	0.84 a	18.44 b	18.01 b
kinetin	0 ppm	36.27 c	69.57a	2.9 a	1.07 a	26.16 a	21.78 a
	5 ppm	49.17 a	70.78 a	1.94 b	0.79 b	20.5 b	23.32 a
	10 ppm	46.70 b	51.92 b	2.37 a	0.77 b	14.83 c	12.71 b

Numbers with the same letters within a column are not different significantly by DMRT (P 0.05).

Table (4) shows that there was significant variation among the treatments. The interaction of grafting success of cherry carried on Feb.20 and treated with 5 mg/L¹ kinetin gave the highest values (52.00% , 71.56 cm and 27.37cm²) for (grafting success percentage, budshoot length and leaves area per budshoot) respectively which were superior to the other interactions. while Feb.20 with control gave the highest values (3.5, 1.11 cm and 27.66)for number of lateral shoots, budshoot diameter and number of leaves per bud shoot) which are different significantly from other in-

teractions. The reasons for the superiority of the first interaction may be due to the simple effects of both date of grafting and kinetin whereas the reasons for superiority of the second interaction may be due to the effect of date only, these results are in agreement with those published by (Hama- Saleh , 2004, Kako *et al* .,2012 and Mohammed Ali *et al* ., 2015).Vigor growth with high number of lateral shoots were observed for cherry budshoot (Fig b,c) so thinning was done to avoid separating grafting union .

Table (4): The interaction effect between grafting time and Kinetin concentration on grafting success and some growth characteristics of Cherry grafting on Almond.

Cherry							
Date	kinetin	Grafting success (%)	Bud shoots length (cm)	Number of buds shoot	Bud shoots Diameter (cm)	Number of leave per scion	Leaves area (cm ²)
20/ February	0ppm	37.00 c	70.63 a	3.5 a	1.1 a	27.66 a	20.18 c
	5 ppm	52.00 a	71.56 a	2.46 b	0.80 b	24.00 b	27.37 a
	10 ppm	48.200 ab	55.73 b	2.4 b	0.82 b	16.00 c	14.01 d
1/ March	0 ppm	35.53 c	68.50 a	2.3 b	1.04 a	24.66 b	23.37 b
	5 ppm	46.33 b	70.00 a	1.41 c	0.77 b	17.00 c	19.26 c
	10 ppm	45.200 b	48.10 c	2.34 b	0.71 b	13.66 d	11.40 e

Numbers with the same letters within a column are not different significantly by DMRT (P = 0.05).

CONCLUSION

The data recorded in this experiment reveal that bitter almond which grow wildy is ideal rootstock for plum and cherry. Cherry has showed faster budshoot growth rate than plum. The highest budshoot length on February 20 may be due to rapid formation of graft union, longer growth period as well as early bud break.

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Fig (a): Qadri plum cultivar budshoot 5 monthes from grafting.



Fig (b , c): sweet cherry budshoots 5 monthes from grafting.

EFFECT OF DIFFERENT CONCENTRATIONS OF ORYZALIN AND DIFFERENT TIME OF SHAKING ON DURATIONS ON MITOTIC INDEX PERCENTAGE OF *Crepis Capillaris* WITHOUT B CHROMOSOMES.

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ABSTRACT

This work aimed to study the effects of different concentrations of oryzalin and time duration of shaking on mitotic index of *Crepis capillaris* (without B chromosomes). The result clarified that higher concentrations of oryzalin and shaking on long time duration resulted on increasing MI% as compared with other treatments.

KEY WORDS: Oryzalin concentrations, shaking times, mitotic index, crepis capillaries.

INTRODUCTION

Crepis capillaris L. waller ($2n=2x=6+B_s$) is especially good plant for cytogenetic analysis of cells under *in vitro* and *in vivo* conditions. It has a simple karyotype, that is, only three pairs of morphologically distinct chromosomes and occasional accessory B chromosomes (Maluaszynska, 1997 and Maluaszynska *et al.*, 2003). The chromosomal stability of *Crepis capillaris* callus at the diploid level was confirmed under various experimental conditions during about one year of callus culture (Maluaszynska, 1990 and Jones *et al.*, 2007). Oryzalin ($C_{12}H_{18}N_4O_6S$) or (3, 5, dinitro- N^4N^4 dipropylsulphanil amide) is a persistent herbicide derived from the toluidine chemical family from Dow Agro Sciences, USA. In Agriculture applications, it acts as a germination inhibitor of weed seeds and is effective against graminaceous and some dicotyledoneous plants. This herbicide shows strong binding to plant tubuline and has microtubule depolymerising activity (Petersen *et al.*, 2002). Most antimitotic agents bind to tubulin, thereby inhibiting the formation of microtubules and the polar migration of chromosome during mitosis, resulting in cell with double chromosome number (Peterson *et al.*, 2002). The deformity in spindle formation and chromosome segregation during mitosis may result in chromosomal aberrations like lagging chromosome, sticky chromosomes and bridge formation (Siddiqui *et al.*, 2007).

MATERIALS AND METHODS

Selection Of Media

The Medium used was Murashige and Skoog media (MS) (1962). This medium was obtained from HiMedia Laboratories. Medium did not contain sucrose and agar; hence, these components had to be added to the medium before use.

Media Preparation

An amount of 4.41 grams of the powdered medium was dissolved in deionized water and other ingredients were added. The pH of the medium was adjusted to 5.7 using HCl or NaOH. The medium was usually prepared in lots of 1000 ml containers and then poured into small sterile glasses at 30 ml of medium for each glass and then autoclaved at $121^{\circ}C$ under a pressure of 1 kg/cm^2 for 15 minutes and left in growth room to be used for the next day.

PLANT MATERIAL AND EXPLANTS PREPARATION

Source Of The Seeds

Seeds of *Crepis capillaris* were obtained from Herbiseed (for specialist seeds). Seeds of *Crepis capillaris* ($2n=6$) and ($2n=6+2B$ chromosome) were sterilized in a mixture of 5 ml of absolute alcohol + 5 ml of 3% of H_2O_2 for 5 minutes and then washed several times with sterilized distilled water. The sterilized seeds were cultured in jars containing 30 ml of basal medium without growth regulators. The cultures were maintained in growth room at $24 \pm 1^{\circ}C$ and 16/8 hours light/dark photoperiod (white, natural fluoresced light). After 4-5 weeks, the roots of developed plantlets were fixed to determine the number of chromo-

some and presence or absence of B chromosomes and then their leaves with an area of 1cm² were cultured on MS media supplemented with 5.0 mg l⁻¹ NAA + 0.2 mg l⁻¹ BA to obtain callus. The calli of both plants were subcultured every 4-5 weeks. At each passage, only healthy and well growing callus pieces were transferred on to a new medium.

Oryzalin Preparation

An amount of 0.3463 mg of oryzalin powder was dissolved in 100 ml acetone to obtain (1mM) and then four different concentrations were prepared from this stock solution (0.0, 35, 45, 55 µM) by taking (0.0, 3.5, 4.5 and 5.5 ml) and completing them to 100 ml by sterilized liquid (MS) media.

Treatments Of Callus

Four concentrations of oryzalin were used (0.0, 35µM, 45 µM and 55µM) and 10 replications were used for each treatment.

The callus at 3rd passage was treated with oryzalin in liquid medium for five and ten days duration using shakers (at 90 rpm). Minisart filter (0.45 µm) was used for the sterilization of the treatments.

The treated calli were washed with sterilized distilled water 5 times, then cultured on MS medium which was supplemented with 5.0 mg l⁻¹ NAA + 0.2 mg l⁻¹ BA and subcultured every 4-5 weeks until passage 10. At passage 10, the obtained calli were divided into two groups; the first group was subcultured every 4-5 weeks on MS media with the same composition until the end of the protocol. The second group was cultured on regeneration MS media without growth regulators. At passage 12th, the calli were subcultured on ½ strength media without growth regulators for two passages.

At passage 14th, the obtained callus was treated with different concentrations of BA and NAA for obtaining organogenesis and plants using half and full MS media.

The treatments used were:

- A- 3.0 mg l⁻¹ BA + 0.5 mg l⁻¹ NAA.
- B- 2.0 mg l⁻¹ BA + 0.5 mg l⁻¹ NAA.
- C- 1.0 mg l⁻¹ BA + 0.2 mg l⁻¹ NAA.
- D- 1.0 mg l⁻¹ BA + 0.5 mg l⁻¹ NAA.
- E- 4.0 mg l⁻¹ BA + 0.5 mg l⁻¹ NAA.
- F- 5.0 mg l⁻¹ BA + 0.5 mg l⁻¹ NAA.
- G- 6.0 mg l⁻¹ BA + 0.5 mg l⁻¹ NAA.
- H- 3.0 mg l⁻¹ BA + 3.0 mg l⁻¹ NAA.
- I- 3.0 mg l⁻¹ BA + 2.0 mg l⁻¹ NAA.
- J- 3.0 mg l⁻¹ BA + 1.0 mg l⁻¹ NAA.
- K- 2.0 mg l⁻¹ BA + 0.5 mg l⁻¹ NAA.
- L- 7.5 mg l⁻¹ BA + 1.25 mg l⁻¹ NAA.
- M- 5.0 mg l⁻¹ BA + 1.25 mg l⁻¹ NAA.
- N- 2.5 mg l⁻¹ BA + 1.25 mg l⁻¹ NAA.
- O- 10.0 mg l⁻¹ BA + 0.5 mg l⁻¹ NAA.

- P- 10 mg l⁻¹ BA + 1.25 mg l⁻¹ NAA.
- Q- 12.5 mg l⁻¹ BA + 1.25 mg l⁻¹ NAA.
- R- 15 mg l⁻¹ BA + 1.25 mg l⁻¹ NAA.
- S- 7.5 mg l⁻¹ BA + 0.75 mg l⁻¹ NAA.
- T- 7.5 mg l⁻¹ BA + 0.5 mg l⁻¹ NAA.
- U- 7.5 mg l⁻¹ BA + 0.25 mg l⁻¹ NAA.
- V- 5.0 mg l⁻¹ BA + 0.5 mg l⁻¹ GA3.

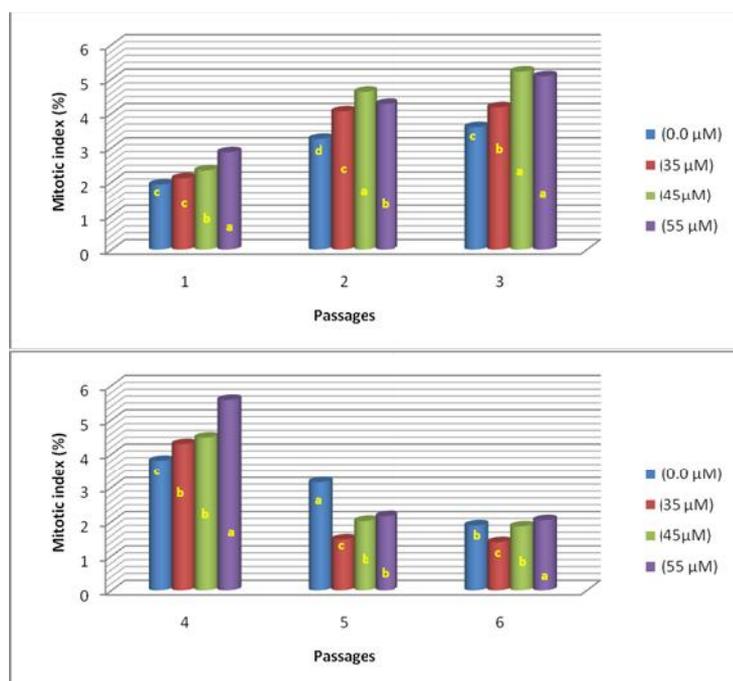
Both liquid and agar solidified media were used for rooting stage. In case of liquid medium, a filter paper bridge was prepared and insert into the culture tube in such a way that the two arms were dipping into the liquid medium and on which the explants were placed and remained on the above medium. Both media were supplemented with 0.5 mg l⁻¹ NAA.

At passage 21th, the roots of developed plantlets were fixed as mentioned previously in order to determine the chromosome number. Moreover, the calli were fixed after 7 days of each passage. Mitotic Index (MI) calculated depending on that of Yadav and Yadav (2010), as follows: Mitotic Index = $\frac{\text{Total Number of dividing cells}}{\text{Total Number of cells observed}} \times 100$

RESULTS

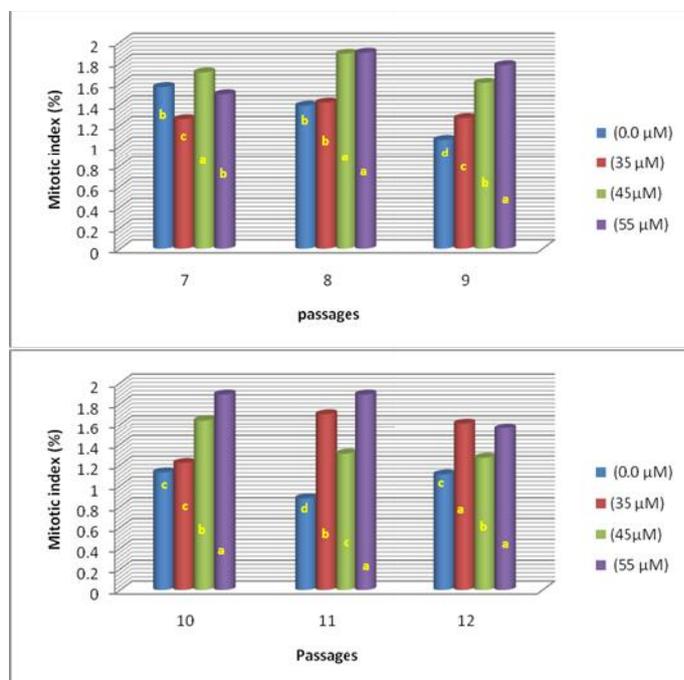
The effect of oryzalin concentrations on the percentage of callus cell mitotic index of *Crepis capillaris* without B chromosome from passage one to passage 6 is presented in Figure (1). It is clear from passages one, four and six that the exposure of callus to 55 µM of oryzalin had a significant effect on increasing callus cell MI as compared to other treatments which gave the rate of (2.87, 5.58 and 2.04%) respectively. In the same figure in passage two, the callus treated with 45 µM oryzalin recorded a high value of callus cell MI (4.63%), while in passage three, both 45 and 55 µM of oryzalin registered a high level of callus cell MI (5.22 and 5.08%); however, in passage five, the control treatment pointed a high rate of callus cell mitotic index (3.15 %).

Figure (2) states the effect of oryzalin concentrations on the percentage of callus cell mitotic index of *Crepis capillaris* without B chromosome from passages seven to passage twelve. The result in passage seven proved that the application of 45 µM of oryzalin had a significant increase of the callus cell MI (1.71%), while in passage eight, both concentrations of oryzalin (45 and 55 µM) obtained a significant effect of callus cell MI (1.89 and 1.90%) respectively. Regarding passages nine, ten and eleven, the higher concentrations of oryzalin gave rise of callus cell MI (1.78, 1.89 and 1.89%) respectively, whereas in passage twelve, it is estimated that both concentrations of oryzalin 35 and 55 µM caused in buildup of callus cell MI (1.61 and 1.56%) respectively.



**Different Letters within each Passage Represented Significant Differences According to Duncan's Multiple Range tests at 5% Level.

Fig. (1): Effect of Oryzalin Concentrations on the Percentage of Callus Cell Mitotic Index of *Crepis capillaris* without B Chromosome from Passage 1 to Passage 6.

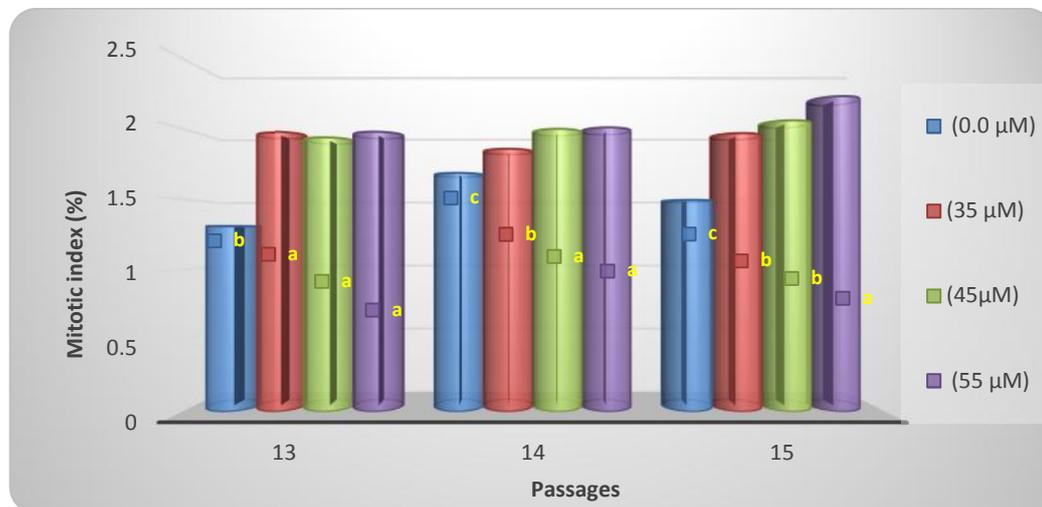


**Different Letters within each Passage Represented Significant Differences According to Duncan's Multiple Range tests at 5% Level.

Fig. (2): Effect of Oryzalin Concentrations on the Percentage of Callus Cell Mitotic Index of *Crepis capillaris* without B Chromosome from Passage 7 to Passage 12.

Figure (3) manifests the effect of oryzalin concentrations on the percentage of callus cell mitotic index of *Crepis capillaris* without B chromosome from passage thirteen to passage fifteen. The data elucidated in passage thirteen and fourteen that the

control treatment registered the lowest value in contrast with rest of the treatments, considering passage fifteen, 55 μ M of oryzalin induced growth of callus cell MI (2.22%)

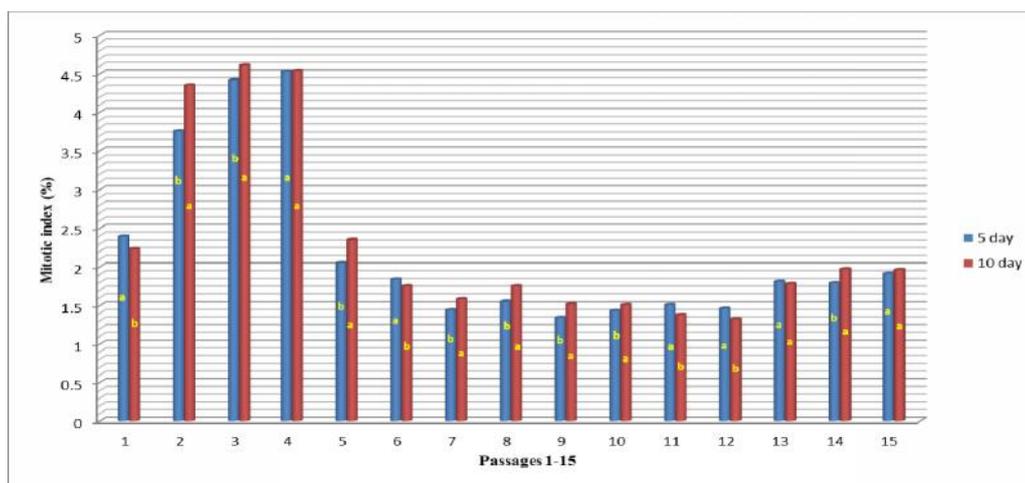


**Different letters within each passage represented significant differences according to Duncan's multiple range tests at 5% level.

Fig. (3): Effect of oryzalin concentrations on the percentage of callus cell mitotic index of *Crepis capillaris* without B chromosome from passage 13 to passage 15.

Figure (4) illustrates the effect of time durations of shaking on the percentage of callus cell mitotic index of *Crepis capillaris* without B chromosome after oryzalin treatments from passages one to passage 15. It is clearly distinguished in passage one, six, eleven and twelve that the first time durations of shaking (five days) had a significant effect as compared with second time durations (ten days) on the callus cell mitotic index, while in

opposed to passages two, three, five, seven, eight, nine, ten and fourteen the second time durations (ten days) proved to have a significant effect on first time durations on increasing the callus cell mitotic index percentage. On the other hand, in the passages four, thirteen and fifteen there were no significant effects between time durations on the callus cell MI.



**Different Letters within each Passage Represented Significant Differences According to Duncan's Multiple Range Tests at 5% Level

Fig. (4): Effect of Time Durations on the Percentage of Callus Cell Mitotic Index of *Crepis capillaris* without B Chromosomes after Oryzalin Treatments from Passage 1 to Passage 15

DISCUSSION

Regarding Figures (1-3), it is obvious that the application of higher concentrations of oryzalin (55 μ M) within fifteen passages resulted in the production of higher mitotic index percentage. Figure (4) display, that ten days of shaking had possibility to increase the rate of MI (%) over all the passages two, three, five, seven, eight, nine, ten and fourteen. Dermen (1940) stated the elimination of typical metaphase formation and the elimination of anaphases and telophases may accounted for an apparent increase of metaphase (mostly distorted) but actually the metaphases represent the sum total of anaphase and telophase which would have been formed normally but are prevented from formation. The increase in MI within three hour may or may not be significant depending on the population of beans used (MacLeod, 1966), but it is highly significant after a 24 hrs of recovery period (MacLeod, 1965; Davidson and MacLeod, 1966) or after continuous treatment (Evans, *et al.*, 1957).

CONCLUSIONS

It is calculated that High concentrations of oryzalin were more effective in increasing Mitotic index in *Crepis capillaris* without B chromosome. As well as, *Crepis capillaris* without B chromosome was easily regenerated to plantlet, after treatment with oryzalin in contrast to *Crepis capillaris* with 2B chromosomes. Accordingly it can be recommended to extend the number of passage to more than two years to get regeneration from *Crepis capillaris* without B chromosomes to analyze MI%, applying molecular methods to follow up the changes in molecular level of *Crepis capillaris* without B chromosome after mutagen treatments and using other mutagens for interplay it on MI %.

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**RESPONSE OF TURF GRASS MIXTURE TO SOME SOIL AMENDMENTS
(PEAT MOSS , PERLITE AND PLANT GEL) UNDER SULAIMANI GOVERNORATE
(PISHDER REGION) CONDITIONS**

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ABSTRACT

This experiment was carried out in Raparen University, Pishdar Region, located in Sulimani Governorate 35° 32' N, 45° 21' E, and 730 meters altitude for the period from March 26th 2012 to December 26th 2012 to study the performance of cold season grass mixture consist of six grasses (*Lolium perenne* Green fair 5%, *Lolium perenne* Keystone 5%, *Festuca arundinacea* Stariett 35%, *Festuca arundinacea* Olympic gold 35%, *Poa pratensis* Panduro 10%, *Poa pratensis* Miracle 10%) to three soil amendment, peat moss which used in three level (0, 1, 2) Litter/m², perlite (0, 3) Litter/m², and plant gel (0, 100, 150) gm/m². The experiment was laid out by use Randomize Complete Block Design(RCBD) with three replication . The results can be summarized as follows.

Add peat moss as a soil amendment to the media of lawn with 2 litter/m² decreased root depth and increased total chlorophyll when compared with other levels. Also add perlite level of 3 litter/m² increased root depth 51.62 cm and decreased soil pH 7.65 significantly, when compared with other levels. And add plant gel 150 gm/m² decreased root depth 50.32 cm significantly. The highest plant density 512 plants/m² and plant length 16.16 cm was recorded in treatment that contain the third level of peat moss (2 liter/m²) and second level of perlite (3 litter/m²), while the largest leaf area which reached 131.71 mm² were recorded in the first level of peat moss (0 liter/m²) and second level of perlite (3 litter/m²). The triple interaction among all factors had an effect on leaf area. the highest chlorophyll content 62.03 mg/100 gm fresh weight was found in treatment that contain of the 1 litter/m² of peat moss, 0 litter/m² of perlite and 150gm/m² of plant gel . In the case of vegetative fresh weight the highest value 478.67 gm/m² was recorded in the soil that contain 2 Litter/m² peat moss, 3 Litter/m² perlite and 100 gm/m² plant gel.

KEYWORDS: Turf grasses mixture, a soil amendments ,peat moss, perlite ,Plant Gel.

INTRODUCTION

Lawns are smooth, living carpets that add beauty and recreation to the location. It is an area of aesthetic and recreational land planted with grasses (Herbet, 1993). The Lawns as any herbal plant can survive when it is cut at an altitude of low appropriate component and covers green above the soil surface (Johnson, 1996). A healthy lawn provides play area and adds oxygen to us air filters pollutant from air and runoff water, cools the environment, provides soil erosion (Stier, 2008). Green spaces covered 70-80% of the most area of the land in the public and private gardens, parks, roads, squares or sports stadiums, also absorption the sound and reduces the noise (AL-Baali, 1967 and Al kaiee and Noah, 2004). There are two types of lawn; warm season grasses and cold season grasses (Bruneau, 2000)

,the activity of cold season grasses are in the fall, winter and spring with relatively lower temperatures (15-25 °C) this group mostly involved in the process of dormancy in the summer. It includes more than 20 species (Kentucky blue grass) *Poa Pratensis* L., *Poa nemoralis*, Annual Ryegrass (*Lolium multiflorum*), Italian Ryegrass (*Lolium multiflorum*), (English rye grass) *Lolium perenne* L., (Fescue grass) *Festuca* sp., (Meadow fescue) *Festuca pratensis* L (Pink, 2004).

Stier (2008) pointed that one of the most important steps in turf grass establishment is the selection of high quality seeds or a seed mixture that is adapted to the site conditions and achieved the use of the turf. There are some mixtures of seeds that give satisfactory results. The most important seeds mixture that are used in Iraq soil is the mixture consisting of (50%) *poa pratensis*,

25% *Lolium italicum*, 20% *Alba Agrosis* and 5% *Trifolium repens* (AL Baali, 1967).

Growing media are the substrates in which a plant will grow. It includes all the materials that are used by the professional and markets. They provide the nutrition's; air spaces for good respiration; and retain sufficient available water to enable plant growth (Schmilewski and elimanngbh, 2008). There are some materials mixed with soil to improve the qualities of the media is called soil amendments. Most of the available soil amendments peat moss it provides drainage and yet allows oxygen to be available to the root systems of the potted plant (Robbins and Evans, 2000). Peat moss is the least decomposed form of the peat types, is typically light tan to brown in color, light weight high in moisture-holding capacity and very acid pH 3.8 to 4.3. It is inherently hydrophobic repels water so a wetting agent already must added to the mixture. (Albert, 2005 and Jeanromy, 2012).

Perlite is a volcanic material heated to (850°C), it is light weight, chemically inert, pH neutral, sterile and odorless, and its particles create tiny air tunnels, which allow moisture and oxygen to flow freely to roots (Robbins and Evans, 2000). Fine perlite can be used alone as a seed medium or it can be mixed half-and-half with shredded sphagnum moss or shredded peat moss (Vanstraiten, 2002). Stadium soil of Louis University High School was suffering from compaction that caused by clay soil and heavy use so add 1/3 perlite to 2/3 of soil mix to renovated by tilling the top of 150 mm of soil. After two years of hard usage, the non-treated playing area has brown and with no turf cover. Although the frequency of irrigation is unchanged during the dry season, it has been determined that only 1/3 as much water is required on the perlite treated sections (Barton, 2008).

Plant Gel is 100% Non-Toxic, biodegradable, and odorless super absorbent crystal, that absorbs water up to 400 times its weight and has a life span of approximately 5 to 7 years. It is an excellent growing medium for plants due to its water absorbing ability. This media allows the availability of 90% of the water and nutrient to the plant's root system. (Aveni *et al.*, 2002). When mixed with soil, or other compost creating thousands of tiny reservoirs within the growing medium. (Beard, 1997). Dissolved nutrients can be absorbed into the gel particles and extracted

from it by plant roots unimpeded. Also plant gel increased the stored moisture available to tomato plants and increased their production in drought-stressed, the quality of tomato yield was also improved by application gel to the growing medium due to the reduced impact of water stress during the growing cycle (Johnson and Piper, 1997).

The objective of this study was to determine the effects of some soil amendments (peat moss, perlite and Plant Gel) on turf grass mixture, and finding a suitable soil amendment for the growth of lawns under the Pishdar Region conditions.

MATERIALS AND METHODS

The study was carried out in Raparen University, Pishdar Region, located in Sulimani city 35° 32' N, 45° 21' E, and 730 meters altitude, for a period from 26th March 2012 to 26th December 2012.

It was used mixture of six grasses seeds (cold season grasses) obtained from the Lebanon Mountain Company for cultivation and landscape in Sulaimani city, Consisting of *Lolium perenne* Green fair 5%, *Lolium perenne* Keystone 5%, *Festuca arundinacea* Stariett 35%, *Festuca arundinacea* Olympic gold 35%, *Poa pratensis* Panduro 10%, *Poa pratensis* Miracle 10.

Soil fields were Prepared for planting by making plots (1 × 1) m, then mixing the agriculture media that have been studied to 15 cm depth with soil amendments (figure 1), peat moss which used in three level (0, 1, 2) Litter/m², perlite (0, 3) Litter/m², and plant gel (0, 100, 150) gm/m². The experiment was carried out by use Randomize Complete Block Design with three replicate, so the experiment was consist of 3×2×3=18 treatments, each planted with this mixtures with rates of 30 gm/m² then comb, coverage and pressed experimental unit use wooden roller. The soils of experimental field are analyzed to obtain its physical and chemical contents table (1). In addition, average of maximum and minimum temperature, and humidity of experiment location are measured by use of thermo hydrograph device as in table (2).

Irrigation was conducted after seeds scattering, and sprinklers used with light irrigation to prevent seeds. Mowing process differs according to the type and by using special tool to this process, the lawn clippes collected to weight for the study purposes.



Fig. (1): making plots (1 × 1) m and Preparing Soil



Fig. (2): View of grasses in the growth phase

30 gm of urea for each treatment added after with equal amount after mowing.

Data measurements began from the first day, until the end of the experiment, including the following experimental data:

- **Plant Density (plant/m²)** : Plant density calculate by making square from metal silk it area 225cm², then randomly threw on the flat to calculate plant number that located in that area of 225cm² (Jordon ,2003).

- **Plant Length (cm)** : Length was calculated before each mowing by using measuring ruler.

- **Leaf Area (mm²)** : The area of the leaves has been measured by using a special digital device (AM300 2003.Bioscientific ltd. SG129TA.U.K).

- **Leaf Width (mm)** : Leaf width measured by the same devices that are use in leaf area measured.

- **Root Depth (cm)**:Roots depth measured by digging around the sides of the experimental units as in fig. (4). The active root which was collected about 50% of the total turf root,active root and root depth measured in the same time (Smith and Contributor 1999).

- **Total Chlorophyll (mg/100 gm fresh weight)**: The Total chlorophyll has been measured by special digital device (Chlorophyll meter, SPAD-502, Konica Minolta).

- **Fresh Weight of clipping (gm/m²)**: Fresh weights were calculated during each mowing, the Clipping collected and weighted by sensitive balance.

-**Dry Weight of clipping (gm)**: The fresh clipping that produce in the mowing after balance putted in the oven at 70°C for 72 hours then weighted by sensitive balance.

- **Soils pH**: Soil pH are measured by pH meter device (Huxley, 1992).

The experiment was laid out in a Randomize Complete Block Design (RCBD) with three replicat, as means were compared according to Duncan multiple rang(P 0.05)(Alrawii and Abdulaziz ,1980)

Table (1): Some physical and chemical characteristics of the soil.

Clay	Silt	Sand	Textural name	Bulk density	Available water%	O.M.C
577.82	378.38	43.80	salty clay	1.2	11.43	25.27

Table (2): Average of maximum and minimum temperature, and during the period of Mar to Dec. 2012 for the experiment location

Month-Year	Air Temp. °C		Relative Humidity %
	Max.	Min.	
March	19.3	9.60	54.4
April	25.0	14.3	46.1
May	30.7	18.8	36.0
June	36.9	24.9	24.7
July	39.9	27.1	26.1
August	40.6	26.3	25.0
September	33.8	18.2	24.0
October	31.2	16.3	21.0
November	26.1	13.3	47.1
December	19.5	9.40	48.5

RESULTS AND DISCUSSION

1. Effect of peat moss on plant density, leaf area, leaf width, total Chlorophyll, root depth and soil pH of lawn grasses:

The Results in table (3) show that add 1, and 2 liter/m² of peat moss as soil amendment to the agriculture media of lawns have had insignificant effect on the plant density, leaf area and leaf

width, whereas the high level of peat moss displayed significant effect on the total Chlorophyll (56.53) mg/100 gm w.t when compared with other treatments, and the less effect on total Chlorophyll (49.91) mg/100 gm w.t was for the level 1 liter/m² treatment.

Table (3). Effect of peat moss on plant density, leaf area, leaf width, total Chlorophyll, root depth and soil pH of lawn grasses.

Peat moss liter/m ²	Plant density (plant/m ²)	Leaf area (mm ²)	Leaf width (mm)	Total Chlorophyll (mg/100 gm w.t)	Root depth (cm)	Soil pH
0	439.04 a	114.20 a	2.48 a	51.45 b	51.58 a	7.70 a
1	444.32 a	99.33 a	2.29 a	49.91 b	51.71 a	7.64 a
2	471.04 a	116.91 a	2.46 a	56.53 a	50.61 b	7.69 a

Means with same letter for each characters are not significantly different at 5% level based on Duncan's Multiple Rang Test.

In the other side, the roots depth were decreased significantly 50.61 cm as a result to increase of the peat moss from 1 to 2 liter/m². The root depth response to the peat moss may be referred to its role in modifying the physical characteristics of the soil such as increase soil porosity, water and nutrients absorption, therefore the root Deepened in the soil (Jones *et al.*, 2013). Also Increase total Chlorophyll are agree with (Ebrahimi *et al.*, 2012) on straw berry plant, and this result may refer to the soil amendments that are added to the agriculture media in providing enough air space, Porosity so that gas interchanges in soil easily.

2. Effect of perlite on plant density, leaf area, leaf width, total Chlorophyll, root depth and soil pH of lawn grasses :

The result in table (4) showed that the perlite haven't any significant effect on plant density, leaf area, leaf width, and total chlorophyll, while the soil pH character (7.65) decreased significantly as a result to increase of perlite to 3 liter/m² when compared with control treatment that gave (7.71), on the other hand the roots depth increased significantly 51.62 cm as a result to increased perlite soil amendment that added to the agriculture media from 0 to 3 liter/m².

Table (4): Effect of perlite on plant density, leaf area, leaf width, total Chlorophyll, root depth and soil pH of lawn grasses.

Perlit liter/m ²	Plant density (plant/m ²)	Leaf area (mm ²)	Leaf width (mm)	Total Chlorophyll (mg/100 gm w.t)	Root depth (cm)	Soil pH
0	446.72 a	109.35 a	2.38 a	52.96 a	50.98 b	7.71 a
3	456.16 a	110.87 a	2.45 a	52.30 a	51.62 a	7.65 b

Means with same letter for each characters are not significantly different at 5% level based on Duncan's Multiple Rang Test.

This result may be returned to the perlite soil amendment properties that increase soil porosity and their fore root depth effected significantly may be refer to its role in modifying the physical characteristics of the soil such as increase soil porosity, water and nutrients absorption, therefore the root Deepened in the soil. The soil pH results are the same as (Perry, 2008). And (Seyedi, 2008) that most developed root length of lilium increase significantly but the leaf area and leaf width were not effected by addition of perlite. As well (Silber *et al.*, 2012)) pH is increased when perlite is added to the soil and insignificant; it became important

only at the highest pH, which increase from 7.3 at 6 °C to 7.7 at 50 °C in both grades of perlite and soil.

3. Effect of plant gel on plant density, leaf area, leaf width, total Chlorophyll, root depth and soil pH of lawn grasses:

Data In table (5) showed that there are no significant differences in all characters except root depth which decreased significantly from 52.41 cm for control treatment to 51.17 cm for plants that grow in media that amendment with 100 gm of plant gel/m² and to 50.32 cm for 150 gm plant gel/m².

Table (5): Effect of plant gel on on plant density, leaf area, leaf width, total Chlorophyll, root depth and soil pH of lawn grasses.

Plant gel gm/m ²	Plant density (plant/m)	Leaf area (mm ²)	Leaf width (mm)	Total Chlorophyll (mg/100 gm w.t)	Root depth (cm)	Soil pH
0	464.0 a	116.22 a	2.46 a	51.56 a	52.41 a	7.66 a
100	438.08 a	108.97 a	2.39 a	51.37 a	51.17 b	7.71 a
150	452.32 a	105.65 a	2.41 a	54.96 a	50.32 c	7.67 a

Means with same letter for each characters are not significantly different at 5% level based on Duncan's Multiple Rang Test.

The non effect of Plant gel on the most characters except root depth in the (table 5) may be referred to its role in increasing soil moisture or to the high temperature in the growing season of lawns which caused decomposition of plant gel therefore loss there effect. (Johnson and Piper, 1997). Also these result agree with (Tangwang and Carl, 1987) on foilga the plant growed in the gel reducing irrigation frequency and had less water lose that help root to deeper in the soil. As well maybe because it did not contain the nutrients and also did not contain major and minor elements so it had no effect on plant density, leaf area, leaf width, soil pH and total chlorophyll.

4. Effect of peat moss on plant length, fresh and dry weight of clipping leaf of lawn grasses :

Data In table (6) showed that increased peat

moss level from 0 to 1 and 2 liter/m² to agriculture media had significant effect on the plant length in the three mowing of lawn at first August, September and November and the best value reach 15.55 cm for august mowing compared with the control treatment (0) liter/m² peat moss that give the less value 10.83 cm in the November mowing. Also add peat moss increased fresh weight significantly in first Augustus and November mowing and the highest value for the two mowing reach 257.61 gm and 375.33 gm/m² respectively whereas the lower value 215.55 gm/m² for control, in contrast this factor haven't any effect on the September mowing. Whereas the dry weight for the three mowing had no significant effect on this parameter

Table (6): Effect of peat moss on plant length, fresh and dry weight of clipping leaf of lawn grasses.

Peat moss liter/m ²	first August			first September			first November		
	Length(c m)	Weight (gm)		Length	Weight (gm)		Length	Weight (gm)	
		Fresh	Dry		Fresh	dry		Fresh	Dry
0	14.05 b	215.55 b	97.05 a	13.37 b	164.83 a	93.83 a	10.83 b	286.00 b	101.55 A
1	15.25 a	236.22 ab	104.83 a	14.60 a	181.94 a	89.61 a	11.65 ab	352.38 a	107.17 A
2	15.55 a	257.61 a	107.83 a	13.91 ab	174.11 a	85.00 a	12.38 a	375.33 a	101.33 A

Means with same letter for each characters are not significantly different at 5% level based on Duncan's Multiple Rang Test.

This results may be due to the highest organic matter content which is responsible for improving the medium structure and plays an important role in the water holding capacity of soils for a close relationship between the fraction loss on ignition and the water content of the soils (Schmilewski and Delimannmbh,2008) . Also (Albert, 2005) refer peat moss contains more than 95% organic matter and less than 2% ash making beneficial soil amendment therefore that

make increase in the fresh weight and plant length it probably had not effect on dry weight.

5. Effect of perlite on plant length, fresh and dry weight of clipping leaf of lawn grasses :

The data in Table (7) clarified that the all characters for all mowing have no significant difference as a result to increased perlite from 0 to 2liter/m². Because perlite does not contain the nutrients , only have the role in increase soil aeration and make small tunnels help in oxygen exchange between the soil and atmosphere (Hitechcock, 1982).

Table (7): Effect of perlite on plant length, fresh and dry weight of clipping leaf of lawn grasses.

Perlite liter/m ²	first August			first September			first November		
	Length	Weight (gm)		Length	Weight (gm)		Length	Weight (gm)	
		Fresh	Dry		Fresh	dry		Fresh	Dry
0	14.57 a	241.81 a	105.8 a	13.90 a	177.25 a	91.03 a	11.62 a	328.6 a	103.63 a
2	15.33 a	231.11 a	100.5 a	13.98 a	170.0 a	87.92 a	11.62 a	347.18 a	103.0 a

Means with same letter for each characters are not significantly different at 5% level based on Duncan's Multiple Rang Test

6. Effect of plant gel on plant length, fresh and dry weight of clipping leaf of lawn grasses :

The data in table (8) showed that adding plant gel to the agriculture media of lawn caused significantly decrease in the plant length at first August from 15.47cm for control treatment to 14.44 cm for mediate level of this amendment (100) gm/m², oppositely in first November the increase of the level of plant gel to 150 gm/m² caused significantly increased in this character 12.01cm

when compared with control which gave 11.12cm, whereas the other characters in the same table haven't had any effect as a result to added this material. Plant gel crystal, that absorbs up to 400 times its weight water and also improved rate and speed of grass seed germination (Wedin and Tilman, 1994). The effect of plant gel on plant length in first August may be due to the accumulation of plant gel near the root then increased in the length of the plant.

Table (8): Effect of plant gel on plant length, fresh and dry weight of clipping leaf of lawn grasses.

Plant gel gm/m ²	first August			first September			first November		
	Length	Weight (gm)		Length	Weight (gm)		Length	Weight (gm)	
		Fresh	Dry		Fresh	dry		Fresh	dry
0	15.47 a	247.72 a	103.38 a	14.41 a	181.72 a	97.11 a	11.12 b	335.55 a	105.33 a
100	14.44 b	233.61 a	103.05 a	13.57 a	166.72 a	86.77 a	11.73 ab	347.55 a	103.00 a
150	14.94 ab	228.60 a	103.27 a	13.90 a	172.44 a	84.55 a	12.01 a	330.61 a	101.72 a

Means with same letter for each characters are not significantly different at 5% based on Duncan's Multiple Rang Test.

7. Effect of interaction between peat moss and perlite on plant density, leaf area, leaf width, total Chlorophyll, root depth and soil pH of grasses:

Although the interaction between peat moss and perlite as shown in table (9) hadn't any affect on plant density and leaf width, they had significantly effect on the leaf area 131.71 mm² and total chlorophyll which reached to the highest

value 57.05 mg/100 gm f.w. when treated with the highest level of peat moss 2liter/m² and highest level of perlite 3liter/m². Also the root depth increased significantly as the level of the two factors were increased and the highest value reached 54.15 cm while the less value was for 3liter/m² and non peat moss which reached 47.06 cm . The soil pH ranged from 7.58 to 7.73 for all interactions.

Table (9):Effect of interaction between peat moss and perlite on plant density, leaf area, leaf width, total Chlorophyll, root depth and soil pH of lawn grasses.

Peat moss liter/m ²	Perlite liter/m ²	Plant density	Leaf area	Leaf width	Total Chlorophyll	Root depth	Soil pH
0	0	433.76 a	96.69 ab	2.47 a	49.96 ab	53.01 b	7.73 a
	3	444.32 a	131.71 a	2.51 a	49.21 ab	50.16 d	7.68 ab
1	0	442.56 a	112.48 ab	2.19 a	52.94 ab	52.87 b	7.71 a
	3	442.32 a	86.18 b	2.40 a	49.97 ab	50.55 c	7.58 b
2	0	464 a	118.90 ab	2.5 a	56.01 ab	47.06 e	7.70 a
	3	478.08 a	114.72 ab	2.42 a	57.05 a	54.15 a	7.68 ab

Means with same letter for each characters are not significantly different at 5% level based on Duncan's Multiple Rang Test.

These results were agreed with (Ebrahimi *et al.* 2012) on straw berry plant and might be due to the increase in perlite which provided aerial and gas interchanges for the root of the plant, and improved the growth features of the Plant .The result are similar (Samadi, 2011) on cucumber when he used perlite with organic matter led to significant increase in leaf area , leaf width, plant length and fresh weight.

8. Effect of interaction between peat moss and plant gel on plant density, leaf area, leaf width, total chlorophyll, root depth and soil pH of lawn grasses :

The data In table (10) showed that the effect of interaction between peat moss and plant gel on plant density, leaf width and leaf area were

statistically insignificant whereas the differences between the values of total chlorophyll and root depth and soil pH were significant, the highest of chlorophyll value was 57.11 for lawn plants that treated with 2Liter/m² peat moss and 150 gm/m² plant gel, while the less value was 47.18 for lawn plants that treated with 1Liter/m² peat moss and 100gm/m² plant gel , whereas the effect of this interaction on root depth was significant and the highest value was 53.83 for control treatment and the less value was 48.06 cm for the treatment that consist of the highest level of the two factors. pH soil character have unstable increase as the level of the tow factor different and the highest 7.80 for control treatment whereas the less was 7.53 2liter/m² and zero liter/m² plantgel.

Table (10). Effect of interaction between peat moss and plant gel on plant density, leaf area, leaf width, total Chlorophyll, root depth and soil pH of lawn grasses.

Peat moss liter/m ²	Plant gel gm/m ²	Plant density	Leaf area	Leaf width	Total Chlorophyll	Root depth	Soil pH
0	0	426.72 a	105.38 a	2.57 a	49.85 ab	53.83 a	7.80 a
	100	442.56 a	112.94 a	2.50 a	52.97 b	49.71 g	7.73 ab
	150	448 a	124.29 a	2.42 a	52.55 ab	51.21 d	7.59 bc
1	0	464 a	112.95 a	2.18 a	47.33 b	50.21 f	7.53 c
	100	426.56 a	89.56 a	2.28 a	47.18 ab	53.23 b	7.67a c
	150	442.56 a	94.92 a	2.50 a	55.23 ab	51.70 c	7.73 ab
2	0	501.28 a	129.75 a	2.62 a	57.51 a	53.18 b	7.65a c
	100	445.28 a	122.91 a	2.45 a	54.96a b	50.58 e	7.72 ab
	150	466.56 a	97.76 a	2.32 a	57.11 a	48.06 h	7.70 ab

Means with same letter for each characters are not significantly different at 5% level based on Duncan's Multiple Rang Test.



Fig. (3): Root depth of the control treatment

This result agree with (Altland and Krause ,2010) on switch grass lowered pH over time. Peat moss, were effective at reducing substrate pH and buffering against change. Peat moss provided the additional benefit of improving physical properties of the switch grass substrates, chlorophyll content was affected by peat moss, Chlorophyll content and peat moss substrate combinations, There was a quadratic relationship between substrate pH and chlorophyll readings Maximum chlorophyll content Where an increase pH led to an increase in the chlorophyll content, also may be peat moss Improves the physical characteristics of the soil, which led roots deeper into the soil.

9.Effect of interaction between perlite and plant gel on plant density, leaf area, leaf width, total Chlorophyll, root depth and soil pH of lawn grasses :

Data In table (11) showed that the effect of interaction between perlite and plant gel on plant density, leaf width, leaf area and total chlorophyll were statistically insignificant where as the differences between the values of root depth and soil pH were significant, and the highest value was 52.58 cm for the lawn plants that treated with 3Liter/m² perlite and 150 gm/m² plant gel whereas the less value was 50.12 cm for the highest levels of the two factor.

Table (11): Effect of interaction between perlite and plant gel on plant density, leaf area, leaf width, total Chlorophyll, root depth and soil pH of lawn grasses.

perlite liter/m ²	Plant gel gm/m ²	Plant density	Leaf area	Leaf width	Total Chlorophyll	Root depth	Soil PH
0	0	456.8 a	125.59 a	2.48 a	52.78 a	52.23 b	7.68 a
	100	412.32 a	93.86 a	2.3 a	50.02 a	50.18 b	7.73 a
	150	471.04 a	105.62 a	2.2 a	56.07 a	50.53 c	7.72 a
3	0	471.04 a	108.85 a	2.40 a	50.34 a	52.58 a	7.63 a
	100	460.32 a	123.08 a	2.49 a	52.72 a	52.16 b	7.68 a
	150	433.76 a	102.69 a	2.45 a	53.85 a	50.12 d	7.62 a

Means with same letter for each characters are not significantly different at 5% level based on Duncan's Multiple Rang Test.

This result agree with (Samadi, 2011) and might be to due the role of Perlite that help in increase soil aeration and make small tunnels to grow root in the soil and help in oxygen exchange between the soil and atmosphere (Hitechcock, 1982).

10. Effect of interaction between peat moss, perlite and plant gel on plant density, leaf area,

leaf width, total Chlorophyll, root depth and soil pH of lawn grasses :

In table (12) show that the triple interaction between the three soil amendment peat moss, perlite and plant gel on leaf area, leaf width were statistically insignificant whereas the differences between the values of plant density, Total Chlorophyll, root depth and soil pH were significant,

Table (12): Effect of interaction between peat moss, perlite and plant gel on plant density, leaf area, leaf width, total Chlorophyll, root depth and soil pH of lawn grasses.

Peat moss Liter/m ²	Perlite Liter/m ²	Plant gel gm/m ²	Plant density	Leaf area	Leaf width	Total Chlorophyll	Root depth	Soil PH	
0	0	0	426.56 ab	93.50 a	2.75 a	49.40 ad	56.50 a	7.75 ae	
		100	410.56 ab	77.96 a	2.31 a	47.93 cd	52.26 d	7.87 a	
		150	464 ab	118.61a	2.35 a	52.56 ad	50.26 f	7.58e f	
	3	0	426.56 ab	117.26 a	2.38 a	50.30 ad	51.16 e	7.84 ab	
		100	474.56 ab	147.91a	2.68 a	56.00 ad	47.16 g	7.59 df	
		150	432 ab	129.96 a	2.48 a	52.53 ad	52.16 d	7.60 df	
	1	0	0	453.28 ab	129.31 a	2.03 a	47.13 cd	50.16 f	7.63 bf
			100	376.56 b	99.56 a	2.10 a	49.56 ad	52.23 d	7.72 ae
			150	496 ab	108.56 a	2.43 a	62.03 a	56.23 a	7.78 ae
3		0	474.65 ab	97.73 a	2.33 a	47.53 cd	50.26 f	7.44 f	
		100	474.56 ab	79.55 a	2.32 a	44.80 d	54.23 c	7.62 cf	
		150	389.28 ab	81.28 a	2.56 a	48.43 bd	47.16 g	7.68 ae	
2		0	0	490.56 ab	153.96 a	2.75 a	61.83 ab	50.03 f	7.68 ae
			100	448 ab	104.05 a	2.46 a	52.56 ad	46.06 h	7.61 df
			150	453.28 ab	98.68 a	2.33 a	53.63 ad	45.10 i	7.81 ad
	3	0	512 a	105.55 a	2.50 a	53.20 ad	56.33 a	7.63 bf	
		100	442.65 ab	141.78 a	2.46 a	57.36 ad	55.10 b	7.84 ab	
		150	480 ab	96.83 a	2.31 a	60.60 ac	51.03 e	7.59 df	

and the highest value of plant density was 512 plant/m² for the lawn plants and treated with (2liter/m² peat moss, 3Liter/m² perlite and 0

gm/m² plant gel) whereas the less value was 376.56 cm for (1Liter/m² peat moss, 0 liter/m² perlite and 100 gm/m² plant gel), the highest total

of chlorophyll 62.03 mg/100g f.w. obtained in (1 liter/m² peat moss 0 liter/m² perlite 150 gm/m² plant gel) treatment while the less value was 44.80 mg/100g f.w for (1 liter/m² peat moss, 3 liter/m² perlite 100 gm/m² plant gel). Root depth for plant that cultivated in media that does not contain soil amendment gives 56.50cm while the media that contains (2 liter/m² peat moss 0 liter/m² perlite 150 gm/m² plant gel) give the less value 45.10cm of the root depth.

These results agree with (Tomas, 1993) on *Matthiola incana* 'Pink Apple blossom' and 'Miracle Crimson' (stock) and (Ebrahimi *et al.*, 2012) on straw berry plant. The reason of root depth effect may refer to feature of perlite which had a water-holding capacity equivalent to 3 - 4 times its body dry weight, also play essential role in increasing the porosity (Sadawii, 1990). Also agree with Smith and Porter (1989) on cowpea (*Vigna unguiculata* (L.) Walp.) density increase when grown in Perlite and inoculated with

Nitrogen, as for pH soil maybe these results agree with Altland and Krause (2010).

11. Effect of interaction between peat moss and perlite on plant length, fresh and dry weight of clipping leaf of lawn grasses :

The plant length in the first August and November was significantly increased table (13) as a result to the interaction effect between peat moss and perlite and the highest value was 16.16 cm, 12.48 cm for plants that planted in media that amendment by 2 liter/m² peat moss and 3 liter/m² perlite for the two months respectively while the less values 13.50 cm, 10.53 cm were for the control treatment 0 liter/m² peat moss, 0 liter/m² perlite respectively. Also the fresh weight, in all months was affected by this interaction and the highest values at first August 259.77 gm for the highest levels of the two amendment, first September 209.22 gm and first November 409.88 gm for 2 liter/m² peat moss and 3 liter/m² perlite.

Table (13): Effect of interaction between peat moss and perlite on plant length, fresh and dry weight of clipping leaf of lawn grasses.

Treatment		first August			First September			first November		
Peat moss liter/m ²	Perlit liter/m ²	Length	Fresh weight	Dry weight	Length	Fresh weight	Dry weight	Length	Fresh weight	Dry weight
0	0	13.50	224.44	100.77	12.94	178.00	103.44a	10.53	287.11	101.55
		c	ab	a	a	a		c	b	ab
	3	14.61	206.66	93.33	13.81	151.66	84.22	11.13	284.88	96.55
		bc	b	a	a	b	ab	bc	b	ab
1	0	15.27	240.55	105.11	14.77	154.66	76.11	12.05	358.00	104.89
		ab	a	a	a	b	b	ab	ab	ab
	3	15.22	226.88	104.55	14.42	209.22	103.11	11.25	346.78	105.11
		ab	ab	a	a	a	a	ac	ab	ab
2	0	14.94	255.44	111.77	14.11	199.11a	93.55ab	12.27	340.77	95.11
		ab	a	a	a			ab	ab	b
	3	16.16	259.77	103.88	13.72	149.11b	73.44	12.48	409.88	107.55
		a	a	a	a		b	a	a	a

Means with same letter for each characters are not significantly different at 5% level based on Duncan's Multiple Rang Test.

The highest dry weight in the first September was for treatments 2 liter/m² peat moss and 3 liter/m² perlite while in the first November the highest value was 104.89 gm for 1 liter/m² peat moss and 0 liter/m². This result was agreed with (Smith and Porter, 1989) which mentioned that the soil and peat moss lead to an increase in height of cowpeas plant of the first week of growth due to the high portability peat moss to retain water for a

longer period than the soil alone. Also (Matkin, 2010) stated that the perlite helps in increase aeration, but it does not have the ability to pull nutrients as peat moss does so it does not have an effect on plant height. Also these results agree with (Samadi, 2011) on cucumber when the use of perlite with organic matter led to significant increase in plant length and fresh weight.

12. Effect of interaction between peat moss and plant gel on plant length, fresh and dry weight of clipping leaf of lawn grasses:

Although the dry weight of the plants lawn for the three months were in insignificant deference as shown in table (14), the fresh weight for all months were statically significant as the results of the interaction effect of peat moss and plant gel and the highest values are 282.16, 86.33, 405.00 cm for the three month respectively and this result were obtained when treated with (2sliter/m², 100 gm/m²), (0 liter/m², 0 gm/m²), (2 liter/m², 100

gm/m²) peat moss and plant gel respectively for the three months. In addition, the first August plant length that was planted in non soil amendment had the highest value 15.91 cm while the plants media with 0liter/m² peat moss and 150 gm/m² plant gel had the less value 13.66 cm when compared. In the other way the plant length, for the first September cutting was 15.33cm for the media that amendment with 1liter/m² peat moss and 0gm/m² plant gel with significant superior than other treatments.

Table (14). Effect of interaction between peat moss and plant gel on plant length, fresh and dry weight of clipping leaf of lawn grasses.

Treatment		first August			First September			First November		
Peat moss liter/m ²	Plant gel liter/m ²	Length	fresh weight	Dry weight	Length	fresh weight	Dry weight	length	Fresh weight	Dry weight
0	0	14.66 ab	246.66 a-c	100.00 a	13.88 ab	116.33 a	111.00 a	10.13 b	313.50 a-c	190.0 a
	100	13.66 b	213.33 b-d	93.66 a	13.16 ab	89.83 ab	97.33 a	10.83 b	283.00 bc	155.83 a
	150	13.83 b	186.66 d	97.50 a	13.08 b	75.33 b	96.33 a	11.53 ab	261.50 c	148.66 a
1	0	15.91 a	263.33 ab	109.00 a	15.33 a	88.83 ab	103.66 a	11.75 ab	374.33 ab	177.83 a
	100	14.58 ab	205.33 cd	103.83 a	13.88 ab	84.16 b	113.50 a	11.75 ab	354.67 ac	168.5 a
	150	15.25 ab	240.0 ac	101.66 a	14.38 ab	95.83 ab	104.33 a	11.46 ab	328.16 a-c	199.5 a
2	0	15.83 a	233.16 a-d	101.16 a	14.03 ab	86.16 ab	101.33 a	11.50 ab	318.83 ac	177.33 a
	100	15.08 ab	282.16 a	111.66 a	13.66 ab	86.33 ab	98.16 a	12.61 a	405.00 a	175.83 a
	150	15.75 a	257.50 ac	110.66 a	14.05 ab	82.50 b	104.50 a	13.03 a	402.16 a	169.16 a

Means with same letter for each characters are not significantly different at 5% level based on Duncan's Multiple Rang Test.

In addition, the highest level of peat moss and plant gel give the highest plant length 13.03 cm which significantly superior than the control. These results may be due to peat moss that increase soil adorable and help the root to deeper in the soil then absorption nutrient and increase in plant length. Also these result agree with (Jones *et al.* 2013) on Hybrid Bermuda grass that plant length, root length and root surface increase when use peat moss with sand soil , and when plant length increase cause increase in fresh weight of

clipping , but dry weight as said previously didn't effect because of decomposition clipping in the oven less the weight .

13. Effect of interaction between perlite and plant gel on plant length, fresh and dry weight of clipping leaf of lawn grasses :

The data In table (15) showed that the interaction between perlite and plant gel had a significant effect on plant length in the first August and the media which amendment with 3liter/m² perlite and 0gm/m² plant gel recorded the

highest value 15.88cm compared with the 0 liter/m² perlite and 100gm/m² plant gel that recorded the less value 13.49 cm. also the plant length in first November with 0 liter/m² perlite and

150gm/m² plant gel give the highest value 12.50cm. In the contrast, all fresh and dry weight for the three months were statically non significant as a result to these factors.

Table (15): Effect of interaction between perlite and plant gel on plant length, fresh and dry weight of clipping leaf of lawn grasses.

Treatment		first August			First September			First November		
perlite liter/m ²	Plant gel gm/m ²	Length	Fresh weight	Dry weight	Length	Fresh weight	Dry weight	Length	Fresh weight	Dry weight
0	0	15.05 ab	247.66a	105.11a	14.61 a	180.55 a	97.11 a	10.86 b	306.89 a	105.89 a
	100	13.94 b	252 a	108.22 a	13.44 a	174.33 a	91.66 a	11.50 ab	344.11 a	104.11 a
	150	14.72 ab	225.77 a	104.33 a	13.64 a	176.88 a	84.33 a	12.50 a	334.88 a	100.88 a
3	0	15.88 a	247.77 a	101.66 a	14.22 a	182.88 a	97.11 a	11.38ab	364.22 a	104.55 a
	100	14.94 ab	215.22 a	97.88 a	13.70 a	159.11 a	81.88 a	11.96 ab	351.0 a	101.88 a
	150	15.16 ab	230.33 a	102.22a	14.03 a	168.00 a	84.77 a	11.52 ab	326.33 a	102.55 a

Means with same letter for each characters are not significantly different at 5% level based on Duncan's Multiple Rang Test.

These results agree with (Samadi, 2011) on cucumber and (simth and porter, 1989) on cowpea, and also may be because of accumulation of peat moss and plant gel in the beginning of culture near the root caused to increase in the plant length in the first August and decrease in temperature in first November specially the grass that we used cool season grass that make to increase in length in that month.

14. Effect of interaction between peat moss, perlite and plant gel on plant length, fresh and dry weight of clipping leaf of lawn grasses:

The interaction between the three soil amendment have had significant effect on all characters, in table (16) except the dry weight in the first August which was not effected significantly as a result to this factor. the treatment that this media was amendment with 1 liter/m² peat moss, 3 liter/m² perlite and 0 gm/m² plant gel gave the highest value plant length in august 16.83cm when compared with the less value 12.83cm for the interaction of 0 liter/m² peat moss, 0 liter/m² perlite and 100gm/m² plant gel. Also in September the media that contained 1 liter/m² peat moss, 3 liter/m² perlite and 0 gm/m² plant gel superior significantly than others interaction and gave the highest value reach 16.00cm. In addition, plant length for plants that cut in November and planted in soil which amendment with 2 liter/m² peat moss, 3 liter/m² perlite and 100gm/m²

plant gel give the highest value 13.73cm compared with 9.26cm for the control treatment. In the other hand the fresh weight in the first August for the treatment 2 liter/m² peat moss, 3 liter/m² perlite and 100gm/m² plant gel superior significantly 295.00gm than others treatments. While in the first September the media that amendment with 1 liter/m² peat moss, 3 liter/m² perlite and 0 gm/m² plant gel gave highest value 242.33 gm compared with the less value 113.33gm for the treatment 1 liter/m² peat moss, 0 liter/m² perlite and 0 liter/m² plant gel, also in the first November fresh weight reach 478.66gm in the media that contained 2 liter/m² peat moss, 3 liter/m² perlite and 150gm /m² plant gel which superior significantly than the most of others treatments. In the first September for the treatment that didn't contain any soil amendment had the highest effect on dry weight 136.00 gm in contrast to the treatment 1 liter/m² peat moss, 0 liter/m² perlite and 0 gm/m² plant gel which gave the less value 60 gm. Also in the first November the highest dry weight 121.00gm was for the media 1 liter/m² peat moss, 0 liter/m² perlite and 100gm/m² plant gel had compared with the treatments 2 liter/m² peat moss, 0 liter/m² perlite and 0 gm/m² plant gel and other treatment which gave the less values 90.33gm.

These results agree with (Hountin et al., 1995) on barley (*Hordeum vulgare* L.) that significant

relationship was found between peat moss and straw yield, and plant height. Results from this study indicate that peat moss-shrimp wastes compost could represent a potential means of renovating low fertility sand soils, also agree with (Moraghebi and Mahebbi, 2010) on

Polyanthus, perlite-sand treatment caused increase in plant length, as well (Seydi, 2008) on liliun that increasing the percentage of peat moss substrates in media caused increase in all growth plant length.

Table (16): Effect of interaction between peat moss, perlite and plant gel on plant length (cm), dry weight of clipping (gm) and fresh weight of clipping (gm)

Peat moss Liter/m ²	Perlit Liter/m ²	Plant gel mm/m ²	First August			First September			First November			
			Length	Fresh weight	Dry weight	Length	Fresh weight	Dry weight	Length	Fresh weight	Dry weight	
0	0	0	14.33a -d	266.66 ab	106.66 a	13.83 ab	216.66 ab	136.00 a	9.26 d	317.66 bd	121.00 ab	
		100	12.83 d	243.33 ac	104.00 a	12.50 b	160.00 bc	93.00 ad	10.66 cd	285.67 cd	101.00 ab	
		150	13.33 cd	163.33 e	91.66 a	12.50 b	157.33 bc	81.33 bd	11.66 ad	258.00 d	97.66 ab	
	3	0	15.00 ad	226.66 ae	93.33 a	13.93 ab	163.33 bc	96.66 ad	11.00 bd	309.33 bd	101.00 ab	
		100	14.50 ad	183.33 ce	83.33 a	13.83 ab	151.66 bc	86.66 bd	11.00 bd	280.33 cd	93.66 b	
		150	14.33 ad	210.00 be	103.33 a	13.66 ab	140.00 bc	69.33 cd	11.40 ad	265.00 d	95.00 ab	
	1	0	0	15.00 ad	253.33 ac	106.66 a	14.66 ab	113.33 c	60.00 d	11.33 ad	322.00 bd	102.33 ab
			100	15.16 ad	243.33 ac	107.66 a	14.83 ab	166.32 bc	83.33 bd	12.33 ac	415.33 ac	121.00 ab
			150	15.66 ac	240.00 ad	101.00 a	14.43 ab	184.33 ac	85.00 bd	12.50 ac	336.66 bd	104.33 ab
3		0	16.83 a	273.33 ab	111.33 a	16.00 a	242.33 a	117.66 ab	12.16 ac	426.67 ab	104.33 ab	
		100	14.00 ad	167.33 de	100.00 a	12.93 ab	170.67 abc	85.00 bd	11.16 bd	294.00 bd	106.00 ab	
		150	14.83 ad	240.00 ad	102.33 a	14.33 ab	214.68 ab	106.66 ac	10.43 cd	319.66 bd	104.33 ab	
2		0	0	15.83 ac	223.00 ae	102.00 a	15.33 ab	211.66 ab	95.33 ad	12.00 ac	281.00 cd	94.33 b
			100	13.83 bd	269.33 ab	113.00 a	13.00 ab	196.68 ab	98.66 ad	11.50 ad	331.32 bd	90.33 b
			150	15.16 ad	274.00 ab	120.33 a	14.00 ab	189.00 abc	86.66 bd	13.33 ab	410.00 ac	100.66 ab
	3	0	15.83 ac	243.33 ac	100.33 a	12.73 b	143.00 bc	77.00 bd	11.00 bd	356.67 ad	108.33 ab	
		100	16.33 ab	295.00 a	110.33 a	14.33 ab	155.00 bc	74.00 bd	13.73 a	478.67 a	106.00 ab	
		150	16.33 ab	241.0 ac	101.00 a	14.10 ab	149.33 bc	78.33 bd	12.73 ac	394.34 ad	108.33 ab	

Means with same letter for each characters are not significantly different at 5% level based on Duncan's Multiple Rang Test

Depending on the results of the study conclude the following: We conclude that using peat moss, perlite and Plant gels as a soil amendments haven't had any effect on plant density, leaf area, leaf width. Except when increased the levels of peat moss to 2litter/m² decreased root depth and increased total chlorophyll. As well as perlite levels in 3litter/m² increased root depth and decreased soil pH. At the same time plant gels levels in 150 gm/m² decreased root depth.

In the case of interactions the highest plant length 16.16 cm was recorded in treatment that contain 2 liter/m² of peat moss and 3 litter/m² of perlite, while the largest leaf area which reach 131.71 mm² were recorded in 0 liter/m² of peat moss and 3 litter/m² of perlite.

The triple interaction between all factors had an effect on leaf area. the highest chlorophyll content 62.03 mg/100 gm fresh weight was found in treatment that contain of the 1 litter/m² of peat moss, 0 litter/m² of perlite and 150gm/m² of plant gel. In the case of vegetative fresh weight the highest means which was recorded 478.88 gm/m² was in the soil that contain 2 Litter/m² peat moss, 3 Litter/m² perlite and 150 gm/m² plant gel.

Based on the results and conclusions of the study, we recommend to adding soil amendments before planting to obtain the best growth of lawn. And further researches and studies with another concentration of all amendment that use in this study. We also recommend to using this mixture of seeds for planting in the gardens of Pishdar Region because of its success and its response to environmental conditions.

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EFFECT OF SHADING AND PACLOBUTRAZOL ON THE GROWTH OF THREE SPECIES OF LAWN GRASSES.

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ABSTRACT

This study was carried out in the Permam Erbil governorate from 15th March, 2011 to 15th September, 2011. to study the response of three species of *Festuca* lawns: *Festuca ovina* var hardtop, *Festuca arundinacea* var palladio, *Festuca rubra* var bargreen to three shade levels 0, 25%, 75% and three concentrations of Paclobutrazol 0, 1000 and 2000 mg.l⁻¹. The experimental was preferment by use randomized complete block design. The results can be summarized as follows: *Festuca arundinacea* var palladio was superior significantly in accumulative dry weight of clipping growth and dry weight of roots whereas *Festuca ovina* var hardtop was superior significantly in leaf area and decreased significantly in coverage percentage whereas the three species gave non significant results in the other characters. The second concentrations (1000) mg.l⁻¹ of Paclobutrazol gave the best significant results for all studies characters except dry weight of root. Although the dry weight of root and leaf area gives the best significant values when planted in 50 and 0 % shade; the others four characters cannot affected significantly by this factors.

KEY WORDS: Shading, paclobutrazol lawns.

INTRODUCTION

The lawns grasses which followed the gramineae family defined as any grass that can be cut and made up thick vegetation that covers the soil surface (Christian, 2004). It have distinct characteristics, such as low growth habit, prostrate creeping tendency, high shoot density and coarse-to-fine leaf texture and occupy about 70-80% of the area of our land in gardens (Beard, 1973; Alderson and Sharp, 1994). Its plants contains meristematic regions close to the soil surface that create rhizomes, stolon's which in turn contribute in the development of grass and make it able to withstand the agricultural services like mowing, fertilizing and irrigation, also the production of turf grass is one of the most important economic sectors for some countries like America, British and Netherlands (Al-Ba'aly, 1967; Salih, 2001; Casler and Duncan, 2003).

It is the main element in the landscaping design and have a multi benefits such as absorb carbon dioxide and releases oxygen (every 25 m² of the turf absorb what they can get it out of one man's carbon dioxide per hour), reduce noise pollution, reduce heat from the sun and increase the relative humidity through the process of

transpiration (Duble, 1996; Salih, 2001; Al-Qiei and Noah, 2004).

The shade which may cause by trees, shrubs, buildings... etc seriously affects the quality and growth habit of the lawns grasses surfaces (Bell and Danneberger, 1999). Higgins (1998) mention that it is necessary to take into account the amount of light in the park due to their importance in obtaining good grass stability and spread with a thick growth and healthy. Also Dudeck and Peacock (1992) found that decreases light results in a decrease in the number and size of the roots, which leads to a reduction in the ability of the grass to stay. With increased shade, morphological changes was observed in different turf grass species such as reduction in root density, quantity of clippings mass, lawn density and degree of coverage shoot vertical growth increased under shade (Newell *et al.*, 1999, Koh *et al.*, 2003). Also Qian and Engelke (1999) found that exposing *Zoysia matrella* grass in the greenhouse to different levels of shading 0, 30, 60, 90% shade gave the highest rate of coverage, color and quality under the shade levels and pointed out that the increase in the levels of deception has led to a reduction in the number and size of the roots. Furthermore, Physiological changes such as a

reduction in chlorophyll and carotenoids contents as well as carbohydrate reserves have been observed in different grasses species responding to light reduction (Van Huylenbroeck and Van Bockstaele, 2001; Jiang, 2005). Also Lissbrant (2005) found that the Shade affected the biomass negatively on perennial ryegrass (*Lolium perenne* L.) it increased with increased the light or decreased the shade from 80 to 50 then 0%. Plant growth retardants are commonly applied to containerized crops when plants are likely to become too large relative to the container size (Tayama *et al.*, 1992). The use of the plant growth regulators (PGRs) as “chemical mowing agents” was envisioned many years ago because of the tremendous economic benefits (Davis and Curry, 1991) and additional potential benefits including: improved color, fewer clipping, deeper roots, fewer seed heads, less time spent in trimming (Johnson, 1992). Much of the mowing stress to turfgrass, as well as clippings and labor inputs, can be reduced by applications of plant growth regulators (PGRs). Additionally, applications of PGRs such as fluprimidol and paclobutrazol may be used to reduce populations of annual bluegrass, *Poa annua* L. (Christians, 1998). On the other hand various reports have shown the effectiveness of some growth retardants on growth and physiological responses of various ornamentals. For example, Olsen and Andersen (1995) found that Paclobutrazol at 32 mg.l⁻¹ and cycocel (CCC) at 285 mg.l⁻¹ don't have a significant effect on number of branches in *Osteospermum ecklonis*. Rossini-Pinto *et al.*, (2005) observed that 2000 mg.l⁻¹ CCC significantly increases chlorophyll content of pot zinnia flower (*Zinnia elegans*) and caused reduction of plant height and length of branches and has no effect on fresh and dry weight of plant. In coneflower (*Rudbeckia hirta*) application of growth retardants such as Paclobutrazol (5 and 15 mg.l⁻¹) and CCC (2000 mg.l⁻¹) increased cone diameter compared to control (Hojjati *et al.*, 2010). Gopi *et al.*, (2005) showed that application of retardants on *Amorphophallus* reduces leaf area due to inhibition of gibberellin synthesis, increment of abscisic acid content and cell elongation prevention within the leaf.

paclobutrazol are used as plant growth retardants for high maintenance lawn grasses management to suppress shoot growth and shade conditions. Inflorescences to reduce clipping

production, mowing. On the other hand, paclobutrazol is primarily frequency and improving aesthetics (Turgeon, 1999). The aim of this study is to investigate the response of three species of lawn grasses to different levels of shade and paclobutrazol (PGRs)

MATERIAL AND METHODS

This study was carried out in the Permam Erbil governorate from 15th March, 2011 to 15th September, 2011. The experiment was conducted to study the response of three species of *Festuca* lawns: *Festuca ovina* var hardtop, *Festuca arundinacea* var palladio, *Festuca rubra* var bargreen to three shade conditions 0, 25%, 75% and spray with three concentrations of Paclobutrazol 0, 1000 and 2000 mg.l⁻¹. Each observation was cultivated into plastic pot (25 cm diameter) media consist of river soil, peat moss (2:1 by volume). The seeds (which its origin is Baren Brug Company in Netherland) and obtained through the Gulistan Company for Agricultural Consulting in Duhok city are sown in pots (50 seeds/ pots). The experimental design was a randomized complete block design (RCBD) by using 4 pots for each one of the four replications. Six months after the experiment was growth, plants were harvested and data recorded include accumulative dry weight of vegetative growth (clipping yield) g, dry weight of roots g/ plant (dried at 70 °C for 72 h) (Al-Sahaf, 1989), Leaf area (cm²), total chlorophyll mg.g fresh weight (Wintermans and Dimots, 1965), Color degree, and Coverage percentage (estimated by measuring the covered area with turf relative to the total area of the unit). The statistical analysis and Means comparison by use Duncan's Multiple Ranges Test under 5% was done by using SAS program (SAS, 2001).

RESULT AND ISSECTION

Accumulative dry weight of vegetative growth (dry clipping yield) (g/pot)

The results in Table (1) showed that the highest accumulative dry weight of vegetative growth (23.06) g/pot was observed for *Festuca arundinacea* species whereas the lowest value 18.04 g/pot was for *Festuca rubra* with significant variation among the species.

Although the shade hadn't any significant effect on this characteristic, it was decreased

significantly to (18.97) g/pot with increased the paclobutrazol to 2000 mg.l⁻¹ compared with control and 1000 mg.l⁻¹ which give 20.74, 20.37 g/ pot respectively. Triple interaction among the

three factors showed that the highest accumulative dry weight (26.38) g/ pot was obtained for *Festuca arundinacea* species that spray with 1000 mg.l⁻¹ of Paclobutrazol and planted in 75% shade.

Table (1): Effect of paclobutrazol and shade on the accumulative dry weight of three species of lawns grasses (g/plant).

species	Paclobutrazol	Shade			Paclobutrazol effect	Species effect
		0%	50%	75%		
<i>Festuca ovina</i> var hardtop	0	19.15f-j	19.89 e-j	22.42 b-f	0	18.97 b
	1000	20.28d-i	17.58 i-k	19.25 f-j		
	2000	17.70 h-k	17.70 h-k	16.78 jk		
<i>Festuca arundinacea</i> var palladio	0	21.09c-h	22.30 b-f	23.80 a-c	1000	23.06 a
	1000	25.23ab	21.91 b-f	26.38 a		
	2000	23.33a-d	21.57 c-g	21.97 b-f		
<i>Festuca rubra</i> var bargreen	0	18.46g-j	22.87 b-e	16.70 jk	2000	18.04 b
	1000	17.00i-k	18.45 g-j	17.29 h-k		
	2000	18.18h-j	19.07 f-j	14.39 k		
Shade effect		20.05 a	20.15 a	19.89 a		

Means with same letter for each factor and interaction are not significantly different at 5% level based on Duncan's Multiple Range test.

Dry Weight Of Roots (G)

The results in Table (2) indicated that shading with 50% shade gave the best dry weight of roots (22.33) g/plant compared with 0 and 75 % which decreased significantly to 20.88 and 17.84 g/ plant respectively. Also significant variation in the dry weight of roots was noticed among the different *Festuca* species and the highest weight 22.50 g/ plant was for *Festuca arundinacea* which superior significantly than the other species. Like this the dry weight of roots was decreased significant from 22.85 to 20.53 and 17.66 g/ plant as a result to

increase the paclobutrazol concentration from 0 to 1000 and 2000 mg.l⁻¹ respectively.

In addition, the triple interaction among shade levels, *Festuca* species and concentrations of Paclobutrazol showed significant effect on this character and the highest weight was 27.67 g/ plant for *Festuca arundinacea* grow in 50% shade and spray with 1000 mg.l⁻¹ of Paclobutrazol and this weight was decreased to 12.51 g/ plant for *Festuca rubra* grow in 75% shade levels and spray with 1000 mg.l⁻¹ of Paclobutrazol.

Table (2): Effect of paclobutrazol and shade on the Dry weight of roots growth (g/plant) for three species of lawns.

Species	paclobutrazol	Shade			paclobutrazol effect	Species effect
		0%	50%	75%		
<i>Festuca ovina</i> var hardtop	0	22.43cd	24.27b-d	20.21e-g	0	20.42b
	1000	19.55f-h	25.33a-c	17.10h-j		
	2000	17.67hi	21.00ef	16.22i-k		
<i>Festuca arundinacea</i> var palladio	0	25.83ab	21.04ef	27.67a	1000	22.50a
	1000	24.54b-d	27.67a	19.24f-h		
	2000	23.46cd	18.00 g-i	15.08jk		
<i>Festuca rubra</i> var bargreen	0	18.59g-i	27.62a	18.00 g-i	2000	18.13c
	1000	17.83 g-i	21.03ef	12.51l		
	2000	18.04 g-i	15.00jk	14.51kl		
Shade effect		20.88b	22.33a	17.84c		

Leaf Area (cm²)

The data in Table (3) showed significant differences between the means of leaf area as a result to uses different shade levels, the highest mean reach 1.74 cm² when planting in 0 % shade level and decreased this value to 1.28 cm² when grown under 75% shade. On the other hand, there are significant differences among different *Festuca* species in leaf area and the higher leaf area 1.74 cm² was for *Festuca ovina* while least area 1.34 cm² was for *Festuca rubra*. As for Paclobutrazol concentrations noticed that the leaf area of lawns

significantly increased with increasing the Paclobutrazol levels to 1000 mg.l⁻¹ (2.00) cm² then decreased to 1.03 cm² when spray with 2000 mg.l⁻¹.

The interaction among the three factors had a significant effect on this character and the highest area (3.23) cm² was for *Festuca arundinacea* which grew in 0% shade and Paclobutrazol while the lowest leaf area (0.65) cm² was recorded for *Festuca rubra* that planted in 75% shade and spray with 2000 mg.l⁻¹ of Paclobutrazol.

Table (3): Effect of paclobutrazol and shade on the Leaf area (cm²) of three species of lawns.

Species	paclobutrazol	shade			Paclobutrazol effect	Species effect
		0%	50%	75%		
<i>Festuca ovina</i> var hardtop	0	1.79 b-e	1.53 b-g	1.55 b-g	0	1.74 a
	1000	1.38 c-j	1.63 b-f	1.48 b-h		
	2000	1.28 d-j	1.59 b-g	1.26 d-j		
<i>Festuca arundinacea</i> var palladio	0	3.23 a	2.15 bc	1.99 b-d	1000	1.45 b
	1000	2.01 b-d	1.83 b-e	1.60 b-g		
	2000	1.56 b-g	2.24 b	1.36 c-j		
<i>Festuca rubra</i> var bargreen	0	1.46 b-i	1.04 e-j	0.93 f-j	2000	1.34 b
	1000	1.61 b-g	0.81 g-j	0.68 ij		
	2000	1.38 c-j	0.72 h-j	0.65 j		
Shade effect		1.74 a	1.50 b	1.28 c		

Total Chlorophyll Content In Vegetative Growth (mg/100 g fresh weight)

It can be seen from Table (4) that significant variation in the total chlorophyll content was noticed among the three concentration of paclobutrazol and the highest value was found in 1000 mg.l⁻¹ (29.49) mg/100 g f. w. compared with control which gives the least value (25.57) mg/100 g f. w. visa versa the shading and species hadn't any significant effect on this characteristic.

Regarding the triple interaction between all studying factors cleared that there were significant differences between the treatments and the highest significant values (36.15) mg/100 g f. w. was for *Festuca arundinacea* which grew in 0% shade and spray with 1000 mg.l⁻¹ of Paclobutrazol then decreased to 21.53 mg/100 g f. w. for *Festuca ovina* which grew in 50% shade and spray with 0 mg.l⁻¹ of Paclobutrazol.

Table (4): Effect of paclobutrazol and shade on the total chlorophyll content (mg/100 g fresh weight) for three species of lawns.

species	paclobutrazol	Shade			Paclobutrazol effect	Species effect
		0%	50%	75%		
<i>Festuca ovina</i> var hardtop	0	22.07d	21.53d	26.77b-d	0	26.29a
	1000	25.97b-d	24.83b-d	26.77b-d		
	2000	26.93b-d	29.10a-d	26.13b-d		
<i>Festuca arundinacea</i> var palladio	0	33.36ab	31.47a-c	25.04b-d	1000	28.50a
	1000	36.15a	31.85a-c	25.52b-d		
	2000	27.76a-d	28.4a-d	25.81b-d		
<i>Festuca rubra</i> var bargreen	0	27.21b-d	25.90 b-d	23.23cd	2000	26.36a
	1000	29.50a-d	26.44b-d	29.47a-d		
	2000	24.30cd	24.03cd	24.67b-d		
Shade effect		28.14a	27.07a	25.93 a		

Quality Degree

The results in Table (5) showed that shade levels and different *Festuca* species haven't any significant effect on the quality degree of different turf grass species, whereas a significant variation in the quality degree was noticed among the Paclobutrazol concentration, and the highest degree 8.11 was recorded for 1000 mg.l⁻¹ which differs significantly when compared with other

species. On the other hand, the triple interaction between the studying factors cleared that there were significant differences between treatments. *Festuca arundinacea* which grew in 75% shade and sprayed with 1000 mg.l⁻¹ of Paclobutrazol gave the highest significant degree of quality (8.67) compared with the lowest degree 5.00 of *Festuca rubra* which grew in 0% shade and spray with 2000 mg/l⁻¹ of Paclobutrazol.

Table (5). Effect of paclobutrazol and shade on the quality degree of three species of lawns.

species	paclobutrazol	Shade			Paclobutrazol Effect	Species effect
		0%	50%	75%		
<i>Festuca ovina</i> var hardtop	0	8.00 a-c	6.67 c-g	6.00 e-h	0	7.07 a
	1000	8.33 ab	7.00 b-f	7.33 a-e		
	2000	7.33 a-e	6.33 d-h	5.33 gh		
<i>Festuca arundinacea</i> var palladio	0	8.00 a-c	8.33 ab	8.00 a-c	1000	7.15 a
	1000	8.33 ab	7.33 a-e	8.67 a		
	2000	8.33 ab	7.67 a-d	8.33 ab		
<i>Festuca rubra</i> var bargreen	0	5.33 gh	7.67 a-d	5.67 f-h	2000	6.89 a
	1000	5.67 f-h	6.33 d-h	5.33 gh		
	2000	5.00 h	7.00 b-f	6.67 c-g		
Shade effect		7.15 a	7.15 a	6.81 a		

Coverage Percentage (%).

It can be seen from Table (6) that increased the shade cannot effect significantly on the coverage percentage. Whereas significant differences appeared among the species and the highest value 81.30% for *Festuca arundinacea* while the least value was 75.00 % for *Festuca ovina*. As for the Paclobutrazol significant effect was obtained when spray with 1000 mg.l⁻¹ with

the highest value 85.37% whereas the lease value was 70.56% without spray.

On other hand, the interaction among the factors indicated that the higher cover percentage 93.33% obtained in *Festuca arundinacea* grass that grew in 0% shade and spray with 1000 mg.l⁻¹ Paclobutrazol, while these value decreased to 60.00% in *Festuca rubra* grass that grew in 0% shade and spray with 2000 mg.l⁻¹ of Paclobutrazol.

Table (6): Effect of paclobutrazol and shade on the Coverage percentage for three species of lawns.

species	paclobutrazol	Shade			Paclobutrazol effect	Species effect
		0%	50%	75%		
<i>Festuca ovina</i> var hardtop	0	73.33 b-h	85.00 a-e	66.67 e-h	0	75.00 b
	1000	83.33 a-e	83.33 a-e	75.00 a-h	78.04 b	
	2000	77.33 a-h	85.00 a-e	73.33 b-h		
<i>Festuca arundinacea</i> var palladio	0	88.33 a-d	85.00 a-e	71.67 c-h	1000	81.30 a
	1000	93.33 a	90.00 a-c	91.67 ab	85.37 a	
	2000	81.67 a-f	86.67 a-d	80.00 a-g		
<i>Festuca rubra</i> var bargreen	0	70.00 d-h	63.33 f-h	71.67 c-h	2000	77.67 ab
	1000	76.67 a-h	61.67 gh	76.67 a-h	70.56 c	
	2000	60.00 h	71.67 c-h	83.33 a-e		
Shade effect		78.22 a	79.07 a	76.67a		

Increased leaf area significantly as a result to increased the shade from 0 to 75 % as shown in table (3) and dry weight of root to 50% shade may be refer to that all turfgrasses grow best in full-sun conditions; In shaded areas, the specific wavelengths of light available to a turfgrass plant are altered and the amount of light available can reduce the plant's ability to efficiently perform photosynthesis. This result was expected since it agrees with the previous studies which obtained that the yield is likely to decrease (Kephart *et al.*, 1992; Redfearn *et al.*, 1999). And with Vartha (1973) who showed that perennial ryegrass decreases in dry weight when exposed to shade and by Lin *et al.* (1999) who show that several cool season grass species (i.e. ryegrass) possessed some shade tolerance to 50% shade, and did not show significant differences in dry weight compared to 0% shade as happen in the accumulative dry weight of vegetative growth of our study which cannot effected significantly by this factor. A somewhat contradicting response was presented by Garrett and Kurtz (1983), who showed that tall fescue can produce higher yield in shaded conditions, than when grown in the open and which was presented by AL-Mizory (2007) who found that 50% shadowing led to significant increase in leaf area (2.27 cm²), shoots dry accumulative weight (370.55 g) Whereas planting in open-air conditions 0% shadowing, has led to significant increase in planting density (71. 36 plant/ 100 m²) dry weight of roots (55.46 g).

The significant effects of paclobutrazol on most of characters as shown in tables (1, 3, 4, 5, 6) may be attributed to the role of PGRs in alter plants physically by reducing shoot elongation as

a result to gibberellic acid inhibitors and causing biochemical alterations including changes in levels of protein and amino acids and production of allelochemicals (Campbell, 1988). Also Plant growth regulators are often used on turfgrass to reduce mowing frequency and grass clippings, increase root growth and stress tolerance, and suppress seed head formation. Given their effects on grass physiology, which include changes in plant nutritional value and production of plant allelochemicals (Rogers *et al.*, 2001). Also they may serve to increase root mass and cause turf to transpire less, therefore conserving soil moisture (Brueninger and Watschke, 1989).

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DETERMINATION OF ACCUMULATED OIL AND PROTEIN IN SEED OF RAPESEED DURING SEED DEVELOPMENT

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ABSTRACT

This study was carried out in Qrdarash Resrech/collage of Agriculture-Erbil during winter season 2014-2015 to detect the correlation between oil and protein accumulation in different rapeseed varieties at different stage of seed development. RCBD with three replication was used. Each replication consisted of 4 plots 4m², five rows/plot 5 length and 40cm between rows. When pod formation reach 90% five samples were taken at different dates from four chosen plant from each plant and subjected to oil and protein analysis. The results showed that Pactol variety had higher oil % about 43.40 while Pioneer variety revealed higher protein% 27.13. The interaction between varieties and sampling date effect on oil and protein %. Pactol variety had higher oil% at first week 45.5 and Pioneer had low oil % at fourth week but recorded higher % of protein at second week 28.62. Significant negative correlation found between oil% and sampling date for Pactol, Topscore and Pioneer (-0.15, -0.85 and -3%) respectively. While positive linear correlation recorded between protein and varieties Pioneer, Star and Pactol (1.51, 1.03 and 0.08%) respectively.

KEYWORDS: Rapeseed, oil and protein%, seed development.

INTRODUCTION

Canola belongs to the botanical Brassicaceae family and includes the species *Brassica napus*, *B.rapa* and *B.juncea* (Daun, 2011). The oil is the most valued component of the seed, generally accounting for 65%–80% of the seed rate. The oil-free meal has 35% - 50% protein and is usually used as protein supplement in animal feed (Tan *et al.*, 2011). Quality of canola seed includes oil and protein concentrations. These two components are contrariwise affected by growing environments (Si *et al.*, 2003). Oil concentration of canola seed is reduced by the adversarial environmental conditions, during seed development and maturation (Si and Walton, 2004). Between the environmental parameters disturbing the concentration of canola oil, temperature is one of the most important ones decreasing the seed oil content (Pritchard *et al.*, 2000). While (Praveena *et al.*, 2000; Ahmad and Hassan, 2000) found that the high temperature increases the oil content while low temperature affects the fatty acid composition of the oil in other crops. Pritchard *et al.*, 2000) High oil contents (and low seed protein contents) were correlated with cooler spring temperatures and higher spring rainfall. Oil

contents were lowest, on average, in canola grown in dry years, or from the hotter regions. Canvin (1965) reported that there was a reduction of 1.2% in oil content for each 1°C temperature increase. Recently, Pritchard *et al.* (1999) concluded that year and region were far more important factors than cultivar concerning oil and seed protein content. Oil content diverse more with year than with region. On average, oil content demolish by 0.38% per 1°C increase in maximum spring temperatures. Sadalla *etal.*, (2011) shows that oil accumulation at 32, 39 days after pollination in maize seed and in time of harvest in fall season was significantly difference from spring season, and positive correlation was found between temperature and oil % in spring season while negative correlation was found in fall season.

Munshi and Kochar (1994) with the conclusion that oil proportion in the pods decreased with the phase of siliqua growth, likewise, in soybean central capsules had seeds with less oil content than seeds from lateral capsules (Gularia *et al.*, 2008).

The oil content in canola varies significantly depending on the variety, agronomic conditions and the environment in which it is grown. Si and Walton (2004) Cultivars differed in their capacities to produce oil and seed yield. The

ranking of cultivars for oil concentration, and seed yield. Both seed yield and oil concentration decreased with delayed sowing. On average, oil concentration was reduced by 1.1% for every 2 weeks delay in sowing (Si and Walton, 2004).

There was negative correlation between oil and protein content due to different effect of temperature during seed filling phase. It's observed that there were negative correlation between oil and high mean of temperature and positive correlation for protein content. This was confirmed by Bahatty, (1964) agree with Prichard *et al.*, (1999) which they reported that the decrease in temperature increase oil% and decrease protein%. The aim of this study was increase oil and protein content in the seed has been one of the major focuses; this study was investigated of accumulation of oil and protein content in the seeds of rapeseed cultivar at different time of seed formation.

MATERIAL AND METHODS

Experiment was conducted at Agriculture Research Station – Grdarash / Collage of Agriculture-Erbil, during the winter season 2014-2015. Four rapeseed cultivars (*Brassica spp.*) (Topscore, Star, Pioneer and Pactol) were planted in RCBD design with three replications consist of four plot each 4m², five rows/plot with 5m long and 40cm between rows, The seed rate was 4kg/h. Nitrogen fertilizer 240kg/h and 100kg/h of Phosphorus were applied at planting date. Four plants from each plot (variety) were chosen and labelling with red stripe, when pod formation reach 90% according (Elias and Copeland, 2001). Five samples were taken from chosen plant for estimation the seed oil and protein content. Table (1) shows planting date, mean of temperature / sampling date for each variety.

1– Oil content estimation using Soxhlet extractor according to (A.O.A.C, 1980).

2– Protein content estimation using Kheldal method according to (A.O.A.C, 1980).

The data were subjected to statistical analysis using SAS programmer (2004).

Table (1): sampling date for each variety

time/ week	variety	average of temperature / week	date of sampling/variety
time 1	topscore	21.38	18/4/2015
time 2		21.31	25/4/2015
time 3		24.26	2/5/2015
time 4		34.64	9/5/2015
time 5		32.06	18/5/2015
time 1	pioneer	20.58	11/4/2015
time 2		21.38	18/4/2015
time 3		21.31	25/4/2015
time 4		24.26	2/5/2015
time 5		32.06	18/5/2015
time 1	star	21.38	18/4/2015
time 2		21.31	25/4/2015
time 3		24.26	2/5/2015
time 4		34.64	9/5/2015
time 5		32.06	18/5/2015
time 1	pactol	23.31	21/4/2015
time 2		22.01	28/4/2015
time 3		22.14	5/5/2015
time 4		27.44	12/5/2015
time 5		32.06	18/5/2015

RESULTS AND DISCUSSION

Oil Content

Table (2) showed that Pactol variety had the higher oil % which was about 43.4 comparing with other three genotypes Pioneer, Topscore and Star. The minimum oil% was found in the Pioneer variety 37.50. These results agree with (AL-Marsomy, 2002; Jassim and Thany, 2004) results they found there were a differences among seed varieties for oil% while (Sarkes, 2006) in his study found the Pioneer variety recorded the highest oil%.

Significant effect of interaction was found among varieties and sampling date for oil%. In first week (1st date) Pactol had highest oil % 45.5, while Pioneer had lowest oil% at (4th date) it was 33. This difference in oil% is due to the genotypes response to temperature during seed filling stage at different sampling date.

Figure (1) revealed that there was a linear negative correlation between oil% and sampling date for these varieties (Pactol, Topscore and Pioneer). The oil% reduce about (0.15, 0.85 and 3) % respectively, with the progress of growing stage and seed formation according to formulas ($\hat{Y} = 43.85 - 0.15x$, $\hat{Y} = 41.05 - 0.85x$,

$\hat{Y} = 45 - 3x$) respectively. While the same figure shown there was positive linear correlation between oil% and sampling date for Star variety. The oil% was increased about 1.1% with progress in growth and seed formation according to the formula
 $(\hat{Y} = 35.7 + 1.1x)$.

Protein Content

Table (3) showed that the effect of varieties behavior was different on protein% comparing to oil%. The Pioneer variety was dominance in protein% 27.13, while the Topscore had the lowest protein% 22.17 which was not differences from Star and Pactol. These results agree with (AL-Marsomy, 2002) who found there were the differences among varieties in protein% and the sampling date were not different significantly, but the protein% increased at 2nd and 3rd sampling date which correlated with increase in temperature during these period. This result agree with (Canvin, 1965) who observed that increase in temperature over 20°C during seed filling lead to increase protein%, also (Prichard *etal*, 1999)

found that with decrease in temperature the oil% increased and protein% decreased.

Significant effect on protein% was found for the interaction between sampling date and varieties. Pioneer recorded at second date the higher protein% 28.62, while Topscore variety recorded lowest percentage about 19.18 at first date sampling.

From figure (2) we can observed, there was negative time correlated between protein% and sampling date for Topscore variety, the decrease in protein% was 0.05 with seed growth progress according to formula
 $(\hat{Y} = 22.32 - 0.05x)$.

At the same figure there was positive linear correlation between protein% and sampling date for the varieties Pioneer, Star and Pactol, where the protein% increased about 1.51, 1.03 and 1.08 % respectively with the progress of seed filling according to $(\hat{Y} = 23.35 + 1.51x$, $\hat{Y} = 21.14 + 1.03x$ and $\hat{Y} = 24.86 + 0.08x)$.

Table (2): effect of variety and sampling date on oil content

Variety / Time	Time 1	Time 2	Time 3	Time 4	Time 5	mean of variety
Topscore	37.00 b-f	44.00 ab	38.00 a-f	37.50 b-f	36.00 c-f	38.50 b
Pioneer	41.50 a-e	40.00 a-f	35.50 def	33.00 f	-	37.50 b
Star	38.00 a-f	34.50 ef	42.50 a-d	38.50 a-f	41.50 a-e	39.00 b
Pactol	45.50 a	42.00 a-e	42.00 a-e	43.50 abc	44.00 ab	43.40 a
Mean of time	40.50 a	40.12a	39.50a	38.12a	40.50a	

Table (3): effect of variety and sampling date on protein content

Variety / Time	Time 1	Time 2	Time 3	Time 4	Time 5	mean of variety
Topscore	19.18 c	22.83 c	26.02 bc	25.01 bc	17.84 c	22.17 b
Pioneer	23.99 bc	28.62 a	36.06 ab	29.87 abc	-	27.13 a
Star	24.64 bc	20.02 c	23.58 bc	26.40 bc	26.00 bc	24.25 b
Pactol	25.63 bc	25.60 bc	22.91 c	25.27 bc	26.24 bc	25.13 b
Mean of time	23.36a	26.76a	27.14a	26.64a	23.56a	

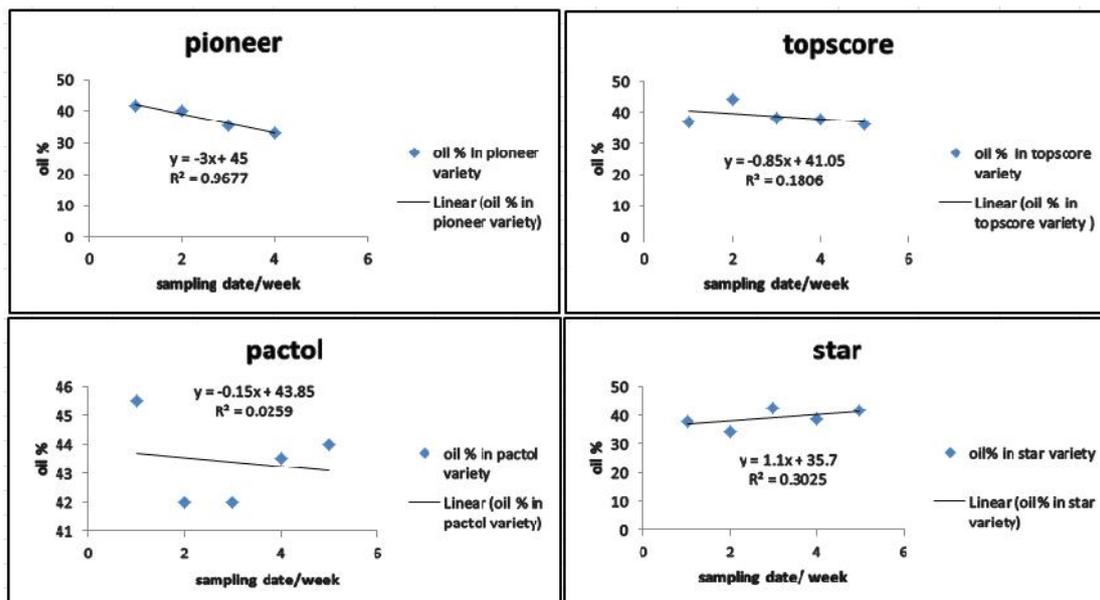


Figure (1): Relationship between oil % and sampling date for different variety.

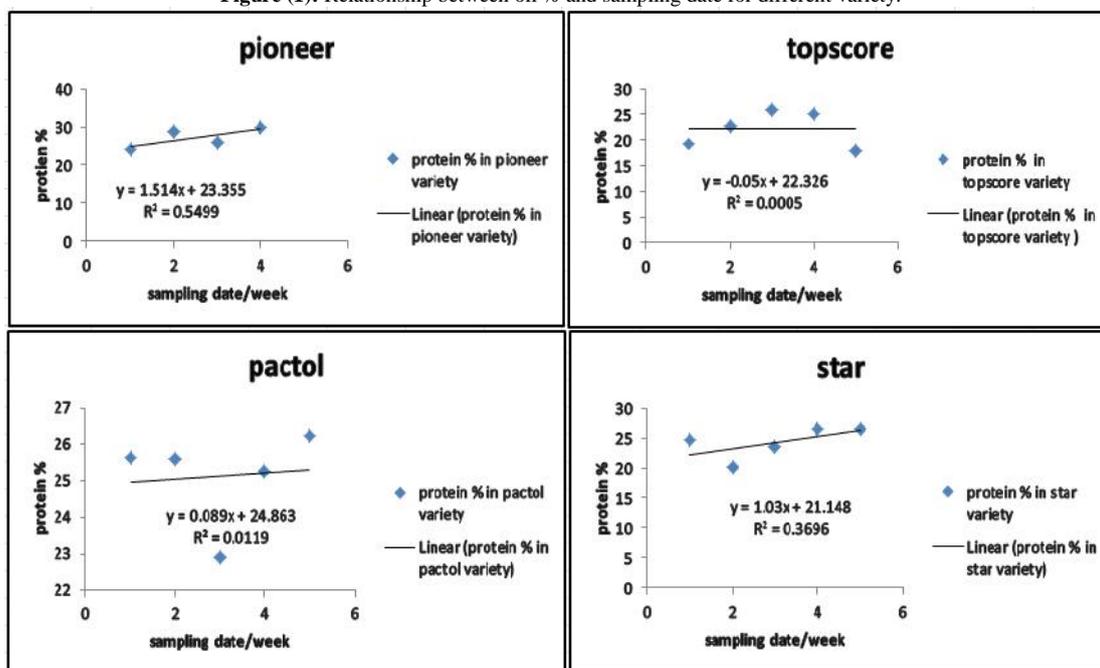


Fig. (2): Relationship between protein % and sampling date for different variety.

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INFLUENCE OF ORGANIC MANURES AND GIRDLING DATES ON FLOWERING AND YIELD OF APPLE TREE FRUIT AFTER TWO YEARS APPLICATION

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ABSTRACT

This investigation was carried out during growing season of 2014-2015 on six years old apple tree cv. Xank (*Malus domestica* Borkh) grown in the orchard at Gavarky, Duhok governorate, Kurdistan region, Iraq. To study the effect of two girdling date (before full bloom and after fruit set), sheep manure application at three levels (0, 4 and 6 kg.tree⁻¹), and compost application at levels (0, 3 and 5 kg.tree⁻¹), on some characteristics of apple fruits. According to obtained results, it noticed that girdling (date 1) was best time for girdling, and the high level of sheep manure and compost (6 kg.tree⁻¹ and 5 kg.tree⁻¹) respectively. The interaction between girdling (date 1) and 6 kg.tree⁻¹ sheep manure give high yield. Moreover, the interaction between girdling (date 2) and 5 kg.tree⁻¹ compost increase fruit set and tree yield. The superior combination was among (girdling (date 1) + 6 kg.tree⁻¹ sheep manure + 5 kg.tree⁻¹) which cause to improve all studied parameters except number of fruit.

KEYWORD: Girdling, Sheep manure, Compost, Apple

INTRODUCTION

The Apple (*Malus domestica* Borkh) is perennial tree belonged to Rosaceae family, its popular to be consumed due to their convenience and durability. It has arisen in the Caucasus region of southeastern Europe (Watkins *et al.*, 2013). There are more than 2000 varieties of apple grow in temperate climate zones and in a wide range of soil types (Rome, 2006). "Girdling" is usually carried out by cutting through the phloem and removing a strip of tissue from the bark of tree. When no strip of tissue is removed, the process is seems to as scoring. The main function of girdling is to reduce the transfer of carbohydrates to lower parts of the tree and to the roots. In this way, carbohydrates were accumulated above the girdling area (Davie *et al.*, 1995). According to (Minh, *et al.*, 2012) the girdling of Wax apple that done before flowering about three weeks, lead to reduce bud drop, and fruit drop. They found that girdling lead to enhance fruit parameters (fruit length, fruit diameter, fruit set, fruit weight, and total soluble solid). Recently researchers have started to give attention positive effect of organic manure application more than of chemical fertilization for environment and on human beings healthy as

sheep manure and compost (Janick, 2007). (Zuoping, *et al.*, 2014) indicated that the application of organic manure at 25-30 t.ha⁻¹ with chemical fertilizer on "Fuji" apple trees caused an increase in fruit quality, and total yield. Moreover, applying the organic fertilizer and two kinds of vermicomposts together on the apple rootstocks, it shown that it has a significant effect in improving the quality and growth (Grzyb, *et al.*, 2012). The aim of study was to investigate the effect of organic manures and girdling on flowering and yield characteristics of apple tree fruits after two years of application to improve flower buds induction and yields.

MATERIALS AND METHODS

This study was carried out on private orchard of six years old of apple trees, located in Gavarky, center of Duhok city during season of 2014-2015. To investigate the effect of girdling date, sheep manure and compost after two years of application on flowering, fruit set, number of fruit/tree, fruit drop and total yield of cv. Xank apple trees. Girdling was done by removing the bark of three main branches of each tree carefully about 5 – 6 mm in two times (date 1) before flowering on 19/3/2014 and (date 2) after fruit set on 19/4/2014

by knife. The application of sheep manure was done in January 26th 2014, by a working hole around the tree under the projection of branches at three levels (0, 4, and 6 kg.tree⁻¹). The compost that was used in this experiment consisted from residues waste of Duhok city, produced in Kawashi factory of compost fertilizer. The application of compost was done in 26th January 2014, by working hole around the tree under the projection of branches at three levels (0, 3, and 5 kg.tree⁻¹). The experiment was consisted of 18 treatments with three replications; with individual tree for each experimental unit. The total number of trees used was 54 trees and using Randomize Complete Block Design (RCBD) as factorial experiment (Al-Rawi and Khalaf-Alla, 2000). Moreover, the data were analyzed statistically by using (SAS, 1996).

RESULTS AND DISCUSSIONS

1- Number Of Flowers.Branch⁻¹

From table (1), it is clearly shown that, the girdling (date 1) had significantly the highest number of flowers.branch⁻¹ (462.63 flowers.branch⁻¹) than girdling (date 2) which recorded the lowest flowering value (394.56 flowers.branch⁻¹). Number of flowers was increased significantly as increasing the application of sheep manure at (6 kg.tree⁻¹), higher flowering numbers (487.72 flowers.branch⁻¹). Moreover, the lowest value was with (0 kg.tree⁻¹) which were (392.06 flowers.branch⁻¹). The application of compost at (5 kg.tree⁻¹) recorded the highest flowering numbers which was (492.72 flowers.branch⁻¹), while the lowest flowering (357.06 flowers.branch⁻¹) was recorded in control. It clearly shown the interactions of girdling (date 2) with sheep manure at (6 kg.tree⁻¹) recorded the highest flowering (530 flowers.branch⁻¹) as compared with other treatment. The interactions between girdling (date 1) with (5 kg.tree⁻¹) of compost register the highest value for flowering which

Table (1): Effect of girdling date, sheep manure, compost and their interactions on number of flowers.branch⁻¹ of apple tree cv. Xank at season 2015

Girdling dates	Sheep Manure (kg.tree ⁻¹)	Compost (kg.tree ⁻¹)			Girdling * Sheep manure	Girdling
		0	3	5		
Date 1	0	261.67 i	551.67 b	655.00 a	489.44 b	462.63 a
	4	419.67 g	452.67 f	486.67 de	453.00 c	
	6	343.33 h	510.00 cd	483.00 e	445.44 c	
Date 2	0	246.67 i	215.67 j	421.67 g	294.67 e	394.56 b
	4	351.00 h	366.00 h	360.00 h	359.00 d	
	6	520.00 c	520.00 c	550.00 b	530.00 a	
Compost		357.06 c	436.00 b	492.72 a	Sheep manure	
Girdling *	Date 1	341.56 e	504.78 b	541.56 a		
Compost	Date 2	372.56 d	367.22 d	443.89 c		
Sheep manure *	0	254.17 f	383.67 e	538.33 a	392.06 c	
Compost	4	385.33 e	409.33 d	423.33 cd	406.00 b	
	6	431.67 c	515.00 b	516.50 b	487.72 a	

The same letters in means of each interaction was not significantly different from each other according to Duncan's multiple ranges test at 5% level.

Recorded (541.56 flowers.branch⁻¹) as compared with all other treatment. The interactions between sheep manure and compost, the highest flowering numbers is obtained from (0 kg.tree⁻¹ sheep manure + 5 kg.tree⁻¹ compost) and it is significantly higher than all other interaction treatments. The interactions of girdling date, sheep manure, and compost together was resulted increase in the number of flowering. The highest value obtained with girdling (date 1) + 0 kg.tree⁻¹ sheep manure + 5 kg.tree⁻¹ compost, which was (655 flowers.branch⁻¹) as compared with all other treatment.

2- Fruit Set (%)

The data in the table (2) display that there no significant differences between girdling dates in the fruit set. When applying sheep manure and compost, it lead to increase fruit set with increasing the amount of application. The

interactions effect of girdling date and sheep manure in promoting the fruit set, the best interaction treatment was girdling (date 1) with 6 kg.tree⁻¹ sheep manure application which recorded (84.67%). Also the interactions effect of girdling (date 2) with compost application at 5 kg.tree⁻¹ gave the highest value of fruit set the value were registered (77.65%) compared with other interaction treatments. The results fairly show that the interactions between sheep manure application at 6 kg.tree⁻¹ + compost application at 5 kg.tree⁻¹ gave the clearly significant differences the value documented as (86.69%). compared with control. The data in the same table display the interactions between girdling (date 1) + 6 kg.tree⁻¹ sheep manure + 5 kg.tree⁻¹ compost resulted in higher fruit set compared with all other interaction treatments

Table (2): Effect of girdling date, sheep manure, compost and their interactions on fruit set (%) of apple tree cv. Xank at season 2015

Girdling dates	Sheep Manure (kg.tree ⁻¹)	Compost (kg.tree ⁻¹)			Girdling * Sheep manure	Girdling
		0	3	5		
Date 1	0	77.86 bd	43.07 h	38.41 h	53.11 d	69.88 b
	4	63.81 g	81.22 bc	70.53 ef	71.85 c	
	6	83.52 b	73.88 de	96.62 a	84.67 a	
Date 2	0	78.39 bd	74.90 de	77.17cd	76.82 b	75.48 a
	4	81.51 bc	74.68 de	79.04 bd	78.41 b	
	6	66.35 fg	70.54 ef	76.75 cd	71.21 c	
Compost		75.24 a	69.50 c	73.09 b	Sheep manure	
Girdling * Compost	Date 1	75.06 ab	66.06 c	68.52 c		
	Date 2	75.42 ab	73.37 b	77.65 a		
Sheep manure * Compost	0	78.13 b	58.98 d	57.79 d	74.75 c	
	4	72.66 c	77.95 b	74.78 bc	75.13 b	
	6	74.94 bc	72.21 c	86.69 a	77.94 a	

The same letters in means of each interaction was not significantly different from each other according to Duncan's multiple ranges test at 5% level.

3- Number Of Fruit.Tree⁻¹

It is clear in table (3) that the number of fruits per tree increased in girdling (date 1) which was (231.85 fruit.tree⁻¹) than of (189 fruit.tree⁻¹) from girdling (date 2). Sheep manure application lead a significant increase in number of fruit per tree at 6 kg.tree⁻¹ (251.39 fruit.tree⁻¹) as compared with control (155.56 fruit.tree⁻¹). The application of

compost at 5 kg.tree⁻¹ resulted in increasing the number of fruit per tree significantly (237.39 fruit.tree⁻¹) as compared with control (168.95 fruit.tree⁻¹). The highest number of fruit per tree was gained with girdling (date 1) + 4 kg.tree⁻¹ sheep manure, which was (272.11 fruit.tree⁻¹), as compared with all other interaction treatments. Data in the same table indicated that the number

of fruit per tree increased at interactions between girdling (date 1) and 3 kg.tree⁻¹ compost and it is documented as (260.33 fruit.tree⁻¹) as compared with other interaction treatments. The highest significant value of number of fruit per tree obtained with interactions effect 6 kg.tree⁻¹ of sheep manure plus 5 kg.tree⁻¹ compost which was (302.50 fruit.tree⁻¹), as compared with all other interaction treatments. Regarding the triple interactions effect of girdling date, sheep manure, and compost in providing the number of fruits per tree, the highest significant effect was at girdling (date 1) + 4 kg.tree⁻¹ sheep manure + 3 kg.tree⁻¹ compost (349.33 fruit.tree⁻¹) as compared with all other treatment combinations.

4- Fruit Drop (%)

It is clear in table (4) that the fruit drop in girdling date (1) (28.82%) is more than fruit drop in girdling date (2) (25.21%). The fruit drop is increase at 6 kg.tree⁻¹ sheep manure compared with control. The compost application at 0 kg.tree⁻¹ lead to increase the fruit drop (28.26%). In the other hand, the control fruit drop was little (67.22). The interaction between girdling (dates 2) with 6 kg.tree⁻¹ sheep manure resulted in highest fruit drop of Xank tree compared with other treatments. Regarding the interactions between girdling date (1) + 0 kg.tree⁻¹ compost, give the highest fruit drop of Xank tree (30.70%) compared with some interaction treatments.

Table (3): Effect of girdling date, sheep manure, compost and their interactions on number of fruit.tree⁻¹ of apple tree cv. Xank at season 2015

Girdling dates	Sheep Manure (kg.tree ⁻¹)	Compost (kg.tree ⁻¹)			Girdling * Sheep manure	Girdling
		0	3	5		
Date 1	0	150.00 i	168.67 h	163.33 h	160.67 e	231.85 a
	4	187.67g	349.33 a	279.33 c	272.11 a	
	6	210.33 f	263.00 d	315.00 b	262.78 b	
Date 2	0	114.00 j	149.00 i	188.33 g	150.44 f	189.00 b
	4	160.00 hi	181.33 g	188.33 g	176.56 d	
	6	201.67 f	228.33 e	290.00 c	240.00 c	
Compost		168.95c	223.28 b	237.39 a	Sheep manure	
Girdling * Compost	Date 1	182.67 d	260.33 a	252.56 b		
	Date 2	158.56 e	186.22 d	222.22 c		
Sheep manure * Compost	0	132.00 h	158.83 g	175.83 f	155.56 c	
	4	173.83 f	265.33 b	233.83 d	224.33 b	
	6	206.00 e	245.67 c	302.50 a	251.39 a	

The same letters in means of each interaction was not significantly different from each other according to Duncan's multiple ranges test at 5% level.

The interactions between 6 kg.tree⁻¹ sheep manure and 0 kg.tree⁻¹ compost has significant effect in increasing the fruit drop compared with all other treatments. The main triple interaction among both girdling dates (2) + 6 kg.tree⁻¹ sheep manure + 0 kg.tree⁻¹ compost resulted in highest fruit drop (45.01%) compared with other treatments.

5- Tree Yield (Kg.Tree⁻¹)

It is completely shown in table (5) that the girdling date (2) has significant effect in the total yield (19.52 kg.tree⁻¹) than girdling date (1) which was (17.29 kg.tree⁻¹). The sheep manure has a

visible effect in increasing the tree total yield mainly (22.78 kg.tree⁻¹) from 6 kg.tree⁻¹ as compared with control (12.90 kg.tree⁻¹). When increasing the amount of compost it lead to increase the total yield as in this table the 5 kg.tree⁻¹ has significantly effect in increasing the total yield (21.27 kg.tree⁻¹) as compared with control (15.10 kg.tree⁻¹). The interactions between girdling (date 1) + 6 kg.tree⁻¹ sheep manure gave the maximum total yield (24.02 kg.tree⁻¹) compared with other interactions treatments but it doesn't significantly differ with girdling date (2) + 4 kg.tree⁻¹ sheep manure (23.77 kg.tree⁻¹). About

the interactions effect between girdling date and compost application of Xank apple tree, noticed that the girdling (date 2) + 5kg.tree⁻¹ compost resulted in maximum total yield production, it is registered as (23.30 kg.tree⁻¹) as compared with all other interaction treatments. The data in the same table, proves that the sheep manure application at 6 kg.tree⁻¹ with compost application at 5 kg.tree⁻¹ give the highest total yield, which is (26.76 kg.tree⁻¹) compared with control which is (10.27 kg.tree⁻¹) and other combinations. The interactions effect shows that the girdling (date 1) + 6 kg.tree⁻¹ sheep manure + 5 kg.tree⁻¹ compost resulted in greater significant increase in the total yield parameter of Xank apple tree (27.77 kg.tree⁻¹). In the other hand, the little production obtained with girdling (date 2) + 0 kg.tree⁻¹ sheep manure + 0 kg.tree⁻¹ compost (8.90 kg.tree⁻¹).

According to the results that obtained from table (1 – 5), the girdling dates and organic manures had clear effect on the parameters (number of flower.tree⁻¹, fruit set, number of fruit.tree⁻¹, tree yield and fruit drops). This may due to nutritional state of tree, girdling cause to supply the tree with excess amount of carbohydrates that stored in the upper part of the

tree by making interruption area which prevent transferring them to the lower part of tree (root) (Hossain *et al.*, 2006; and Gomaa *et al.*, 2009). Girdling (date 1) lead to increase flowering this due to that the girdling was done before flowering, so the reproductive buds have meaningful amount of carbohydrates to form highest amount flowers. Girdling (date 2) resulted in increasing tree yield as in table (5) this may due to the result in table (4), the fruit drop in girdling (date 1) is higher than of (date 2) even that the number of fruit in girdling (date 1) is more than (date 2) that in table (3) (Khandaker *et al.*, 2011; Zhao *et al.*, 2013). Organic manure had a positive effect on most of studied parameters this may be due to the effect of organic manure on increasing number of perfect flower per inflorescences by equipping nutrients for plants, which considered and determine factor to information and development of flowers parts (Fayed, 2010). In addition, the reasons of increase fruit setting may be attributed to the role of organic manure in improving soil physical and chemical characters and increasing aeration and moisture necessary for roots growth and absorption of water and nutrients. (Tisdale *et al.*, 1993; Van slyke, 2001).

Table (4): Effect of girdling date, sheep manure, compost and their interactions on fruit drop (%) of apple tree cv. Xank at season 2015

Girdling dates	Sheep Manure (kg.tree ⁻¹)	Compost (kg.tree ⁻¹)			Girdling * Sheep manure	Girdling
		0	3	5		
Date 1	0	26.38 fg	37.21 b	31.21 de	31.60 b	28.83 a
	4	31.06 de	10.96 i	27.08 f	23.03 c	
	6	34.66 bc	31.25 de	29.66 df	31.86 b	
Date 2	0	28.09 ef	16.55 h	11.31 i	18.65 d	25.22 b
	4	4.41 j	23.78 g	32.60 cd	20.26 d	
	6	45.02 a	35.93 b	29.30 df	36.75 a	
Compost		28.27 a	25.95 b	26.86 b	Sheep manure	
Girdling * Compost	Date 1	30.70 a	26.47 b	29.32 a		
	Date 2	25.84 bc	25.42 bc	24.40 c		
Sheep manure * Compost	0	27.23 d	26.88 d	21.26 e	25.12 b	
	4	17.73 f	17.37 f	29.84 c	21.65 c	
	6	39.84 a	33.59 b	29.48 c	34.30 a	

The Same letters in means of each interaction was not significantly different from each other according to Duncan's multiple ranges test at 5% level.

Table (5): Effect of girdling date, sheep manure, compost and their interactions on total yield (kg.tree⁻¹) of apple tree cv. Xank at season 2015

Girdling dates	Sheep Manure (kg.tree ⁻¹)	Compost (kg.tree ⁻¹)			Girdling * Sheep manure	Girdling
		0	3	5		
Date 1	0	11.63 k	12.77 j	13.27 ij	12.56 e	17.29 b
	4	13.97 i	15.25 h	16.69 g	15.30 c	
	6	18.81 f	25.48 bc	27.77 a	24.02 a	
Date 2	0	8.90 l	12.72 j	18.09 f	13.23 d	19.52 a
	4	20.65 e	24.61 c	26.05 b	23.77 a	
	6	16.66 g	22.23 d	25.75 b	21.55 b	
Compost		15.10 c	18.84 b	21.27 a	Sheep manure	
Girdling * Compost	Date 1	14.80 f	17.84 d	19.24 c		
	Date 2	15.40 e	19.85 b	23.30 a		
Sheep manure * Compost	0	10.27 h	12.75 g	15.68 f	12.90 c	
	4	17.31 e	19.93 d	21.37 c	19.54 b	
	6	17.74 e	23.86 b	26.76 a	22.78 a	

The same letters in means of each interaction was not significantly different from each other according to Duncan's multiple ranges test at 5% level.

CONCLUSIONS

According to the results, girdling (date 1) was more effective in providing all studied parameters except of total yield, which had highest value in girdling (date 2). Moreover, the high level of sheep manure and compost (6 and 5 kg.tree⁻¹) respectively had a variable effect in all studied parameters. The interaction between girdling (date 1) and 6 kg.tree⁻¹ sheep manure was superior interaction in providing most of studied parameters as in interaction between girdling (date 1) and 5 kg.tree⁻¹ compost. In the other hand, the interaction between 6 kg.tree⁻¹ and 5 kg.tree⁻¹ compost was more influential in stimulating most of studied parameters. In the triple interaction among treatments, the girdling (date 1) + 6 kg.tree⁻¹ sheep manure + 5 kg.tree⁻¹ cause to improve the most studied parameters.

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EFFECT OF HUMIC ACID AND LIQUORICES EXTRACTION ON GROWTH OF THREE VARIETIES of Strawberry (*Fragaria X ananassa* Douch.)

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ABSTRACT

This study was conducted in Erbil/ Sablagh village on Murtka road during growing season of 2012-2013 in side of greenhouse, and the experiment done in CRD split-plot design and using three strawberry variety (Festival, Fortuna and Rubygem). Three concentrations of humic acid (85%) (0, 2 and 4) g.l⁻¹ and three concentrations of Liquorices extract (0, 2 and 4) g.l⁻¹ were used in 01/03 to 05.03.2013 as a foliar application. The study aimed to investigate number of parameters like vegetative growth which including leaf area, number of runner, number of daughter plants, Chlorophyll content, crown diameter and dry weight. The results showed that the best concentration of Humic acid was 2 g.l⁻¹ in most of the parameters while the best Liquorices extraction concentration was 2 g.l⁻¹ also in most of the parameters, and interaction between the Varieties, Humic acid and Liquorices extract, was the superiority of the share Festival Variety+ concentrations 2 g.l⁻¹. Humic + 2 g.l⁻¹ Licorice extract in the majority parameters.

KEY WORDS: Strawberry, small fruits, humic acid, liquorice

INTRODUCTION

Strawberry (*Fragaria X Ananassa* Duch.) Is belong to Rosaceae family *Fragaria* Genus, which give fruits that characterized by its beautiful shape, delicious taste and the nutritional value. Strawberries are an excellent source of strawberries have significantly high amounts of anthocyanins and ellagic acid, vit .C which is also a powerful natural antioxidant. Rich in B-complex group of vitamins, contain vit . A, vit. E, and health promoting flavonoid poly phenolic antioxidants such as lutein, zeaxanthin, and beta-carotene in small amounts. They contain good amount of minerals like potassium, manganese, fluorine, copper, iron and iodine, as well as providing a good dose of fibre, folic acid. They also contain significant amounts of phytonutrients and flavanoids which makes strawberries bright red. They have been used throughout history in a medicinal context to help with digestive ailments, teeth whitening and skin irritations. Their fibre and fructose content may help regulate blood sugar levels by slowing digestion and the fibre is thought to have a satiating effect. Leaves can be eaten raw, cooked or used to make tea. More specifically, perennating buds are ones that are formed prior to unfavourable conditions (i.e. dieback of the winter and then die back when the cold hits). The buds are protected throughout the

winter dormancy period and then come to life again in the spring (Al-Saidi, 2002), (Marvin, 2012)

Festival is short day varieties selected to compete in Florida's winter and early spring fresh fruit. Festivals superior disease resistance, rain damage, has demonstrated excellent firmness and shelf life and excellent pollination under cool humid conditions result in high percentage of marketable fruit especially in the early part of the season. The fruit had excellent dessert and aromatic quality. The consistent internal red color makes the festival an excellent candidate for freezer market.

Fortuna is short-day variety released by university of Florida strawberry variety development program. Selected for earliness, fruit quality, and productivity, the variety adapt to high value fresh market winter production region. Fortuna produces a high percentage of large attractive and uniformly shaped fruit early in the season. It holds its fruit size and shape throughout its production cycle. It bears fruit on long pedicels, facilitating both pollination and fruit harvest. The seeds of the fruit are slightly sunken below the surface, giving the Fortuna a glossy, bright red colour. The fruit ships well and taste as good as it looks

Rubygem, this short day strawberry variety was selected for its earliness and excellent flavour.

It ships well for a variety of its succulence, bloom and fruit carried above and beyond the plant canopy for ease of picking and disease resistance, dense and compact plant habit; it requires little or no winter chill in the nursery setting. Temperate zone nursery propagation suggests that excessive chill may result in irregularities in fruit shape. Rubygem appears to be best adapted to low chill propagation systems. (www.emcocal.com)

Humic acid is highly beneficial for both plant and soil; it maintains proper plant growth as well as it increases nutrient uptake, tolerance to drought and temperature extremes, activity of beneficial soil microorganisms, and availability of soil nutrients particularly in alkaline soils and low organic matter without excessive use of agricultural chemicals which are considered a menace to the environment (Russo and Berlyn, 1990, Eissa et al., 2007 and Ismail et al., 2007). Therefore, uses of Humic acid improve nutrient availability especially microelements it promotes nutrient uptake as chelating agent. Furthermore, Humic acid materials may increase root growth in a similar manner to auxins (O'Donnell, 1973, Tatini, et al., 1991 and Khattab et al., 2012). In this respect, Humic acid has many

effects due to their increase of cation exchange capacity which affects the retention and availability of nutrients, or due to a hormonal effect (Chunhua et al., 1998).

Liquorices The English name of the plant is Liquorices while Botanic name is Glycyrrhiz aglabra (Gg). Glycyrrhiza means sweet root in Latin (Oxford, 1993), and glabra means smooth fruit of plant (Tyler et al., 1988). The plant belongs to Leguminosae family the genus glycyrrhiza contains 14 kinds the Glycyrrhiza. The Liquorices shrub grows in subtropical climates in rich soil to a height of four or five feet. It has oval leaflets, white to purplish flower clusters, and flat pods. Below ground, the Liquorices plant has an extensive root system with a main taproot and numerous runners. The main taproot, which is harvested for medicinal use, is soft, fibrous, and has a bright yellow interior (Varsha et al., 2013). The reason of using Liquorices is to promote the growth of the plant because it contains growth regulator hormones like gibberellins (Dawood, 2010).

The aim of study to promoting vegetative growth, Stimulating growth and production of

runners Production of strong seedling ,Increasing the yield, reducing the import of seedlings and reduce the cost.

MATERIALS AND METHODS

The study was conducted, in a commercial greenhouse at Sablagh Village locating on Murka-Kerkuk main road within Erbil Governorate, during growing season 2012-2013. The investigation performed by using three strawberry varieties (Festival, Fortuna and Rubygem) imported from Turkey as a seedling were transported by truck under cooling condition at 4 °C. The seedling planted four days after importing in 15/11/2012, the treatments were applied on the plants when they were completely established after four months, and the treatments consist of Humic acid (85%) (0, 2 and 4) g.l-1 and Liquorice extraction with three concentrations (0, 2 and 4) g.l-1, the plants was treated in order to observe the treatments effect efficiently on vegetative growth and daughter plants formation. The experiment's design was split plot within CRD and three replicates was carried out. The data were statistically analyzed with computer using SAS system (2002) and the difference between treatment means significantly tested with Duncun Multiple Range at 5% level (Al-Rawi and Khalafalla, 2000)

The soil sample analysing was analysed in Agricultural Research Centre– Ain kawa, Erbil. The results are illustrated in the following table (1):

Table(1): Some chemical and physical properties of the soil studies

Properties	Value	Unit
EC	0.5	ds m-1
pH	7.2	-
Nitrogen (N)	0.17	%
Potassium (K)	200	mg kg-1(ppm)
Organic matter (OM)	0.07	%
Gypsum block	0	kPa
Clay	Silt	Sand
61.4 %	26.6 %	12 %
Soil texture	Clayey or Clay	

*The soil sample analysing was performed in Agricultural Research Centre– Ain kawa, Erbil

Three plants were taken from each treatment to observe the effect of application of humic acid and liquorice extraction on plants. The data for the following parameters were recorded:

Leaf area (cm²/leaf) the leaf area was measured using (khalifa, 2007).

Dry weight (g), The chosen plants were taken, Afterwards, each pack/envelop was weighed using a sensitive balance (Alsahaaf, 1989). Chlorophyll content, the chlorophyll content in the leaves was determined by chlorophyll meter SPAD-502 (Hardin et al., 2012).

Crown diameter (cm), Verna was used to measure of crown diameter.

Number of daughter plants/plant, for the above parameter, three plants were taken.

RESULTS AND DISCUSSION

Effect of Humic Acid and Liquorices Extraction on Growth of Three Varieties of Strawberry

1- Leaf Area (cm²)

There was a significant difference between the varieties which Rubygem was the highest with (14.70 cm²) and Festival was (14.45 cm²) and the lowest was Fortuna with (14.15 cm²) as indicated in (Table 2).

For humic acid, there was also significant difference between the concentrations, which best result of leaf area obtained from 2g.l⁻¹ and it was (15.74 cm²) and the lowest was in zero g.l-1 and 4g.l-1 humic acid (13.55cm²) and (14. 01 cm²) respectively as indicated in (Table 2).

There were also significant difference among the three concentrations of liquorice extract, the 4 g. l⁻¹ had the highest leaf area with (15.65 cm².leaf-1) and the lowest leaf area was for zero

g.l-1 liquorice with (13.81cm².leaf⁻¹) as indicated in (Table 2).

There was a significant different in leaf areas within an interaction between varieties and humic acid which best result obtained from in Rubygem variety 2g.l⁻¹ humic acid which recorded (14.70 cm².leaf-1) as indicated in (table, 4) and the lowest leaf area was of share of in Fortuna variety +0g. l⁻¹ which was (13.16 cm².leaf-1) as display in table (2).

Concerning the interaction between Varieties and Liquorice data revealed that the maximum value was recorded from Rubygem and 2g. l⁻¹ Liquorice compared to the minimum value from the interaction between Festival and 0 g. L-1 Liquorice.

For the interactions between the studies factors, table (2) indicates that the interactions of Rubygem Variety and 2g. l⁻¹ Liquorice significantly surpassed on most of the treatments in leaf area trait.

The combination between foliar application of humic acid and Liquorice had significant effect on leaf area the maximum value was recorded as a result of the interaction between 2g.L⁻¹ Liquorice and 2g. l⁻¹ humic acid which was (17.69cm²) , but the lowest value was noticed from the interaction of 0 g. L⁻¹ Liquorice and 0 2g.L⁻¹ humic acid which was (12.71cm²) as indicated in (Table2).

There was a significant different in leaf areas within interaction between the varieties and concentration of humic acid and liquorice, which best result obtained from Rubygem variety and 2 g.L-1 humic acid with 2 g. l- liquorice which was (19.61 cm²), and the lowest result was share of Fortuna variety and 0 g. l⁻¹ humic acid with 2g. l⁻¹ liquorice which was (12.36 cm²) as indicating in (Table 2).

Table (2): Effect of Humic Acid and Liquorices Extraction on leaf area (cm²) of Three Varieties of Strawberry

Varity	Liquorice g.l ⁻¹	Humic acid g.l ⁻¹			Variety * Liquorice	Variety Mean
		0	2	4		
Festival	0	13.70 f	14.25 ef	12.73 gh	13.56 c	14.45 b
	2	14.63 def	15.58 d	15.18 de	15.13 a	
	4	15.26 d	13.83 efg	14.91 de	14.67 ab	
Fortuna	0	12.83 gh	14.02 ef	13.00 fgh	13.28 c	14.15 c
	2	12.36 h	18.50 a	13.56 f	14.81 ab	
	4	13.66 f	14.86 d	14.53 f de	14.35 b	
Rubygam	0	12.43 h	17.81 c	13.51 fg	14.58 ab	14.70 a
	2	13.56 fg	19.61 a	13.41 fg	15.53 a	
	4	13.50 g	13.18 g	15.28 d	13.99 bc	

Variety *	Festival	14.53 c	14.55 c	14.27 cd	Liquorice Mean
	Fortuna	12.95 e	15.79 b	13.70 de	
Humic acid	Rubygam	13.16 de	16.87 a	14.07 cd	
Humic acid *	0	12.98 e	15.36 b	13.08 e	13.81 b
Liquorice	2	13.52 de	17.91 a	14.05 cd	15.16 a
	4	14.14 c	13.96 d	18.85 a	15.65 a
Humic acid Mean		13.55 b	15.74 a	14.01 b	

The means with the same letters in each column indicates to non significant differences in (5 %) level of probability by Duncan's Multiple Range Test.

2- Runner. Plant⁻¹

In table (3) shows The varieties effect significantly on the number of runners of the strawberry, which the highest result obtained from Festival variety which was (13.11 runner.plant⁻¹) and the lowest was of share of Fortuna variety with (10.67 runner. plant-1).

For the Humic acid, there was also a significant difference between the concentrations, in which best result for the number of runner obtained from 2 g. l⁻¹ recording (12.22 runner.plant-1) and the lowest was in 4 g. l⁻¹ humic acid (11.29 runner.plant-1), but there were no significant difference between 4 g. l⁻¹ humic acid and 0 g. l⁻¹ humic acid.

For the liquorice extract, the highest number of runners was of share of 4 g. l⁻¹ which was (12.55 runner.plant⁻¹) and the lowest was for 0 g. l⁻¹ which was (10.33 runner.plant⁻¹).

The combination between the varieties and humic acid, had significant effect on number of runners which the highest value was recorded as a result of the interactions between Festival + (2 g. l⁻¹ of Humic acid) which was (13.66 runner.plant⁻¹). But there were no significantly diverse in the concentrations (0 g. l⁻¹ and 4 g. l⁻¹ of humic acid) with similar variety, the lowest value recorded

with Rubygam + 0 g. l⁻¹ that was (9.89 runner.plant⁻¹).

From the interactions, the data in Table (3) shows that the interactions of the varieties and the liquorice were effected significantly on number of runners; the maximum value was obtained from the interactions Festival +4 g. l⁻¹ Liquorice (14.22 runner.plant⁻¹).

Table (3) also shows the combination between humic acid and liquorice. This combination significantly increased number of runners in strawberry plant, while the interaction of 4 g. l⁻¹ Liquorice + 0 g. l⁻¹ Humic acid gave highest value (13.55), but there were no significantly difference between liquorice and humic acid at concentrations (4 g. l⁻¹ +4 g. l⁻¹) and (2 g. l⁻¹ +2 g. l⁻¹) respectively, but the lowest value recorded with (0 g. l⁻¹ Liquorice + 0 g. l⁻¹ Humic acid) (7.78 runner.plant⁻¹).

Concerning the interactions of studied factors, results indicated that the maximum runner numbers (16.00) was recorded from the interactions of (Festival + 4 g. l⁻¹ Liquorice +4 g. l⁻¹ Humic acid), compared to the interaction Rubygam + 4 g. l⁻¹ Liquorice +4 g. l⁻¹ Humic acid) that recorded the lowest value (4.67 runner.plant⁻¹).

Table (3): Effect of Humic Acid and Liquorices Extraction on on runner.Plant-1 of Three Varieties of Strawberry

Varieties	Liquorice ^{g.l⁻¹}	Humic acid ^{g.l⁻¹}			Variety * Liquorice	Variety Mean
		0	2	4		
Festival	0	10.66 de	15.33 ab	11.66 c	12.55 bc	13.11 a
	2	14.66 ab	14.00 ab	9.000 def	12.55 bc	
	4	15.00 a	11.66 cd	16.00 a	14.22 a	
Fortuna	0	8.000 f	8.000 f	7.00 fg	7.67 g	10.67 b
	2	11.33 cd	14.66 ab	13.33 cb	13.11 ab	
	4	11.66 cd	11.33 cd	10.66 de	11.22 de	
Rubygam	0	4.67 g	14.33 ab	13.33 bc	10.78 ef	10.74 b
	2	11.00 cd	9.67 def	9.00 def	9.89 f	

	4	14.00 ab	9.00 def	11.66 cd	11.55 cd
Variety	Festival	13.44 a	13.66 a	12.22 ab	
*	Fortuna	10.33 d e	11.33 c	10.33 de	Liquorice
Humic acid	Rubygam	9.89 e	11.0 cd	11.33 c	Mean
Humic acid	0	7.78 d	12.55 ab	10.66 c	10.33 b
*	2	12.33 bc	12.78 ab	10.44 c	11.85 a
Liquorice	4	13.55 a	11.33 c	12.77 a	12.55 a
Humic acid Mean					
		12.22 a	12.22 a	11.29 b	

The means with the same letters in each column indicates to non significant differences in (5 %) level of probability by Duncan's Multiple Range Test.

3- Number Of Daughter Plant.Plant⁻¹

Table (4) Point out those varieties had significant effect on number of daughter plant.plant⁻¹ where the highest result obtained from Festival variety which (26.11.plant⁻¹) was compared to the lowest number at Rubygem variety with (18.82.plant⁻¹).

Data in same table shows that the Hmic acid, there was also significant difference between the concentrations, which the best result of daughter number of plant was obtained from (2 g.l⁻¹) with (23.37.plant⁻¹) and the lowest were in (4 g.l⁻¹) Humic acid with (21.52 daughter plant.plant⁻¹), but there was no differentiation with (0 g.l⁻¹).

Foliar application of the Liquorice extract showed both concentration (2g.l⁻¹ and 4g.l⁻¹) significantly increased number daughter which were (24.67 and 23.74 daughter plant.plant⁻¹) respectively and the lowest was for 0 g.l⁻¹ which was (9.39.plant⁻¹) as indicated in (Table 4).

In the same table, the interactions between varieties + Humic acid has significantly increased daughter number of plant, the maximum value (28.55.plant⁻¹) was recorded from the combination of Festival +0 g.l⁻¹ Humic acid compared to other interaction treatments.

Table (4) show that the interactions of varieties + Liquorice extract effected significantly on daughter number of plant, results pointed that the highest number was recorded from the interactions of Festival + 4 g.l⁻¹Liquorice, which was (29.0 daughter plant.plant⁻¹) compared to the lowest value was recorded at Robygam + Liquorice (0g. l⁻¹ and 2 g.l⁻¹) which recorded (17.78.plant⁻¹ and 17.78.plant⁻¹) respectively.

In interaction between Humic acid and liquorice extract, there was a significant difference which the highest was of share of 2g.l⁻¹ of Humic acid and 2g.l⁻¹ of Liquorice extract with (26.33 daughter plant. plant⁻¹) and the lowest was for 0g.l⁻¹ of Humic acid and 0g.l⁻¹ of liquorice extract with (9.388. plant⁻¹) as showed in (table 4).

Concerning the interaction of studied factors, results indicated that the maximum number (33.66 daughter plant.plant⁻¹) was recorded from the interaction of (Fortuna + 2g. l⁻¹ Humic acid +2g.l⁻¹ Liquorice) compared to the interaction (Robygam+ 0 g. l⁻¹ Humic acid +0 g.l⁻¹ Liquorice) that recorded the lower value (7.67 daughter plant.plant⁻¹).

Table (4). Effect of Humic Acid and Liquorices Extraction on number of daughter plant.plant-1 of Three Varieties of Strawberry

varieties	Liquorice g.l ⁻¹	Humic acid g.l ⁻¹			variety *	Variety Mean
		0	2	4		
Festival	0	21.00 h	28.00 d	22.66fgh	23.89 b	26.11 a
	2	32.00 bc	27.00 d	17.33 jk	25.44 b	
	4	32.66 ab	23.33 efg	31.00 c	29.00 a	
Fortuna	0	15.33 k	13.33 l	12.00 lm	13.55 e	21.51 b
	2	23.66 ef	33.66 a	26.66 d	27.99 a	
	4	22.66 fgh	21.33 h	25.00 e	23.00 b	
Rubygam	0	7.67 n	24.00 ef	21.66gh	17.78 d	18.82 c
	2	19.00 i	18.33 ij	16.00 k	17.78 d	
	4	23.33 efg	18.00 ij	21.33 h	20.89 c	
Variety	Festival	28.55 a	26.11 ab	23.66 bd	Liquorice Mean	
*	Fortuna	20.55 ef	22.77 de	21.22 e		
Humic acid	Rubygam	16.67 g	20.11 ef	19.66 f		
Humic acid	0	14.67 e	21.78 c	18.77 d	18.41 b	
	2	24.89 b	26.33 a	20.00 cd	23.74 a	
	Liquorice	4	26.22 a	22.00 c	25.78 ab	
Humic acid Mean		21.93 b	23.37 a	21.52 b		

The means with the same letters in each column indicates to non significant differences in (5 %) level of probability by Duncan's Multiple Range Test.

4- Chlorophyll Content

It's clear from table (5) that the varieties affected significantly on the chlorophyll content of the strawberry plant, which the highest result was recorded in Festival variety which was (52.66) and the lowest was share of Fortuna variety (38.39).

For the Humic acid, there was also significant difference between the concentrations, which the best result of chlorophyll content obtained from 2g.l⁻¹ recording (48.01) and the lowest was in 0 g.L Humic acid recording compared to the lowest value (41.97) as illustrated in (Table 5).

Spray with Liquorice at both concentrations also increased chlorophyll content significantly, highest chlorophyll content obtained with spraying with 2g.l⁻¹ that was (50.81) compared to the lowest value ((44.21) at control as showed in (Table 5).

Table (5) also indicated that the interactions between varieties and Humic acid has significantly increased from chlorophyll content, the maximum value (62.08) was recorded from the combination of Festival and 2g.l-1 Humic acid

compared to lowest value (39.11) was recorded at Robygam and 2 ml.l⁻¹ Humic acid.

Form Table (5) indicated that the interactions of the varieties and Liquorice were significantly affected on leaf chlorophyll content. The highest value (74.82) which with the interactions of Festival and 0 g.l⁻¹ Liquorice compared to the lowest value was recorded at Fortuna and 0g.l⁻¹ liquorice.

Same table indicates that the interactions between Humic acid and Liquorice affected significantly on chlorophyll content of three varieties in strawberry, the maximum value was recorded from interactions of 4 g.L⁻¹ humic acid and 2 g.L⁻¹ liquorice (54.00) and the lowest value was obtained (0 g.l⁻¹ humic acid and 0 g.l⁻¹ liquorice) was (38.37) .

Concerning the interaction between three studied factors, the highest chlorophyll content was recorded from Festival +4 ml.L⁻¹ humic acid + 4g.l⁻¹ Liquorice (85.90) and the lowest value was obtained from Robygam + 0g.l⁻¹ Humic acid + 0 ml.L⁻¹ Liquorice.

Table (5): Effect of Humic Acid and Liquorices Extraction on on on number of daughter plant.plant-1 of Three Varieties of Strawberry.

Varieties	Liquorice g.l ⁻¹	Humic acid g.l ⁻¹						Variety *	Variety Mean
		0		2		4			
Festival	0	56.83	d	81.73	b	85.90	a	74.82	52.66
	2	46.73	g	69.70	c	32.80	m	49.74	
	4	34.16	l	34.80	l	31.30	m	33.42	
Fortuna	0	43.40	h	39.70	ij	35.43	kl	30.51	38.39
	2	49.15	fg	50.10	f	36.46	k	45.24	
	4	34.56	l	37.43	jk	46.23	g	39.41	
Rubygam	0	28.00	n	38.73	j	39.16	j	35.3	41.16
	2	38.50	j	41.16	i	53.33	e	44.33	
	4	46.40	g	38.73	j	46.46	g	43.86	
Variety	Festival	45.91	cd	62.08	a	50.00	b	Liquorice Mean	
*	Fortuna	44.79	d	42.41	e	39.37	f		
Humic acid	Rubygam	39.37	f	39.11	f	46.32	c		
Humic acid	0	38.37	d	53.39	a	40.86	c	44.21	
	2	44.79	b	53.65	a	54.00	a	50.81	
	4	42.74	b	36.99	e	41.33	c	45.40	
Liquorice									
Humic acid Mean		41.97	c	48.01	a	45.40	b		

The means with the same letters in each column indicates to non significant differences in (5 %) level of probability by Duncan's Multiple Range Test.

5-Shoot Dry Weight (g)

As shown in table (6) the varieties effect significantly on the shoot dry weight of the strawberry plant, which the highest result obtained from Fortuna variety which was (118.21 g) and the lowest was share of Rubygem variety with (54.07 g)

It is obvious from the same table there was significant effect of Humic acid on shoot dry weight particularly at 2g.l⁻¹ which gave the highest value (109.57g) and the lowest value recorded(151.63g) in control (82.51).

Table (6) also illustrated that strawberry plant sprayed with Liquorice was proportionally enhancing shoot dry weight with obtained significant effect, spray with 2g.l⁻¹ Liquorice gave the highest value (104.65 g) and the lowest value was recorded in control (85.54g).

The interaction between varieties and Humic acid effected significantly on the shoot dry weight, the interactions treatment of Fortuna + 2g.l⁻¹ Humic acid appeared to be the most

operative treatment, as it gave the maximum value (151.63g), While the Robygam and 4ml.l⁻¹ Humic acid (51.66g).

Concerning the interactions between the varieties and Liquorice it is declared significant effect on the shoot dry weight, the treatment combination of Fortuna a 2g.l⁻¹ Liquorice gave the maximum shoot dry weight as compared with Robygam and 4g.l⁻¹ of Liquorice.

The results in the same table obviously indicated that combination between foliar application of Humic acid at concentration 2g.l⁻¹ and Liquorice at concentration 2g.l⁻¹ had significant effect shoot dry weight compared to control.

The combination among the three studies factor there were significant differences between the treatments, the maximum value of shoot dry weight was noticed from combination of Festival + 4g.l-1 Humic acid +2g.l⁻¹ Liquorice (172.0 g), while the Robygam +0g.l⁻¹ Humic acid + 0g.l⁻¹ Liquorice, which gave the lowest value (33.66g)

Table (6): Effect of Humic Acid and Liquorices Extraction on Shoot dry weight(gm) of Three Varieties of Strawberry.

varieties	Liquorice g.l ⁻¹	Humic acid g.l ⁻¹			variety *	Variety Mean
		0	2	4		
Festival	0	64.00 k	134.3 d	108.0 e	102.1 e	108.36 b
	2	161.0 c	103.6 ef	97.00 fg	120.53 b	
	4	103.33 ef	94.33 g	108.3 e	101.99 e	
Fortuna	0	75.33 i	159.6 c	81.00h	104.64 d	118.28 a
	2	85.66 h	123.3 e	203.3 a	137.42 a	
	4	98.33 fg	172.0 b	68.00jk	112.78 c	
Rubygam	0	33.66 o	59.00 kl	55.00 lm	49.22 g	54.07 c
	2	52.33 mn	48.66 n	45.66n	48.88 g	
	4	69.00 j	70.00 j	53.33 m	64.11 f	
Variety *	Festival	109.44 c	110.74 c	104.43 d		
	Fortuna	86.44 e	151.63 a	117.43 b	Liquorice Mean	
	Rubygam	51.66 g	59.22 f	51.33 g		
Humic acid *	0	57.66 h	98.97 d	81.33 f	85.54 c	
	2	99.66 d	117.63 a	115.32 b	110.87 a	
	4	90.20 e	112.11 c	77.21 g	93.17 b	
Humic acid Mean		82.51 c	109.57 a	91.29 b		

The means with the same letters in each column indicates to non significant differences in (5 %) level of probability by Duncan's Multiple Range Test.

6- Crown Diameter (cm)

The effect of the varieties was significant which the highest result obtained from two varieties of Festival and Fortuna which was (1.52cm and 1.51cm) respectively and the lowest was of share of Rubygem variety with (1.40 cm) indicating in (Table 7).

Table (7) indicates that spraying strawberry with 2g.l⁻¹ and 4g.l⁻¹ Humic acid significantly increased Crown diameter (1.52cm, 1.41cm) respectively compared with control was (1.36 cm).

For the Liquorice extract, the highest crown diameter was observed with 4g.l⁻¹ where it was (1.53 cm) which was significantly over topped other concentrations, and the lowest was for concentration of 2g.l⁻¹ Liquorice (1.37 cm), but there was not significantly difference with control, as indicated in (Table 7).

The effect interactions between the varieties and Humic acid were shown in table (7). Festival variety of Strawberry plant treated with 2 g.l⁻¹ of

Humic acid, showed the maximum significant value (1.65 cm), while the minimum value (1.20 cm) was obtained with Rubygam variety 0 g.l⁻¹ of Humic acid. Table (7) shows that the interaction of the Fortuna +4g.l⁻¹ Liquorice significantly increased and gave the highest value (1.64cm) whereas the lowest value (1.38cm), was obtained the interaction of Rubygam + 0g.l⁻¹.

For the interaction between Humic acid and Liquorice, same table clearly indicated that significantly affected on crown diameter the high value (1.67cm) was 0g.l⁻¹ of 2 g.l⁻¹ of Humic acid + Liquorice a and the lowest was 0g.l⁻¹ Humic acid and 0g.l⁻¹ Liquorice.

The combination among the three studies factor there were significant differences between the treatments, the maximum value of crown diameter was noticed from combination of Festival +2 g.l⁻¹ of humic acid + 0g.l⁻¹ of Liquorice, while the minimum value was obtained at Rubygam +0g.l⁻¹ Humic acid + 0 g.l⁻¹ Liquorice.

Table (7): Effect of Humic Acid and Liquorices Extraction on Crown diameter (cm) of Three Varieties of Strawberry.

Varieties	Liquorice g. ⁻¹	Humic acid ml.L ⁻¹			Variety *	Variety Mean
		0	2	4		
Festival	0	1.30 g	1.80 a	1.500 d	1.53 c	1.52 a
	2	1.47 de	1.55 cd	1.15 i	1.39 g	
	4	1.75 ab	1.60 c	1.55 cd	1.63 b	
Fortuna	0	1.17 ij	1.45 ef	1.08 j	1.44 d	1.51 b
	2	1.18 ij	1.55 cd	1.58 c	1.44 d	
	4	1.70 b	1.53 cd	1.70 b	1.64 a	
Rubygam	0	1.15 j	1.75 ab	1.23 hi	1.38 h	1.40 c
	2	1.22 h	1.15 i	1.50 d	1.42 e	
	4	1.23 h	1.55 cd	1.42 f	1.40 f	
Variety *	Festival	1.51 b	1.65 a	1.40 e	Liquorice Mean	
Humic acid	Fortuna	1.35 g	1.51 b	1.45 d		
	Rubygam	1.20 h	1.48 c	1.38 e		
Humic acid *	0	1.21 f	1.67 a	1.27 e	1.38 b	
	2	1.21 f	1.42 d	1.41 d	1.37 c	
Liquorice	4	1.57 b	1.46 c	1.56 b	1.53 a	
Humic acid Mean		1.36 c	1.52 a	1.41 b		

The means with the same letters in each column indicates to non significant differences in (5 %) level of probability by Duncan's Multiple Range Test.

The parameters that studied vegetative growth which include (leaf area, number of runners, number of daughter plant, dry weight, chlorophyll content, Shoot dry weight (g) and crown diameter effected somehow by the factors and treatments that used in the study. The different between the varieties appeared because the plants are influenced by genetic and environmental factors and phenotypic expression of some quantitative traits depends on genotype, where environment plays a minor role. On the other hand, phenotypic expression of some quantitative traits is greatly influenced by environmental factors and genotype plays minor role. (Hartl and Jones, 1998)

In case of liquorices its effect on the studied parameters through it content of some growth regulator, Liquorice contains Gibberellins (Ojaili 2005) Since it contains Gibberellins it will affect the water content ratio inside the plant by increasing plasticity cell walls, which increases the permeability and so lead to entry the largest amount of water and nutrients Cleland, R. E. (1986). And also liquorice contain mevalonic acid, which has a activist role in the Biosynthesis extract of Gibberellins then increase the level of internal Gibberellins contains in addition to contain other substances affect the division

and cell elongation such as carbohydrates (Droush, 1976)

In case of humic acid it is also affected on the parameters. Humic acid has a great influence on plant growth and development and many previous studies reported promoting impact of humic acid on growth parameters. Increasing quantitative and qualitative characteristics by using humic acid have been reported by many researchers (Kamari-Shahmaleki et al., 2012; Ferrara and Brunetti, 2010; EL-Ghozoli, 2003; Sarir et al., 2005 and Shehata et al., 2011). Formation of complex between

humic acid and mineral ions, catalysis of humic acid by the enzymes in plant, influence of humic acid on respiration and photosynthesis, stimulation of nucleic acid metabolism and hormonal activity of humic acid are amongst effective assumptions that have been expressed to describe the effect of humic acid on plants growth parameters. So, increase of vegetative growth characteristics by using humic acid are considerable, and our findings were in accordance with previous works (Ozdamarullu et al., 2011; Turkmen et al., 2004).

In case of interaction between whole the factors. The difference between the varieties has been interpreted to genetic variation in the

different nature and strength of growth between varieties approved, either moral influence of each of humic acid and liquorice extract attributable to the impact Physiological single and joint interoperability Hartl and Jones, 1998) (Droush, 1976)

CONCLUSION

Based on results obtained from this study, the significant increase were recorded on vegetative growth characteristics of strawberry, it is concluded that the vegetative parameters the best variety was the Festival and the worst was Rubygem. Best concentration of Humic acid and Liquorice extraction was 2g.l^{-1} in most of the parameters, when the strawberry varieties sprayed with Humic acid and Liquorice extract, the highest significant interaction values were recorded in Festival variety at concentration of Humic acid and Liquorice extract was 2g.l^{-1} .

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In vitro* PROPAGATION OF APRICOT (*Prunus armeniaca* L.) ROYAL CULTIVAR AS AFFECTED BY EXPLANT SOURCE AND THEIR TAKING TIME

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ABSTRACT

At establishment stage of Royal apricot on MS medium, axillary buds were taken from open field orchard, lath house and greenhouse. The results revealed that the best explants source was greenhouse and the rate of successful shoot formation (83%) was higher followed by the lath house and open field orchard. The results showed that the buds taken from dormant cuttings in January and treated with BA + GA₃ gave better results when compared with those taken in spring. At shoot multiplication stage, the highest number of shoots (2 shoots/ explants), the longest shoots (3.0 cm) and the highest number of leaves per (7 leaves/ explants) were achieved while adding 0.5 mg l⁻¹ BA to MS medium which was significantly higher than the rest treatments. Kinetin was less effective than BA at the same concentrations on shoot multiplication apricot. The best rooting parameters were recorded when 1.0 mg/l IBA was added to a half strength MS salts medium by giving 6.0 roots per explant with 3.8 cm in length and a 75% of rooting success. The plantlets performed well after being transferred to soil and did not show any morphological abnormalities.

KEYWORDS: *Prunus armeniaca* L., Micropropagation, Explant source, Royal cultivar

INTRODUCTION

Apricot (*Prunus armeniaca* L.) is a deciduous drupe fruit belongs to the *Rosaceae*, Rose family. The improvement of plant *in vitro* technique during the last decades has opened successful micropropagation protocols of a number of woody species (Osterc, 2004). In the current horticultural practice, the propagation of apricot is achieved only from seed, budding or grafting. To propagate elite varieties, grafting and budding methods must be employed, since difficulties in the rooting of the stem cuttings from mature fruit bearing trees would prevent traditional propagation methods. Compared with the traditional methods of vegetative plant propagation, micropropagation has the advantages of facilitating the production of uniform and healthy plants, as well as to reduce propagation time. Furthermore, micropropagation techniques do not depend on the climatic conditions and are especially useful in species that present recalcitrant seeds, which rapidly lose their viability; it is the case of several tropical perennial species (George *et al.* 2008). This investigation

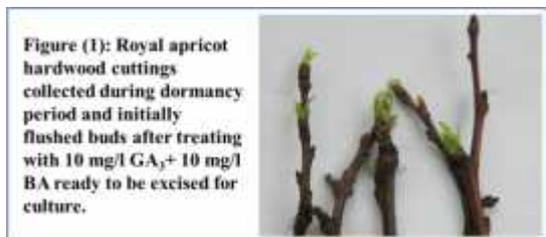
aimed to develop a procedure for mass production of apricot after testing various growth regulators at different concentrations, taking a practical step toward meeting the increased local demand for such economical important trees in Iraqi Kurdistan Region and the reported information and results of this investigation would also be useful in future breeding and clonal propagation experiments with such important fruit-tree species.

MATERIALS AND METHODS

The present investigation was conducted at the laboratories of Plant Tissue Culture of Horticulture Department, College of Agriculture, at the University of Duhok, Iraqi Kurdistan Region during the period from January, 2012 to June, 2013. Axillary of apricot (*Prunus armeniaca* L.) were used in this study as explants. The collected hardwood cuttings (young branches) of 10-15 cm in length were collected from the field and 5cm of the bases of cuttings were immersed in 10 mg l⁻¹ GA₃+ 10 mg l⁻¹ BA as forcing treatment according to Toma (2009) for two weeks under 4°C. The treatment solution was changed every 2-

*This research paper is a part of the second author's MSc thesis

3 days to get rid of the released phenolic compounds. The initially flushed buds (Figure 1) were excised and washed with tap water for an hour.



The buds immersed in 150 mg l⁻¹ citric acid and 100 mg l⁻¹ ascorbic acid to control browning as antioxidant agents or adsorbents (Wang *et al.*, 1994). After axillary buds excision from the collected apricot cuttings in two dates (January and April), they were washed with tap water for an hour followed by soap solution. The explants were dipped in the respective antioxidant solutions for 30 min. They were then surface sterilized with sodium hypochlorite (2.5%) for 15 min. under aseptic conditions of the laminar air flow cabinet. Finally, they were rinsed three times in sterilized distilled water prior to culture in initiation medium. Then the buds were cultured on MS medium (Murashige and Skoog, 1962) supplemented with 30 g l⁻¹ sucrose, 7 g l⁻¹ agar.

Working within the aseptic atmosphere of the Laminar-air-flow cabinet, the explants were removed into sterilized Petri dishes and shortened to about 1cm in length using fine end scalpels and forceps. After removing the expanding leaves, three explants were cultured in each culture vessel with their cut base embed in the culture medium. They were initiated on MS medium supplemented with 0.1mg l⁻¹ NAA and 1mg l⁻¹ BA. Then they were transferred to the shoot multiplication. At shoot multiplication stage, cytokinins including BA and kinetin each at 0, 0.5, 1.0, 1.5, 2.0 and 2.5 mg l⁻¹ and 0, 0.5, 1.0, 1.5, 2.0 and 2.5 mg l⁻¹ were respectively investigated on MS medium to enhance shoots multiplication. At root formation stage, IBA at 0, 0.25, 0.5, 0.75 and 1.0 mg l⁻¹ was tested on MS medium to induce root formation on previously produced microshoots. For both multiplication and root formation stages, three explants were cultured in each culture vessel and each treatment was replicated five times. The

number of leaves, number of shoots and means length of shoots as shoot multiplication parameters and the number of roots and their mean length rooting percentage as rooting parameters were recorded after 6 weeks from culture. At acclimatization stage, plantlets with well-developed roots were removed from the culture medium and after washing the roots gently under running tap water, plantlets were transferred to plastic pots (10 cm diameter) containing autoclaved garden soil, farmyard manure and sand (2:1:1). All plantlet were irrigated with ¼ MS basal salt solution devoid of sucrose and inositol every 4 days for two weeks. The potted plantlets were covered with porous polyethylene sheets for maintaining high humidity and were maintained under the culture room conditions. The relative humidity was reduced gradually and after 30 days the plantlets were transplanted to nursery and kept under shade in a net house for further growth and development.

All experiments were designed as completely randomized design (CRD). The comparison between means was carried out according to Duncan's multiple range test ($P < 0.05$) using a computerized program of SAS (SAS, 2007).

RESULTS AND DISCUSSION

In general, the results recorded during this investigation clearly appeared that apricot plant is considered one of the difficult trees in response to *in vitro* propagation associating with several difficulties during different developmental stages of its micropropagation. Such difficulties included contamination, browning, hyperhydrecity, apical necrosis, poor rooting, etc. Many practical lab steps were followed during the current experiments to overcome such obstacles and accepted results were obtained.

Effect of Explants Source on Micropropagation of Apricot:

The results revealed that the best explants source was greenhouse (Table 1) and the rate of successful shoot formation was higher followed by lath house and open field orchard. After 4 weeks from culture, the explants developed to microshoots as stage and transferred to the multiplication (Figure 2).

Table (1): Effect of explants source on *in vitro* apricot axillary buds segments culture

Source of explants	Number of explants inoculated	Number of survived explants	Percentage of Survived Explants
Open field orchard	30	3 b	10 b
Lath house	30	5 b	16.6 b
Greenhouse	30	25 a	83.3a

Different letters within columns represent significant differences according to Duncan's multiple range test at 5% level.



Figure (2): Royal apricot successful initiated bud explants taken from seedling grown in greenhouse after four weeks in culture.

A high significance of successful survived explants was obtained with explants taken from greenhouse (83%), as compared to the lowest percentage (16.6%) of survived explants taken from lath house and 10% from open field orchard. This is in agreement with several other reports with woody plants (Siril and Dhar, 1997). The major problem faced the initiation stage of

apricot micropropagation during the current investigation was hyperhydricity. Hyperhydricity, also termed vitrification, is a physiological disorder frequently related to the *in vitro* environment during micropropagation of woody plants. Apricot shoot tips at the proliferation stage are very sensitive to hyper hydration (Figure 3).

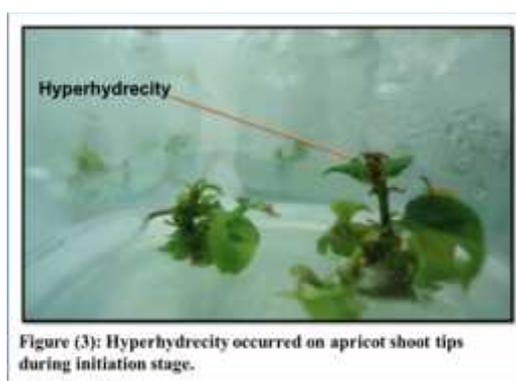


Figure (3): Hyperhydricity occurred on apricot shoot tips during initiation stage.

Treatments that decrease hyperhydricity, without affecting micropropagation rates in apricot, are the application of a bottom cooling system for 1 or 2 weeks in each culture cycle; and increasing agar concentration of the culture medium (0.6–0.8%) or the use of Agar gel TM (0.5%) as gelling agent (Pérez-Tornero *et al.*, 2000). A bottom cooling system was arranged to solve this physiological disorder by placing the cultured

vessels on a plate contained ice for two weeks (Figure 4). High relative humidity (RH) is probably the most important environmental factor that induces hyperhydricity. The bottom cooling system decreases the RH inside the *in vitro* culture jar by condensing water on the cooled culture medium (Vanderschaeghe and Debergh, 1987).

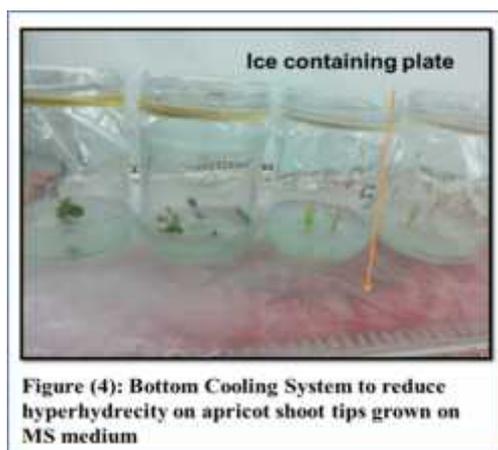


Figure (4): Bottom Cooling System to reduce hyperhydricity on apricot shoot tips grown on MS medium

Effect Of Explants Taking Date (January And April) On Micropropagation Of Apricot:

The results showed that the buds taken from dormant cuttings in January and treated with (BA+GA₃+IBA) gave better results when compared with those taken in April because dormant shoots underwent forcing treatment, during this process all phenolic compounds were released out and the levels of endogenous hormones plus the exogenously added growth regulators became higher especially cytokinins.

These results partially agree with Mahmood *et al.* (2008) who used dormant shoots and placed them in sterile-distilled water, then transferred to a mixture of

10 mg l⁻¹ kinetin and 10 mg l⁻¹ GA₃ for 3 weeks, after 3 weeks their buds became active and the growth resumed 0.5- 1.0cm and used as explants.

Multiplication Stage: Microshoots produced at the establishment stage were used as explant source for multiplication stage. Table (2) shows the effect of different BA concentrations on shoot multiplication of apricot plant. The highest number of shoots (2 shoots/ explants), the longest shoots (3.0 cm) and the highest number of leaves per (7 leaves/ explants) were achieved while using 0.5 mg l⁻¹ BA treatments which were significantly higher than the rest treatments.

Table (2): Effect of BA on Royal apricot shoot multiplication stage after six weeks from culture.

BA Concentrations (mg l ⁻¹)	Number of Shoots/shoot explant	Mean length of Shoots(cm)	Number of Leaves/shoot
0.0	1.0b	1.1b	3.9b
0.5	2.0a	3.0a	7.0a
1.0	1.0b	0.3c	. c
1.5	1.0b	. b	1.6d
2.0	1.0b	. c	2.5c
2.5	. b	. c	4.8b

Different letters within columns represent significant differences according to Duncan's Multiple range tests at 5% level.

These results confirm the findings of Al Qudaht and Maarri (2009), Rayya *et al.* (2010) and Ahmad *et al.* (2003) that BA is the most important growth regulator for shoot multiplication and shoot length. It is common to observe a relationship between BA concentration and shoot number, length and leaves number (Figure 5). The reasons behind the positive role of BA on the

multiplication stage might be due to cytokinins great role in releasing lateral buds from the dominance of terminal buds without the need to remove the apical bud by promoting formation of xylem tissues of buds which facilitate the transformation of water and nutrient leading to lateral bud growth (Mohammed and Al-Younis, 1991).

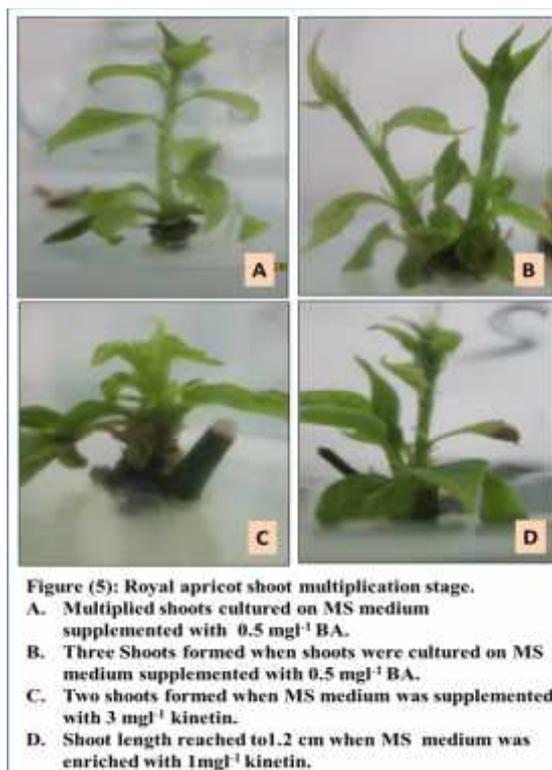


Table (3): shows the effect of different concentrations of kinetin on apricot shoot multiplication stage. The number of new shoots per explant increased with the increase of kinetin concentration and the best result was obtained with 3 mg l⁻¹ which reached to 1.7 shoots/ explant. Shoot length was also positively affected by the

kinetin concentration and the longest shoots (1.2cm) were recorded at 1 mg l⁻¹ kinetin concentration. Concerning the number of leaves, the highest number of leaves reached to 7.1 with 1.5 mg l⁻¹ which was significantly different when compared with 1 mg l⁻¹.

Table (3): Effect of kinetin on Royal apricot shoot multiplication stage after six weeks.

Kinetin Concentrations (mg l ⁻¹)	Number of Shoots/explant	Mean length of Shoots(cm)	Number of Leaves/explant
0.0	1.0b	0.8a	3.7b
0.5	1.0b	0.6b	6.3ab
1.0	1.0b	1.2a	2.3b
1.5	1.0b	0.5b	7.1a
2.0	1.0b	0.5b	3.2b
3.0	1.7a	0.9a	3.1b

Different letters within columns represent significant differences according to Duncan's multiple range test at 5% level.

The most important conclusion that can be drawn from these results is that kinetin was less effective than BA at the same concentrations on shoot multiplication apricot. The reasons behind BA superiority might be due to its molecular structure and the number of double bonds on its side chain of benzyl ring. On the other

hand, BA is the most effective cytokinin in cell division and overcoming apical dominance as compared to other cytokinins (Bommineni *et al.* 2001 and Bashi, 2006).

Root Formation Stage: Apricot shoots rooted well with different concentrations of IBA but most shoots showed symptoms of apical necrosis because of low

endogenous cytokinin, which could be overcome by dipping the shoot tips in solutions of 10 mg/l of BA prior to transfer to rooting medium. Perez-Tornero and Burgos *et al.* (2000) faced a similar problem while rooting the shoots of different apricot cultivars. They could solve apical necrosis symptoms by dipping in BA solutions of 22.2 or 44.4 μM of BA before transferring to root formation medium.

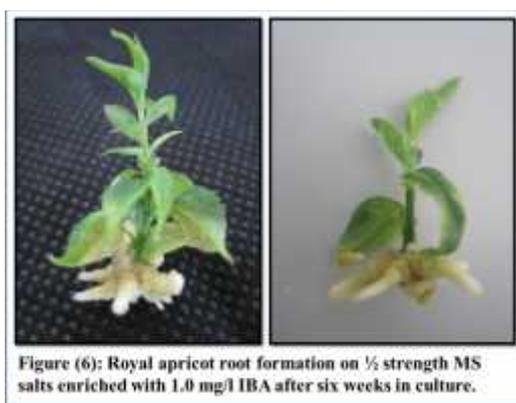
The roots were initiated following 2-3 weeks of incubation on rooting media of specific concentrations thereafter. The roots were adventitiously initiated at cut

margins of the shoots. One of the major physiological effects of the auxins is the stimulation of adventitious roots formation in both *in vitro* and *in vivo* cuttings (Hartmann *et al.*, 2002). Data presented on Table (4) reveals that the best rooting parameters were obtained while adding 1.0 mg l^{-1} IBA to a half strength MS medium by giving 6.0 roots per explant with 3.8 cm in length and a 75% of rooting success (Figure 6). These results were followed by the use the full strength and finally $\frac{1}{4}$ strength MS salts.

Table (4): Effect of IBA and different MS salt strengths on Royal apricot roots formation stage

IBA (mg l^{-1})	MS salt strength	Number of roots/ explant	Rooting	
			Mean length of roots (cm)	Percentage (%)
0.00	1/4 Strength	0.0 e	0.0 d	0.0 d
	1/2 Strength	0.0 e	0.0 d	0.0 d
	1/1 Strength	0.0 e	0.0 d	0.0 d
0.25	1/4 Strength	0.0 e	0.0 d	0.0 d
	1/2 Strength	2.0 c	0.90 c	34.0 c
	1/1 Strength	2.0 c	1.4 bc	20.0 d
0.50	1/4 Strength	1.3 d	1.4 bc	14.5 e
	1/2 Strength	2.0 c	1.5 bc	56.0 b
	1/1 Strength	2.1 c	1.1 bc	23.3 d
0.75	1/4 Strength	2.0 c	1.7 bc	18.0 e
	1/2 Strength	2.7 b	1.6 bc	50.0 b
	1/1 Strength	2.0 c	2.0 b	34.0 c
1.00	1/4 Strength	3.7 b	3.0 a	25.0 d
	1/2 Strength	6.0 a	3.8 a	75.0 a
	1/1 Strength	3.0 b	2.2 b	45.0 b

Different letters within columns represent significant differences according to Duncan's multiple range test at 5% level.



These results proved that auxins have a role in rooting process since they promote adventitious roots initiation in the bases of cultured shoots (Abdul, 1987 and Saleh 1990). These results are in agreement with those found by Petri and Scorza (2009) on plum plant, who observed that reducing the levels of MS salts in the medium to half increased rooting success. The reason behind the superiority of half MS salts on the full MS salts in rooting trait is due to the higher C/N ratio since the same sucrose was used with both salt strengths this may result in increasing the percentage of root primordial and roots number (Gawel *et al.*, 1990).

Acclimatization Stage: The *in vitro* propagated apricot plantlets were gradually shifted from lab condition into out-air conditions. They were transferred to pots containing a steam sterilized soil mix (peatmoss+ silt+ Styrofoam 1:1:0.5, v/v/v) (Fig. 12). The pots were enclosed by glass beakers and placed in growth room at the lab set at 23-25° C and exposed to 16 hrs daily to 1000 lux illumination. The plants were irrigated with a nutrient solution containing

1/4 strength of MS salts. At the second week the plants were covered by polyethylene bags. After a week, the polyethylene bags were pored, after 8 to 10 days, the bags were opened and after another 8 to 10 days, the bags were removed and plants were grown under regular greenhouse conditions. A good performance was found with plantlets transferred to soil. Most of the plantlets began to grow well and did not show any morphological abnormalities (Figure 7).

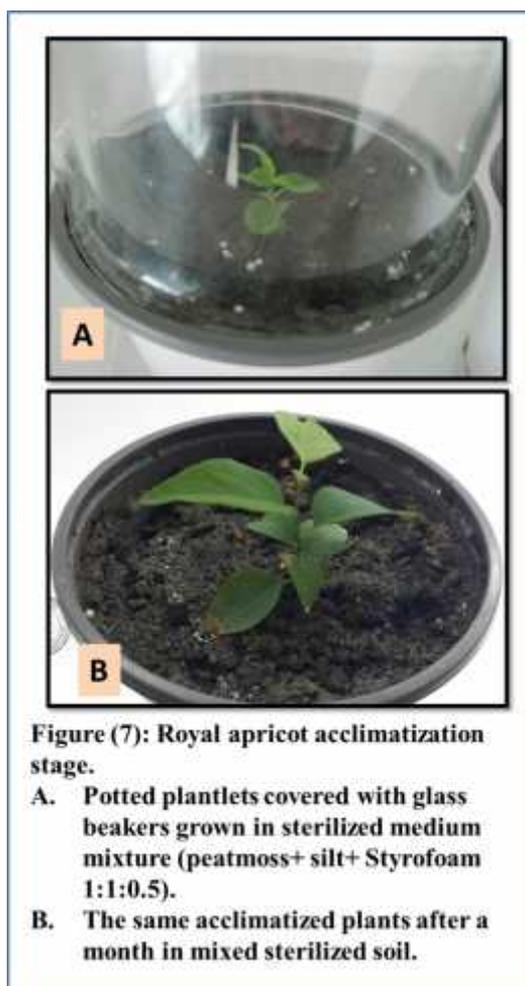


Figure (7): Royal apricot acclimatization stage.

- A. Potted plantlets covered with glass beakers grown in sterilized medium mixture (peatmoss+ silt+ Styrofoam 1:1:0.5).**
- B. The same acclimatized plants after a month in mixed sterilized soil.**

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EFFECT OF FOLIAR APPLICATION OF ALGAMIX AND ASCORBIC ACID ON YIELD AND QUALITY OF GRAPE (*Vitis vinifera* L.) cv. BAE-DANK

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ABSTRACT

This experiment was conducted on 19 years old grapevine cv. Bae-Dank in a private vineyard located near Shar-Bazher town, Sulaimani governorate, Kurdistan region, Iraq, during the growing seasons of 2015 in order to study the effect of different concentration of algamix (0, 2 and 4 ml.l⁻¹), Ascorbic acid (0, 0.75 and 1.5 g.l⁻¹) and their interaction on yield, berries quality and chemical characteristics of berries. Foliar application of Algamix significantly increased number of cluster, cluster weight, No. of berries per cluster, yield, berry length and diameter, weight and size of 100 berries, as well as TSS, juice and total sugar percentage and juice density. Whereas same treatment significantly reduced total acidity percentage. On the other hand foliar application of Ascorbic acid significantly increased number of cluster, No. of berries per cluster, yield, size of 100 berries, as well as TSS and total sugar percentage.

Foliar application of ascorbic acid at concentration (1.5 g.l⁻¹) improved all yield characteristics but had no effect on berry quality and chemical characteristic of berries. The best results with regard to yield and fruit quality of grapevine were obtained due to foliar application of algamix at concentration (4 ml.l⁻¹) as compared to untreated vine.

KEY WORDS: Algamix, Ascorbic acid, grape, Bae-Dank.

INTRODUCTION

Grape is the most favored, high nutritional value and likeable fruit crops in the world (Gawadshahen, *et al.*, 2012). It has a delicious taste and a good source of sugar, acids, minerals, vitamins and tannins and possesses a sweet flavor (Isbatand Zeba, 2011). Grapes are adapted to a wide range of climates and they have been distributed in the tropics, subtropics and the temperate regions (Patel and Olmo, 1955). There are 75 cultivars grown in Iraq now, generally they are seeded cultivars and few cultivars are seedless, most of these cultivars are grown in Kurdistan Region (Al-Rawi, 2005; Alsaidi, 2014). Bae-Dank is a seedless variety that is not native to northern Iraq. It is planted in the orchards of Wazha village in Sulaymaniyah Governorate. This variety has excellent commercial properties, equivalent to known varieties as Thompson Seedless, Barlete, and others. Its cluster is short cylindrical. The berries are compact, light-yellow in color, round in shape with little elongation, organized set, and big size (USIAD, 2005). Cassan *et al.*, (1992)

stated that in nature, Seaweed extract (Algamix) measured as a vital source of nutrition. Seaweed extracts are a good source of trace elements to improve marginal deficiencies (Aitken & Senn, 1965; Khan, *et al.*, 2012), also, it contains various trace elements (Fe, Cu, Zn, Co, Mo, Mn & Ni), vitamins, amino acids and plant growth hormones (IAA, IBA & Cytokinins) that have positive effects on plant growth and development (Metting *et al.*, 1990; Spinelli *et al.*, 2009; Abdel-Mawgoud *et al.*, 2013). Birjely (2011) investigated the effect of foliar application of Urea, Ascorbic acid and Seaweed extract on Vegetative growth, Yield and its components and Chemical characteristics of berries, of the European grape (*Vitis vinifera* L.) cv. Rash-Mew. Results indicated that foliar spray of seaweed extract at 15 ml.l⁻¹ had significant increases in all vegetative growth, yield and its components and chemical characteristics of berries. Khan, *et al.*, (2012) studied the effect of foliar applications of a combination of amino acids and *Ascophylum nodosum* (Seaweed) extract at different growth stages on the growth and physico-chemical characteristics of grapes cv.

'Perlette'. They found that foliar applications of Seaweed extract improved yield and physico-chemical characteristics of the grapes.

Ascorbic acid as an antioxidant has Auxinic action and owns a synergistic effect on flowering and production (Farag, 1996 and Ahmed *et al.*, 1997). Abdulrahman (2013) mentioned that the Ascorbic acid (vitamin c) inters in many biological processes in the plant as a growth – regulating factor. Horemans, *et al.*, (2000) mentioned that in plants there are numerous physiological processes that ascorbic acid takes a vital role in them including the regulation of growth, differentiation, and metabolism. Fayed (2010) Investigated the effect of foliar application of thiamin, ascorbic acid and citric acid during two growing seasons (2006-2007) on growth, yield and bunch characteristics of Thompson seedless grapevine. Results showed that foliar application of thiamin, ascorbic acid and citric acid, either alone or in combination between them increased bunch physical and chemical properties. Abd El-Razek *et al.*, (2015) carried out an experiment on nine year old Flame seedless grapevines (*Vitis vinifera* L.) during two successive growing seasons of (2013-2014), to study the effect of soil application of chelated Fe, Zn and Mn with foliar application of GA3 and ascorbic acid. They found that all treatments increased the yield, cluster weight, berry weight, TSS and reduced the acidity compared with the control.

Consequently, this experiment was carried out to investigating the effect of different rates of Algamix and Ascorbic acid and their combination on grapevine cv. Bae-Dank, to improve the yield and fruit quality.

MATERIAL AND METHOD

This study was carried out on a private vineyard located near Shar-Bashar town, Sulaimani governorate, Kurdistan region, Iraq, during growing season 2015 to investigate the effect of foliar application of three concentration of both Algamix (seaweed extract) (0, 2 and 4 ml.l⁻¹) and Ascorbic acid (0, 0.75 and 1.50 g.l⁻¹) on the productivity and berries quality of grapevine cv. Bae-Dank. So this experiment included two factors, the first factor included following three concentrations of Algamix, while the second factor was three concentrations of Ascorbic acid. The vines were sprayed twice per season:

1- first (two weeks after growth began).

2- second (at the same previous date and two weeks after berry setting).

Therefore, the experiment consisted of nine treatments with three replications, with one individual vine for each experiment unites and applied as factorial experiment by using (RCBD) design. So the numbers of vines used were 27 vines. A detergent powder as wetting agent at (1-2 g.l⁻¹) was added to all the spraying solution including 0.0 % Ascorbic acid and Algamix (control). The vines were sprayed with both (Ascorbic acid and Algamix) solutions till run off 2 L/vine. Horticultural practices except the addition of Ascorbic acid and Algamix were used as usual. Potential effects of Ascorbic acid and Algamix were evaluated in terms of the change in No. of cluster per vine, cluster weight, No. of berries per cluster and yield as well as weight and size of 100 berries and length and width of berries, TSS acidity, sugar, juice %, juice density . All results were analyzed statistically by using SAS programs (2003). Duncn's multiple tests at 5% level of portability was to compare the treatment according to (Al-Rawi and Kalafalla, 2000).

RESULTS AND DUSCUION

1. Yield characteristics of grape:

It's clear from Table (1) that No. of clusters per vine, cluster weight, No. of berries per cluster and yield per vine sprayed with algamix are significantly superior on that untreated. Highest No. of clusters per vine, cluster weight, No. of berries per cluster and yield per vine (29.56, 437.69, 109.78 and 12.813) respectively gave by vines sprayed with algamix at conc. (4ml.l⁻¹) compared with lowest value (18.33, 345.19, 83.33 and 6.670) respectively resulted from untreated vine.

Data presented in table (1) also shows that increasing concentration of Ascorbic acid significantly increased number of clusters per vine, No. of berries per cluster and yield as compared to the control, the highest values were 29.78, 104.33, 12.678 respectively obtained from spraying Ascorbic acid with 1.5 g.l⁻¹ which significantly surpassed control treatment, whereas spraying Ascorbic acid had no significant effect on the cluster weight.

Same table shows that the interaction between ascorbic acid and algamix significantly increased No. of clusters per vine, cluster weight, No. of

berries per cluster and yield, the highest value (33.00, 463.67, 118.67 and 15.035) respectively were resulted from the interaction of 4ml.l⁻¹ Algamix + 1.5 g.l⁻¹ ascorbic acid, while the lowest value (13.33, 73.00 and 4.291) of number of

clusters, number of berries and yield per vine respectively obtained from non- treated vines, the lowest cluster weight was resulted from interaction of 0 Algamix + 0.75 g.l⁻¹ of Ascorbic acid.

Table (1): Effect of foliar application of Algamix and Ascorbic acid and on yield characteristics of grape (*Vitis vinifera*L.) cv. Bae-Dank.

Treatment		Parameters				
		Number of Clusters	Cluster weight (g)	Number of Berries (Berries/cluster)	Yield (kg/vine)	
Algamix (ml.l ⁻¹)	0	18.33 b	345.19 b	83.33 b	6.670 b	
	2	28.11 a	377.75 ab	99.67 a	10.603 a	
	4	29.56 a	437.69 a	109.78 a	12.813 a	
Ascorbic acid (g.l ⁻¹)	0	21.44 b	356.08 a	85.67 b	7.830 b	
	0.75	24.78 ab	378.00 a	102.78 a	9.578 b	
	1.5	29.78 a	426.56 a	104.33 a	12.678 a	
Algamix 0	Ascorbic acid	0	13.33 c	324.67 ab	73.00 c	4.291 d
		0.75	16.67 bc	304.50 b	88.33 bc	5.655 cd
		1.5	25.00 ab	406.42 ab	88.67 bc	10.065 abc
Algamix 2	Ascorbic acid	0	24.00 ab	349.58 ab	91.00 bc	8.372 bcd
		0.75	29.00 a	374.08 ab	102.33 ab	10.503 abc
		1.5	31.33 a	409.58 ab	105.67 ab	12.934 ab
Algamix 4	Ascorbic acid	0	27.00 ab	394.00 ab	93.00 b	10.828 ab
		0.75	28.67 a	455.42 ab	117.67 a	12.576 ab
		1.5	33.00 a	463.67 a	118.67 a	15.035 a

Means with the same letter are not significantly different according to Duncan multiple ranges test at 5% level.

2. Berries quality:

Data presented in table (2) shows that berries quality properties represented in term of diameter and length of berry and weight and size of 100 berries for vines sprayed with algamix was overtopped significantly on that untreated. Highest values (17.12, 19.05, 320.71 and 294.11) respectively were obtained by spraying vines with algamix at conc. (4 ml.l⁻¹)

compared with lowest values (15.86, 17.38, 276.97 and 244.44) respectively obtained by untreated vine. Same table also shows that foliar application of ascorbic acid had no significant effect on diameter, length of berry and weight of 100 berries of grapevine, while high concentration of Ascorbic acid significantly increased size of 100 berries which recorded the maximum size of 100 berries (285.33).

Table (2): Effect of foliar application of Algamix and Ascorbic acid on berries characteristics of grape (*Vitis vinifera*L.) cv. Bae-Dank.

Treatment		Parameters				
		Berry diameter (mm)	Berry length (mm)	Weight of 100 berries (g)	Size of 100 berries (cm ³)	
Algamix (ml.l ⁻¹)	0	15.86 b	17.38 b	276.97 b	244.44 b	
	2	16.67 a	18.41 a	302.36 ab	265.78 b	
	4	17.12 a	19.05 a	320.71 a	294.11 a	
Ascorbic acid (g.l ⁻¹)	0	16.20 a	17.95 a	284.23 a	248.78 b	
	0.75	16.71 a	18.25 a	300.78 a	270.22 ab	
	1.5	16.75 a	18.63 a	315.02 a	285.33 a	
Algamix	Ascorbic acid	0	15.48 d	16.98 d	263.80 c	224.67 c
		0.75	16.12 bcd	17.31 cd	280.20 bc	240.67 bc

0		1.5	15.97 cd	17.85 bcd	286.90 abc	268.00 abc
Algamix	Ascorbic acid	0	16.05 bcd	17.88 bcd	288.87 abc	246.00 bc
		0.75	17.07 ab	19.01 ab	300.10 abc	276.00 ab
2	Ascorbic acid	1.5	16.90 abc	18.33 bc	318.10 abc	275.33 ab
		0	17.06 ab	18.99 ab	300.03 abc	275.67 ab
Algamix	Ascorbic acid	0.75	16.93 abc	18.44 bc	322.03 ab	294.00 a
		4	1.5	17.38 a	19.72 a	340.07 a

Means with the same letter are not significantly different according to Duncan multiple ranges test at 5% level.

For the interaction, Data in table (2) shows that the highest value of diameter and length of berry and weight and size of 100 berries (17.38, 19.72, 340.07 and 312.67) respectively were obtained in vines sprayed with Algamix at 4 ml.l⁻¹ and Ascorbic acid at conc. 1.5 g.l⁻¹ Compared with lowest value in untreated vine.

3. Chemical characteristic of berries:

Concerning the foliar application Algamix, data in table (3) shows that the highest value of TSS, juice percentage, total sugar and juice density (17.43, 76.23, 22.01 and 3.084) respectively were obtained with vines sprayed with algamix at 4 ml.l⁻¹ which were surpassed significantly with untreated vine, while the same cocentration of Algamix significantly reduces total acidity percentage. For the effect of Ascorbic acid, data in table (3) also shows that ascorbic acid at concentration of 0,75 g.l⁻¹ and 1.5 g.l⁻¹ significantly

increased TSS and total sugar percentage which were (16.32 and 20.74 %) respectively and exposed no significant impact on juice percentage, total acidity and juice density.

Table (3) also indicates the interactions between the two factors which gave a significant effect in chemical characteristic of berries. The interaction between sprays of 4 ml.l⁻¹ algamix + 1.5 g.l⁻¹ Ascorbic acid gave the highest TSS and juice density (17.92 and 3.683) respectively, highest juice and total sugar percentage was obtained with interaction of 4 ml.l⁻¹ algamix + 0.75 g.l⁻¹ Ascorbic acid (77.82 and 3.683) respectively which were superior significantly to some of the other treatment. On the otherhand the interaction between sprays 4 ml.l⁻¹ algamix and 0.75 g.l⁻¹ Ascorbic acid significantly reduced total acidity percentage and recorded the lowest value (0.142 %) compared to the highest total acidity (0.128 %) from the control.

Table (3): Effect of foliar application of Ascorbic acid and Algamix on yield characteristics of grape (*Vitisvinifera*L.) cv. Be-danka.

Treatment	Parameters						
	TSS (%)	Juice percentage (%)	Total sugars (%)	Total acidity (%)	Juice density		
Algamix (ml.l ⁻¹)	0	15.35 b	72.73 b	16.79 b	0.128 a	1.266 b	
	2	14.87 b	76.23 a	19.33 ab	0.110 ab	1.924 b	
	4	17.43 a	74.41 ab	22.01 a	0.106 b	3.084 a	
Ascorbic acid (g.L ⁻¹)	0	15.07 b	74.36 a	17.46 a	0.121 a	1.593 a	
	0.75	16.32 a	74.98 a	20.21 a	0.113 a	2.226 a	
	1.5	16.26 a	74.03 a	20.47 a	0.110 a	2.456 a	
Algamix 0	Ascorbic acid	0	14.45 e	72.33 cde	14.31 b	0.142 a	0.917 c
		0.75	16.30 acd	70.85 e	18.11 ab	0.120 ab	1.437 bc
		1.5	15.30 cde	75.01 a-d	17.96 ab	0.122 ab	1.443 bc
Algamix 2	Ascorbic acid	0	14.15 e	76.76 ab	18.27 ab	0.112 ab	1.370 bc
		0.75	14.90 de	76.27 ab	19.35 ab	0.111 ab	2.163 abc
		1.5	15.55 cde	75.67 abc	20.37 a	0.108 ab	2.240 abc
Algamix 4	Ascorbic acid	0	16.62 abc	74.00 b-e	19.79 ab	0.110 ab	2.493 abc
		0.75	17.75 ab	77.82 a	23.15 a	0.108 ab	3.077 ab
		1.5	17.92 a	71.42 de	23.09 a	0.101 b	3.683 a

Means with the same letter are not significantly different according to Duncan multiple ranges test at 5% level.

It is clear from table 1- 3 that the foliar spray of algamix, had a positive effect on must

parameters, since spraying grapevine with 4 ml.L⁻¹ algamix significantly increased must yield and

its component represented in clusters characteristics and berries physical and chemical qualities, this effect may be due to the role of macro and micronutrient (the main content of Algamix) in stimulating growth characters (Kulk, 1995) and their role in improving the nutrient uptake by root (Crouch, *et al.*, 1990), and increasing vegetative growth parameters due to increasing N, P and K % in the leaves (Mancuso *et al.*, 2006) and their role in activating the cell division and increasing biosynthesis of organic products that lead to accumulation of carbohydrates and protein in clusters and berries and increasing cell respiration, photosynthesis and various enzymes reaction (Turan and Kose 2004; Vernieri *et al.*, 2005). The results in tables (1-3) indicate that the foliar application of antioxidant (Ascorbic acid) improved the yield and cluster physical properties, these may be due to the auxinic action of Ascorbic acid on enhancing the cell division and cell elongation, which were reflected positively on the leaf area (Wassel *et al.*, 2007). The accumulation of dry matter production in bunch and berries can be assumed proportionally to the solar radiation intercepted by foliage resulting in more efficiency of photosynthesis processes. Therefore, an expected increase in carbohydrates supply to berries, can explain the improvement in the yield, cluster weight, cluster length, berries width and other characteristics in this study (Fayed, 2010). Moreover, the effect of Ascorbic acid on increasing the foliage by the great carbohydrate accumulation led to increasing the food supply to the flower clusters, which in turn, decreased the abortion of these clusters, then increased number of cluster per vine (Ahmed and Morsi, 2001), the improvement in growth, berry set, cluster number surely reflected on the improvement of the yield per vine.

CONCLUSION

Based on the results obtained from the present study concerning the effect of foliar application of algamix and Ascorbic acid on grapevine cv. Bae-Dank (*Vitis vinifera* L.) at two different growth stages had a positive effect on yield, berry quality and chemical characteristics, the conclusions can be that foliar application of algamix were more effective in increasing yield characteristics of grape, berries quality and chemical characteristic of berries especially at concentration 4ml.l⁻¹, ascorbic acid at concentration 0.75 g.l⁻¹ increased

most of the parameters. The interaction of algamix (4 ml.l⁻¹) and ascorbic acid (1.5 g.l⁻¹) increased all berry quality, the combination of (0.75 g.l⁻¹ Ascorbic acid + 4 ml.l⁻¹ algamix) improved all chemical characteristic of berries except acidity.

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EFFECT OF ALGAMIX AND CaCl_2 ON GROWTH AND YIELD OF POTATO (*Solanum Tuberosum* L.) UNDER PLASTIC HOUSE CONDITIONS

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ABSTRACT

The experiment was conducted in a plastic house at the vegetable research farm of Horticulture Department, College of Agriculture/ University of Dohuk, Kurdistan region/ Iraq, during the growing season of 2014-2015, to investigate the effects of Seaweed Extracts Algamix, (1 ml.l^{-1} & 2 ml.l^{-1}) and Calcium Chloride (0.5 g.l^{-1} & 1 g.l^{-1}) in addition to the Control on growth and yield of Potato (*Solanum tuberosum*, L.) cv. Arnuoba grown under plastic house condition. Results showed that Algamix (1 ml.l^{-1}) and calcium chloride (0.5 g.l^{-1}) had significant differences in some vegetative and yield characters. Spraying Potato with 1 ml.l^{-1} Algamix significantly increase plant length and P% in leaves, while 0.5 g.l^{-1} of CaCl_2 significantly increased chlorophyll and N% in leaves. The highest tuber weight indicated in control treatments, where as no significant differences occurred in yield parameters.

KEYWORDS: Algamix, CaCl_2 , growth, yield, Potato in Plastic house.

INTRODUCTION

Potato (*Solanum tuberosum*) is a starchy and tuberous crop of the Solanaceae family and an important commercial cash crop of the world (Bayrami *et al.*, 2012). It is basically a cool season crops in origin and has been grown traditionally under conditions that prevail in the northern latitudes of Europe and America and in tropical highlands. Now potato is successfully grown in tropical, sub tropical and temperate climate (Malik, 1995). Fertilization is an important factor in potato production to obtained optimal yield and quality of tubers. The potato is a plant with high nutrient demands because of forming abundant vegetative mass and a high quantity of tubers at the unit area. It is a great of nitrogen, phosphorus, potassium, magnesium and calcium, as well as micro elements (Fit and Hangan, 2010). High potato yields can be obtained through the application of optimal nutrient doses in balanced proportions (Poljak *et al.*, 2007).

Use of seaweed extracts formulations as bio-stimulants in crop is well established (Khan *et al.*, 2009). In agriculture and horticulture, application of seaweed extracts has proved beneficial for the growth and yield (Verkleij, 1992), deep root development and better seed germination (Abetz, 1980), delay of fruit senescence, and improved plant vigour and yield quality and quantity (Ferreira and Lourens, 2002). Seaweed extracts are natural extracts of herbs plants and sea algae, it contains the Macro and Micro nutrient, amino acids, gibberellins, cytokines and auxen's which stimulate cell division and enhance cell enlargement

leading, increment of photosynthesis processes, enhancement of root and vegetative growth (O'Dell, 2003). Blunden *et al.*, (1996), who studied the effect of seaweed (*Ascophyllum nodosum*) extract on Potato plant, showed that the seaweed extract significantly increased the chlorophyll content in the leaves when either added to the soil or sprayed on the vegetative growth as compared to control. Morales-Rayán (2004) studied the effect of seaweed extract (*Ascophyllum nodosum*) on the yield of Potato under greenhouse conditions, he found a significant increased in tuber yield with increasing concentration of seaweed extract. AL-Bayati (2010) showed in a study on potato plant that by using four seaweed extracts (Marmarine, Algaren, Sluamine L-24 and Alga 600), significant increases in plant length, number of stem per plant, leave area, as compared to control treatments.

Calcium is one of the most abundant elements in soil and this element is known to play several important roles in plant membrane structure and function, and contributes to maintenance of cell membrane stability and wall structure (Marschner, 1995; Palta, 1996). Calcium deficiency has been linked to many disorders especially in fruit and storage organs (Bangerth, 1979) and has been shown to improve quality and yield of these plants. Adequate calcium is a critical aspect of the mineral nutrition of potatoes. Calcium has role in cell signaling by acting as secondary messenger and maintains the integrity of plasma membrane. It plays a regulatory role in the balance of cation anion. Ca sensing proteins are involved in many cellular processes like cytoplasmic streaming, organelles and

vesicles transport, microtubules dynamics, cell division, chromosome segregation, cell elongation, tip growth and morphogenesis (Reddy, 2001). Ca influence cellular pH and also act as a regulatory ion in the source sink translocation of Carbohydrates through its effects in cells and cell walls. Senay and Kleinhenz (2003) showed that treated potato with Ca had lower tuber number and greater tuber size as compared to the control. Also the total tubers and the total yield was increased by Ca applications (Ozgen and Palta 2005). The highest tuber dry matter and yield of potato plant under condition of higher than optimum temperature was obtained with the foliar fertilizer of Megagreen, which contains calcium (Tea Horvat et al., 2014).

Lack of research information in Iraq, and especially in Dohuk that prevent farmers from using adequate levels of nutrients in potato plants grown under plastic house condition, therefore the aim of this study was to determine the effect of sea weed extracts (Algamix) and Calcium chloride on growth and yield of potato and in this study we attempted to produce potato plants similar to field conditions, this yield is quite equivalent to what is expected under good field conditions.

MATERIALS AND METHODS

The experiment was conducted in plastic house (500 m²), (10 × 50) m provided with a drip irrigation system. The plastic house was located at the Vegetable Research Farm, Horticultural Department, College of Agriculture, University of Duhok, Kurdistan region/Iraq, during the growing season of 2014-2015. The land of the plastic house was ploughed for two perpendicular lines and the soil was floured by a rotator, the land sterilized by using Formalin at 2% (1L/m²). The soil was ploughed again to mix the organic matter into the soil particles, then the area was amended. The whole area was divided into two equal parts, each part divided into three blocks each of them

with 24 plots. Both sides along the plastic house were separated by 1m apart. Also both ends of the plastic house were separated by 1m apart. The area was well irrigated and the doors were kept closed for a few days for a good disinfection. Potato tubers (28-35 mm) of variety "Arnouba" were planted on Nov. 24th 2014. The experiment with two fertilizers Seaweed extracts (Algamix) with two concentration (1 ml.l⁻¹ & 2 ml.l⁻¹) and CaCl₂ (0.5g.l⁻¹ & 1 g.l⁻¹) with control treatment was arranged in a randomized complete block design with three replications. Each fertilizer treatment included eight plants in rows. The fertilizers was carried out three times during vegetation (60, 75 and 90 days after planting) in the period from the start of tuber formation to the stage of full tuberization with rates recommended by manufacturers as a foliar fertilizers. The results were analyzed using the SAS, 2007 program. Means values were compared using Duncan's multiple range tests at 0.05% level (AL-Rawi and Khalaf Alah, 2000). Data were recorded for plant length, No. of branches, leaf area, total chlorophyll, leaf dry weight, (N, P, K) % in leaves, No. of tubers. plant⁻¹, tuber weight g, plant yield Kg, total yield km.m² and total yield ton. donum⁻¹, carbohydrates and total soluble solid in tubers.

RESULTS AND DISSCUTION

VEGETATIVE GROWTH PARAMETERS

Results in table (1) shows significant differences in plant length and total chlorophyll on leaves when sprayed potato plant with Algamix and CaCl₂, the highest plant length (51cm) was in 1 ml.l⁻¹ Algamix and the highest chlorophyll (36.00) in leaves when (0.5 g.l⁻¹) CaCl₂, as compared to other treatments. No significant differences obtained in parameters (No. of branches, leaf area cm² and leaf dry weight gm).

Table (1): Effect of Algamix and CaCl₂ on vegetative growth parameter of Potato cv. Arnoba.

Treatments	Parameters				
	Plant length cm	No. of branches	Leaf area cm ²	Total chlorophyll (SPAD)	leaf dry weight gm
Control	42.22 ab	7.67 a	499.57 a	31.33 b	17.58 a
Algamix 1 ml.l ⁻¹	51.00 a	8.78 a	444.57 a	32.07 b	19.56 a
Algamix 2 ml.l ⁻¹	37.66 b	7.55 a	464.13 a	35.03 a	19.82 a
CaCl ₂ 0.5g.l ⁻¹	44.22 ab	8.88 a	381.09 a	36.00 a	17.88 a
CaCl ₂ 1g.l ⁻¹	41.44 ab	8.33 a	460.11 a	35.97 a	18.22 a

Means within a column followed with the same letters are not significantly different from each other according to Duncan's multiple range test at 5% level.

The data in table (2) indicated that significant differences in N and P in leaves as sprayed potato plant with Algamix and CaCl₂, the highest N (2.016%) when sprayed potato by 0.5 g.l⁻¹ CaCl₂ and (0.074%) P in 1 ml.l⁻¹ Algamix, while the

lowest N and P (1.624% and 0.033%) as sprayed with (1 ml.l⁻¹ Algamix and 1 g.l⁻¹ CaCl₂) respectively. No significant differences obtained as spraying potato plant with Algamix and CaCl₂ on K% in leaves.

Table (2): Effect of Algamix and CaCl₂ on nutrients content in leaves of Potato cv. Arnoba.

Treatments	Parameters		
	N%	P%	K%
Control	1.941ab	0.052 ab	28.160 a
Algamix 1 ml.l ⁻¹	1.624 b	0.074 a	32.000 a
Algamix 2 ml.l ⁻¹	1.920 ab	0.059 ab	31.040 a
CaCl ₂ 0.5 g.l ⁻¹	2.016 a	0.057 ab	32.960 a
CaCl ₂ 1 g.l ⁻¹	1.960 ab	0.033 b	32.000 a

Means within a column followed with the same letters are not significantly different from each other according to Duncan's multiple range test at 5% level.

The increasing some vegetative growth characters caused by seaweed extract Algamix as shown above, (Table, 1&2). In general, seaweed extracts contain important growth hormones like Auxin, gibberellins and Cytokinin which induce cell division, increase cell enlargement, lead to balance of the physiological and biological processes, increase photosynthesis processes and improve growth characters (Jensen, 2004). The positive effect of seaweed extracts on the vegetative growth characters may be due to the mineral content Zn, Cu and B in the seaweed extracts which promote cell division and enlargement and induce the photosynthesis leading to better vegetative growth. It might also be due to the macronutrient that the seaweed extracts contain like N, P, K, which (macronutrients) play a great role in plant nutrition which are essential for the growth of plant (Lopes *et al.*, 2008 and Attamimy, 2009). These are in harmony with Blunden *et al.*, (1996), Morales-Rayan (2004) and AL-Bayati (2010).

Calcium plays a vital role in plant growth, which goes through the cell wall structure as a Calcium Pectate that promote the longitudinal growth of the cell. AL-Naimy (1999) reported that the role of Ca is important in plant growth because helps to protein synthesis which increases nitrate absorption by the plant. It has an important function in the integrity and stability of cell membrane (Paiva *et al.*, 1998; Marschner, 1995) and membrane permeability; it enhances pollen germination and growth; activates a number of enzymes for cell mitosis, division and elongation; possibly detoxifies the presence of heavy metals in the tissue. Giordano *et al.*, (1982) mentioned that it is important to save Calcium in the cell for continuing the division process of the meristematic cell. Calcium had an effect on increasing dry matter in the plant during increased photosynthesis process. AL-

Sahaf (1989) reported that Ca is an important element for plant growth and development, which enters the Middle Lamella structure in the cell wall as Calcium pectate; it also enters the cell membrane structure that is important for the conservation of penetration and activity. These results are in agreement with the findings by Senay and Kleinhenz (2003), Ozgen and Palta (2005) and AL-Mtori (2010).

Yield Parameters

The results in table (3) display that Algamix and CaCl₂ concentration had no effect on yield characters likes (No. of tubers. plant⁻¹, plant yield Kg, total yield Kg.m⁻², total yield ton.donum⁻¹, carbohydrates and TSS), expect in tuber weight. There was significant increase in tuber weight and the highest tuber weight results in control treatments (166.39 g), where as the lowest value (98.41g) resulted when spray potato plant by 1 g.l⁻¹ CaCl₂.

Table (3): Effect of Algamix and CaCl₂ on yield parameters of Potato cv. Arnoba.

Treatments	Yield parameters						
	No. of tubers.plant ¹	tuber weight g	plant yield Kg	Total yield Kg.m ²	Total yield ton. donum	Carbohydrates	TSS
Control	9.33 a	166.39 a	1.32 a	7.06 a	15.54 a	3.49 a	5.16 a
Algamix 1ml.l ⁻¹	8.78 a	159.29 ab	1.36 a	7.28 a	16.01 a	3.54 a	5.06 a
Algamix 2ml.l ⁻¹	11.33 a	127.28 ab	1.42 a	7.60 a	16.71 a	3.41 a	5.09 a
CaCl ₂ 0.5 g.l ⁻¹	12.00 a	127.87 ab	1.51 a	8.08 a	17.77 a	3.65 a	5.05 a
CaCl ₂ 1 g.l ⁻¹	13.33 a	98.41 b	1.29 a	6.90 a	15.18 a	3.59 a	4.90 a

Means within a column followed with the same letters are not significantly different from each other according to Duncan's multiple range test at 5% level.

CONCLUSION

From previous results, it could be suggested that using seaweed extract of Algamix in addition to CaCl₂ is considered a suitable application to improve vegetative growth of potato plants grown under plastic house condition.

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IMPACT OF GROWTH REGULATORS IN BUDDING SUCCESS PERCENTAGE AND GROWTH OF TWO APRICOT (*Prunus armenica* L.) CULTIVARS

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ABSTRACT

This study was conducted during the growing season of 2012 and 2013 in the nursery of horticulture department of Akre technical institute in order to assay the effects of plant growth regulators concentrations. The treatments tested (Auxin IAA (50,100 mg.L⁻¹), IBA (50,100 mg.L⁻¹), 2,4,5-T (20,40 mg.L⁻¹) and Kinetin (10 mg.L⁻¹) on the percentage of budding success and vegetative growth of apricot transplants. The results obtained that the most of the studies characters of the tested cultivars were significantly affected by plant growth regulators. The highest budding success percentage (90.90%) was in cultivar 1 which treated with IAA 100 mg.L⁻¹, while the highest length (120.0 cm) in cultivar 2 which treated with 2,4,5-T (20 mg.L⁻¹), cultivar 1 in treatment Auxin IAA 50 mg.L⁻¹ gave the highest average diameter of transplants (1.45 cm) and number of branches (14.00 branches/transplants) was achieved from the interaction between the cultivar 1 and the treatment of 2,4,5-T (40 mg.L⁻¹), and cultivar 2 in treatment auxin IAA (50 mg.L⁻¹) gave the highest average chlorophyll content in leaves reached (32.30).

KEY WORDS: Growth regulators, budding, apricot

INTRODUCTION

Apricot (*Prunus armenica* L) is one of the temperate regions fruits belong to Rosaceae family. It is of high economic importance for Iraqi Kurdistan Region and its culture is continuously increasing, but unfortunately Apricot quality and quantity is still poor and do not meet the local demand. Propagation by seed is not recommended because seed may be produced by cross-fertilization may yield undesirable trait combinations, because seedlings grown from crosses between commercial fruiting varieties contain a mix of parental genetic backgrounds they will not be identical to either parent and will differ in growth and fruiting habit. This variability is desirable for plant breeding and development of new varieties, not for uniform growth in an orchard establishment Apricot, and other fruit of stone fruit have a low rooting percentage (Hartmann, et al, 2002) because fruiting varieties tend to have a poor root system that is susceptible to pests, pathogens, or environmental stress, because of that, stone fruits are typically propagated using budding or cutting techniques and grown on rootstock varieties. The stone fruit (Apricot, Plum, Peaches and Nectarines are Summer budded, from late July to September, is

also common in Apricot, Plum, Peach and Nectarine trees grown for retail nurseries because a tree with a larger caliper is produced.

Concerning scion stem diameter, Bolat (1995) got apricot transplant with different diameter since he got 10.15 mm for Salek cultivar while it was 11.8 mm for Hasanbey cultivar.

Al-Safi and Al-Djaili (2000) studied the effects of three apple cultivars scions on the budding success percentage on three different apple rootstocks. They found that Sharaby and Saify apple cultivars gave increases in budding success percentages reached to 70.92% and 70.19% respectively as compared with Kuffi apples which gave only 61.67% only. Furthermore, they gave increases in vegetative growth of the successful scions when compared to Kuffi apples which were estimated at 84.47, 84.89 and 74.81 cm respectively.

Ullah *et al.* (2000) doing budding of some almond on peach stocks found that success percentage was high for all tested cultivars except Genco which gave the lowest success.

Al-Kayssi (2011) referred that the cultivar had significant effect on budding of Plum on apricot stocks by increasing the success percentage, length rates of branches and the number of lateral

vegetative branches.

Treatment plant with growth regulators like auxins and cytokinins has a great role in inducing cells enlargement and elongation and producing callus which is considered as a condition for uniting the scion with the stock for injuries healing. Auxins and cytokinins are the most commonly used growth regulators in plant propagation in both traditional and micro propagation.

Hana and Yousif (2000A, B) found that using kinetin at 2mg.L^{-1} significantly increased the success percentage and the length and diameter of transplants. The interaction between kinetin and IAA was effective as well on the length and diameter of transplants.

Al-Safi (2002) studied the effect of auxin on the growth of transplants of three local apple cultivars (Ajamy, Sharaby and Kuffi). His results declared that the treatment with IAA at 25 and 50mg.L^{-1} significantly increased budding success percentage as well as increased the vegetative growth rates as compared with the control.

Saleh (2004) studies the effect of auxin (IAA) at 0, 30 and 60mg.L^{-1} on pistachio budding success on two kinds of rootstocks and he found that the treatment was ineffective in increasing branches growth rates.

Al-Zebari et al. (2012) referred that the treated scions of Peach cultivars with growth regulators included (IBA 60 and 120mg.L^{-1} , 2,4,5-T 20 and 40mg.L^{-1} , Kinetin 5 and 10mg.L^{-1} , Kinetin 5 + IBA 60mg.L^{-1} , Kinetin 5 + IBA 120mg.L^{-1} , Kinetin 10 + IBA 60mg.L^{-1} , Kinetin 10 + IBA 120mg.L^{-1}) significantly affect the tested traits as well including budding success percentage, length, diameter and number of produced branches and chlorophyll content in leaves. Al-Zebari (2012) found that the application of IBA and kinetin (0, 30, 60, and 90mg.L^{-1} IBA and (0, 3, 6, and 9mg.L^{-1} Kinetin)) in budding of mulberry gave significant effects on percentage of successful budding, length and diameter of scions mulberry. While the best treatment in percentage of budding success scion, length and diameter of scions was found in high concentration of IBA and kinetin.

Al-Zebari et al. (2015) in study to determine the impact of kinetin and IBA (6 and 12mg.L^{-1}) or IBA (50 and 100mg.L^{-1}) or interaction treatments on the budding success percentage of peach (Dixired cultivar) the results showed that the second level of Kinetin increased the success

percentage of budding compared with all the growth regulators treatments, and the first level of the IBA in high sapling character. To increase budding success percentage in the seedlings of Apricot and improving their vegetative growth, this investigation was carried out (treatment with plant growth regulators) by using various concentration auxin and kinetin.

2. MATERIALS AND METHODS

This study was conducted during the growing season 2012 and 2013 in one the nursery of horticulture department, of Akre institute in order to assay the effects of some plant growth regulators concentrations on the percentage of budding success and vegetative growth of apricot transplants budded on two year seedlings of apricot. Seeds were sown on rows apart from each other by 80 cm at sowing distances 10-15 cm at March 1st 2012. The budding process was performed on the end September, 2012. Scions (buds) of two local Apricot cultivars (cultivar **Hajji** and **Isa**) are prepared from mature annual growth from a public orchards and the buds are taken from the mid of the branch at morning. Budding is performing on the stem of the stock on height 12-15 cm from the ground. Stem diameter of transplants is about 10 to 12.0 mm. Inverted T-budding method which use in the local nurseries. Scions were soaked in growth regulators according to test the different concentrations of Auxin (IAA 50 , 100mg.L^{-1} , and IBA 50 , 100mg.L^{-1}) and (2,4,5-T 20 , 40mg.L^{-1}) and (Kinetin 10mg.L^{-1}). The unite area between scion and stock is tightly band to grantee the success of budding process to avoid drought and increase their unity. In the later spring the bandages are removing and transplants are punched above the budding area of about 5cm to enhance buds to growth. The suckers below budding zone are removing till the soil ground. Factorial experiment (2×8) with Randomized Complete Block design (RCBD) with three replicate and 10 transplants per replicate were used in this study.

(¹):1-Hajji cultivar: Irregularly shaped trees and leaves are large and thick with dark color.

The fruits are large-sized, fruit dark yellow color with fibers. The tree infected by insect stems borer.

2-Isa cultivar: Trees medium size and scattered. Small-sized leaves, not thick, light-colored.

Fruits small-sized, juice and delicious taste.

The following parameters are measured in this experiment: Budding success percentage, length and diameter of the grown scions (transplant), branches number of the grown scions (transplant) and chlorophyll percentage in leaves (SPAD).

RESULT AND DISCUSSION

The results in table (1) showed that the cultivars are significantly affected on the success percentage of budding for Apricot seedlings and the superiority of the first cultivar was significantly and reached (63.1%) while the second cultivar reached (54.75%) in the success percentage of budding. It also the growth regulators significantly affected in this character, and highest percentage wise (Auxin IAA 100mg.L⁻¹) which reached (84.34%), while lowest percentage was in (Auxin 2-4-5 40mg.L⁻¹) reached (42.47%). As is clear from the table itself the interaction between the cultivars and growth regulators was significant effect on the success percentage of budding, and the highest percentage in the first cultivar and (Auxin IAA 100mg.L⁻¹) amounted to 90.90% and the lowest percentage is in the first cultivar and (Kinetin 10 mg.L⁻¹) amounted to 37.72%. This may be due to the influence common for each of the cultivars and growth regulators.

Table (1) explains that cultivars variations have their effects on budding success percentage, this result agreed with Ullah et al. (2000) in Almond, Al-Safi and Al-Djaili (2000) in Apple, Al-Kayssi (2011) in Plum, and Al-Zebari et al. (2012) in Peach. This may be due to the differences between the cultivars in extent response to budding, The reason behind that might be due to the differences among cultivars in their budding response, also growth regulators affected significantly the budding success percentage, this result agreed with Hana and Yousif (2000A, B) in Pistachio and Al-Safi (2002) in apple, Al-Zebari et al. (2012) in Peach and Al-Zebari (2012) in Mulberry. This result may be due to the referred to the effects of growth regulators affecting xylem and phloem differentiation and lignification process which is considered as very important factors in formation of a strong union area in grafting and budding due to the enhancement of this auxin to the cambium activity which reflected in a better union than the other cultivars or might be due to the co-effect of both the cultivar and the auxin. The interaction between the cultivars and growth regulators was significant effect on the success percentage of budding. This may be due to the influence common for each of the cultivars and growth regulators.

Table (1): Impact of growth regulators in budding success percentage of two Apricot cultivars

Growth regulators	Cultivars		Growth regulators effect
	Cultivar 1	Cultivar 2	
Control	45.48 i	66.66 e	56.07 d
IAA 50mg.L ⁻¹	81.81 c	40.10 j	60.96 c
IAA 100mg.L ⁻¹	90.90 a	77.77 d	84.34 a
IBA 50mg.L ⁻¹	40.31 j	40.10 j	45.21 e
IBA 100mg.L ⁻¹	53.33 g	38.57 k	45.95 e
2,4,5-T 20mg.L ⁻¹	68.88 d	62.54 f	65.71 b
2,4,5-T 40mg.L ⁻¹	46.36 i	38.57 k	42.47 g
Kinetin 10 mg.L ⁻¹	37.72 k	50.50 h	44.11 2
Cultivar effect	63.1 a	54.75 b	

Means having the same letters in a column are not significantly different at 5% level.

The data in table (2) indicate that there is no significant effect of the cultivar in the length of the grown scions. As same as both cultivars the growth regulators did not affect in the grown scions. The interaction between the cultivars and growth regulators was significant effect in the grown scions, and the highest rate in the length of

the grown scions was in the second cultivar II and growth regulator (Auxin 2-4-5 20mg.L⁻¹) reached 120.00cm, and the lowest rate in the length of the grown scions was in the second cultivar II and growth regulator (Auxin IAA 50 mg.L⁻¹) reached 76.50 cm. This may be due to the combined useful effect between cultivars and growth regulators.

Table (2) Impact of growth regulators in length of the grown scions of two Apricot cultivars

Growth regulators	Cultivar 1	Cultivar 2	Growth regulators effect
Control	95.00ab	95.00ab	95.00 a
IAA 50mg.L ⁻¹	105.00 ab	76.50 b	90.75 a
IAA 100mg.L ⁻¹	97.50 ab	114.00 ab	105.75 a
IBA 50mg.L ⁻¹	107.50 ab	100.00 ab	103.75 a
IBA 100mg.L ⁻¹	90.00 ab	95.00 ab	92.50 a
2,4,5-T 20mg.L ⁻¹	107.00 ab	120.00 a	113.50 a
2,4,5-T 40mg.L ⁻¹	114.00 ab	96.50 ab	105.25 a
Kinetin 10 mg.L ⁻¹	95.00 ab	92.50 ab	93.75 a
Cultivar effect	101.38 a	98.69 a	

Means having the same letters in a column are not significantly different at 5% level.

The results in table (3) shown that the significant effect of the cultivar in developing diameter of grown scion , the highest rate was in the treatment of cultivar 2reached 1.23 cm and the lowest rate was in the treatment of cultivar (1) reached 1.10cm, this is consistent with what it found Bolat (1995) in apricot and Al-Kayssi (2011) in Plum. The results also indicate that the growth regulators was effected significantly on diameter budding and received the highest rate in

(Auxin IAA 50mg.L⁻¹) amounted to 1.34 cm and the lowest rate in (Kinetin 10 mg.L⁻¹) amounted to 0.93 cm.The interaction between cultivars and growth regulators had significant effect in this character and received the highest rate in the first cultivar + (Auxin IAA 50mg.L⁻¹)and the second cultivar + (Auxin 2,4,5-T 40mg.L⁻¹) reached 1.45 cm and the lowest rate in the firstcultivar+ growth regulator (Auxin 2,4,5-T 20mg.L⁻¹) reached 0.80 cm.

Table (3):Impact of growth regulators in diameter of the grown scions of two Apricot cultivars.

Growth regulators	Cultivar 1	Cultivar 2	Growth regulators effect
Control	1.25 a-c	1.15 a-d	1.20 ab
IAA 50mg.L ⁻¹	1.45 a	1.23 a-c	1.34 a
IAA 100mg.L ⁻¹	1.35 a	1.20 a-d	1.28 ab
IBA 50mg.L ⁻¹	0.90 ed	1.30 ab	1.10 bc
IBA 100mg.L ⁻¹	1.00 b-e	1.20 a-d	1.10 bc
2,4,5-T 20mg.L ⁻¹	0.80 e	1.35 a	1.08 bc
2,4,5-T 40mg.L ⁻¹	1.15 a-d	1.45 a	1.30 ab
Kinetin 10 mg.L ⁻¹	0.90 e-d	0.95 c-e	0.93 c
Cultivar effect	1.10 b	1.23 a	

Means having the same letters in a column are not significantly different at 5% level.

The results in table (4) declares that the cultivars had significant effect in the number of branches and got the highest rate in the cultivar1amounted to 7.19 branch / transplant,while the lowest rate in the second cultivar2 amounted to 5.63 branch / transplant . and The results show in the table itself also that growth regulators was significant effect in the number of branches ,showed the highest rate in (Auxin 2-4-5 40mg.L⁻¹) amounted to 11.50 branch / transplant, while the lowest rate in (Auxin IAA 100mg.L⁻¹) reached 4.25 branch / transplant.

The interaction between the two cultivars and growth regulators had significant effect in this character and the highest rate in the cultivar1 and the growth regulator (Auxin 2,4,5-T 40mg.L-1) amounted to 14.00 branch / transplant and the lowest rate in the treatment of the cultivar2 and the growth regulator (control) and growth regulator (Auxin IAA 100mg.L⁻¹) amounted to 4 branch / transplant ,which are no differ with most treatment .This may be due tothe combined effect useful between of cultivars and growth regulators.

Table (4): Impact of growth regulators in number branches of the grown scions of two Apricot cultivars.

Growth regulators	Cultivar 1	Cultivar 2	Growth regulators effect
Control	5.00 c-e	4.00 f	4.50 f e
IAA 50mg.L⁻¹	6.50 c-f	5.50 d-f	6.00 b-d
IAA 100mg.L⁻¹	4.50 e f	4.00 f	4.25 e
IBA 50mg.L⁻¹	5.50 d-f	7.00 b	6.25 bc
IBA 100mg.L⁻¹	8.50 bc	5.00 e f	6.75 b
2,4,5-T 20mg.L⁻¹	8.00 b-d	6.00 d-f	7.00 b-e
2,4,5-T 40mg.L⁻¹	14.00 a	9.00 b	11.50 a
Kinetin 10 mg.L⁻¹	5.50 d-f	4.50 ed	5.00 e f
Cultivar effect	7.19 a	5.63 b	

Means having the same letters in a column are not significantly different at 5% level.

From the results shown in the Table (5) gives a clear idea that the cultivars did not affect in the content of leaves chlorophyll (SPAD). While the growth regulators used had significant effect in the content of leaves chlorophyll and appeared the highest rate in the treatment of growth regulator (Auxin IAA 50mg.L⁻¹) significant disagreed with most of the treatment reached 31.70 while the lowest rate in the treatment of growth regulator (Auxin IBA 50mg.L⁻¹) reached 24. The interaction between the cultivar and growth regulators used in this study caused the significant difference the highest rate was in the treatment of cultivar 2 and growth regulator (Auxin IAA 50 mg.L⁻¹) reached (32.30), while the lowest rate in the treatment of cultivar 2 and (Auxin 2,4,5-T 40mg.L⁻¹) reached (22.47). This may be due to the influence of cultivars and growth regulator.

The results in table (3 and 4) indicated that the cultivars of Apricot (*Prunus armenica* L.) effect significantly in diameter and number of branches

of grown scions of two Apricot cultivars. This is consistent with what it found Bolat (1995) in apricot, Al-Kayssi (2011) in Plum and Saleh (2004) in Pistachio.

This may be due to differences among species in the emergence of branch number formed. Also the results in table (3 and 4) declare that the treatment of growth regulators was significant effect in diameter and number of branches. This is consistent with the results obtained Al-Zebari et al. (2012) in Peach and Saleh (2004 in Pistachio), referred that growth regulators (auxins) compounds have a main role in expanding and elongating cells through their role in inducing cambium activity and cell division.

The interaction between the cultivars and growth regulators was significant effect in the grown scions (in diameter and number branches of scions) This may be due to the combined effect useful between of cultivars and growth regulators in this characters.

Table (5): Impact of growth regulators in leaves relative chlorophyll content (SPAD) of two Apricot cultivars.

Growth regulators	Cultivar 1	Cultivar 2	Growth regulators effect
Control	27.53 b-e	29.20 a-d	28.37 b-c
IAA 50mg.L ⁻¹	31.10 ab	32.30 a	31.70 a
IAA 100mg.L ⁻¹	30.60 a-c	27.50 b-e	29.05 ab
IBA 50mg.L ⁻¹	22.97 de	26.17 b-e	24.57 c
IBA 100mg.L ⁻¹	27.50 b-e	26.77 b-e	27.13 bc
2,4,5-T 20mg.L ⁻¹	25.77 b-e	24.67 c-e	25.22 bc
2,4,5-T 40mg.L ⁻¹	27.53 b-e	22.47 e	25.00 bc
Kinetin 10 mg.L ⁻¹	32.10 a	23.90 de	28.00 b-c
Cultivar effect	28.14 a	26.62 a	

Means having the same letters in a column are not significantly different at 5% level.

4. CONCLUSION

The results of this investigation indicated that the cultivars of Apricot (*Prunus armenica* L.) effect significantly on budding success percentage, diameter of the grown scions and number branches of the grown scions. Treated scions of Apricot cultivars with growth regulators significantly budding success percentage, diameter of the grown scions, number branches of the grown scions and leaves relative chlorophyll content.

The best treatment was (cultivar 1 + auxin IAA 100mg.L⁻¹ in budding success percentage reached 90.90%, cultivar 2 + auxin 2,4,5-T 20mg.L⁻¹ in length of the grown scions reached 120.00 cm. and diameter of the grown scions reached 1.45 mm.

,cultivar 1 + auxin 2,4,5-T 40 mg.L⁻¹ in number branches of the grown scions reached 14.00, and cultivar 1 + kinetin 10 mg.L⁻¹ in leaves relative chlorophyll content reached 32.30.

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RESPONSE OF TWO CULTIVARS OF STRAWBERRY USING CULTIVATED WITH SOIL AND HYDROPONIC CULTURE

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ABSTRACT

The response of two short day strawberry cultivars, Sweet Charlie and Rubygem cultivated in hydroponic (NFT), Nutrient film technique and soil was studied at Erbil directorate of agricultural researches/ Ankawa, in order to identify the most suitable cultivar, two experiments lasted seven months (October, 2013 - April, 2014) were carried out, Physical and chemical properties and nutrients concentrations of plants were measured. In hydroponic Sweet Charlie resulted a significant increase of fresh and dry plant weight, increase number of leaves per plant, plant mortality, while the significant increasing of leaf length, leaf area, chlorophyll, crown length and diameter, at Rubygem. The greatest increase of fresh and dry plant weight, increase number of leaves per plant, leaf length, leaf area, chlorophyll, crown length and diameter, with decrease in plant molarity at using nutrient solution in both hydroponic and soil cultivation. Comparison of vegetative growth and nutrients content showed that the best of these traits were obtained in soil for Rubygem.

KEYWORDS: Hydroponic, nutrients, soil, strawberry, water

INTRODUCTION

Strawberries (*Fragaria ananassa* Duch.) belong to the family Rosaceae in the genus *Fragaria*, genus of more than 20 species of flowering plants and their edible fruit, it is a small herbaceous perennial plant, which can be grown as an annual or perennial crop under commercial cultivation (Hancock, 1999). Strawberries are native to the temperate regions of the Northern Hemisphere, and cultivated varieties are widely grown throughout the world. (Hancock, 1999). The cultivation of strawberries in Iraq is relatively recent (Franco, 2009) and consumption is relatively low and that most of the strawberries consumed in Iraq are imported from Syria, Iran, Turkey, is the relatively high cost of production in Iraq if compared to other producing countries. That reduced production in Iraq can be attributed to the lack of integrated combat and poor nutrition and fertilization through irrigation and salinity, which greatly affect the growth and production (Hanna, 1982). That the use of modern agricultural techniques in the production of strawberries in Iraq could increase the yield per

hectare to (22.42 / Tons / hectare) instead of the current low productivity (8.07 Tons/hectare) (Franco, 2009).

Rubygem is a short-day cultivar, the leaf color of the upper side is medium green with a slightly concave shape in cross-section. Blistering is absent or very weak and glossiness is weak. The terminal leaflet's length-to-width ratio is longer than broad, with an obtuse shape of the leaf base. Strawberry cultivars grown in specific areas are adapted to the day length and temperatures of that region. Sweet Charlie is also short day cultivar, varies according to planting date, but they tend to be smaller and more compact, leaves are generally slightly cupped, medium to dark green, and semi-glossy. (Royal Horticultural Society, 1995).

Plants need adequate nutrients in all stages of growth, which should be available in the growing medium, soil is usually the most available growing medium for plants. It provides anchorage, nutrients, air, water, etc. for successful plant growth. However, soils do pose serious limitations for plant growth too, at times. Presence of disease causing organisms and nematodes, unsuitable soil reaction, unfavorable soil

compaction, poor drainage, degradation due to erosion etc. are some of them (Beibel, 1960). There are many disease infection in hydroponic as well as not only soil.

Hydroponics has actually been in use for thousands of years. The famous Hanging Gardens of Babylon, one of the seven wonders of the ancient world, are largely believed to have functioned according to hydroponic principles. Built around 600 B.C. in Babylonia, or Mesopotamia, the gardens were situated along the Euphrates River, assumed to be the first large scale use of hydroponic (Benton, 2005). Hydroponic systems will not compensate for poor growing conditions such as improper temperature, inadequate light, or pest problems, hydroponically grown plants have the same general requirements for good growth as field-grown plants.

The purpose of this study is to compare between soil set-up and a hydroponics set-up of two cultivars of strawberry to find out which cultivation and solution made the plants grow faster and become larger, the major difference is the method by which the plants are supported and the inorganic elements necessary for growth and development are supplied.

MATERIALS AND METHODS

The first trial for hydroponic crops in Erbil directorate of agricultural researches are grown under uncontrolled environments in lath-house with partial protection covered on top and three sides with clear plastic film against harsh weather conditions (Temperature, wind and rain), while hydroponic crops normally are grown in greenhouses with sophisticated systems for controlling conditions of the microclimate (temperature, humidity, carbon dioxide, light) and nutrient solution composition (pH, and dissolved oxygen concentration).

Two experiments lasted seven months (October, 2013-April, 2014) were carried out with two strawberry cultivars (Sweet Charlie V1 and Rubygem V2), cultivated in as well as in soil according to the traditional growing method in the region and soilless (Hydroponic) using the nutrient film technique (NFT) making locally available materials in local markets, 1.5m the high, 2m the width of the system, with 24 PVC pipe (2.5 inch width) each 12 pipe in one side, which involves the circulation of a nutrient solution through shallow channels in a closed-loop

system, set on a flat surface with a 1% slope to allow nutrient flow back into the recirculation tank. The movement of nutrient solution down the gullies also ensures that the nutrient solution is sufficiently aerated. The roots of the plants grow in a shallow film of water and nutrient solution inside cultivation channel. These channels were designed to have small holes for pots to install plantlets, the nutrient solution was circulated electrically driven with non-phytotoxic impellers, two pumps are normally provided, should one fail the other is switched on automatically every 15 minutes and collected to one catchment tank with a capacity of 40 liters (Jensen and Collins, 1985). The solution was introduced to the top of the gullies through a small flexible pipe. When the timer turns the pump on nutrient solution is pumped into the grow tray, while when the timer shuts the pump off the nutrient solution flows back into the reservoir (the catchment tank) for re-use (Ahmed, et al. 2004., Albright and Langhans, 2014). In order to identify the most suitable cultivar for out-of-season production in soilless cultivation, plants were planted in 9 rows spaced between plants apart between and within row in both soilless culture and soil (15) cm, (16 plant/pipe) (Hancock, 1999). Horizontal small cork pots, which are available on the market can be stacked vertically on 20-October- 2013.

Nutrient solution used in the NFT system for strawberry production was decided according to previous studies (Jones and Milla, 1991). Depending on the analysis of the tap water (Ahmad, et al. 2004), Water is the primary ingredient in a nutrient solution and therefore the single most important factor to growth (Graves 1983). Nutrient solution should contain Nitrogen, Phosphorus and Potassium as macro nutrients. Nitrogen is primary to foliage plant growth. Phosphorus helps for building strong roots and it is vital for flower and seed production. Final macro-element Potassium is required for increasing chlorophyll in foliage and it also helps to regulate stomata openings and by that way induce better usage of light and air by plants. Some chemical and physical properties of the soil and water are described in Table (1). The plants were manually irrigated with water and nutrient solution after cultivation and as needed until the end of the experiment and were applied for hydroponic by using a pump, volume of them was adjusted twice a week by adding tap water and nutrient solution up to recognized mark in the

tank. The nutrient solution was completely renewed every two weeks, similarly, the pH and the EC of the nutrient solution were measured and maintained within a range of 5.8 to 6.1 and 1.9 to 2.3 mS cm⁻¹, respectively, when the fresh nutrients were added into the 40 L container by using portable pH meter and EC meter. The recommended EC for media based growing systems range between 1.4 and 3 mS cm⁻¹. Under low light intensity, EC levels should be higher (2 – 2.4 mS cm⁻¹) than under warmer conditions. The pH for hydroponic strawberry production should be maintained between 5.8 and 6, to facilitate maximum uptake of elements (Morgan, 2006). Before planting a crop, flush out the new hydroponic installation entirely for 1 day with a dilute nutrient solution that is then discarded. Pre-plant soil fumigation Thiophanate Methyl (Topsin) was originally investigated for control of *Verticillium dahliae* infection of strawberry (Wilhelm and Koch, 1956).

We monitored our strawberries plants twice a week and recorded air temperature, tank

temperature, number of plants, color of strawberries and color of leaves. Data recorded after 150 days from transplanting date, three strawberry plants for each variety per replicate from each treatment were randomly taken to determine the following parameters, no.leaves.plant⁻¹, leaf length (cm), leaf area(cm²), chlorophyll % (using a digital leaf area meter, leaf total chlorophyll reading in the fifth mature leaf from the top of the plant (using Minolta chlorophyll meter Spad-501, Minolta Co., Japan), crown length(cm), crown diameter (cm) and plant mortality%. At the end of each experiment, plants were cut off from the base; the roots were removed and washed, all plants' tissue samples were dried at approximately 60°C in an oven until weight became constant to determine dry weight. Plant samples were analyzed by the lab at Erbil directorate of agricultural researches, total concentrations of major elements (N,P, K%) of plant materials were determine.

Table (1): Some properties of the soil and water used in the study*

Characteristics	Experiment media
Soil	
pH (pH- meter)	7.9
EC (Electrical conductivity)	0.2 des/m
Organic mater	0.7 %
Nitrogen %	0.132
P ₂ O ₅	6.65
K ₂ O	120 ppm
Soil texture	Sandy clay loam
Water	
pH	7.8
EC (Electrical conductivity)	0.2 des/m

*The data analyzed at Erbil directorate of agricultural researches

RESULTS AND DISCUSSION

First experiment: hydroponic

The present values in (Table 2) revealed the consistent and most significant results for growth parameters between two cultivars cultivated in hydroponic, V1 resulted a significant increase of fresh and dry plant weight (29.43, 16.86 g) respectively, increase number of leaves per plant(44.00), plant mortality (22.93%), while the significant increasing of leaf length (15.29 cm),

leaf area (17.00cm²), chlorophyll (44.60%), crown length and diameter (3.01, 1.45 cm) respectively, recorded at V2. These obtained differences in growth characteristics of strawberries plants could be related to distinction in origin and genetic and chemical properties of varieties. Thus, the determination of the most favorable nutrient ratio for each species is of major importance.

Table (2): Cultivar responses to in terms of hydroponic on vegetative growth parameters of strawberry*

Cultivar	Plant fresh weight (g)	Dry plant weight (g)	No. leaves. plant ⁻¹	Leaf length (cm)	Leaf area (cm ²)	chlorophyll %	Crown length (cm)	Crown diameter (cm)	Plant mortality %
V1	29.43 a	16.86 a	44.00 a	11.00 b	13.92 b	34.66 b	2.86 b	1.27 b	22.93 a
V2	17.47 b	10.90 b	40.50 b	15.29 a	17.00 a	44.60 a	3.01 a	1.45 a	17.95 b

* The similar letters vertically between treatments mean there are no significant differences between them using Duncan's Multiple Range test at (0.05) level.

The results of the study (Table 3) indicate that the effectiveness of nutrient solution applications with respect to hydroponic on all vegetative growth parameters, Plant fresh weight (30.07g), dry plant weight (16.60 g), no. leaves. plant⁻¹ (41.50), leaf length (15.62 cm), leaf area (16.66 cm²), chlorophyll (43.47 %), crown length and diameter (3.35, 1.44 cm) respectively, while Plant mortality is more in water hydroponic cultivate

(22.43 %) than in nutrient solution (18.46 %). Nutrient solution recycling in the NFT system affected plant growth, one of the modern soil-free cultivation methods is hydroponic method whose advantages such as control of crop nutrition, the capacity to increase planting density, decreasing diseases and pests and increasing the quantity and quality of the (22.43%) product have attracted many growers (Tuzel, *et al.* 2001).

Table (3): Effect of water and nutrient solution in hydroponic on vegetative growth parameters of strawberry*

Solution	fresh plant weight (g)	Dry plant weight (g)	No. leaves. plant ⁻¹	Leaf length (cm)	Leaf area (cm ²)	chlorophyll %	Crown length (cm)	Crown diameter (cm)	Plant mortality %
Water	16.83 b	11.155 b	37.50 b	10.67 b	14.26 b	35.79 b	2.52 b	1.28 b	22.43 a
Nutrient	30.07 a	16.60 a	41.50 a	15.62 a	16.66 a	43.47 a	3.35 a	1.44 a	18.46 b

* The similar letters vertically between treatments mean there are no significant differences between them using Duncan's Multiple Range test at (0.05) level.

Significant differences in means between treatment combinations variety and solution were observed in the vegetative growth contributing characters (Table 4) such as: fresh and dry plant weight (39.75, 20.75 g) and crown length (3.51cm) and no. leaves. plant⁻¹ (45) were greater in V1 with nutrition solution and the lowest was produced in V2 in water (14.55, 9.34 g, 14.55 cm and 32) respectively. The maximum effective increase leaf length (18.23 cm), leaf area (18.00 cm²) and chlorophyll (42.85 %) and crown diameter (1.55 cm) was found in V2 with nutrient solution. The results of analysis also showed that plant mortality increased in V1 with water (25.52%), the lowest value was in V2 in nutrient solution (16.57 %). Theoretically, nutrient availability is optimal when the nutrient concentrations in the root zone correspond approximately to the nutrient-to-water uptake ratio. Under such conditions, plants do not have to consume energy to take up or to

actively exclude any nutrient ions, whose concentrations are lower or higher than their nutrient-to-water uptake ratios, respectively. However, the nutrient-to-water uptake ratios fluctuate widely in response to different climatic conditions, even within the same day. Therefore, it is not possible to provide a nutrient solution with nutrient concentrations which would be continuously in accordance with the corresponding nutrient-to-water uptake ratios. On the other hand, due to the very low volume of nutrient solution per plant, changes in the nutrient-to-water uptake ratio might quickly result in large alterations of the ionic concentrations in the solution. Indeed, due to a more intensive plant uptake during particular time intervals, some nutrients may become depleted while others may accumulate. Over time it is anticipated that most closed hydroponic systems will develop some type of microbial community (Ehret, *et al.* 2001).

Table (4): Effect of interaction between cultivar, water and nutrient solution in hydroponic on vegetative growth parameters of strawberry*

Solution	Cultivar	Fresh plant weight (g)	Dry plant weight (g)	No. leaves. plant ⁻¹	Leaf length (cm)	Leaf area (cm ²)	chlorophyll %	Crown length (cm)	Crown diameter (cm)	Plant mortality %
Water	V1	19.10 b	12.97 b	43.00 a	9.00 c	12.52 c	30.23 c	2.21 d	1.21c	25.52 a
	V2	14.55 c	9.34 c	32.00 c	12.34 b	16.00 ab	41.34 b	2.83 c	1.35 b	19.33 bc
Nutrient	V1	39.75 a	20.75 a	45.00 a	13.00 b	15.31b	39.08 b	3.51 a	1.32 b	20.34 b
	V2	20.38 b	12.45 b	38.00 b	18.23 a	18.00 a	47.85 a	3.18 b	1.55 a	16.57 c

* The similar letters vertically between treatments mean there are no significant differences between them using Duncan's Multiple Range test at (0.05) level.

Results in (Table 5) declare that nitrogen percentage showed higher significant increase in V2 (3.31 %) On contrast, contents of phosphorus and potassium presented significant increase in V1 (0.27 and 0.91 %) respectively. These obtained differences in growth characteristics in this respect, it can be suggested that these differences in nutrient contents between both cultivars could be related to the effect of genotype.

However, nitrogen (4%), phosphorus (0.30 %) and potassium (1 %) contents in hydroponic with nutrient solution significant differences with water. Plants grown in hydroponic are only possible if nutrition is optimized. This implies the accurate management of all factors involved in crop nutrition: nutrient solution composition, water supply, nutrient solution temperature, dissolved oxygen concentration, electrical conductivity and pH of the nutrient solution. If any of these factors is under non-optimal conditions, plants may suffer from stress leading to a decline of yields and product qualities. In order to specify the range of optimal conditions of a particular crop, a precise diagnosis of plant stress caused by an incorrect

management of any of abovementioned factors is needed. This review analyzes, for every factor, the optimum ranges that have been reported and the physiological methods that can be used to diagnose plant stress at non-optimal conditions.

Concerning the interaction, there were significant differences detected among them on the nutrient content, nitrogen (3.66 %) responded significantly to V2 with nutrient solution, while the highest values of phosphorus and potassium percentage were obtained in V1with nutrient solution (0.29 and 0.96 %) respectively. It could be concluded from the overall results that all the hydroponic with

nutrient solution performed better than water cultivation. Mineral contents were affected by varieties where using nutrient solution increased the nutrients significantly. This also may be a result of increasing the vegetative growth of the plants cultivated in hydroponic which may increase the uptake of these elements (Ahmed, *et al.* 2004).

Table (5): Effect of cultivar, water, nutrient solution and their interactions in hydroponic cultivation on nutrient content of strawberry*

Treatments		N%	P%	K%
Cultivar				
	V1	2.37 b	0.27 a	0.91 a
	V2	3.31 a	0.23 b	0.78 b
Solution				
	Water	2.28 b	0.26 b	0.38 b
	Nutrient	4.00 a	0.30 a	1.00 a
Solution	Cultivar	Interactions		
Water	V1	2.33 d	0.27 ab	0.66 c
	V2	2.80 c	0.25 b	0.58 d
Nutrient	V1	3.19 b	0.29 a	0.96 a
	V2	3.66 a	0.27 ab	0.89 b

* The similar letters vertically between treatments mean there are no significant differences between them using Duncan's Multiple Range test at (0.05) level.

Second Experiment:

Soil the results of second experiment (Table 6) showed that the most significant results for growth parameters between two cultivars cultivated in soil, V1 resulted a significant increase of fresh and dry plant weight (31.57, 18.79 g) respectively, increase no. leaves. Plant⁻¹ (53.00), plant mortality (19.88 %), while the significant increasing of leaf length (17.85 cm), leaf area (18.69 cm²), chlorophyll (45.83 %), crown length

and diameter (3.33, 1.52. cm) respectively, recorded at V2. Nutritional status of strawberry is influenced not only by many factors such as soil, temperature, humidity, fertilization growing management, but also by cultivars used (Daugaard, 2001, Ames *et al*, 2003). There are several reports available in the literature indicating that strawberry can be planted on different times of the year depending on the variety, location and climates (Sharma and Sharma, 2004).

Table (6): Cultivar responses to in terms of soil on vegetative growth parameters of strawberry*

Cultivar	fresh plant weight (g)	Dry plant weight (g)	No. leaves. plant ⁻¹	Leaf length (cm)	Leaf area (cm ²)	Chlorophyll %	Crown length (cm)	Crown diameter (cm)	Plant mortality %
V1	31.57 a	18.79 a	53 a	13.87b	16.77 b	37.22 b	3.04 b	1.30 b	19.88 a
V2	19.36 b	13.93 b	44 b	17.85 a	18.69 a	45.83 a	3.33 a	1.52 a	15.93 b

* The similar letters vertically between treatments mean there are no significant differences between them using Duncan's Multiple Range test at (0.05) level

The results of the study (Table 7) indicate that the effectiveness of nutrient solution applications with respect to hydroponic on all vegetative growth parameters, fresh plant weight (32.15), dry plant weight (20.03 g), no.leaves. plant⁻¹ (51.50), leaf length

(18.53 cm), Leaf area (19.72 cm²), chlorophyll (45.93 %), crown length and diameter (3.71, 1.48 cm) respectively, while Plant mortality is more in water hydroponic cultivate than in nutrient solution(19.28 %).

Table (7): Effect of water and nutrient solution in soil on vegetative growth parameters of strawberry*

Solution	fresh plant weight (g)	Dry plant weight (g)	No. leaves. plant ⁻¹	Leaf length (cm)	Leaf area (cm ²)	chlorophyll %	Crown length (cm)	Crown diameter (cm)	Plant mortality %
Water	18.78 b	12.69 b	45.50 b	13.19 b	15.74 b	37.115 b	2.67 b	1.33 b	19.28 a
Nutrient	32.15 a	20.03 a	51.50 a	18.53 a	19.72 a	45.93 a	3.71 a	1.48 a	16.53 b

* The similar letters vertically between treatments mean there are no significant differences between them using Duncan's Multiple Range test at (0.05) level.

Significant differences in means between treatment combinations cultivar and solution were observed in the vegetative growth contributing characters (Table 8) such as: fresh and dry plant weight (42.13, 23.34g), no.leaves.plant⁻¹ (55.00), crown length (3.76 cm), the lowest percentage of mortality (14.63%) was in V2 with nutrient solution.

Nutrient uptake and accumulation in plant tissues is very important for growth and development, and partly depends on their availability in the growth media. However, the uptake of these nutrients and their accumulation in plant

organs may be affected by various environmental factors including exposure to high or low temperature, thus, affecting the overall plant performance (One of the observations was related with the yellow spots on the leaves of the plants). Yellow spots on the leaves may indicate several problems from different types of diseases, it is generally acknowledged that low temperatures are capable of decreasing nutrient uptake and accumulation in plants due to reduced metabolic activities which ultimately affects growth and development of the plant (Gavito, *et al*. 2001)

Table (8): Effect of interaction between variety, water and nutrient solution in soil on vegetative growth parameters of strawberry*

Solution	Cultivar	Fresh plant weight (g)	Dry plant weight (g)	No. leaves .plant ⁻¹	Leaf length h (cm)	Leaf area (cm ²)	Chlorophyll %	Crown length (cm)	Crown diameter (cm)	Plant mortality%
Water	V1	21.00 b	14.23 b	51.00 b	11.23 c	14.32 c	32.11 c	2.31 c	1.23 d	21.32 a
	V2	16.55 c	11.14 c	40.00 d	15.14 b	17.15 b	42.12 b	3.00 b	1.43 b	17.23 b
Nutrient	V1	42.13 a	23.34 a	55.00 a	16.50 b	19.21 ab	42.32 b	3.76 a	1.36 c	18.43 b
	V2	22.16 b	16.72 b	48.00 c	20.55 a	20.23 a	49.54 a	3.65 a	1.60 a	14.63 c

* The similar letters vertically between treatments mean there are no significant differences between them using Duncan's Multiple Range test at (0.05) level.

Results in (Table 9) declare that nitrogen (3.58 %) and potassium (0.69 %) showed higher significant increase in V1, on contrast, contents of phosphorus (0.23) presented significant increase in V2. These obtained differences in growth characteristics In this respect, it can be suggested that these differences in nutrient contents between both varieties could be related to the effect of genotype.

However, nitrogen (3.31 %), phosphorus (0.23 %) and potassium (0.91 %) contents in soil with nutrient solution significant differences with water. In winter season, irrigation water from taps is always available at lower temperatures

ranging between 0 - 10°C plant production in winter period in the greenhouse can be achieved by modifying temperatures to optimum levels through use of specialised heaters. Successes in using such systems in different plants has been reported (Moorby and Graves, 1980; Sethi and Sharma, 2007). The interaction effect, a significant difference was realized between interactions cultivars and solutions. The highest values of nutrient content, nitrogen (3.33 %), phosphorus and potassium percentage (0.32 and 0.80 %) respectively were responded significantly to V1 with nutrient solution

Table (9): Effect of variety, water, nutrient solution and their interactions in soil cultivation on nutrient content of strawberry*

Treatments		N%	P%	K%
Cultivar				
	V1	3.58 a	0.41 b	0.69 a
	V2	3.13 b	0.23 a	0.30 b
Solution				
	Water	2.40 b	0.19 b	0.78 b
	Nutrient	3.31 a	0.23 a	0.91 a
Solution	Cultivar	Interaction		
Water	V1	2.99 b	0.30 a	0.74 b
	V2	2.77 b	0.21 b	0.54 d
Nutrient	V1	3.33 a	0.32 a	0.80 a
	V2	3.22 ab	0.23 b	0.61 c

* The similar letters vertically between treatments mean there are no significant differences between them using Duncan's Multiple Range test at (0.05) level.

CONCLUSION

We believe this is how the algae were able to grow so quickly in two cultivars and methods of cultivation especially in hydroponic. To the success of hydroponics must cultivate in greenhouse to control environmental conditions so you must take the costs of establishing it into

account. Also, more studies are required to further enhance the strawberry production by applying soilless culture techniques. From this experiment we are able to conclude that growing strawberries in a hydroponic system requires an extensive knowledge of the strawberry life cycle. However, much more research should be done with more

cultivars to determine the optimum feasibility as well as methods to improve production.

The application of soilless culture for crop production is not common in Kurdistan/Iraq due to their lower technological development in agriculture and non-availability of electricity. A crucial factor in the progress of soilless culture is the level of technical knowledge of growers. We had many problems with our experiment because of the system themselves. It took a very long time to set up and when they were finally set up and the strawberries were transplanted into the systems, leaving the strawberries in cooling storage, power cut and low temperature, that we did not have time to try in our project that could have made a difference.

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EFFECT OF CULTIVARS, CONTROLLED RELEASE FERTILIZERS (CFR) AND MEDIA ON THE GROWTH AND VOLATILE OIL OF *Rosmarinus officinalis* PLANT.

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ABSTRACT

This study was carried out in the Nigul Nursery- Duhok city from Feb. 2013 to Jan. 2014. Aimed to evaluate three soilless media composed of different rates of (Sheep manure, sawdust, hay and lawns clipping) by volume compared with river soil and peat moss as control, further more to study the effect of Controlled Release Fertilizers (CRF) type (Basacote p-Max 9M) with four levels (0, 6, 12 and 24) gm.pot⁻¹ size (5) liter on the growth and volatile oil of two cultivars "prostratus" and "Tuscan Blue" of *Rosmarinus officinalis* L. plants. The results can be summarized as follows: The media₂ which consist of (40 sheep manure: 20 sawdust: 20 hay: 20 lawns clipping) by volume gave the highest significant values of Ash (9.15) % and Iso value (89.46) %, while the media₁ (25 sheep manure: 25 sawdust: 25 hay: 25 lawns clipping) gave the highest significant values of growth index (28165) cm³/plant when compared with river soil and peat moss media which in turn gave the highest significant values of volatile oil percentage (1.24)%, volatile oil production (0.721) ml/plant. Fertilizing of rosemary plant with 6 gm. pot⁻¹ led to significant increase in Ash percentage (9.10) %. While the highest significant results for growth index (28209) m³, volatile oil percentage (1.27) % and volatile oil production (0.744) ml/plant was obtained with fertilizer levels 24 gm.pot⁻¹. The prostratus cultivar showed significant increase in volatile oil percentage (1.363) %, volatile oil production (0.658) ml/plant and ISO value (92.96) % when compared with Tuscan Blue.

Key words: Rosemary, soilless media, Controlled Release Fertilizers, Cultivars.

INTRODUCTION

Rosemary (*Rosmarinus officinalis*) is a common household plant which belongs to the Lamianaceae family. Its originality is the Mediterranean, and northwestern Spain (Kowalchik and Hylton, 1987). It is a dense evergreen hardy perennial aromatic herb, 1 to 2 m tall; It commonly begins to flower in late winter and continues through spring (Anonymous, 2009). It grown best in good drained loam neutral to alkaline (6.5–7.0) pH (Doulgas, 1971)..Although rosemary is popular as a culinary spice and antioxidant herb, it uses as potted florist's crop and garden plant (Chipault *et al.*, 1956; Debaggio, 1990). It is high important plant for its essential oil that used in perfumes, soaps and for purposes of fragrant bodily perfumes or aroma. (Anonymous, 2007). Moreover it use as a tonic, stimulant, carminative to treat

flatulence, diuretic, hepatoprotective, antirheumatic, expectorant, anti-inflammatory. Also their oil are use as lotions for the treatment of various ailments like arthritis, gout, muscular pain, a neuralgia, stimulating the hair bulbs to renew activity, and prevent premature baldness (Singh and Guleria, 2013; Begum *et al.*, 2013).

Rosemary cultivars are classified as having prostrate or upright growth habits; prostrate cultivars are often used as potted plants, along the top of walls, or on steep banks due to their droopy nature, whereas the upright cultivars which described as a sprawling habit are used as hedges in areas suitable for perennial establishment (Bown, 2001; Vigot, 2004).////////Slow or Controlled Release Fertilizer (CRF) is a one-time application fertilizer that will release nutrients slowly into the growing media over the crop cycle live, it is predominant product used in the nursery

today and on high-return horticultural crops, to offer advantages to growers and potential to reduce the amount of leach loss of nutrients and decrease the applications requirements for mineral nutrients in a certain period of time by a single use of fertilizers (Cabrera, 1997; Dole and Wilkins, 1999). Boyle *et al.*, (1991) reported that essential

oil content was highest in rosemary plants were fertilized with 12N-5.2P-12.5K (CRF) at 9.0 gm/pot.

Compost or soilless mixes are the most often used growing media for bedding plants. These mixes provide anchorage that enables the plant to support itself and regulate the supply of water, oxygen, and nutrients to the roots (Kessler, 2004). It caused increased in water holding capacity, reduced frequently irrigation and decrease lost of N, P, K and Mg from the container and increase water retention of pine bark (Tyler *et al.*, 1992). Hammo and Saaban (2010) found that media consisted of (1 manure : 1 sawdust), and (1 manure : 1 sawdust : 1 leaves mold) by volume increase leaves area, leaves number, fresh weight, root fresh weight for *Nephrolepis exaltata* plant by 386.99, 193.65, 246.69, 210.19% consecutively compared with those grown in river soil media. Also Salyh (2013) found that the percentage of volatile oil of geranium that grown in soilless media or peat moss was increased significantly when compared to the river soil.

According to the Cepex (2010) statistics, the expected essential oil yield in South Africa is 20 to 80 kg oil/hectare whereas the essential oil is between 0.2 and 1.3 % of the fresh mass, yield of dried leaf should be 2000 kg/hectare (Anonymous, 2013). So the objectives of this study were to Evaluating the activity of three soilless mixture of compost by comparing their with peat moss and river soil on the growth and oil production of two cultivars of rosemary "Tuscan Blue" and evaluation of pasacote fertilizer (Controlled Release Fertilizer) then obtains the best concentration of it for the best growth and oil production.

MATERIALS AND METHODS

This study was carried out in Nigul nursery / Duhok city during the period between 10th Feb 2013 to 11th Jan 2014, at an altitude of 540 m above the sea. After the rooted cuttings were transported to (5) liter pots all the subsequent agriculture processes required were done according to the plant need.

three factors which include: two cultivars of Rosemary; "prostratus" and "Tuscan Blue", four rates of controlled Release Fertilizers (CRF) type (Basacote p-Max 9M) which consist of nitrogen 17%, phosphorus 43%, iron 0.15%, copper 0.05%, magnesium 0.06%, molybdenum 0.015%, zinc 0.01% (0, 6, 12 and 24) gm.pot⁻¹, which were labeled for 270- 360 day release applied at top dressed evenly over the substrate surface in 28 April 2013. Moreover three soilless media media1: (25 sheep manure: 25 sawdust: 25hay: 25 lawns clipping), media2: (40 sheep manure: 20 sawdust: 20 hay: 20 lawns clipping), media3: (20 sheep manure: 20 sawdust: 20 hay: 20 lawns clipping: 20 peat moss) by volume compared with river soil and peat moss as control were studies, So that the experiment was consisted of 5×4×2= 40 treatments with three replicates and ten plants for each one. Performed by use (RCBD) design and the means comparison was done by Duncan's Multiple Ranges test under 5% (SAS, 2001).

At the end of the study the following data have been recorded, Plant Growth Index (cm³) which were calculated according to Hidalgo (2001) by the following formula? **Growth index (cm³) = 3.14[1/2×(less width + large width)/2]² × plant height**, Volatile oil percentage and its amount per plant (ml/plant) which were extracted by using water distillation method (Modified Clevenger) according to British pharmacopoeia (1968) which was mentioned by Ranganna (1985), Ash which was estimated according to Ranganna (1985) and ISO certificate: International Standards Organization (ISO

11164:1995). Which include that Whole rosemary leaves should contain a minimum of 1.2 % volatile oil, maximum of 10% foreign matter, maximum of 2 % woody stems, and a maximum of 7% ash. So the ISO value was calculated by using the following formulas (Anonymous 1995; Anonymous, 2013): **ISO**

Value = (volatile oil × 0.40) + (foreign matter × 0.20) + (woody stem × 0.20) + (Ash × 0.20). Foreign matter percentage and Woody stem percentage were calculate by weighting after separated from the other parts of plants amples.

Table (1): Some physical characteristics of the media.

Media number	Soilless media Mixed by equal volumes (V:V)					bulk density gm/cm ³
	weight of one liter (kgm)	Water retention %	Aeration %	Total (porosity %)		
River soil	1.02	45	13	58	1.02	
Peat moss	0.18	69	6	75	0.18	
Media1 (25 sheep manure: 25 sawdust: 25hay: 25 lawns clipping)	0.50	72	10	82	0.50	
Media2 (40 sheep manure: 20 sawdust: 20 hay: 20 lawns clipping)	0.72	77	9	86	0.72	
Media3 (20 sheep manure: 20 sawdust: 20hay: 20 lawns clipping: 20 peat moss)	0.62	72	8	80	0.62	
Textural for river soil		sand %	55.5%	Sandy clay loam		
		clay %	26.5%			
		silt%	18%			

Table (2): Some chemical characteristics of the media.

Media number	Soilless media Mixed by equal volumes (V:V)							
	pH	Ec ds.m ⁻¹	CaCO ₃ %	k mg.l ⁻¹	p mg.l ⁻¹	N mg.l ⁻¹	C/N Ratio	Organic mater
River soil	8.3	0.2	19	27	5	840	27	1.17
Peat moss	6.1	0.4	6	65	98	700	10	2.45
Media1 (25 sheep manure: 25 sawdust: 25hay: 25 lawns clipping)	8.4	0.4	10	190	119	770	16	1.62
Media2 (40 sheep manure: 20 sawdust: 20 hay: 20 lawns clipping)	8.4	0.7	14	229	142	1120	15	2.26
Media3 (20 sheep manure: 20 sawdust: 20hay: 20 lawns clipping: 20 peat moss)	8	0.7	15	215	115	1260	14	2.51

The soil was analyzed at Horticulture and Soil & Water Dept. Laboratories/ College of Agriculture/ Duhok University.

RESULT AND DISCUSSION

1- Growth index of plant (cm³)

The data in Figure (1) indicated that the plant growth index of "Tuscan Blue" cultivar which reach (27745) cm³ was more than "Prostratus" (20663) cm³ with significantly increased reach 34.27%. On the other hand increased Controlled Release Fertilizers (CRF) from 0 to 24 gm. pot⁻¹ caused significantly increased of this plant from 19141 to 28209 cm³ with increasing percentage reached 47.4%. Also the media1 which composed of (25% sheep manure: 25% sawdust: 25% hay: 25% lawns clipping) was significantly superior than the others media and gave the highest growth index

(28165) cm³ when compared with peat moss which gave (25224) cm³ and media3 which gave (24275) cm³ which in turn were significantly superior to the river soil and media2 which decreased to 21113 and 22244 cm³ respectively.

The triple interaction as shown in table (3) cleared that the "Tuscan Blue" cultivar of rosemary growing in media₂ and fertilized with 24 gm.pot⁻¹ gave the highest significant value of plant growth index reached 37495 cm³ in compared with the least value 9416 cm³ for non-fertilized "Prostratus" cultivar plants that grew in river soil with increasing percentage reached 298.21%.

Table (3). Effect of the interaction among cultivars, Controlled Release Fertilizers (CFR) and media on the index (cm³) of *Rosmarinus officinalis* plant.

Cultivars	CRF levels (gm.pot ⁻¹)	Media				
		River soil	Peat moss	Media 1	Media 2	Media 3
Prostratus	0	9416 ^e	19791 ^{j^p}	21930 ^{h^m}	14333 ^q	17002 ^{m^q}
	6	15628 ^{o^q}	21202 ^{iⁿ}	22143 ^{h^m}	14490 ^{p^q}	18954 ^{k^q}
	12	19057 ^{k^q}	25033 ^{f^j}	23032 ^{g^l}	20312 ^{i^o}	27480 ^{d^h}
	24	29652 ^{c^f}	25723 ^{fⁱ}	26966 ^{e^h}	16083 ^{n^q}	25027 ^{f^j}
Tuscan Blue	0	20405 ^{i^o}	20748 ^{i^o}	24384 ^{f^k}	18680 ^{l^q}	24724 ^{f^j}
	6	24649 ^{f^j}	25055 ^{f^j}	35741 ^{ab}	27332 ^{d^h}	23585 ^{g^l}
	12	25650 ^{eⁱ}	31869 ^{b^e}	36477 ^{ab}	29227 ^{d^f}	27740 ^{d^g}
	24	24446 ^{f^k}	32369 ^{b^d}	34644 ^{a^c}	37495 ^a	29688 ^{c^f}

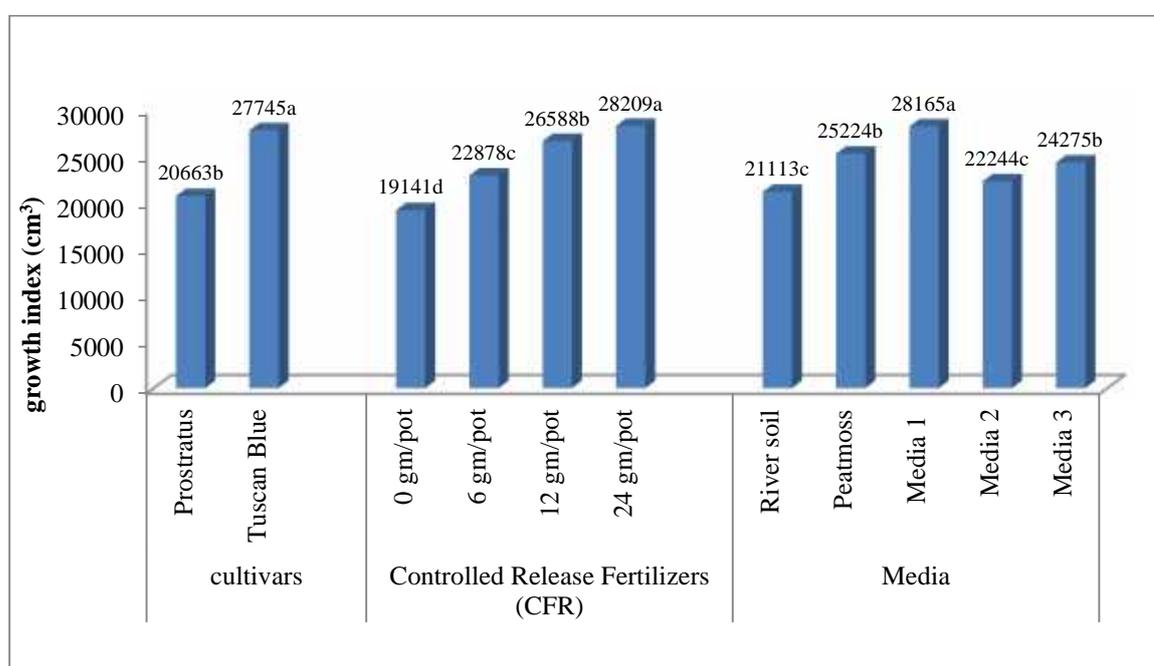


Fig.(1): Effect of cultivars, Controlled Release Fertilizers (CFR) and media on the growth index (cm³) of *Rosmarinus officinalis* plant

2- Volatile Oil Percentage

The data in Figure (2) demonstrated that “Prostratus” cultivar was superior significantly in the Volatile oil percentage and gave (1.36) % when compared with “Tuscan Blue” cultivar which gave (0.84) % with increasing percentage reached 63.04%. Also increasing the Controlled Release Fertilizers (CRF) from 0 to 24 gm. pot⁻¹ increased this percentage from 1.00% to 1.27%. In addition, the peat moss media showed significantly effect on this character and increased the

volatile oil percentage to 1.24% compared with the river soil media which gave the least value 1.02%. //The triple interaction between cultivars, Controlled Release Fertilizers (CRF) and media as shown in table (4) indicated that the best volatile oil percentage was obtained in the “Prostratus” cultivar plants that planted in peat moss and media₃ and fertilized with 24 gm.pot⁻¹ of (CRF) which gave 2.50 and 1.84 % for the two media respectively in compared with the least value (0.67%) which found in the “Tuscan Blue” cultivar that grew in the river soil and fertilized with 6 gm.pot⁻¹ of (CFR).

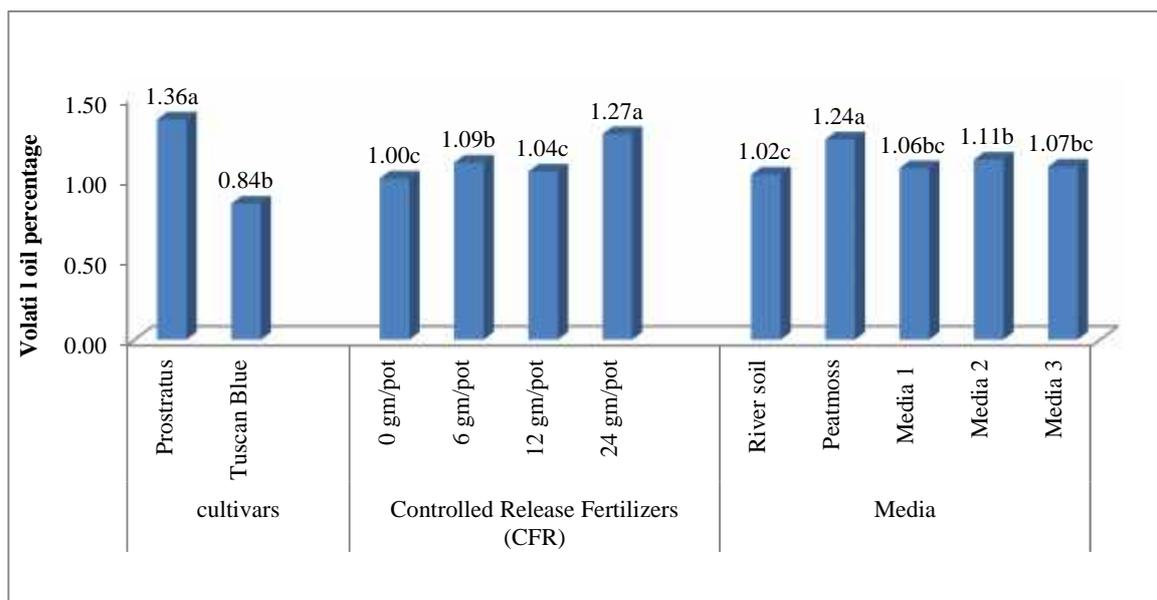


Fig. (2): Effect of cultivars, Controlled Release Fertilizers (CFR) and media on the Volatile oil percentage of *Rosmarinus officinalis* plant.

Table (4): Effect of interaction among the cultivars, Controlled Release Fertilizers (CFR) and media on the Volatile oil percentage of *Rosmarinus officinalis* plant.

Cultivars	CRF levels (gm.pot ⁻¹)	Media				
		River soil	Peat moss	Media 1	Media 2	Media 3
Prostratus	0	1.33 ^{d-g}	1.10 ^{g-j}	1.37 ^{d-f}	1.10 ^{g-j}	0.94 ^{i-l}
	6	1.43 ^{de}	1.70 ^{bc}	1.20 ^{e-h}	1.20 ^{e-h}	1.25 ^{e-g}
	12	1.25 ^{e-g}	1.25 ^{e-g}	1.14 ^{f-i}	1.30 ^{d-g}	1.33 ^{d-g}
	24	1.29 ^{d-g}	2.50 ^a	1.25 ^{e-g}	1.50 ^{cd}	1.84 ^a
Tuscan Blue	0	0.73 ^{lm}	0.75 ^{k-m}	1.00 ^{h-k}	0.90 ^{i-m}	0.73 ^{lm}
	6	0.67 ^m	0.89 ^{j-m}	0.88 ^{j-m}	1.00 ^{h-k}	0.73 ^{lm}
	12	0.73 ^{lm}	0.82 ^{k-m}	0.89 ^{j-m}	0.90 ^{i-m}	0.78 ^{k-m}
	24	0.73 ^{lm}	0.89 ^{j-m}	0.75 ^{j-l}	1.00 ^{h-k}	0.94 ^{i-l}

3- Volatile oil production per plant (ml/plant)

The data in Figure (3) clarified that the volatile oil production of rosemary plants increased significantly in “Prostratus” cultivar to (0.658) ml/plant when compared with “Tuscan Blue” which gave (0.508) ml/plant. In addition, increased (CRF) rates from 6 to 24 gm.pot⁻¹ led to significantly increased of this characteristic from 0.546 to 0.744 ml/plant in compared with the (0) gm.pot⁻¹ (control) which decreased to (0.426) ml/plant. Also the media showed significantly effect on volatile oil production and the Peat moss gave the highest significant value (0.721) ml/plant

compared with river soil media which decreased to (0.446) ml/plant with increasing percentage reached 61.66%. The interaction between the three factors as shown in Table (5) caused significantly effect and the highest volatile oil production (1.433) ml/plant was recorded for the “Prostratus” cultivar of rosemary plants which growing in peat moss and fertilized with 24 gm.pot⁻¹ of (CRF) in compared with the least value (0.331) ml/plant which obtained in the “Tuscan Blue” cultivar plants that non-fertilized and grew in media3.

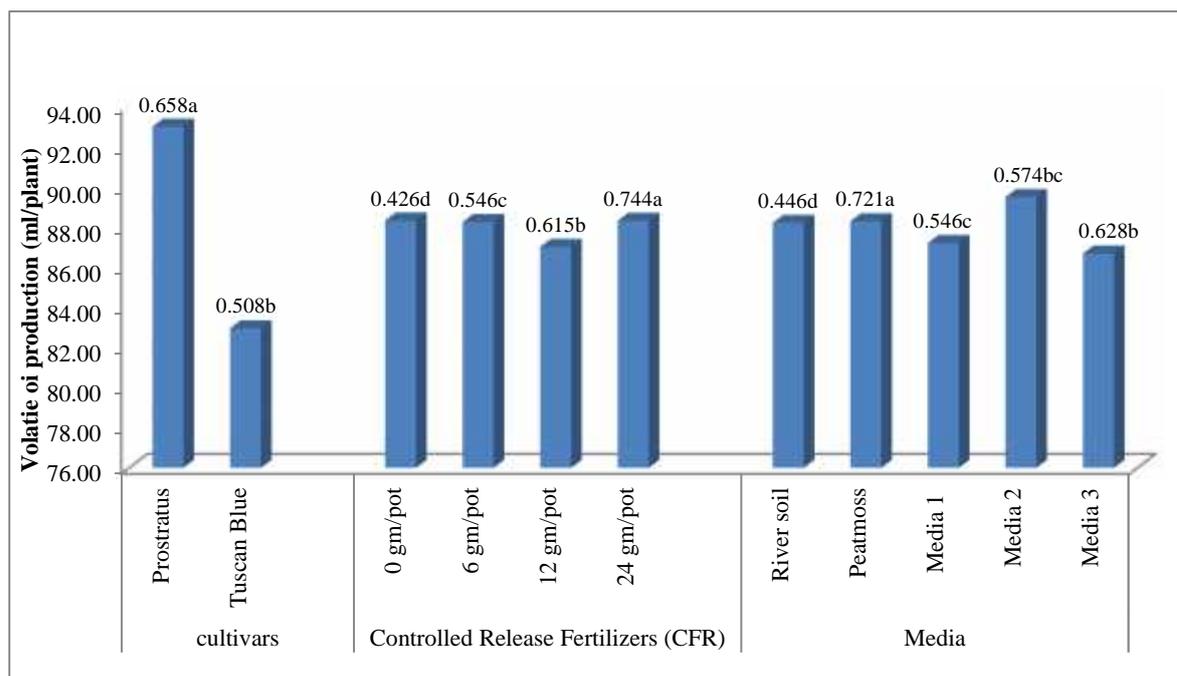


Fig. (): Effect of cultivars, Controlled Release Fertilizers (CFR) and media on the Volatile oil production of *Rosmarinus officinalis* plant.

Table (5): Effect of interaction between cultivars, Controlled Release Fertilizers (CFR) and media on the Volatile oil production (ml/plant) of *Rosmarinus officinalis* plant.

Cultivars	CRF levels (gm.pot ⁻¹)	Media				
		River soil	Peat moss	Media 1	Media 2	Media 3
Prostratus	0	0.416 ^{i-m}	0.481 ^{h-m}	0.424 ^{i-m}	0.377 ^{i-m}	0.465 ^{i-m}
	6	0.539 ^{g-l}	0.927 ^c	0.411 ^{i-m}	0.426 ^{i-m}	0.679 ^{d-h}
	12	0.517 ^{g-m}	0.818 ^{cd}	0.471 ^{i-m}	0.795 ^{c-e}	0.829 ^{cd}
	24	0.574 ^{f-j}	1.433 ^a	0.542 ^{g-l}	0.847 ^{cd}	1.179 ^b
Tuscan Blue	0	0.354 ^{lm}	0.363 ^{k-m}	0.696 ^{d-g}	0.348 ^{lm}	0.331 ^m
	6	0.366 ^{k-m}	0.495 ^{g-m}	0.578 ^{f-j}	0.611 ^{e-i}	0.433 ^{i-m}
	12	0.426 ^{i-m}	0.506 ^{g-m}	0.676 ^{d-h}	0.596 ^{f-i}	0.519 ^{g-m}
	24	0.374 ^{j-m}	0.743 ^{c-f}	0.567 ^{f-k}	0.591 ^{f-i}	0.588 ^{f-i}

4- Ash Percentage The data in Figure (4) demonstrated that there are no significant differences in the ash percentage of the “Prostratus” and “Tuscan Blue” cultivar plants and each one gave 8.68, 8.58% respectively. In addition, increased CRF rates to 6 and 12 gm.pot⁻¹ led to significantly increased of this characteristic to 9.10% and 8.93 % in comparison with the 0 (control) and 24 gm.pot⁻¹ which decreased to 7.81 and 8.67 % respectively. Also the planting media showed significant effect on ash

percentage of this plant and the media2 gave the highest significant value (9.15%) compared with river soil and peat moss which decreased to 8.23, 8.29% respectively.

As shown in Table (6) the highest ash percentage (10.22) % was recorded for the “Prostratus” cultivar that growing in media2 and fertilized with 12 gm.pot⁻¹ of (CRF) compared with the least value (6.08%) which obtained in the “Prostratus” cultivar plants that non-fertilized and grew in peat moss.

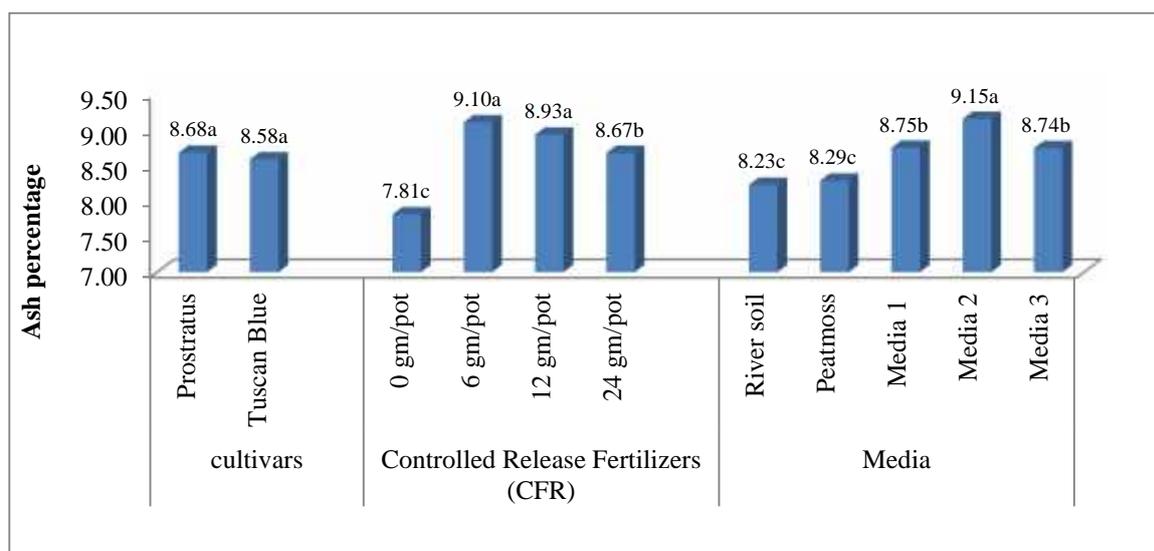


Fig.(4): Effect of cultivars, Controlled Release Fertilizers (CFR) and media on the Ash percentage of *Rosmarinus officinalis* plant.

Table (6): Effect of interaction between cultivars, Controlled Release Fertilizers (CFR) and media on the Ash percentage of *Rosmarinus officinalis* plant.

Cultivars	CRF levels (gm.pot ⁻¹)	Media				
		River soil	Peat moss	Media 1	Media 2	Media 3
Prostratus	0	7.13 ^{lm}	6.08 ^o	9.40 ^{a-e}	6.96 ^{mn}	8.68 ^{e-h}
	6	8.58 ^{e-i}	7.28 ^{k-m}	9.68 ^{a-d}	9.95 ^{ab}	9.85 ^{a-c}
	12	9.80 ^{a-c}	9.52 ^{a-e}	7.90 ^{h-l}	10.22 ^a	8.46 ^{f-i}
	24	7.67 ^{i-m}	9.51 ^{a-e}	8.30 ^{f-j}	9.84 ^{a-c}	8.70 ^{e-h}
Tuscan Blue	0	6.16 ^{no}	9.45 ^{a-e}	8.98 ^{c-g}	9.07 ^{b-g}	6.19 ^{no}
	6	8.35 ^{f-j}	8.69 ^{e-h}	9.85 ^{a-c}	10.00 ^{ab}	8.79 ^{d-h}
	12	9.14 ^{b-f}	8.26 ^{f-j}	7.71 ^{i-m}	8.83 ^{d-g}	9.45 ^{a-e}
	24	8.96 ^{c-g}	7.50 ^{i-m}	8.14 ^{g-k}	8.32 ^{f-j}	9.80 ^{a-c}

5- International Standards Organization (ISO) value.

The data in Figure (5) indicated that the ISO value for the plants of “Prostratus” cultivar increased significantly to (92.96) % when compared with “Tuscan Blue” cultivar which reached (82.93) %. On the other hand, the addition of the Controlled Release Fertilizers (CRF) had no significant effect on this characteristic when compared with the control treatment except the rate 12 gm.pot⁻¹ which led to decrease this characteristic. Whereas, the media2 gave the highest significant value of ISO (89.46) % when compared with the media1 and media3 which gave lowest value of *Rosmarinus officinalis* plant.(87.18, 86.66) % respectively. the interaction between cultivars, media and (CRF) levels led to increase the ISO value significantly and the

highest value obtained in the “prostrates” plants that non-fertilized and planted in the river soil (97.40) % whereas the lowest value obtained for the “Tuscan Blue” cultivar which fertilized with 24 gm.pot⁻¹ and cultivated in media1 (79.48) %. The significantly increased in all studied characters as a results to the media effect may be discussed firstly by return to the Table (2) which appears that the components of soilless media and peat moss contains the highest amount of organic matters compared with river soil which produce as a result to decomposed of sheep manures and other components and change to vermicompost which is relatively homogeneous and a tendency to hold nutrients over a long period required for vegetative cycle of plants grown in pots or act as a buffer against pH change, or due to the beneficial effect of compost which may supply the plant

directly with nutrients and micro-organisms that recycle nutrients and soil formation (Varanini and pinton 1995; Ndegwa *et al.*, 1999; Khalil, 2000, Khalil *et al* 2002 and Hendawy, 2008) . farther more, it can be explained as a result of the increase of the permeability of plant membranes due to humate application which caused in improve growth of various groups of beneficial microorganisms, accelerate cell division, increased root growth and all plant organs for a number of horticultural crops (Poincelot, 1993).

Increased most of characters as a result to increased Controlled Release Fertilizer (CRF) might explained firstly due to the largely content of nitrogen (17%) in the Controlled Release Fertilizer type (Basacote p-Max 9M) that use in this experiment which is largely used for protein

synthesis and had favorable effect on cell elongation and multiplication resulting in increased plant height. Or might be returned to a consequence of nitrogen influence on photosynthesis, the amount of photo-assimilates that are produced by the plant, dry matter partitioning then organ development (Panchabhai *et al.*, 2005; Dordas, 2009; Dordas *et al.*, 2008). Or might be explained to the important role of nitrogen in the synthesis of the plant constituents and limiting the conditions which increase the volatile oil production in annual herbal (Jones *et al.*, 1991). Or due to the positive effects of nitrogen on activation of photosynthesis and metabolic processes of organic compounds in plants which, in turn, encourage plant vegetative growth.

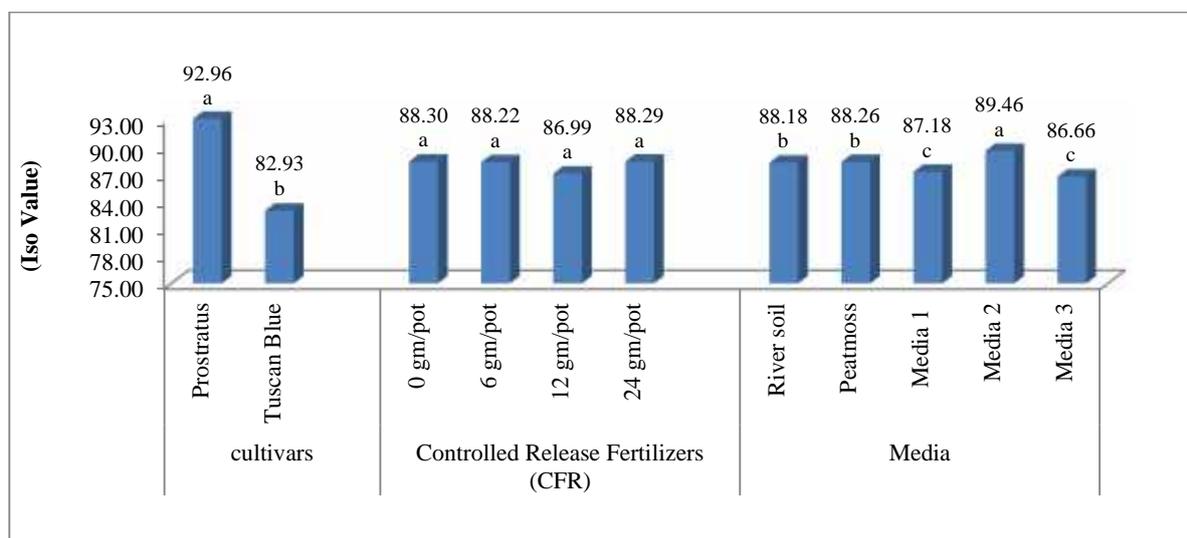


Fig. (): Effect of cultivars, Controlled Release Fertilizers (CFR) and media on the Iso value

Table (7): Effect of cultivars, Controlled Release Fertilizers (CFR) and media on the International Standards Organisation (ISO) value of *Rosmarinus officinalis* plant.

Cultivars	CRF levels (gm.pot ⁻¹)	Media				
		River soil	Peat moss	Media 1	Media2	Media 3
Prostratus	0	97.40 ^a	92.45 ^{b-d}	92.48 ^{b-d}	93.32 ^{b-d}	86.18 ^{fg}
	6	93.93 ^{bc}	95.22 ^{ab}	92.17 ^{cd}	93.82 ^{bc}	93.08 ^{b-d}
	12	93.43 ^{b-d}	93.43 ^{b-d}	89.50 ^e	93.67 ^{bc}	90.63 ^{de}
	24	94.77 ^{bc}	93.30 ^{b-d}	94.18 ^{bc}	93.75 ^{bc}	92.53 ^{b-d}
Tuscan Blue	0	84.38 ^{f-h}	81.75 ^{f-g}	85.60 ^{fg}	85.35 ^{fg}	84.05 ^{f-i}
	6	80.35 ^{kl}	83.75 ^{f-j}	82.50 ^{h-k}	86.28 ^f	81.13 ^{k-l}
	12	80.92 ^{k-l}	81.95 ^{h-l}	81.53 ^{h-l}	83.35 ^{g-l}	81.45 ^l
	24	80.25 ^{kl}	84.23 ^{f-i}	79.48 ^l	86.17 ^{fg}	84.20 ^{f-i}

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تأثير الاصناف والسماذ بطى التحلل واوساط الزراعة في النمو والزيت الطيار لنبات اكليل الجبل

الخلاصة

اجريت هذه الدراسة في مشتل نيكول الكائن في مدينة دهوك للفترة من شباط الى كانون ثاني . بهدف تقييم ثلاثة اوساط زراعية (بدون تربة) تتالف من نسب حجمية مختلفة من (سماذ الاغنام، نشارة خشب، تبن، قصاصات ثيل) عبر مقارنتها بتربة النهر والبتاموس ودراسة تأثير السماذ البطى التحلل (CRF) نوع (Basacote p-Max 9M) باربعة مستويات () غم/سندانة حجم () لتر في النمو والزيت الطيار لصفين من نبات اكليل الجبل *Rosmarinus officinalis* هما *Prostratus* و *Tuscan Blue*. ويمكن تلخيص أهم النتائج بما يلي. زراعة نبات اكليل الجبل في البتموس اعطى اعلى القيم المعنوية لصفات نسبة الزيت الطيار (.) % حاصل الزيت الطيار (.) (مل/نبات، بينما اعطى الوسط الثاني (سماذ الاغنام، نشارة خشب، تبن، قصاصات ثيل) اعلى القيم لصفات الرماد (.) % قيمة الآيزو (.) % واعطى الوسط الاول (سماذ الاغنام، نشارة خشب، تبن، قصاصات ثيل) اعلى القيم لدليل النمو () سم³. التسميد ب و غم/سندانة من السماذ البطى التحلل (CRF) ادى الى احداث زيادة معنوية في صفة النسبة المئوية للرماد (.) % على التوالي. بينما احتاجت صفات دليل النمو للنبات و نسبة الزيت الطيار وحاصل الزيت الطيار الى زيادة مستوى التسميد الى غم/سندانة لغرض الحصول على نتائج بفروق معنوية مقارنة بالمستويات الاخرى والمقارنة وبلغت للصفات المذكورة على التوالي () سم³، (.) % (.) (مل/نبات . تفوق الصنف المحلي معنويا في صفة دليل النمو الخضري بينما تفوق الصنف المتدلي (*prostrates*) في صفات نسبة الزيت الطيار حاصل الزيت %، فضلا عن قيمة الآيزو (.) % عند مقارنتهم مع بعضهم.

MICROTUBERIZATION RESPONSE OF DESIREE AND MOZART POTATOES (*Solanum tuberosum* L.) TO DIFFERENT KINDS AND LEVELS OF CARBON SOURCES*

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ABSTRACT

This *in vitro* study was conducted to investigate the effect of the various concentrations of different sugars as carbon sources on two potato cultivars (Desiree and Mozart) microtuberization. An attempt was done to achieve a protocol for microtuberization from a single bud explant by determining the most optimal types and concentrations of sugars including sucrose, glucose, fructose and lactose at 70, 80 and 90 g l⁻¹ on MS medium. The best results were obtained from the use of fructose (70 g l⁻¹) for Desiree and Mozart potato by producing 9.00 microtubers per an explant. Whereas, adding glucose and fructose at 80 g l⁻¹ gave the highest mean length for microtubers (2.83 cm) for Mozart potato cultivar. While the highest microtubers diameter (0.63 cm) was recorded at the case of adding 70 g l⁻¹ of fructose for the cultured explants of Desiree potato cultivar. The acclimatized plantlets of both cultivars performed very well at greenhouse condition with about 100% success. The grown microtubers in soil gave uniform plants without any growth abnormalities.

KEYWORDS: Potato, Microtuberization, sugars, carbon sources, sucrose, fructose, glucose, maltose

INTRODUCTION

Potato (*Solanum tuberosum* L.) is one of the most important food and cash crop all over the world (Lemaga *et al.*, 2009). It ranks first in the world from non-grain crops to ensure food security (Ethiopian variety registers, 2006). Potato is a high biological value crop that gives an exceptionally high yield, more protein and calories, vitamins, minerals, carbohydrates and iron per unit area per unit time than any other major crops (Badoni *et al.*, 2010). Many protocols have been developed to induce *in vitro* tubers production via microtuberization. Important factors during the tuberization period include the sugar concentration in the medium, the nitrogen content, the temperature and the light conditions (Seabrook *et al.*, 1993; Leclerc *et al.*, 1994; Ranalli, 1997). The vigor of growth and the rate of tuber production increased with both day length and temperature over the ranges 8–24 h and 15–25°C respectively (Hussey and Stacey, 1981). Potato tuber formation is a complex multi-stage process and involves stolon formation, initiation of microtuberization, and maturation of microtubers.

Each stage is regulated and controlled by a large set of interacting expressed genes throughout the plant (Bachem *et al.*, 2000). Several factors control the induction, growth and development of microtubers *in vitro*. Such factors include sucrose levels (Lawrence and Barker, 1963).

The effect of carbon source is, however, more influential than other factors in promoting microtubers induction. During the past three decades, several attempts have been made to develop hormone-free microtuberization methods. The conventional propagation of potato was characterized by low multiplication rate and susceptibility to pathogens. Susceptibility to pathogens often leads to poor quality and yields due to degeneration. Due to the unavailability of good quality clean seed tubers (Gebremedhin *et al.*, 2008). Dodds *et al.* (1992) reported that the optimal sucrose concentration for tuber initiation ranged from 60 to 80 g l⁻¹. The higher or lower sugar content in the medium led to reduce tuberization and smaller microtubers were produced (Yu *et al.*, 2000). Apart from being a suitable carbon source for consumption by the plantlets, excess

*A Part of The First Author's Phd Dessirtation

sucrose may be converted to starch in developing microtubers. Moreover, sucrose act as a favorable osmotic uniform agent durin microtubers development (Fufa *et al.*, 2013). The most critical stimulus influencing *in vitro* tuberization is sucrose at high concentration (Nistor *et al.*, 2010). Sucrose is a cheap, safe and superior agent for *in vitro* tuberization (Iqbal *et al.*, 2006). The substitution of the carbon source *in vitro* by osmotically active solutes instead of sucrose has been shown to provide a rich carbon source and act as an osmotic regulator (Paiva *et al.*, 2003). Production of mini-tubers as a source for seed potato was investigated by growing in soil micropropagated plants, cultures of several cultivars were initiated from indexed tubers and multiplied on modified MS medium (Ahloowalia, 1994). Ondo Ovono *et al.*, (2009) reported that the use of 1% glucose and/or 1% fructose as carbon source in the presence of 2% sorbitol led to a low rate of tuberization when osmolarity was re-established. Hence, the present study was initiated with the objective to determine optimum concentration of sucrose for *in vitro* tuberization.

MATERIALS AND METHODS

This experiment was conducted at the laboratory of plant tissue culture which belongs to the Department of Horticulture, College of Agriculture, University of Dohuk to investigate the influences of different types of sugars at various concentrations for two potato cultivars Desiree and Mozart on the production and qualitative characters of microtubers. **Plant material**

Meristem culture derived disease-free *Solanum tuberosum* L. cv. Desiree and Mozart was employed at the present experiment. The plantlets were maintained and multiplied through single-node cuttings on a growth regulator-free medium at 30-days interval under a 16 h photoperiod and 8 h dark at 25±2°C.

The experiment was continued with single-node explants. The explants were excised essentially from the middle parts of the microplant shoots for maintaining the explants homogeneity, and were cultured in jar glasses containing 20 ml of microtuberization medium which was based on MS salts supplemented with different concentrations (70, 80 and 90 g l⁻¹) of four sugars types (sucrose, glucose,

fructose and lactose). The pH of the medium was adjusted to 5.7 before autoclaving at 121°C for 20 min and pressure 1.04 kg/ m². The jars were sealed with aluminum foil, and the microtuberization cultures were incubated in the dark one week. The experiment was arranged as factorial based on completely randomized design (CRD) with five replications. After 6 weeks of incubation, length, diameter and number of microtubers were recorded per explant. Data were analyzed using SAS software Ver.9.1. The means of treatments were compared using Duncan's Multiple Range Tests at 5 % probability level using a computerized program of SAS (SAS, 2001)

RESULTS AND DISCUSSION

In the present experiment, in all culture media, microtubers formation from axillary buds was initiated 5-6 days after culture. Many of the microtubers were globular and a few of them were oval-shaped, their size varied from 1-5 cm during the experiment. Skin color of microtubers was usually creamy, sometimes with purple spots. Microtuber eyes numbers were varied from 2 to 6. In some cases, the eyes were grown and their shoot length was no microtubers were developed. In those treatments axillary buds were grown and only shoots were elongated (0.5-10 cm).

Microtuber size (length and diameter)

The highest data for microtubers length and diameter were observed in treatments. Contrarily, microtubers length and diameter were minimum with different concentrations of (Fig. 1). Any increase in concentration up to 80 g l⁻¹ went to profound increase in microtubers length and diameter. Decreasing the microtubers length and diameter was fixed when the concentration of sugars was increased in microtuberization media.

Data presented in Table (1) declare that the highest number of microtubers for Desiree and Mozart potato cultivars were achieved when fructose was added to the culture medium at 70 g l⁻¹ by producing 9.00 microtubers per an explant. Whereas, adding glucose and fructose at 80 g l⁻¹ gave the highest mean length for microtubers (2.83 cm) for Mozart potato cultivar. While the highest microtuber diameter (0.63 cm) was recorded at the case of adding 70 g l⁻¹ of fructose for the cultured explants of Desiree potato cultivar.

Table (1): The effect of different kinds of sugars at different levels on Desiree and Mozart potatoes microtuberization

Cultivars	Sugars (g ^l ⁻¹)		Number of Microtubers	Mean Length of Microtubers (cm)	Mean Diameter of Microtubers (cm)
Desiree	Sucrose	70	5.00 c	0.38 fg	0.27 d-g
		80	3.00 e	0.50 fg	0.35 cd
		90	6.00 b	1.65 b-d	0.34 cd
	Glucose	70	5.00 c	0.67 e-g	0.25 d-g
		80	5.00 c	1.03 d-f	0.38 bc
		90	1.00 g	0.30 fg	0.20 fg
	Fructose	70	9.00 a	1.47 c-e	0.63 a
		80	6.00 b	0.60 e-g	0.17 fg
		90	3.00 e	0.23 fg	0.14 g
	Lactose	70	0.00 h	0.00 g	0.00 h
		80	1.00 g	0.20 fg	0.20 fg
		90	3.00 e	0.34 fg	0.23 e-g
Mozart	Sucrose	70	0.00 h	0.00 g	0.00 h
		80	2.00 f	0.33 fg	0.23 e-g
		90	1.00 g	0.20 fg	0.20 fg
	Glucose	70	4.00 d	1.97 a-c	0.44 b
		80	5.00 c	2.83 a	0.37 b-d
		90	0.00 h	0.00 g	0.00 h
	Fructose	70	9.00 a	2.50 ab	0.45 b
		80	5.00 c	2.83 a	0.43 b
		90	0.00 h	0.00 g	0.00 h
	Lactose	70	3.00 e	0.60 e-g	0.28 cd
		80	0.00 h	0.00 g	0.00 h
		90	1.00 g	0.40 fg	0.20 fg

Table (2) shows the response of both Desiree and Mozart potato cultivars to microtuberization process. It is clear that Desiree cultivar performed better than Mozart in giving higher number of microtubers (3.92)

and greater microtubers diameter (0.26 cm). Whereas, Mozart cultivar was superior upon Desiree in giving longer microtubers reaching to 0.97 cm.

Table (2): The response of Desiree and Mozart potato cultivars to microtuberization

Cultivars	Number of Microtubers	Mean Length of Microtubers (cm)	Mean Diameter of Microtubers (cm)
Desiree	3.92 a	0.61 b	0.26 a
Mozart	2.50 b	0.97 a	0.22 b

Table (3) declares that the addition of fructose was the most convenient in recording the highest values of number of microtubers (5.33 microtubers/ explant), the highest mean length of microtubers (1.27 cm) and the greatest mean diameter of microtubers estimated at

0.30 cm). These values were significantly superior upon the rest of treatments except with glucose in concern to mean length and diameter of microtubers which gave 1.13 cm and 0.27 cm respectively.

Table (3): The effect of different kinds of sugars on potato microtuberization

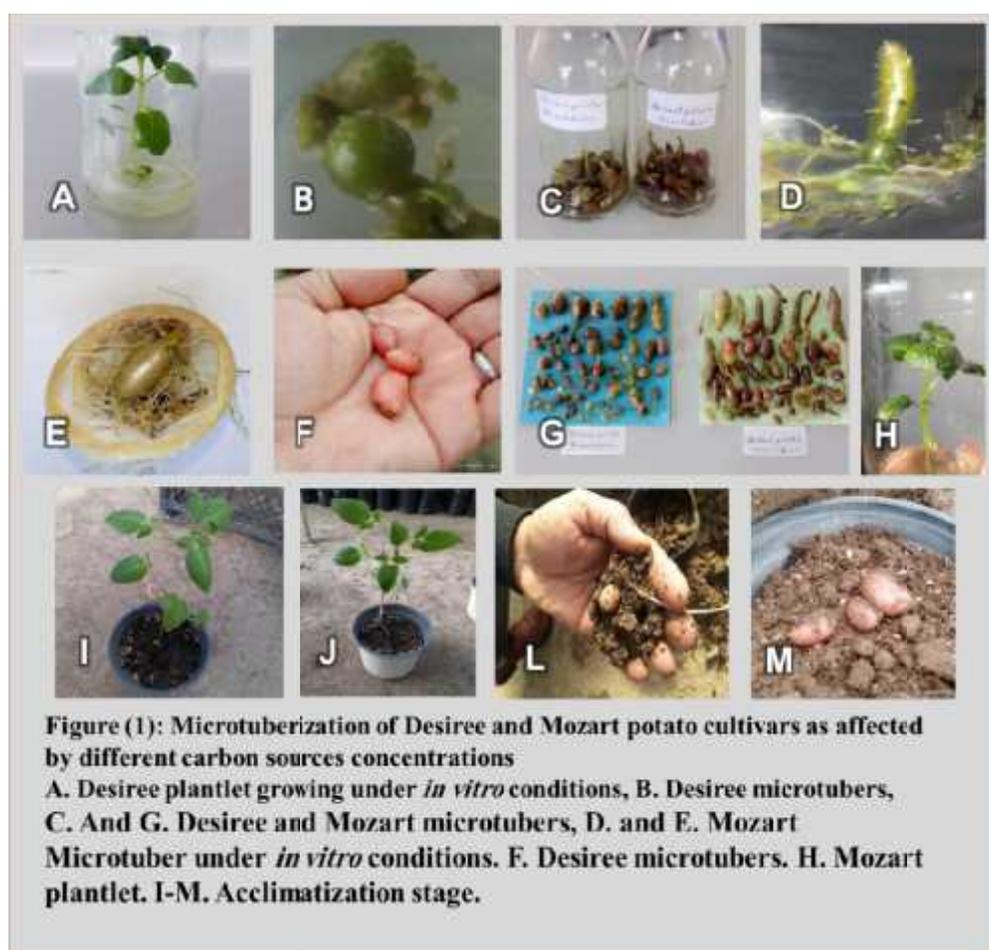
Sugars (g l ⁻¹)	Number of Microtubers	Mean Length of Microtubers (cm)	Mean Diameter of Microtubers (cm)
Sucrose	2.83 c	0.51 b	0.23 b
Glucose	3.33 b	1.13 a	0.27 ab
Fructose	5.33 a	1.27 a	0.30 a
Lactose	1.33 d	0.26 b	0.15 c

Table (4) shows that the dual interaction between Desiree potato cultivar with the addition of fructose gave the highest number of microtubers (6.00 microtubers/ explant). Whereas, the addition of

fructose to the culture medium of growing Mozart potato cultivar gave the highest means of both length (1.78 cm) and diameter of microtubers (0.29 cm).

Table (4): The effect of the interaction between potato cultivars and different kinds of sugars on microtuberization process

Cultivars	Sugars	Number of Microtubers	Mean Length of Microtubers (cm)	Mean Diameter of Microtubers (cm)
Desiree	Sucrose	4.67 b	0.84 b	0.32 a
	Glucose	3.67 c	0.67 bc	0.28 a
	Fructose	6.00 a	0.77 b	0.31 a
	Lactose	1.33 e	0.18 c	0.14 b
Mozart	Sucrose	1.00 f	0.18 c	0.14 b
	Glucose	3.00 d	1.60 a	0.27 a
	Fructose	4.67 b	1.78 a	0.29 a
	Lactose	1.33 e	0.33 bc	0.16 b



In previous studies, it has been reported that high carbon doses induced microtubers formation (Khuri and Moorby, 1996), the possible roles of carbon sources in microtuberization were not argued. Johnson and Ryan (1990) mentioned that sucrose can stimulate some special genes in the potatoes. Dodds *et al.* (1992) reported that low and high sugar concentrations retarded the beginning of microtuberization and less number of microtubers was obtained. The discrepancy of microtuberization among different potato cultivars can be assigned to the differences in carbon sources. The reason behind that might be the influence of carbon sources on some special genes in the potato plant (Johnson and Ryan, 1990). In conclusion, carbon sources must be investigated in accord with cultivars for mass production. The initiation of microtuberization usually needs for 40-80g^l⁻¹ of sugar levels in the developing tuber and for a certain result, it was determined that investigations need maintaining as other factors effected tuber formation consider. These results found in cultivar terms, the better results were obtained with using of fructose (7 %). The acclimatized plantlets of both cultivars performed very well at greenhouse condition with about 100% success. The grown microtubers in soil gave uniform plants without any growth abnormalities (Fig. 1, I and J).

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INFLUENCE of ROOM and FREEZING TEMP/4⁰ C ON SHELF-LIFE OF TRICHODERMA & BACILLUS as BIOINOCULANTS AT STORAGE CONDITION

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ABSTRACT

This study was conducted to evaluate the effect of storage conditions of the shelf life of *Trichoderma viridi* and *Bacillus megaterium*, *T. Viridi* gave the highest colony forming unit (CFU) in 4°C up to 210 days after inoculation. The maximum value of 3.8×10^8 CFU/g was calculated after 15 days of incubation in both temperature, and 210 days after inoculation 4×10^4 and 1.8×10^5 CFU/g, were increased at 4°C and 30°C respectively. Regardless of storing temperature the shelf-life of *Trichoderma* declined gradually with increase in storage period. The results indicated that the survival of *B. megaterium* 4°C and 30°C was the same overall storage time and reach, 3.5×10^5 , 2.8×10^5 CFU//g under 4°C and 30°C respectively. Bacterial spores are dormant structures and they are not affected by the environmental conditions, there is not much variation in the survival of spores 4°C and 30°C.

KEY WORDS: *Trichoderma viridi*, *Bacillus megaterium*, shelf life storage, bio- control agents

INTRODUCTION

Biological control of soil borne plant pathogens has received much attention during the past ten years. The genus *Trichoderma* act as biological control agent and its antagonistic properties of them are based on the activation of multiple mechanisms. It depends on the crop plants and the environmental conditions including nutrient availability, pH, temperature, light and iron concentration (Harman *et al.* 2004). Cow dung and decomposed poultry refuse are noted as excellent, low-cost and available substrates for growth of *Trichoderma harzianum* (Sawant & Sawant 1996). Once active strains have been identified *in-vitro* assays, a further selection must be done by studying other factors such as tolerance of high or low temperatures, suitability for formulation as foliar sprays and/or soil enhancement, spore viability in stored and field conditions, shelf-life and inoculum efficacy under commercial conditions etc. Formulation and shelf-life are prime important for commercial use of any biological agents.

An investigation was undertaken to determine the effect of temperature (room and freezing temp/4°C) and different colored polyethylene bags on shelf life of mass cultured antagonistic

fungi, *Trichoderma* inocula at storage condition. The highest number of colony forming unit (CFU) (1.3×10^5) at freezing temperature (4°C) up to 210 days after inoculation while the same strain gave 1.3×10^4 number of cfu at room temperature. The strain-3((B07D2005) was fully unable to produce any colony at 180 days after inoculation. Highest number of CFU (1.0×10^6) recorded from inocula of the strain-2 packed with Blue colored polyethylene bag stored up-to 180 days after inoculation at room temperature while the Transparent and Semitransparent polyethylene bags showed moderately effective to have viable spores among all of the tested *Trichoderma* strains (Islam *et al.* 2006). The effect of temperature (5, 10, 20, 30 and 40°C) on the shelf life of *Trichoderma viride* formulations (using talc powder, well-decomposed fine powder of farmyard manure (FYM) and lignite powder as carrier materials), stored for 90 days in milky-white polypropylene bag, was investigated. The population of the antagonist in talc, FYM and lignite formulations steadily increased up to 30 days of storage with increasing temperature (5-30°C). The temperature of 20-30°C was the optimum to store the talc-, FYM- and lignite-based *T. viride* formulations in milky white bags.

This indicated that the product could be safely stored as talc-, FYM- and lignite-based formulations in milky-white bags at room temperature (20-30°C) for 90 days (Mandhare, V. K., Suryawanshi, A. V. 2005). (Bhai R S. & M Anandaraj. 2014).

Endospores of *B. megaterium* were formulated in granule formulations. The granule formulation exhibited good physical characteristics, such as high-water solubility and optimal viscosity that would be suitable for spray application. The bacteria remained viable in the dry granule formulation at 10^9 CFU/g after 24 months storage at room temperature (Amornrat Chumthong, 2008). The capacity to form endospore *Bacillus* sp. with the ability to survive in adverse environmental conditions. Bacterial sporulation is a sequence of integrated biochemical reactions, which are independent of its vegetative growth and may be interrupted at certain susceptible stages. Sporulating bacteria possess more adaptive power to establish itself in a new habitat. A wide range of physical and chemical effectors can trigger germination of bacterial spores. However, the success of the survival strategy of spores depends on the presence of an efficient mechanism for returning to the vegetative state under favorable conditions. (Foster SJ & Johnstone K (1989). *Bacillus megaterium* spores were kept under refrigerated (5°C) and room temperature (32°C) for five months and survival of spores was studied by plating them in nutrient agar medium. It was observed that there was not much variation in the storage temperature (5°C & 32°C). The spore cells of *Bacillus megaterium* var *phosphaticum* were observed to five months of storage under refrigerated (5°C) and room temperature (32°C) (Gomathy.M et al. 2007). This study aimed to evaluate the influence of room and freezing temp/4°C on shelf-life of *T. viridi*, and *B. megaterium* at storage condition.

MATERIALS AND METHODS

Of Bioscience and Biotechnology, University Kebangsaan Malaysia, with *Trichoderma viridi* & *Bacillus megaterium* (Isolated from virgin forest soil) to determine their shelf-life under different storage temperature on the mixture of some organic substrates. The organic carrier/substrate used for colonization/multiplication of microbial strains was consisted with mixtures of composed empty fruit bunches (EFB). The carrier was kept into the polyethylene bag at the rate of 150g per polyethylene bag and sterilized properly. The

carrier media preparation and inoculation process for mass culturing of the strains were performed as described by Islam *et al.* (2002). The inoculated bags were placed at room temperature and freezing temperature (4°C). Data were taken on the colony forming unit (CFU) of the *Trichoderma* & *Bacillus* colonized organic substrate (1g mixed with 100 ml sterilized water) up to 210 days after inoculation with 30 days of interval. Colony forming unit was counted using four Petri plates for each treatment containing Potato Dextrose Agar & Nutrient Agar media for both of *T. viridi* and *B. megeterium*, respectively. Sawant and Sawant (1996).

RESULTS AND DISCUSSION

The *Trichoderma* gave highest colony forming unit (CFU) in freezing temperature up to 210 days after inoculation. The maximum CFU value of 3.8×10^8 was calculated after 15 days of incubation in both room and freezing conditions, and 210 days after inoculation such value was harvested 4×10^4 and 1.8×10^5 , respectively at room and freezing temperature (Table 1). Regardless of storing temperature the shelf-life of *Trichoderma* declined gradually with increasing of storage period. From the result, it appeared that minimum level of shelf-life of the mass produced inocula of *Trichoderma* required in keeping at the normal freezing (4°C) temperature rather than room temperature. This finding is a partial agreement with the report stated by Sawant and Sawant (1996) and Ilam et al 2006.

The experiment was conducted in the laboratory of Fermentation technology, School The results (Table 2) indicated that the survival of *Bacillus megaterium* under refrigerated (4°C) and room temperatures was the same overall storage time and reach, 3.5×10^5 , 2.8×10^5 CFU, under (4°C) and room temperatures respectively 210 days after incubation. Bacterial spores are dormant structures and they are not affected by the environmental conditions, there is not much variation in the survival of cells under room and refrigerated temperatures. This data agreed with (Gomathy et al 2007) and (Foster SJ & Johnstone K (1989) who reported those endospores are resistant to desiccation, antibiotics, disinfectants and other chemicals. So bacterial spores remained as such and there is no difference in the survival of cells. The influence of storage temperature on the survival of bacteria depends on the purity of the culture and moisture loss during storage (Gomathy et al 2007).

Table (1):- Effect of temperature on the spore viability of *Trichoderma* in EFB carrier at storage condition

Microbial Strains	Temp	Colony Forming Unit (CFU/g substrate) after Incubation Time (Days)							
		15	30	60	90	120	150	180	210
Trichoderma	Room	3.8 x10 ⁸	2.8 x10 ⁸	2.8 x10 ⁷	2 x10 ⁷	3 x10 ⁶	2 x10 ⁵	4.5 x10 ⁴	4 x10 ⁴
	(4) ^o C	3.8 x10 ⁸	3.4 x10 ⁸	3.9 x10 ⁷	3 x10 ⁷	2.5x10 ⁷	2.9x10 ⁶	3 x10 ⁵	1.8 x10 ⁵
CV%		1.3	1.6	2.3	2.0	2.2	2.4	2.19	2.17

Table (2): - Effect of temperature on the spore viability of *Bacillus* in EFB carrier at storage condition.

Microbial strains	Temp	Colony Forming Unit(CFU/g substrate)After Incubation Time							
		15 D	30 D	60 D	90 D	120 D	150 D	180 D	210 D
Bacillus	Room	1.3x10 ⁸	2.4x10 ⁸	2x10 ⁸	2x10 ⁷	1.2x10 ⁶	4.5x10 ⁵	3x10 ⁵	2.8x10 ⁵
	(4) ^o c	3x10 ⁸	3x10 ⁸	2.3x10 ⁸	2.9x10 ⁷	1.9x10 ⁶	5.6x10 ⁵	4.6x10 ⁵	3.5x10 ⁵

T

o determine the effect of temperature (room and freezing temp/4^oC) on shelf life of mass cultured of *Trichoderma* & *Bacillus* at storage condition, freezing temperature was more clearly effective on *Trichoderma* than *Bacillus* but any way (CFU) was the highest overall storage time for *Trichoderma* and *Bacillus*, which means that it is possible to get long shelf- life for both using EFB as carrier up to 7 months safely. To solve shelf-life issues in biocontrol agent's delivery system, using formulation and granulation are planning to be the next stage of this project to reach to the optimum shelf-life for those agents.

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SUPPRESSION OF RHIZOCTONIA DAMPING OFF USING PEAT- MIX AMENDED WITH *T. harzianum* AND THERMOPHILIC FUNGI

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ABSTRACT

Bio cont –T (W.P) a formula of *Trichoderma harzianum* (*T.h*) was applied with soil drenching at a rate of 10g/L., and 10 ml/kg peat-mix (p.m) used to induce suppression of damping-off on radish. Container media infested with *R. solani* and non-sterilized soil mixture at 0.5% (5g/kg p.m) before incubation in dark at 24 °C for 7, 14, and 28 days, then radish seeds planted (10 per pot). Disease severity was computed after 14 days, and radish seeds were replanted again in the same treatments, subsequently disease rating was also assessed. Disease severity in the first planting reduced to 0.11 and 0.10 in *T.h* amended p.m when incubated for 14 days with and with no pathogenic inoculum, respectively compared to 0.48 in control. However, the impact of incubation periods on the efficiency of *T.h* was non-significant in spite of absence *R. solani* inoculum. In the second planting, full healthy seedlings were resulted in (p.m + *T.h*) incubated for 28 days. In the same treatment disease rating was 0.1 when incubated for 7 or 14 days compared to 0.46 and 0.41 in the control treatments. Apparently, isolates of examined thermophiles fungi significantly ($p < 0.05$) reduced the efficiency of *T.h* in the suppression of pre and post emergence damping off, since the disease occurred with 45.09 - 64.7% for plants grown in p.m inoculated with *T.h* + thermophiles fungi of *Rhizopus stolonifer* and *Aspergillus niger*, respectively compared to 23-52% in the control (*R. solani* + *T.h*). The latter reduced disease severity to 0.1 from that of 0.21 and 0.33 when inoculated with each of *R. stolonifer* or *A. niger*, respectively.

KEYWORDS: *R. solani*, Peat-mix, *T. harzianum*, Thermophilic fungi.

INTRODUCTION

Recently the use of cheap composts for suppression soil borne diseases has increased contributing to the recycling of wastes (Escuadra and Amemiya, 2008; Joshi et al., 2009). Composts can reduce disease incidence caused by *Pythium* spp., *Phytophthora* spp., *Fusarium* spp. and *R. solani* (Hagn et al., 2008) in container mixes and far less under field conditions (Noble and Coventry, 2005).

Various mechanisms of disease suppressive result from a series of physicochemical and biological characters of compost attributed to compost inhabiting microorganisms including competition with pathogens for nutrients, production of antibiotics, parasitism of suppressive agent on pathogens and activation of a plant defense response: systemic acquired resistance (SAR) or induced systemic resistance (ISR) in plants (Trillas et al., 2006).

Disease suppressive compost provides an environment in which disease development is reduced despite pathogens being present e.g. specific suppression of *R. solani* by compost found to be the result of *Trichoderma* spp., present

as antagonistic (Diab et al., 2003). However, general suppression results from a high diversity of microbial biomass that create unfavorable conditions for such disease development as *Phytophthora* spp. on tomato by composts derived from agro-industrial wastes (Ntougias et al., 2008).

Trichoderma spp. distributed under different environmental conditions, cultivate and survive on various inexpensive substrates. *Trichoderma* spp. are able to use a wide range of compounds as carbon and nitrogen sources and induce several enzymes to break plant polymers into sugars for energy and growth. Therefore, these considerable variations make *Trichoderma* isolates attractive candidates for biological control applications including mycoparasitism, competition for space and nutrients, secretion of antibiotics and fungal cell degrading enzymes (Harman, 2006).

Composts can improve the biological, chemical and physical properties of amended soils, decreased soil pH, E. c. and Exchangeable Sodium Percentage (ESP) and produced humic acids that improve nutrient availability (Hussein and Hassan, 2011).

Thermophilic fungi are the chief components that grow in plant material, piles of forestry products and other sources of organic matter that provides a warm, humid and aerobic environment. These strains constitute various genera in the ascomycetes and deuteromycetes that can grow at 20 – 62 °C. Thermophilic fungi have a powerful ability to saccharify under non aseptic conditions, high rate of cellulolysis and potentiate of cellulolytic enzymes that make the process more economical (Sohail et al., 2009).

This work aimed to detect the potential of *Trichoderma harzianum* and thermophilic fungi in the incubated Humobacter -A compost on suppression of Rhizoctonia damping – off on radish.

MATERIALS AND METHODS

Origin of peat –mix compost :

A compost of Humobacter- A provided by Societe des Usines des Engrais Organiques, Lebanon mixed with autoclaved sandy loam soil 1:4 A nutrient analysis of the compost illustrated in (Table 1).

Table (1):- Nutrient analysis of HUMOBACTER-A (organic and ecological fertilizer).

Analysis	% Dry weight
Organic matter	85-92%
Humic acid	12-13%
Fulvic acid	5-6%
pH	5-6
Ec	2-5 ms/cm
C /N	18-20
Moisture content	20-25 %
Total Nitrogen	1.2-2.0%
Phosphorus (P2O5)	0.2-0.4%
Potassium (K2O)	0.4-0.6%
Sulfur S	0.2-0.3 %
Calcium Ca	0.2-0.3 %
Magnesium Mgo	0.15 %
Iron Fe	0.06 – 0.1 %
Micro nutrients	+

+ = Supported with different micronutrients.

Impact of *Trichoderma harzianum* in suppression of Rhizoctonia damping – off

T. harzianum formulated as biocont –T (W. P.) provided by Baraka Agricultural Materials Co. Ltd. Amman, Jordan. For suppression of Rhizoctonia damping – off on radish plant, inoculum of *R. solani* produced in a chopped potato and field soil mixture, air dried and sieved to yield 1 to 2 mm soil inoculum pieces (Nelson and Hoitink, 1983). According to the usage instruction, each gram of *T. harzianum* contained 19×10^7 spore. Bio cont-T liquid applied with soil drenching at a rate of 10g/L., and 10ml/ kg peat-mix was drenched.

Container medium was infested with Rhizoctonia soil inoculum 0.5 % (5 g / kg peat – mix) and 10 ml of *R. solani* mycelial fragments.

The contents were mixed thoroughly in the bags loosely tied and incubated in the dark at 24± 2 °C for 7, 14 and 28 days.

Amended medium was distributed in pots and seeded with radish under greenhouse. Control treatments were medium without *R. solani* and / or isolate of *T. harzianum*. After 14 days, seedlings

were rated on a disease severity scale (Abbasi et al., 2004). After the first disease harvest, the container medium was replanted with radish, and thereafter disease severity was rated again after another 14 days. Mean of disease rating was based on 3 replicates.

Interaction between thermophiles fungi and *T. harzianum* :

To determine whether the mechanism by which the substrate suppressed damping –off was biological in nature, peat – mix was pasteurized by heating in an oven at 50 ± 2 °C for 5 days, moisture lost during pasteurization was restored by wetting the peat-mix using distilled water. Samples from heated peat- mix were taken for thermophiles fungi counts using serial dilution plating 10^4 . Total fungi were enumerated based on the colony forming units (cfu) on PDA media and were identified according to Rajankar et al., (2007).

Thermophilic fungi were grown for 7 days at 45°C on PDA. Spores and hyphae scraped from the surface of the medium in plates (two plates per

isolate) were suspended in 20 ml of sterilized distilled water as described (Chung and Hoitink, 1990). Fungal suspension was poured into a 2 Kg of the autoclaved compost medium in a polyethylene bag and mixed vigorously. Infested media were incubated for 7 days at 24 ± 2 °C and thereafter inoculated with isolates of *T. harzianum* and *R. solani*.

Radish seeds were sown in peat – mix directly and after infesting, damping – off suppression was performed twice with each thermophilic fungus after 14 days and analyzed. Control treatments were media not infested with a thermophilic fungi but infested or not infested with isolate *T. harzianum* and / or *R. solani*. Each bioassay was performed. Frequency of each thermophilic fungi grown in the presence of *R. solani* inoculum were counted after 7 days.

Data analysis

Data were analyzed using Statistical Analysis System (version 8.0; SAS Institute Inc.) subjected to analysis of variance (ANOVA) and pooled together after testing the homogeneity of variance ($p < 0.05$). Mean of the treatments were compared by Duncan Multiple Range Test.

the effectiveness of *T.h.* in protecting seedlings in the presence or absence of *R. solani* propagules.

Table (2):- Incidence of radish damping – off affected by incubated peat – mix infested with *R. solani* and *T. harzianum*.

Treatment **	Incunation period (day)			Mean of treatment
	7	14	28	
P.m.	45.09 cd *	25.48 e	49.01 c	39.86 b
P. m. + R.	78.39 a	37.25 d	64.70 b	60.11 a
P. m. + T. h.	37.25 d	13.72 f	37.25 d	29.41 c
P. m. + R. +T. h.	40.17 cd	13.72 f	37.25 d	30.38 c
Mean of incubation period	50.23 a	22.54 b	a	

*Within each independent factor and interaction the means followed by the same letter (s) are not significantly different ($p < 0.05$). Each value of binary interaction is the mean 3replicates. ** P.m= peat-mix, R= *R. solani*, T. h. = *Trichoderma harzianum*

Infestation of such compost media with an effective biocontrol agent such as *T. h.* induced considerable suppression of disease incidence, though when inoculated with propagules of *R. solani*, since the mean of infected seedlings was 29.41 and 30.38%, respectively compared to 60.1% diseased plants when grown in the infested soil.

The antagonistic activity of the genus *Trichoderma* to *F. solani* and *R. solani* has been widely demonstrated and several reports confirmed that soil treatment with *T. hamatum*, *T. harzianum*, and *T. viride* gave the maximum protection against pre and post emergence damping – off and reduced the disease incidence

RESULTS AND DISCUSSION

Efficiency of incubated peat – mix amended with *T. harzianum* on the damping – off

The occurrence of damping – off on radish seedlings in the medium infested with *R. solani* incubated for 7 days, was significantly higher than of the medium incubated for 14 days and 28 days (Table 2). The addition of *T. h.* to potting – mix with no *Rhizoctonia* inoculum induced more reduction of disease regardless of incubation periods. However, the lowest impact of pathogen mixed with the *T. h.* was 13.72% damping- off on seedlings grown in the peat- mix incubated for 14 days compared to 37.25% when container medium incubated for both incubation periods 7 or 28 days. Our results indicate that incubated peat – mix of (Humobacter- A plus sandy loam soil) is to conducive media to *Rhizoctonia* damping –off of radish. Similar results were also observed by (Nelson and Hoitink, 1983; Kuter et al., 1988). The highest occurrence of diseased seedlings found in both p.m. treatments without bio-control agent explained

to 6.6 and 10%, respectively compared to fungicide Rizolex at 10% (El- Kafrawy, 2002).

In the second planting of incubated peat – mix shown in (Table 3), approximately 80% of the seedlings were healthy in the *T. h.* amended compost regardless of incubation periods, whereas 50.98% of seedlings were infected in the control. Diseases incidence reduced progressively with increasing period incubation and attained its minimum 31.37% after 28 days.

The application of *T. h.* plus *R. solani* inoculum to the composted media incubated to 28 days was also reduced the disease incidence to 25.48% of the replanting seedlings. This trial

demonstrated that marketable suppressive effect started to appear 14 days after addition of *T. h.* to peat – mix. In contrast, The P.m was more conducive substrate and encourage the pathogen attack when applied with no *T.h* biocont. Worthwhile, during composting and incubation of each pathogenic inoculum and bio control agent of *T. h.* , available sources of carbon (glucose , celluloseetc.) are destroyed , before habitant

and colonize the substrate, and parasitize sclerotia of *R. solani* , resulting in eradication of the pathogen and effective biological control (Chung et al., 1988).

Similar results reported that suppression of *Pythium aphanidermatum* and *R. solani* in the composts and other organic materials weren't immediate, but rather occurred within 14 days after infestation (Tuitert et al., 1998).

Table (3): -Incidence of replanting radish damping off. Affected by incubated peat – mix infested with *R. solani* and *T. harizianum* .

Treatment **	Incubation period (day)			Mean of treatment
	7	14	28	
P.m.	56.86 cd *	58.82 c	37.25 f	50.98 b
P. m. + R.	80.39 a	70.58 b	45.09 ef	65.35 a
P. m. + T. h.	21.56 g	23.52 g	17.64 g	20.91 d
P. m. + R. +T. h.	52.94 cde	47.06 def	25.48 g	41.83 c
Mean of incubation period	52.94 a	49.99 a	31.37 b	

*Within each independent factor and interaction the means followed by the same letter (s) are n t significantly different (p 0.05). Each value of triple interaction is the mean of 3replicates. ** P.m= peat-mix , R= *R. solani* , T. h. = *Trichoderma harzianum*.

The duration that various sources of organic matter utilized in container media and their suppressive effects to disease caused by *R. solani* remain unknown. Worthily, the suppressive of soil – borne pathogens colonized the organic matter carry out by inducing the accumulation of such enzymes as chitinase , peroxidase and polyphenol oxidase which play an important role in plant defense mechanisms against pathogens infection (Nawar and Kuti , 2003).

Effect of incubated peat – mix inoculated with *R. solani* and *T. harzianum* on the disease severity of radish

The results indicated that the severity of *Rhizoctonia* damping – off of radish seedlings

grown in peat – mix with addition of *T. h.* revealed that (p. m. + *T. h.*) and (p.m. + *R. + T.h.*) significantly decreased the rate of disease severity (0.10 and 0.11), respectively particularly when incubated for 14 days compared to (0.48) in control which may infected by other saprobes colonized mixed substrate of P.m. and non sterilized field soil (Table 4).

The positive impacts of addition *T. h.* to peat – mix were also observed in decreasing severity of damping –off when seedlings grown in 14 days incubated potting – mix. However, the effectively of the treatments described above on the severity rating was showed clearly in their means assessment of each incubation periods and amendments.

Table (4):- Effect of incubated peat – mix inoculated with *R. solani* and *T. harzianum* on the disease severity of radish.

Treatment **	Incunation period (day)			Mean
	7	14	28	
P.m.	0.24 b *	0.21 c	0.23 c	0.23 b
P. m. + R.	0.47 a	0.48 a	0.40 b	0.45 a
P. m. + T. h.	0.20 cd	0.10 d	0.17 cd	0.16 c
P. m. + R. +T. h.	0.20 cd	0.11 d	0.18 cd	0.16 c
Mean	0.28 a	0.22 b	0.24 ab	

*Within each independent factor and interaction the means followed by the same letter (s) are n t significantly different (p 0.05). Each value of binary interaction is the mean of 3replicates.

** P.m= peat-mix , R= *R. solani* , T. h. = *Trichoderma harzianum*

This work proved the strong colonization of peat – mix by indigenous microorganisms, when applied *T. h.* though infested with the pathogen, especially after 14 days of incubation .

Differences in the effectiveness of bio control agent with / with no a pathogen possibly explained on the basis of a pathogen inoculum potential of an aggressive *R. solani* attacked each seedling

which effects on the severity rating (Bagnasco et al., 1998) . Most of the visible disease symptoms developed within the first 7 days after seeding , and the bio control agent *T. h.* would need to be highly effective immediately after potting to provide control , since the amended peat – mix was incubated for 7 , 14 ,and 28 days before seeding. In the second replanting of radish seeds represented in (Table5), full healthy seedlings were resulted in (p. m + *T. h.*) when grown in 28 days peat – mix incubation.

Severity rating of the same treatments was 0.1 for seedlings cultivated in 7 and 14 days incubated potting –mix compared to 0.46 and 0.41 in the control treatments. Thus, the application of *R. + T. h.* was also comparable in their mean assessment, since the severity rating was 0.20 compared to 0.36 for P.m + *R.* Our study illustrate that treatments with *T. harzianum* gave the considerable protection of radish seedlings against pre and post emergence damping – off.

Table (5):- Damping off disease severity of replanting radish affected by incubated peat - mix inoculated with *R. solani* and *T. harzianum*

Treatment **	Incunation period (day)			Mean
	7	14	28	
P.m.	0.27 b c *	0.31 b	0.16 de	0.25 b
P. m. + <i>R.</i>	0.46 a	0.41 a	0.21 cd	0.36 a
P. m. + <i>T. h.</i>	0.10 e	0.10 e	0.0 e	0.10 d
P. m. + <i>R.</i> + <i>T. h.</i>	0.27 bc	0.22 cd	0.12 e	0.20 c
Mean	0.28 a	0.26 a	0.15 b	

*Within each independent factor and interaction the means followed by the same letter (s) are n t significantly different (p 0.05). Each value of binary interaction is the mean of 3 replicates.

** P.m= peat-mix , *R.* = *R. solani* , *T. h.* = *Trichoderma harzianum*

This potential may be related to the ability of *Trichoderma* spp. to nutrient competition , antibiosis , antagonisms, inhibition of pathogen enzymes, processes of biodegradation , carbon and nitrogen cycling and complex interaction , plant growth stimulation , decomposition of organic matter , symbiosis and nutrient exchange (Howell, 2003 and Harman , 2006).

Effect of selected thermophilic fungi on the activity of *T. harzianum* and suppress *R. solani*

Among thermophiles fungal isolates obtained after heating and incubation of peat – mix , species with high frequency of *A. niger* , *A. terreus* , *Penicillium* spp. and *R. stolonifer* were selected with inoculum of each *R. solani* and *T. harzianum* for radish bioassay. Apparently, isolates of examined thermophiles fungi significantly (p 0.05) copetited the impact of *T. h.* in suppression of pre and post *Rhizoctonial* damping –off and necrotic seedlings, in addition to disease severity since, the percentage of infection ranging between 45 % and 64.7 % for plants grown in peat – mix inoculated with *T. h.* + thermophiles fungi of *R. stolonifer* and *A. niger* , respectively compared to 23.52 % in the control plants. (Table 6).

This result agrees to the idea that application of combined biological control agent with antagonistic activity toward *R. solani* increases the

likeliness of maintain a consistent and suppressive efficient against pathogen (Krause et al., 2001). For more understanding, the mechanisms and symptoms by which *Trichoderma* induces resistance in the plant includes three events: (a) Colonize and infect the outer layers of roots. (b) Once infection occurs, a zone of chemical interaction, *Trichoderma* hyphae are walled off by the plant but are not killed. (c) Chemical elicitors from *Trichoderma* produced by the walled off hyphae interact with putative plant receptors (Harman and Shores , 2007).

The latter treatment of (*R. + T. h.*) contributed a noticeable reduction in disease severity (0.1) from that of 0.21 and 0.33 in the amendments of each *R. stolonifer* and *A. niger* .Several reports demonstrated that endophytic fungi of *Aspergillus* and *Penicillium* spp. might serve as the main components responsible for pronounced antifungal properties involved in protecting the host plant against invasion of such virulent pathogens as *R. solani* (Wang et al., 2008 ; Xiao – Jun et al., 2012). However, a significant (p 0.05) increasing of disease occurrence (74 – 80 %) and disease severity (0.45- 0.54) in plants inoculated with *R. solani* plus thermophiles species were shown in (Table 6).

This review request discussion of the influence of environment parameters on *Trichoderma* and thermophiles species with bio control potential.

Therefore, studies available on the effects of temperature on the spore germination, germ-tube growth and mycelial development submitted that most strains of *Trichoderma* revealed are mesophilic, and cannot protect germinating seeds from soil-borne diseases caused by cold-tolerant strains of pathogens during cold spring conditions (Samuels, 1996). Water conditions also have been shown to strongly affect *Trichoderma* activities, they have a critical effect on saprophytic ability, on the interaction with other fungi (Lupo et al., 1997). Information about the influence of other thermophilic fungi and soil properties on metabolic activities of *Trichoderma* strains is essential for planning their application as bio

control agent. Symptomatic necrotic, pre and post emergence were also developed similarly either in the positive or negatively results of application of *T. h.*

This work confirms considerable effectiveness of *T.harzianum* for avoidance *R. solani* a major cause of radish damping off, in contrary, a pathogen surviving in the peat-mix could not be avoided though the competition of micro biota in the substrate and may attack the seedlings at any time. In this aspect, Chung and Hoitink (1990) reported that *R. solani* propagules were not eradicated from tree park composts when applied with thermophiles isolates of *Humicola* spp.

Table (6):- Effect of selected thermophilic fungi on the ability of *T. harzianum* in suppression Rhizoctonia damping-off.

Amendments	R. solani	T. h.	Infection	% Necrotic seedlings	% Post emergence	% Pre emergence	Dis. Severity	% Frequency
Peat-mix	-	-	52.93 de *	37.25 Ab	3.92 d	11.76 b	0.27 cd	-
Peat-mix	+	-	68.61 Bc	35.29 B	13.72 c	19.60 a	0.43 b	-
Peat-mix	+	+	23.52 G	21.56 C	1.96 d	0.00 d	0.10 e	50.0
P.m+ <i>A. niger</i>	+	-	80.39 A	37.25 Ab	21.56 ab	21.56 a	0.52 ab	43.75
P.mix+ <i>A. niger</i>	+	+	64.70 Cd	45.09 A	11.76 c	7.84 bc	0.33 c	-
P.m + <i>A. terreus</i>	+	-	76.47 Ab	33.33 B	21.56 ab	21.56 a	0.52 ab	28.0
P.m + <i>A. terreus</i>	+	+	60.78 Cd	37.25 Ab	11.76 c	9.80 bc	0.33 c	-
P.m+ <i>Penicillium</i>	+	-	74.51 Ab	31.36 B	17.64 bc	25.48 a	0.54 a	70.43
P.m+ <i>Penicillium</i>	+	+	49.39 Ef	27.44 Bc	11.76 c	7.84 bc	0.27 cd	-
P.m+ <i>R.stolonifer</i>	+	-	80.39 A	33.33 B	27.44 a	19.60 a	0.45 ab	45.0
P.m+ <i>R. stolonifer</i>	+	+	45.09 F	37.25 Ab	3.92 d	3.92 cd	0.21 d	-

*Within each independent factor and interaction the means followed by the same letter (s) are not significantly different (p < 0.05). Each value of triple interaction is the mean of 3 replicates. + & - = Presence & absence of inoculum, respectively.

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اخماد موت البادرات الرايزكتوني باستخدام Peat-mix المدعمة ب *Trichoderma harzianum* (T.h)
والفطريات
الخلاصة
المتحملة
للحرارة

استخدم مستحضر Biocont-T للمقاوم الحيوي *T. harzianum* بمعدل 10 غم/ لتر اضيف بطريقة ترطيب التربة بمعدل 10 مل/ كغم Peat-mix (P.m) لخماد موت بادرات الفجل 0 لوث الوسط بلقاح الممرض *R.solani* المخلوط مع تربة الحقل غير المعقم بتركيز 0.5% (5غم/كغم P.m) قبل تحضينه في الضلام تحت 24 م لفترات 28,14,7 يوما 0 زرع الوسط في اصص بمعدل 10 بذور/ اصيص وحسبت شدة المرض بعد 14 يوما ثم اعيد زراعة البذور واحتساب شدة المرض ثانية بعد 14 يوم ايضا 0 اختزلت شدة الاصابة في الزراعة الاولى الى 0.11 و 0.10 بوجود T.h بعد تحضينها لفترة 14 يوما بوجود او عدم وجود اللقاح الممرض على التوالي بالنسبة الى 0.48 في معاملة المقارنة 0 عموما فان تأثير فترات التحضين على كفاءة T.h كانت غير معنوية رغم غياب لقاح الممرض وفي الزراعة الثانية لبذور الفجل فان الشتلات المزروعة في T.h + P.m كانت سليمة تماما بعد تحضينها لفترة 2 يوما وكانت شدة المرض لنفس المعاملة 0.1 للشتلات المزروعة والمحضنة لفترة 14,7 يوما بالنسبة الى 0.46 و 0.41 في معاملات المقارنة 0 من الواضح فان عزلات الفطريات المحبة للحرارة اختزلت كفاءة T.h معنويا في اخماد موت البادرات قبل وبعد ظهورها لانها تسببت باصابة 45.09 - 64.7 % من الشتلات النامية في P.m والمعداة بلقاح كل من *Rhizopus stolonifer* و *Aspergillus niger* على التوالي مقارنة مع 23-52 % في معاملة المقارنة T.h + *R.solani* واثبتت الاخيرة اختزالا في شدة المرض الى 0.1 بالنسبة الى 0.21 و 0.33 عند العدوى بلقاح كل من *R.stolonifer* و *A.niger* على التوالي .

گفاشتنن لسه مرنا نه مامین بچیک برابزوکونویای ب کارئینانا Peat-mix ب پشتگریا Trichoderma harzianum و کهرویین خوراگرل گهرماتین پوخته

ب کارئینانا Biocont-T ئاماده کری ژ T.harzianum ب ریژهیا 10 گرام/لتر دگهل ئا خا شیداری (تهری) ب ریژهیا 10 گرام/لتر ژ بو لفینا گفاشتن لسه مرنا تهری. میدیاین پیسکری ب نه خوشکهری R.solani دگهل ئا خا کیلگهی ب ریژهیا 0.5% (5گرام / کگرام P.M) بهری بهینه هه لگرتن ل تارباتین و 24° پ بوماوی 7, 14, 28 روزان , چاندنا توقین تفر (10) بو ههر قاپه کی . توندیا نه خوشین هاته وهرگرتن پشتی 14 روزان پاشان توقین تفر دووباره هاته چاندن بو هه مان مامهله کهران و دیسان توندیا نه خوشین هاته وهرگرتن پشتی 14 روزان. ل چاندنا ئیک توندیا نه خوشین کیم بوو تا کو گه هشتیه 0.11 و 0.10 دناف T.h و بهرمایکین P.M. وهختن هاتینه هه لگرتن دگهل و بی فاکسینا نه خوشکهری دیف ئیک دا بهراوردی دگهل کونترولی کو دبیته 0.48 ژبهر قن چندی کارتیکرنا هه لگرتن لسه شیانیت T.h. نه یا گرتن بو سه ره رای دیاربونا R.solani. ل چاندنا دووی دا هه می توق دساخلم بوون دگهل (P.M. و T.h) پشتی بوماوی 28 روزان هاتینه هه لگرتن. ریژهیا نه خوشین دهه مان مامهله کهرا دا گه هشته 0.1 ده می هاتینه هه لگرتن بو ماوی 7 و 14 روزان بهراورد دگهل کونترولی کودبیته 0.46 و 0.41.

ب ئاشکرای دیارکونا کهرویین خوراگرل گهرماتین بو ئه گهری کیم بوون شیانین T.h. ل گفاشتنن مرنا بهری و پشتی ده رکه تنا توقی چونکی دیاربونا نه خوشین بو 45.09 - 64.7% بو وان روه کین شینبووین دناف P.M. و هاتیه فاکسیندان ب T.h. + کهرویین خوراگرل گهرماتین (Aspergillus niger و Rizopus stolonifer) دیف ئیک دا بهراورد دگهل 23-52% کونترولا R.solani. دوماهیکی توندیا نه خوشین ل کیم بوونی دا تا کو گه هشتیه 0.1 ژ 0.21 و 0.33 ده می هاتیه فاکسیندان دگهل هه ر ئیک ژ (A.niger R.stolonifer) دیف ئیک دا.

ASSESSMENT OF MAJOR FUNGAL AND BACTERIAL DISEASES ON APPLE AND PEAR TREES IN DUHOK PROVINCE , KURDISTAN REGION , IRAQ

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ABSTRACT

During spring 2013 to autumn 2014 , systematic survey of diseased apple and pear was carried out in growing areas of Duhok province , Kurdistan Region - Iraq . The major fungal and bacterial diseases observed were apple scab , bacterial canker and gummosis and fire blight. *Xanthomonas* shot –hole was also participated these diseases on pear except scab .

Severe scab was found in Amedy and ranged between 60 % and 95 % with moderate to destructive infection particularly in Kani – masi , the oldest and largest zone to produce apple fruits in Duhok . The bacterial canker and fire blight were also coincided scab in the serious damage of apple trees , since the first dispersed at arange of 45 – 55 % in Sumel , Mangesh , and Zakho , fire blighted apple trees increased to 80 % in Sumel . Apple scab initiated at April and progressed during May – August , and become more severely at postharvest in October. Bacterial canker and fire blight activated during summer months of late June to August. *Xanthomonas* shot – hole and bacterial canker on pear disseminated intensively in Sarsink and Zawa when infected 55 % of trees by each.

KEY WORD: Apple and pear , Apple scab , Field survey , Fire blight , Bacterial canker , Shot -hole

INTRODUCTION

Pome fruit as apple and pear, and stone fruit as peach , apricot and plum , in addition to grapevine and walnut are the most important fruits known in Kurdistan region of Iraq . These fruit grown in temperate zones having a distinct cold climates (Thind , 2001) . Apple is the predominant locally pome fruit followed by pear , while quince groves are limited , these crops are closely related culturally and in management , they often share common diseases.

The most important worldwide diseases occur in grown area are apple scab , fire blight , powdery mildew , bacterial canker , collar and root rot , crown galls , leaf spot , shot – hole and viral infections with mineral deficiencies(Agrios , 2005). Post harvest diseases caused by *Penicillium* , *Monilinia* , *Glomerella* , *Alternaria* in addition to such fruit disorders as pitter bit infect pome fruit in the field and may be progressed during marketing and storage.

Pome fruit are prone to several pests and diseases on different Iraqi locally conditions which damage or kill the entire tree and may reduce the yield to zero. The most common stress visualize on diseased pome fruit include stem cankers , discoloration of young tender shoots , bud blast , thin foliage , die – back and several viral diseases that results in premature fruits

dropping , partial defoliation . These symptoms observe apparently in the poor management orchards.

Growers were constrained to use their own propagating materials accompanied by lack of knowledge on diseases and topped by a shortage of an efficient certification program. Therefore, infected materials were distributed and introduced in to the country and freely circulated. The current survey aimed to assess incidence and severity of major diseases of apple and pear trees grown in the different locations in Duhok , Kurdistan region – Iraq .

MATERIALS AND METHODS

A systematic survey of apple and pear growing areas of the Duhok province , was conducted during early spring 2013 to Autumn 2014 in cooperation with the monitors staff in General Directorate of Agriculture in Duhok province to assess the prevailing , severity, incidence and distribution of the diseases in major growing area of apple and pear within (N 36.86⁰ , E 42.98⁰) . A total of about 68 nurseries and orchards were inspected randomly located, and the percentage of disease incidence and scores of disease severity were recorded at

each location. The disease records were taken in marks using 0 -5 rating scale where 0 = healthy and 5 = destructive (+++++) infections. Diseased samples of infected plant parts (stem , leaf and fruit) were collected from each surveyed location and brought to lab. for isolation and identification. Short description of visualized disease symptoms were documented and supported with diagnostic photos of the damaged plant parts. Duration of progress and development each disease , and disease host range were also recorded.

RESULTS & DISCUSSION



Fig. (1) :- Diagnostic symptoms of apple scab. (A) Scab lesions on apple leaf and pre-mature fruit (B) Advance cracks on fruit.

Powdery mildew =*Podosphaera leucotricha*
Foliage become partly or entirely covered with the white powdery fungus, which eventually kills them. The edges of infected leaves may become wavy, and often roll upwards and inwards (Fig.2 - A), exposing the lower surfaces. Infected leaves fall pre-maturely. When heavily infected, shoots become covered with the fungus and may bear totally infected leaves, such shoots either die or

Field symptoms of the major diseases:
Apple scab = *Venturia inaequalis*

First apple scab symptoms appear in spring , when the new foliage undersides features velvety textured , olive green to brown – shaded lesions or spots . When leaves grow larger , lesions are present on both sides (Fig. 1- A). The feathery – margin spots grow larger in size as the disease advances. The infection of the fruit manifests through acorklike texture of it. Among the advanced symptoms dark scab lesions cracks, (Fig.1- B), the white fungal growth on lesions appear in early Autumn (Becker and Burr, 1994; Ward , 2012).

only grow weakly (Fig.2 - B) . Infected buds are smaller than healthy ones, have a pinched appearance, and open later. Usually all blossoms and leaves produced from an infected buds are affected and fail to set fruits. Fruits may become infected soon after petal-fall. The affected areas become russet and, where growth is restricted, cracks may develop. The russet occurs as a network of fine lines(Nelson,2008 ; Nofal and Haggag , 2006)



Fig. (2):- powdery mildew on apple (A) leaf roll symptoms (B) White powdery covered infected leaves and young shoots.

Bacterial canker and gummosis=*Pseudomonas syringae*

Symptoms on infected trees are typically elongated cankers that are soft or spongy touch and gumming copiously. Cankers may expand rapidly in the spring causing girdling of the main trunk or branches (Fig. 3 - A). Bacterial canker can also kill buds, and sometimes causes brown,

circular lesions on leaves which fall out to give a "shot hole" type symptom (Fig. 3 – B). Fruit lesions include small, brown spots which may be slightly sunken on immature fruits. Symptoms on leaves and fruits are not common , but may be seen in areas with higher rainfall (Agrios , 2005 ; Kazemponr et. al., 2007).



Fig. (3): -Bacteria canker and gummosis on apple trees (A) Shot hole symptoms on leaves (B) Elongated gummy and dark cankers on the old branches.

Fire blight = *Erwinia amylovora*

Symptoms of fire blight are first seen about the time of petal fall. Infected blossoms appear water-soaked and wilt rapidly before turning dark brown; this phase of the disease is referred to as blossom blight. As the bacterial invasion progresses, leaves wilt, darken and remain

attached to the tree this gives the tree a fire-scorched appearance, thus the name "fire blight"(Fig. 4 -A) .

Infected twigs darken and branch tips may bend over forming a "shepherd's crook" (Fig. 4 - B) (Ward and Kaiser ,2012).



Fig.(4) :-Fire blight on apple : (A) Wilting dark leaves with a fire – scorched appearance (B) Infected dark twigs with hanging dead leaves.

Shot- hole = *Xanthomonas euversicatoria*
 Because the most obvious symptoms occur on leaves, the disease is often referred to as "bacterial leaf spot." Symptoms begin as small, yellow-green lesions on young leaves (Fig. 5- A) which usually appear deformed and twisted, or as dark, water soaked, greasy-appearing lesions on older foliage and become tan to brownish-red. Lesion shape is

defined by leaf veinlets, so the shape is angular rather than the round shape that is more typical of fungal leaf spots or injury caused by some pesticides or other chemical sprays (Fig. 5- B).

Under dry conditions, diseased leaves can develop a tattered appearance as the leaf margin and lesion centers become necrotic, dry up disintegrate, and fall (Toju –Tam-Sin et al., 2012 ; Agnello et al., 2011; Zehr and Shepard , 1996).



Fig.(5) :-*Xanthomonas* leaves shot – hole on apple (A) Symptoms of yellow – green lesions (B) Lesion shape of leaf veinlet on old foliage.

Incidence , severity , and Distribution of major diseases:

The status and time of occurrence fungal and bacterial diseases on pome fruits during 2013-2014 at different locations of the Duhok province have been presented in (Table 1).

The maximum incidence of apple scab was observed at Akre (Dinarta , and Gardasin) , it was 60 -65 % with severe to destructive symptoms , Zakho (Batifa and Sirkotke (60 -80 %) . Severe infection of scab found in Amedy (Maye and kani-

masi) ranged between 60 and 95 % during 2013 – 2014. Scab severity was ranged between moderate to destructive infection particularly in Kani- masi , the oldest area locations to grow and produce apple fruits in Duhok.

Bacterial canker and fire blight were also accompanied scab in the most responsible causes for the serious damage of apple trees towards the reduction of yields. The wide spread of bacterial canker appeared at several locations of Sumel (

Dulbabni), Mangesh (Baroshka-Saadi), Zakho (Batifa), with incidence range 15 – 55 % .

Fire blight disseminated severely at Atrosh (Blan) and , Rzgary (Shilan) when occurred with 50 -55 % , and developed to destructive dispersal on 80 % of trees in Sumel (Qasara) . However , the frequency and degree of severity for these diseases depend on such various conditions as altitudes , climates , cultivars , plant age, and management practices. The latter are crucial and remarkable factor for breeding vigorously trees defend pathogens attack (Agrios , 2005).

At the time of survey we have observed that due to these diseases infection , several fruits were dropped pre-maturely under trees severely damaged (with symptoms of discoloration , die-back , bark exfoliation at the cankered areas of trunks and branches) which lead to tree decline.

The range of incidence and severity of apple scab , fire blight , and bacterial canker seem to be more severe and destructive at higher altitudes with relatively more cold and moist climate conditions and on oldest trees. These observations were also reported in Ethiopia by (Handord and Gemu , 2007). However, poor management resulted weakened and predisposed trees to different pathogens and other non- biotic stress .

The production of apple in Iraq is constrained primarily by the pests dispersal particularly apple scab , bacterial canker , fire blight and apple maggot which cause the major damage on trees growth, yields increment , and fruits quality ,

in addition to competition of introduced commercial produce.

It's necessary for growers, get knowledge on the timing of increasing inoculum potential and its dispersal that lead to understanding variance of scab severity , hence local data of forecasting consider a basic requirement at approach disease development and thereafter selection a suitable facilities for its management. Slight infection of apple scab occurred in Akre (Greshofli) during April and progressed to moderate in Akre , Amedi , Shikhan , Mangesh, Sarsink during May – July and August, severe infection dispersed during October in Akre , Zakho (Shilan), Amedi (Kani-Masi) with the favorable conditions predominant which encourage susceptibility and trees predisposition to wind – borne conidia of a pathogen.

Regarding pear trees severe fire blight was found with disease incidence 55 % in Zakho (Bedare) and 65 % at Duhok (Nzarki). Bacterial canker and shot – hole dispersed severely in pear trees at Sarsink and Zawa with 55 % infection by each.

Fire blight and bacterial canker become active in summer . Thus, considerable development of these diseases shown in the most investigated area, at late of June – August compared to April until early June, hence we recommend the growers to pruning infections at this time in addition dormant prunin (Hetherington , 2005).

Table (1) :- Distribution, disease incidence and occurrence time of apple and pear diseases

Host	Disease & Pathogen	Location	Occurrence Time	% Incidence	Disease severity	
Apple	Apple Scab <i>Venturia inaequalis</i>	Akre, Greshsofli	12-5-2014	-	Slight +	
		Mangesh, Mamane	4-6-2013	30	Moderate ++	
		Duhok, Sarsink, Kndk	10-6-2013	30	Moderate ++	
		Duhok, Sarsink	13-6-2013	55	Severe +++	
		Zakho, Batifa	7-7-2013	60	Severe +++	
		Akre, Grdasin	9-7-2013	50	Moderate ++	
		Zakho, Sirkotke	9-7-2013	80	Severe +++	
		Mangesh, Kosa	15-7-2013	50	Slight +	
		Akre, Grbesh	17-7-2013	60	Destructive ++++	
		Mangesh, Bajl	18-7-2013	3	Slight +	
		Amedi, Kanibalav	22-7-2013	50	Severe +++	
		Amedi, Bamarne	23-7-2013	25	Moderate ++	
		Amedi, Barchi	31-7-2013	10	Slight +	
		Zakho, Alwazaxo	4-8-2013	30	Moderate ++	
		Amedy, Shmayla	14/8/2013	75	Severe+++	
		Amedy, Teshambic	15-8-2013	45	Moderate ++	
		Amedy, Dore	20-8-2013	50	Severe +++	
		Akre, Dinarta	21-8-2013	65	Severe +++	
		Akre, Gondkejery	22-8-2013	6	Slight +	
		Amedy, DargalMosa bag	26-8-2013	43	Moderate ++	
		Mangesh, Kerbke	7-10-2013	28	Moderate ++	
		Amedy, Spindare	21-10-2013	40	Moderate ++	
		Amedy, Kani, Mase	21-10-2013	95	Severe +++	
		Amedy, Maye	23-10-2013	60	Severe +++	
		Zakho, Shilan	28-10-2013	20	Moderate ++	
		Powdery Mildew <i>Podosphaera leucotricha</i>	Duhok, Chamane	15-5-2014	1	Slight +
			Amedi, Kanibalave	23-7-2013	50	Moderate ++
			Amedi, Tne	25-7-2013	40	Moderate ++
			Amedy, Kanimase	14-8-2013	60	Severe +++
			Amedy, Dore	20-8-2013	4	Slight +
		Bacterial Canckars & Gummosis <i>Pseudomonas syringae</i>	Zakho, Batifa	6-4-2014	45	Moderate ++
			Zakho, Rzgary	8-4-2014	15	Slight +
			Sumel, Dulbsofli	22-5-2013	55	Severe +++
			Mangesh, Baroshka, Saadi	20-6-2013	55	Severe +++
		Fire Blight <i>Erwinia amylovora</i>	Amedy, Bamerne	24-10-2013	21	Moderate ++
			Duhok, Amedi	28-5-2014	17	Moderate ++
			Rzgari, Shilan	-5-2013	55	Severe +++
			Duhok, Sumel, Qasara	-6-2013	80	Destructive ++++
			Zakho, Bedare	-6-2013	10	Slight +
			Atrosh, Blan	-6-2013	50	Severe +++
			Sarsink, Kndk	-6-2013	5	Slight +
			Atrosh, Beboz	-6-2013	15	Slight +
			Shekhan, Meht	3-7-2013	40	Moderate ++
			Zakho, Khizava	16-7-2013	8	Slight +
			Akre, Beboz	6-6-2013	30	Moderate ++
Bacterial canker and gummosis <i>Pseudomonas syringae</i>	Sarsink		11-6-2013	55	Severe +++	
	Zawita, Bagera	16-6-2013	10	Slight +		
	Duhok, Sarsink	13-6-2013	50	Severe +++		
	Bacterial Shot hole <i>Xanthomonas euversicatoria</i>	Sarsink, Tajika	10-6-2013	30	Moderate ++	
		Sarsink, Chammeal	10-6-2013	30	Moderate ++	
		Duhok, Faidie, Zawa	11-6-2013	55	Severe +++	
	Amedy, Teshambic	15-8-2013	70	Severe +++		
	Amedy, Chamanke	19-8-2013	65	Moderate ++		
	Fire Blight <i>Erwinia amylovora</i>	Zakho, Bedare	-6-2013	55	Severe +++	
		Zakho, Khndak	9-7-2013	1	Slight +	
Duhok, Nzarke		18-7-2013	65	Severe +++		
Zakho, Berkar, Hizawa		28-10-2013	25	Moderate ++		

RESULTS

presented in (Table 2) clarify that apple and pear are subjected to various epidemic diseases. The severe and most serious bacterial diseases on apple were bacterial canker and gummosis caused by *Pseudomonas syringae*, observed with 55 % during May and June , 2013 . Severe Fire blight = *Erwinia amylovora* , were found on pear trees during June . Though prolonged its occurrence on apple during May to July , diseased trees not exceeded more than 36%. During the hottest

summer months of August , bacterial shot –hole by *Xanthomona* spp. infected 68 % of pear trees causing severe prevalence on trees canopy. The major fungal diseases prevailed were apple scab since ,its damage extended from June to October within arange 38 – 49 % of moderate disease severity , powdery mildew , sooty canker , leaf curl , rust of pear caused by *Gymnosporangium sabinae* , witches broom , crown gall were restricted in few fields of some survey locations , hence considered as slight and minor diseases.

Table(2): -Spread of apple and pear diseases under conditions of Duhok province

Host	Disease & Pathogen	Occurrence Time	% Disease incidence	Disease severity
Apple	Apple Scab <i>Venturia inaequalis</i>	6-2013	44	Moderate ++
		7-2013	38	Moderate ++
		8-2013	41	Moderate ++
		10-2013	49	Moderate ++
	Powdery Mildew <i>Podosphaera leucotricha</i>	5-2014	1	Slight +
		7-2013	45	Moderate ++
		8-2013	32	Moderate ++
	Bacterial Cankers & Gummosis <i>Pseudomonas syringae</i>	4-2014	30	Moderate ++
		5-2013	55	Severe+++
		6-2013	55	Severe+++
		10-2013	21	Slight +
		Fire Blight <i>Erwinia amylovora</i>	5-2014	36
Pear	Bacterial canker and gummosis <i>Pseudomonas syringae</i>	6-2013	36	Moderate ++
		Bacterial Shot hole <i>Xanthomonas euversicatoria</i>	6-2013	38
	Bacterial Shot hole <i>Xanthomonas euversicatoria</i>	8-2013	68	Severe+++
		Fire Blight <i>Erwinia amylovora</i>	6-2013	55
	Fire Blight <i>Erwinia amylovora</i>	7-2013	11	Slight +
		10-2013	25	Slight+

CONCLUSIONS AND RECOMMENDATIONS

Apple and pear trees grown in Duhok are prone to various fungal and bacterial diseases which are the major factors responsible for reduction yield quality. Among the diseases apple scab, bacterial canker and gummosis and fire blight on apple and pear in addition to *Xanthomonas* shot – hole were the most frequently and predominantly serious diseases occurred at most surveyed area . Powdery mildew on apple observed in few fields of some locations. Therefore, we can recommended that management strategies required with more training courses for growers about the following practices :

- 1- Wider spacing for mother trees plantation.

- 2- Planting of resistant rootstocks to produce strong healthy , free from diseases.
- 3- Attention of trees , grafting and pruning.
- 4- Selection cultivars for a suitable area , which are resistant or tolerant to such diseases..
- 5- Cultural practices including sanitary measures and production of clean plant materials.

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تقدير اهم الامراض الفطرية والبكتيرية على اشجار التفاح والكمثرى في

محافظة دهوك / اقليم كردستان العراق

الخلاصة

اجري المسح الميداني لامراض التفاح والكمثرى وذلك خلال ربيع ٢٠١٣ ولغاية خريف ٢٠١٤ في عموم مناطق زراعتها في محافظة دهوك . اظهرت النتائج انتشار جرب التفاح والتقرح البكتيري والتصمغ واللفحة النارية على التفاح واشترك مرض تثقب الاوراق مع الامراض المذكورة في اصابة الكمثرى عدا الجرب . لوحظ اصابات شديدة بجرب التفاح في العمادية تراوحت نسبتها بين ٦٠ % و ٩٥ % وباصابات متوسطة الى شديدة جدا في منطقة كاني_ماسي وهي الاكبر مساحة و انتاجا للتفاح في دهوك. تزامنت الاصابات البكتيرية مع الجرب في احداث الضرر الخطير باشجار التفاح حيث انتشرت بنسبة ٤٥ – ٥٥ % في سيميل ومانكيش وزاخو وارتفعت نسبة اصابة الاشجار باللفحة النارية الى ٨٠ % في سيميل . بدأت اصابة جرب التفاح في نيسان وتطورت خلال مايس - اب ثم اشتدت خلال تشرين الاول بعد جني الثمار. ازدادت نسبة الاصابة بمرض اللفحة النارية والتقرح البكتيري خلال اشهر الصيف وتحديدًا من اواخر حزيران الى اب وانتشر الاخير اضافة الى تثقب الاوراق بكثافة على اشجار الكمثرى حيث بلغت ٥٥ % في كل من سرسنك وزاوه لكل مرض على حدى.

پیفانا گرنگترین ئیشین کهرووی و بهکتیری ل سهر دارین سیف و هرمیکا
لپاریزگه ها دهوکی / ههریما کوردستانا عیراقی

پوخته :

روی پیفانه کا دهقهری هاته ئه نجامدان ل سهر ئیشین سیف و هرمیکا د بوهارا ۲۰۱۳ تا کو پایزا ۲۰۱۴ د زوربهی دهقهرین بهرهمئینانا وان ل پاریزگه ها دهوکی . ئه نجامان دیارکر به لاقبوونا گوراتیا سیف و کولبونیت بهکتیری و به نیش دانه و سوتنا ئاگری و دیسان ئیشا کونبونا به لگان دگه ل ئیشین هرمیکی ژبلی گوری بوونی.

توشبونین مهزن بین گوری بوونا سیف ل ئامیدین هاتنه تومارکن ب ریژا ۶۰% و ۹۵% و توشبونین نافنجی و گه لهگ مهزن ل دهقهره کانی ماسی ئه واهه ههتته هژمارتن مهزنترین دهقهر بو بهرهمئینانا سیفا ل دهوکی . ئیشین بهکتیری د هه قدهم بوون دگه ل ئیشین گوری بوونی بو پهیدا کهر زهره رین ترسناک ل سهر دارین سیفان بریزه بین ۴۵ - ۵۵% ل سیمیل و مانگیشکی و زاخو . ریژا توشبوونی ب سوتنا ئاگری بلند بوو تا کو ۸۰% ل سیمیل.

توشبوون ب ئیشا گوری بوونی ل سهر سیفا دهستی کرل هه یفا نیسان و زنده بوون ل هه یقین گولان تا کو ته باخی و دیسان دژوار بوو د هه یفا چریا ئیک تا کو پشتی چینی . ریژا توشبوونی ب ئیشا سوتنا ئاگری و کولبوونا بهکتیری دژوار بوو د مهین هافین دا نه خاسمه د دوماهیا خزیران تا کو ته باخی و بین دوماهین بهر به لاقبو دگه ل کونبوونا به لگان ل سهر دارین هرمیکا و گه هه شته ۵۵% ل سهر سنکی و زاوه بو هه ر ئیشه کی .

APPLICATION OF NEW METHODS FOR CONTROLLING WHEAT SEED GALL NEMATODE *Anguina tritici*

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ABSTRACT

In vitro bioassay revealed that spore suspension of Bio-cont-T *Trichoderma harzianum* (19×10^6 spores / ml) caused mortality to 2nd stage juveniles of wheat seed gall nematode *Anguina tritici* by 53.9%. Application of *T. harzianum* for controlling *A. tritici* under field condition caused significant improvement in some growth and yield criteria of infected wheat plants such as harvest index, seed weight and number of seeds by 30.57, 31.6 and 28.7% respectively.

Soil and foliar fertilizing with urea and compound fertilizer respectively caused significant increasing in harvest index, seed galls weight, spike length, hay weight and number of seeds with non-significant reduction in the disease occurrence. Grazing of wheat seedlings caused significant reduction in the infection criteria with disappearing of seed galls on wheat plants in some treatments particularly at planting date 15/ Dec/ 2010, grazing also improved growth and their yield criteria.

KEYWORDS: *Anguina tritici*, *Trichoderma harzianum*, chemical fertilization, grazing

INTRODUCTION

Ear-cockle disease is one of the major aerial diseases and causes sustainable losses in wheat crop (*Triticum* spp.) of tropical and sub-tropical countries (Kort, 1972). It is distributed in wide range of wheat growing land, still common in Eastern Europe and in part of Asia and Africa (Agrios, 2005). Symptoms of nematode attack can be discerned at seedling stage but farmers generally fail to recognize the disease before harvesting and threshing of the plant (Khan and Athar, 1996). From the first record of *Anguina tritici* in Iraq by Rao (1921), it is still an important nematode pest in Iraq occurred in the most areas of wheat growing with disease incidence 22.9 to 45% on mexipac cv. (Al-Beldaw; *et.al.* 1974) increased to 75% on the same cultivar in Duhok Province in 1989 (Stephan and Antoon, 1990). Ami, *et.al.*, (2004) reported that the percentage of infestation by galls reached 50% as a maximum value in bread wheat in Bashika – Iraqi Kurdistan region. Ear-cockle disease reduces human consumption and market price of wheat (Paruthi and Bhatti, 1988), with significant reduction in the protein and gluten contents of the flour product of infested wheat with seed galls (Mustafa, 2009). The aim of this study is application of new methods for controlling wheat seed gall nematode *A. tritici* included: 1- biological control by Biocont-T (*Trichoderma harzianum*). 2- mineral fertilization involved nitrogen fertilizer (urea) as

soil application and compound fertilizer (NPK). 3- grazing of wheat seedlings in different planting dates.

MATERIALS AND METHODES

1-Vital test of 2nd stage Juveniles (J₂) of wheat seed gall nematode *A. tritici* against bio-control agent *T. harzianum*.

Preparation of J₂ suspension: Second stage juveniles of *A. tritici* suspension was prepared by immersing wheat seed galls in distilled water in a petri dish for 2 hours after which they were opened with the aid of 2 sterilized needles under stereomicroscope for releasing nematode juveniles. J₂ suspension was transferred to a beaker then nematode population counted under stereomicroscope. J₂ suspension was diluted with distilled water to obtain 50 ± 5 J₂/ ml.

Biocont-T, ingredient: *Trichoderma harzianum* contains more than 19×10^7 spores gm⁻¹ was used as a source of biocontrol agent and depending on this concentration other three concentrations were prepared:-

- a-) 19×10^4 = 1 milligram of Biocont-T + 1ml of water.
- b-) 19×10^5 = 10 mg of Biocont-T + 1ml of water.
- c-) 19×10^6 = 100 mg of Biocont-T + 1ml of water.
- d-) distilled water was used as control treatment.

One ml of each concentration was transferred to 5 cm Petri dish containing one ml of juvenile suspension 50 ± 5 J₂ and all petri dishes were covered and incubated at 25 ± 5 C° for one week

Part of M.Sc. thesis of the second author

after which mortality percentage of J_2 was calculated and corrected according to the following equation mentioned by Ami (1998):

Corrected mortality percentage = $100 - 100 \times$ (number of living juveniles in treatment / number of living juveniles in control). This experiment consisted of 4 treatments with 3 replication in Complete Randomized Design (CRD).

2- Biological control by application of Biocont-T (*T. harzianum*):

Biocont-T (Active ingredient: *T. harzianum* more than 19×10^7 spores gm^{-1} "Al-Barakah Organic Agricultural Materials Co.Ltd. Jordan") was applied as shown below:-

1-) Soil drenching at the rate of 200 gm/m^3 applied at wheat seed sowing (Cham6 cv.) and soil infestation with galls.

2-) Application of Biocont.-T at the rate of 1 gm/L of water sprayed on wheat seedlings when initial symptoms detected.

3-) Sowing wheat seeds after infestation by galls without any application of Biocont.-T. (Control-1).

4-) Sowing seeds without any infestation of soil and without application of Biocont.-T. (Control-2)

All in vivo experiments consisted of 4 replications conducted in RCBD. Data obtained from all experiments were analyzed using SAS program and means were compared using Duncan's Multiple Range test $P=0.05$ (SAS, 1999).

3- Effect of mineral Fertilizers on *A. tritici*:

Two types of mineral fertilizer were applied to investigate their effects included: Nitrogen fertilizer (Urea) at the recommended rate of 20 Kg/donum at two times (10 Kg/donum when plants reached 10 cm in height and 10 Kg/donum before blossoming) and compound fertilizer (NPK 20-20-20) by foliar - application at the recommended rate of 1 gm per 2 liters of water before blossoming. Sowing of wheat seeds and soil infestation with 8 galls were done in 15/Dec/2010 and each fertilizer applied separately. This experiment consisted of 3 treatments with 4 replications and conducted in RCBD.

4-Effect of grazing wheat seedlings on ear-cockle disease:

Grazing was conducted when disease symptoms appeared on wheat seedlings by cutting plant shoots at the soil line (equivalent sheep

gazing). Sowing dates and soil infestation with galls were carried out at (15/Nov. 15/Dec. 2010 and 15/Jan.2011). This factorial experiment consists of 6 treatments (3 planting dates \times 2 grassing factors - grassed and non-grassed seedling).

1- Growth and yield criteria:

At the end of growing season, plants were harvested for each above experiments and the following criteria were calculated:

a-Plant height (cm/plant): from the soil line to spike node for four main stems (Osmar *et al.*, 2007).

b- Straw (hay) weight (gm/plant): calculated after air drying.

c- Spike length.(cm/spike) : from node to the spike apex.

d- Number of seeds /spike.

e- Seed weight/spike. (gm/spike)

f-Biological yield = hay weight + seed weight. (gm/plant).

g-Harvesting index according to the following equation :

$$H.i = \frac{\text{Seed yields}}{\text{Biological yield}} \times 100 \text{ for each plant}$$

i-Flag leaf area (cm^2): $L.E = \text{leaf length} \times \text{leaf width in the middle} \times 0.95$ (Kemp, 1960). Leaf area was calculated at the end of the spikes stages in which leaf area reached its maximum size.

j- Chlorophyll %. Measured by Chlorophyll meter (SPAD-502 / Konica Minolta Sensing, INC. made in JAPAN).

2- Infection criterion:

a-Infection percentage=

$$\frac{\text{Number of infected plants in pot}}{\text{Total number of plants in pot}} \times 100 \text{ for each plot.}$$

b-Number of seed galls.(galls/spike or plant).

c-Weight of seed galls.(mg/gall).

d- J_2 population density. (J_2 / dry gall).

*All field experiments were conducted in the field of Faculty of Agriculture and Forestry, University of Duhok .

h- Increment percentage in criteria=

$$\frac{\text{Criteria value in treated treatment} - \text{criteria value in control}}{\text{Criteria value in control (Infested soil with galls)}} \times 100$$

-each value is means of 3 replication

RESULT AND DISCUSSION

1-Vital test of J₂.

Vital test of *T. harzianum* against J₂ of seed gall nematode *A. tritici*: Result revealed that *T. harzianum* had a significant effect in J₂ mortality which increased with increasing of fungal spore's density (Fig.1).



Fig. (1): Mortality percentage of *A. tritici* (J₂) as a result of immersion in spore suspension of biological agent *T. harzianum*.

-each value is means of 3 replication

In general *T. harzianum* showed slightly effects on J₂ this may be attributed to disability of *T. harzianum* on direct parasitism on J₂ of *A. tritici*, here mortality of J₂ might be due to toxic effects of *T. harzianum* throughout producing mycotoxine (Culter and Jacyno, 1990) and its higher enzymatic activity (Bae and Knudsen, 2001) This interpretation may be true because

direct penetration of fungal mycelium or its growth inside nematode body was not observed.

yield criteria of diseased wheat (Table. 2). The positive effect of *T. harzianum* might be attributed to toxic material (mycotoxine) produced by this fungus (Culter and Jacyno, 1990), which cause death of the

Table (1):- Effect of different application of *Trichoderma harzianum*, (Biocont-T) on some infection criteria in wheat plants (cham 6 c v.).

Treatments	Infection percentage %	Galls/plant	weight of gall (mg)	Number of J ₂ /gall
soil Infested with galls	41.89 a	18.13 a	2.57 a	9268 a
Soil application of Biocot-T (Infested with galls)	20.27 b	17.72 a	2.07 a	8171 a
Foliar application of Biocot-T (Infested with galls)	46.50 a	8.90 b	3.5 a	8326 a
Non infested soil	0 b	0 c	0 b	0 b

*means followed by different letters are significantly different based on Duncan's Multiple Range test (P=0.05).

Table (2):- Effect of Biocont-T application on increment % of growth and yield criteria of wheat plants (cham 6 cv.)

Treatments	Soil application of Biocot-T.	Foliar application of Biocot-T.
Criteria		
leaf area (cm ³)	5.8 c	24.07 a
Harvest index (%)	10.21a	30.57 a
Weight of seeds /spike (gm/spike)	8.2 b	31.6 a
straw weight (gm/plant)	2.01d	13.6 b
plant-length (cm/plant)	7.96 b	10.62 b
Number of seeds/spike	12.5a	28.7 a

2- Means followed by different letters within the same character are significantly different based on Duncan's Multiple Range test (P=0.05).

- Each value is mean of four replications.

2-Biological control of *A. tritici* by application of Biocot-T (*Trichoderma harzianum*):

Soil application with *T. harzianum* reduced infection to 20.27%, weight of galls to 2.07 mg/gall and J₂ population density to 8171 J₂/gall (Table. 1). Foliar application of Biocont-T showed more increment in harvest index (%), weight of seeds and number of seeds (30.57, 31.6 and 28.7% respectively and improvement in other growth and nematode, in addition to high enzymatic activity of *Trichoderma spp.* and production of many enzymes such as B-1-3 glucanase, Cellulase, Chitinase and Xylanase (Bae and Knudsen, 2001) and multiple antibiotics such as Demadine, Acetaldehyde, Alkpyrones, Trichodermine, Viridene, Sesquiterene, Gliotoxine (Howell, 1998 and Harman, 2000) and the death of the

nematodes might be due to one of those compounds or all combined. This effect was clearer in the sharp decline of infection percentage after soil application of Biocont-T in addition to its direct effect in reducing the number of gall after foliar application which might be attributed to direct exposure of nematode juveniles to fungal suspension.

3-Effect of Fertilizers:

Less number of galls (13.94 galls/plant) with less J₂ density (6860 J₂/gall) was found in wheat plants fertilized by urea (Table. 3). Foliar application resulted to less infection and galls weight. On the other hand, the effect of urea fertilizer on nematode might be attributed to the toxic effect of Ammonia which was released to nitrate compound before climbing wheat of nematode juveniles on seedlings

(Stapleton *et al.*, 1990). Regarding the effect of foliar fertilization might be attributed to the period of its application at which nematode juveniles were still on outer surface of wheat plants before their entrance flower ovaries and thus nematode killing might be happen as a result of increasing of minerals concentration then disorder of osmotic pressure in nematode habitat.

4-Wheat seedling Grazing:

Interaction between grazing of wheat seedlings and planting dates was 0.05 significant in its effect on the infection criteria (Table. 4). In

general galls didn't appear absolutely (0 gall/plant) in grazed wheat seedling in 15/Dec/2010 comparing to non-grazed, in which number of galls reached 52.75 galls/ in the same planting date. However, gall weight and number of J₂ in galls in grazed treatment was less compared to non-grazed treatments. In contrast, grazing also caused significant increasing in some growth and yield criteria included harvest index, weight of seeds, spike length and number of see/spike comparing with not grazed treatment (control).

Table (3):- Effect of fertilizer in some of the growth, yield and infection criteria of wheat plants (cham 6 c.v)

Characters	Infection percentage	galls/plant	Weight of galls (mg)	Number of J ₂ /gall	leaf area (cm)	Chlorophyll (%)	Harvest index (%)	Weight of seed spike (gm)	spike length (cm/spike)	Straw weight (gm/plant)	plant-height (cm/plant)	Number of seeds/spike
Foliar fertilizer	42.7 a	18.34 ab	2.17 abc	7866 a	14.63 a	34.0 ab	30.63 a	0.33 b	7.5 ab	4.43 b	30.91 ab	12.12 bc
Urea fertilizer	43.6 a	13.9 ab	2.92 abc	6850 b	14.3 a	39.2 a	26.68 ab	0.43 a	8.6 a	8.12 a	33.41 a	20 a
Control	51. 9 a	21.93 ab	3.3 ab	7150 a	11.5 a	31 b	20.08 b	0.25 bc	5.3 c	5.71 b	25.74 b	6.62 c

- Means followed by different letters within the same character are significantly different based on Duncan's Multiple Range test (P=0.05).

- Each value is mean of four replications.

While, it caused non-significant reduction in leaf area and chlorophyll percentage, straw weight and plant length (Table. 5). Disappearing of infection in some grazing treatments might be attributed to elimination of parasitized nematode

juveniles from wheat seedlings after cutting of their stems, while appearing of infection in the other grazing treatment may be contributed to remaining few of J₂ number

Table (4):- Effect of interaction between grazing and planting date on infection criteria.

Sowing date	Grazing	Infection percentage	gall/plant	weigh of gall (mg/gall)	Number of J ₂ /gall
15/Nov. 2010	+	51.11 a	2.79 c	0.35 b	1500 b
	-	60.04 a	14.11 b	2.2 a	9753 a
15/Dec. 2010	+	51.69 a	0 d	0 c	0 d
	-	42.18 a	52.75 a	0.33b	8201 a
15/Jan. 2011	+	46.50 a	2.79 c	0.38 b	631c
	-	62.93 a	4.83c	0.44.b	9531 a

Means followed by different letter within the same character are significantly different based on Duncan's Multiple Range test (P=0.05).

- Each value is mean of four replications.

* + & - = gazing & non-grazing wheat seedling respectively.

Table (5):- Effect of Grazing and not grazing in 15 / Dec / 2010 on growth and yield criteria.

Criteria	grazing	Control (Not grazing)
leaf area(Cm)	15.11 a	17.34 a
chlorophyll %	32.50 a	40.05 a
Harvest index %	34.60 a	11.17 b
Weight of seed /spike(gm/spike)	0.73 a	0.20 b
spike length (Cm/spike)	7.12 a	6.12 b
straw weight (gm/plant)	4.24 ab	5.51 a
plant-length (Cm/plant)	31.32 a	30.16 a
Number of seed/spike	34 a	6.87 b

T -means followed different letter within the same character are significantly different based on Duncan's Multiple Range

test (P=0.05).

-Each value is mean of four replications.

in the bases of seedlings stem near soil surface or remaining of them in soil and attacked seedling after grazing, thus elimination of nematode from wheat seedlings as a result of grazing led to improving growth and yield criteria in second planting date (15 Dec. /2010).

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IDENTIFICATION, PATHOGENICITY AND CONTROLLING OF THE *Macrophomina phaseolina* (Tassi) Goid THE CAUSAL AGENT OF THE CHARCOAL ROT DISEASE ON WATERMELON

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ABSTRACT

Present study was carried out to evaluate the efficiency of the bioagent *Pseudomonas putida* (Pp), plant growth activator Benzo [1,2,3] thiadiazole-7-carbothioic acid-S-methyl ester (BTH) and the fungicide Beltanol (B) for control the charcoal rot disease of watermelon. All the isolates of the pathogen significantly reduced seed germination *in vitro*, the *M. phaseolina* isolate Mpa-2 exhibited entire reduction in the seed germination of 0%. The fungicide B prevented the fungal growth completely *in vitro* and bioagent Pp inhibited the pathogen's growth with 88.8% compared with the control which showed fully growth in petri plate after 7 days. In contrast, no inhibition observed in the BTH treatment. Under greenhouse conditions, combination of Mpa-2+Pp+BTH treatments recorded totally seed germination compared to 65% in control with zero of disease severity corresponds to 83.3% in the control. All the examined agents found to improve the plant vigor through increasing of the fresh and plant dry weight.

KEYWORDS: Charcoal rot disease, *Macrophomina phaseolina*, *Pseudomonas putida*, BTH, Beltanol, Watermelon.

INTRODUCTION

Watermelon (*Citrullus lanatus* (Thumb.) Matsum and Nakai) is one of the most widely cultivated vegetable of the Cucurbitaceous species (Jeffrey, 2001; Boughalleb and El.Mahjoub, 2006). The total production of watermelon in Iraq during 2012 was approximately 350000 ton (FAO, 2015). *Macrophomina phaseolina* (Tassi) Goid. is an important phytopathogenic fungus, infecting a large number of plant species including watermelon, and surviving for up to 15 years in the soil or plant debris as sclerotia (Fujinaga et al. 2002; Baird et al., 2003; Mahdizadeh et al. 2011; Kaur et al. 2012; Lotfalinezhad et al. 2013). *M. phaseolina* infect the plants at any growth stage causing charcoal rot, pre and post-emergence damping off, seedling blight, root and crown rot diseases on various economically crops (Sanei and Razavi, 2011; Jacob et al. 2013; Sharma et al. 2014) The pathogen was reported in the middle and south of Iraq distributed in the fields of watermelon associated with other phytopathogen such as *Fusarium* spp. and *Alternaria* spp. (Hussein and Juber, 2015). The hot climate and water stress conditions lead to widespread disease incidence during the growing season (White, 1999). Plant growth-promoting rhizobacteria (PGPR) a benefit soil inhabitant

bacteria that colonize plant rhizosphere and providing plant growth promotion through different mechanisms. Recently, several PGPR species used to replace the chemicals (Saharan and Nehra, 2011; Rani et al. 2012). These bacterial species belonging to such genera as *Azospirillum*, *Arthrobacter*, *Bacillus*, *Enterobacter*, *Pseudomonas* and *Rhizobium* (Tilak et al. 2005; Egamberdiyeva, 2005; Ahemad and Kibret, 2014; Noumavo et al., 2015). PGPR inoculums are commonly used for improving the growth and yield of crops and offers an attractive way to replace chemical fertilizers, pesticides and other soil amendments (Ashrafuzzaman et al. 2009). Plant defense activator offers alternative methods to pesticides application in the integrated control. BTH (Abiotic inducers) induce the plant resistance against pathogens attack known as systemic acquired resistance (SAR) which is active against various phytopathogens including fungi, bacteria and viruses and nematodes (Monci et al. 2003; Ravi et al., 2012; Biswas et al. 2014; Alhajiyat, 2015). This work aimed to evaluate efficiency of each of the biocontrol agent of *P. putida*, the plant defense activator BTH and the fungicide Beltanol for controlling the charcoal rot disease on watermelon.

MATERIALS AND METHODS

Isolation and identification of the pathogen

Symptomatic watermelon plants showing typical charcoal rot on the root and basal part of stem, collected from four locations around Baghdad capital during 2013-2014. Small segments of infected roots and stalks were surface sterilized with 1% sodium hypochlorite for two minutes and rinsed twice with sterilized distilled water, dried by clean filter paper in the laminar flow cabinet. The pieces were cultivated in the plates containing PDA medium with 200mg/L of Tetracycline and incubated at 25±1C° for 3-5 days. Fungal growth around the segments were transferred individually into PDA and incubated at 25±1C° for 5-7 days. Isolates were identified on the basis of cultural and morphological characteristics as described by Sutton (1980). The

$$\text{Germination (\%)} = \frac{\text{No. of seeds germinated}}{\text{Total No. of seeds}} \times 100$$

Pseudomonas putida isolate

The bacterial isolate of *P. putida* (Pp) was obtained from (Department of Environmental Engineering, Faculty of Engineering, University of Mustansiriyah), inoculum suspension was preserved in the nutrient broth medium and incubated at 27 C° for seven days with constant shaking, Colony forming units CFU/ml was estimated using plate count technique according to the formula below:

No. of CFU/ 1ml = No. of colonies (30-300) × the dilution factor of the plate counted (Harrigan, 1976)

Antifungal assay *in vitro*

The antifungal efficiency of the bioagent *P. putida* (Pp), the plant growth activator (BTH) (Benzo [1,2,3] thiadiazole-7-carbothioic acid-S-methyl ester) trade name Bion[®] produced by the Syngenta company/ South Africa and the fungicide Beltanol (B) produced by Probelte/ Spinach against the fungal isolate of *M. phaseolina* (Mpa-2) were evaluated using the food poisoning technique as described by Nane and Thapliyal (1979). PDA medium was mixed with one ml of each agent, Pp concentration adjusted at 10⁸ CFU.ml⁻¹, BTH 125 mg.l⁻¹ and B 0.25ml.l⁻¹, poured individually into petri dish, a disc of 5 mm of the fungal isolate grown for seven days

isolation frequency of the fungal isolates was calculated.

Pathogenicity of *Macrophomina phaseolina* isolates to watermelon

Sixteen isolates of *Macrophomina phaseolina* isolates were used in this test. Plastic petri dishes (9cm diam.) containing 15-20 ml water agar were inoculated with 5mm diameter agar plugs taken from the margin of master cultures. Seeds of watermelon were surface sterilized by immersing them in 1% sodium hypochlorite solution for two min. The seeds were dried on sterilized filter paper in a stream of filtered air, before transferred to plates using flamed forceps. There were four replicate dishes (contained 25 seeds for each dish) for each isolate. After five days of incubation at 25±1C° the percentage of seed germination was computed according to the following formula:

cultivated aseptically in the center of each plate containing the test agent, similar size of the fungal disc was placed on the PDA alone as a control, each treatment replicated four times, plates incubated at 25±1 C° until the fully fungal growth in the control plates. The antifungal activity was determined by measurement of two perpendicular diametrical for each plate. The percentage of the inhibition calculated according to the formula:

Inhibition (%) = $\frac{\text{Fungal growth diameter in control} - \text{fungal growth diameter in treatment}}{\text{fungal growth diameter in control}} \times 100$

Efficiency of *Pseudomonas putida*, BTH and Beltanol in control charcoal rot

An experiment was conducted in the greenhouse of the plant protection department, college of agriculture, university of Baghdad. Pots (14 cm in diameter) were filled with autoclaved soil (1kg/pot), fungal inoculum of *M. phaseolina* isolate Mpa-2 were prepared by inoculating 5 discs of 5 mm diameter of the fungus grown on PDA (Seven days age) in each 50 gm autoclaved Pearl millet seeds (*Pennisetum glaucum*) and incubated at 25±1 C° for 14 days. Watermelon seeds (Sugar baby cv.) were sown in pots (5seeds/pot). The treatments included Mpa-2+Pp (T1), Mpa-2+BTH (T2), Mpa-2+B (T3), Mpa-2+Pp+BTH (T4), Pp (T5), BTH (T6), B (T7), Mpa-2 (T8) and positive control (T9) without any

addition. Inoculum of Pp was added as soil drench of 40 ml.kg⁻¹ at the concentration of 10⁸ CFU.ml⁻¹ at the same time of seeding, after ten days 40 ml.kg⁻¹ of BTH 125 mg.l⁻¹ was added also by soil drenching, fungal inoculum was added as 1% (w/w) after 12 days and 40 ml.kg⁻¹ of the fungicide Beltanol at the concentration of 1 ml.l⁻¹ was added after 14 days of seeding. Pots were distributed in green house (25±5C°) according to Complete Randomized Design in four replicates and watered as needed. The plants were harvested after 60 days of fungal inoculation, fresh and dry weight of plants were recorded, disease severity which was assessed using a scale of 0-6.

Where: 0 = healthy plants, 1 = 1-3% of the lower leaves yellowing, 2 = 4-10% of the lower leaves yellowing with slight discoloration on the roots, 3 = 11-25% of the leaves are yellowing and wilting towards the apical of the plant with brown discoloration on the roots and crown, 4 = 26-50% of the lower leaves are dried, dark brown discoloration and rotting on the roots and crown, 5 = 51-75% of the leaves drying with black rotting on the roots and crown, 6 = 76-100% of the leaves drying and black rotting all the roots and crown area or plant dead. The percent of disease severity was calculated according to the following formula:

$$\text{Disease severity(\%)} = \left\{ \frac{\sum (\text{No. infected plants} \times \text{their infected degree})}{\text{Total examined tested plants} \times \text{upper infected degree}} \right\} \times 100 (\text{McKinney, 1923})$$

RESULTS AND DISCUSSION

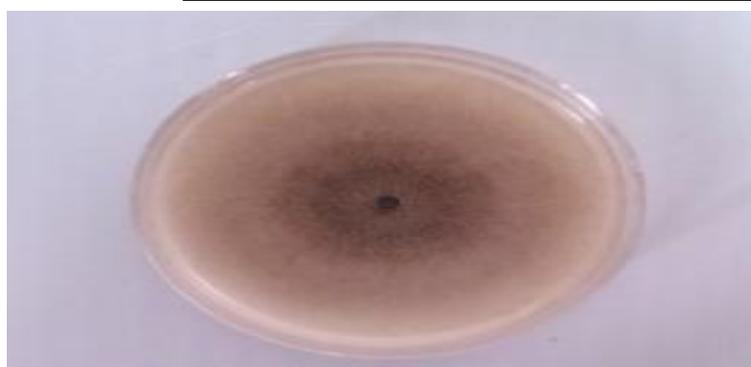
Isolation and identification of pathogen

The results in (Table 1) indicated presence of the phytopathogenic fungus *M. phaseolina* in all the samples with frequency ranged between 45-66%. The fungus formed colonies on the PDA ranged in color from white to brown or gray and darken with age, and produces microsclerotia tiny black in color and smooth round to oblong or irregular in shape (Fig. 1). Cultural and morphological characteristics of this fungus similar to those described by Sutton (1980). These results were in agreement with Aegerter et al. (2000) who isolated several fungi from symptomatic roots of melons in commercial fields in California. The frequency of the fungal isolates

were varied with the root symptomology. *Pythium* spp. and *M. phaseolina* were frequently associated with a wet, brownish root rot. Mahdizadeh et al. (2011) detected fifty two *M. phaseolina* isolates from 24 host plant species through the 14 Iranian provinces, and confirmed to species using species-specific primers. Epidemic charcoal rot in cantaloupe melon (*Cucumis melo* L.) was also observed in Chile during 2011- 2012 when the disease incidence ranged between 32% to 82%, and fifty seven of the isolates identified as *M. phaseolina* based on the cultural and microscopic characteristics Jacob et al. (2013).

Table (1):- Ocurance of *M. phaseolina* in the watermelon root samples

Sample No.	Location	Frequency (%)
1	Abu Ghraib	60
2	Latifia	45
3	Madain	52
4	Taji	66



A



B

Fig. (1);- Cultural and microscopic characteristics of *M. phaseolina*. A= Upper view of *M. phaseolina* colony growth on PDA , B= Microsclerotia x40

Pathogenicity of *M. phaseolina* isolates to watermelon

The results of the pathogenicity test of the *M. phaseolina in vitro* showed that all the isolates significantly reduced seed germination due to percentage of seed germination was 0-65% (Table 2) compared with entire healthy seedling in control treatment. The Mpa-2 isolate revealed the highest full reduction of seed germination. The variation between isolates virulence may be due to soil properties, and environmental conditions

prevailing in the cultivated area and the practices. In this aspect Erzurum et al. (2000) reported that 26 isolates of the total 51 of the fungus *M. phaseolina* recovered from wilted plants collected from several areas in Turkey, isolates of the Mp showed more variation in the pathogenicity ability ranged between 3.5 % to 82 %. Chehri et al. (2010) indicated that eight isolates of the *M. phaseolina* were the main causal agents of the cucurbit crown and stem rot.

Table(2):- Effect of *M. phaseolina* isolates on watermelon seed germination

Location	Isolate	Seed germination (%)
Abu Ghraib	Mpa-1	15
Abu Ghraib	Mpa-2	0
Abu Ghraib	Mpa-3	30
Abu Ghraib	Mpa-4	20
Latifia	Mpl-1	45
Latifia	Mpl-2	50
Latifia	Mpl-3	65
Madain	Mpm-1	30
Madain	Mpm-2	20
Madain	Mpm-3	15
Madain	Mpm-4	10
Madain	Mpm-5	60
Taji	Mpt-1	45
Taji	Mpt-2	25
Taji	Mpt-3	20
Taji	Mpt-4	60
	Control	100

LSD (0.05) = 6

Antifungal assay *in vitro*

The results of the antifungal test of the bioagent *Pseudomonas putida*, and the fungicide Beltanol *in vitro*, demonstrated significant mycelial growth inhibition of the fungus *M. phaseolina*, when exhibited 88.8% and entire growth inhibition, respectively compared to wholly growth in the control (Table 3). Glandorf et al. (2001) confirmed that *P. putida* inhibited plant pathogens through production of the secondary metabolites such as siderophores, antibiotics, phenazine and volatile compounds. No inhibition effect observed in the BTH treatment as shown in the (Fig. 2). Several authors explained that BTH do not have antimicrobial properties against the phytopathogens directly, instead of that it induced active systematic acquired resistance SAR signal

transduction pathway in several plant species (Cole 1999; Godard et al. 1999; Brisset et al., 2002).

Table (3):- Inhibition effect of the bioagent, chemicals inducer and beltanol fungicide against *M. phaseolina in vitro*

Treatment	Inhibition (%)
Mpa-2 + Pp	88.8
Mpa-2 + BTH	0.0
Mpa-2 + B	100.0
Control (Mpa-2)	0.0
LSD (0.05) = 5.5	

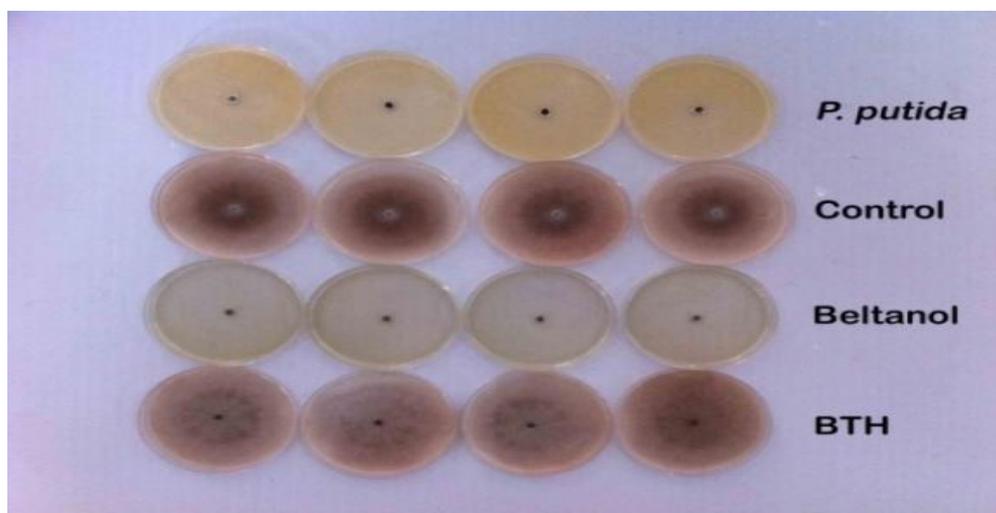


Fig. (2):- Inhibition effect of the *P. putida*, BTH and Beltanol against *Macrophomina phaseolina in vitro*

Efficiency of *P. putida*, BTH and Beltanol in protecting watermelon plants from charcoal rot under greenhouse conditions

The results recovered that, the complete seed germination was observed in the treatment of Pp + BTH compared to 65% in the negative control (Mpa-2 alone), followed by the treatment of fungicide B which was 95% (Table 4). Significant wholly reduction in disease severity was recorded in the B and Pp+BTH treatments compared with 83.3% in the negative control. All the agents has been found to improve the plant growth by increasing the fresh and dry weight of the plants, particularly in the treatment of Pp+ BTH, which attained 13.85, 1.290 gm/plant respectively, similed with 2.46, 0.182 gm/plant for fresh and dry in the negative control for both characters

respectively. The integrated of the bioagent *P. putida* and the plant growth activator BTH together can significantly supported plant health with various ways. In general PGPR such as *P. putida* enhance the plant growth directly by increasing such minerals as nitrogen, phosphorus and other essential nutrients and growth regulators by decreasing the damage effects of the pathogens on the plant in the systems of biological control agents (Rani et al. 2012). The plant defense activator BTH has been developed as a potent SAR, it is often associated with the different cellular defense responses, such as synthesis of phytoalexins, pathogenesis-related proteins (PR), rapid alterations in cell wall component, accumulation of active oxygen species (AOS) and enhanced effect of different defense-related

enzymes (Ryals et al. 1996; Ma and Wang, 2007). Similar results were previously shown that plants inoculated with *Pseudomonas putida* significantly increased plant growth, pod number, chlorophyll, nitrogen, phosphorus and potassium contents and

reduced galling, nematode multiplication and root-rot disease of chickpea caused by *Meloidogyne incognita* and *Macrophomina phaseolina* (Akhtar and Siddiqui, 2007).

Table(4):- Effect of the *P. putida*, BTH and Beltanal on the charcoal rot disease of watermelon under greenhouse condition

No.	Treatment	Germination (%)	Severity (%)	Fresh weight (gm/plant)	Dry weight (gm/plant)
1	MPa-2 + Pp	90.0	16.6	9.87	0.528
2	MPa-2 + BTH	75.0	33.3	5.37	0.467
3	MPa-2 + Beltanal	95.0	0.0	7.70	0.688
4	MPa-2 + Pp + BTH	100.0	0.0	13.85	1.290
5	Pp	100.0	0.0	11.45	0.920
6	BTH	100.0	0.0	8.10	0.793
7	Beltanal	100.0	0.0	8.65	0.780
8	MPa-2	65.0	83.3	2.46	0.182
9	Control	100.0	0.0	9.45	0.839
	LCD (0.05)	4.0	8.6	0.93	0.181

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NEW RECORD OF *AGRIOTES* SPECIES (COLEOPTERA : ELATERIDAE) FROM KURDISTAN REGION-IRAQ

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ABSTRACT

This study includes a new record of *Agriotes sameki* Platia, 2003, (Coleoptera: Elateridae) for the first time in Iraq ; This specimen was distributed in some localities of (Duhok , Erbil , and Sulaimany province) in Kurdistan Region-Iraq ; The diagnostic characters of this genus and specimen have been described in details and illustrated , specially the important body structures such as antenna, pronotum, mandible, tergites 9th , 10th of the abdomen and male genitalia ; The date , localities distribution and method of collection were mentioned .

KEYWORDS: *Agriotes* , Coleoptera , Elateridae , New record , Kurdistan Region-Iraq .

INTRODUCTION

The new record of the *Agriotes* Eschscholtz, 1829 were collected from some localities in Kurdistan region during the period beginning from March to November / (2014) . *A. sameki* Platia 2003, was recorded for the first time in Turkey (Cate, 2007) . In the Palaearctic region there are 145 species belonged to the genus *Agriotes*, (Lobl and Smetana, 2007).

Additionally according to the cite of (www.faunaeur.org). European fauna of this genus has 35 species, and it can be said that the Turkish faunas is very plushy compared with fauna of European species , Mertlik and Platia (2008) mentioned that there are 69 specimens belonged to the genus *Agriotes*. which is about 47% of Palaearctic region . Several studies have been conducted on this genus by different authors from Turkey and since 1985, described thirty new species in Turkey (Guglielmi and Platia, 1985; Cate and Platia, 1997; Platia and Gudenzi, 1998a, ; Platia, 1989, 2003, 2004a, ; Platia and Schimmel, 1992, 1993). Platia and Gudenzi, (1997) recorded six species of genus *Agriotes* in Syria and Iraq .

According to present literature (Platia and Gudenzi 1997; Platia 2003, 2010 and 2011 and 2012 ; Cate 2007 ; Platia et al. 2009 and 2011 ; Platia and Nemeth 2011). There are 42 species spread in Iraq ,Greece, Lebanon, Turkey and Syria .

The first species of the genus *Agriotes* in Iraq was recorded by Candeze (1863) . Previously in Iraq, Derwesh (1965) mentioned that there are twelve species of click beetles one

of them belong to the genus *Agriotes* . Al-Ali (1977) founded three species in Iraq one specimen of the family elateridae belong to the genus *Agriotes* .

Recently in Iraq, Akrawi (2010) conducted a taxonomic study on this family in Kurdistan region- Iraq , and twelve species were mentioned , one species was belonging to the genus *Agriotes* and was recorded for the first time in Iraq . Platia & Akrawi (2013) contributed to the study of the family Elateridae from Kurdistan region- Iraq and through this study 17 species of this family were reported, two new species of genus *Agriotes* was recorded for the first time in the world (*A. kurdistanus* n. sp., *A. duhokensis* n. sp.) .

MATERIALS AND METHODS

This specimens were collected from different places in Duhok, Sulaimany and Erbil province from Kurdistan region –Iraq , during the period beginning from March to November (2014) Light traps were installed within the Orchard fields and were examined every ten days once time ; after the specimens were killed by freezing or within the alcohol, the preserved of specimens were conducted in the special Riker mounts of insects .

Examination and Measurements

The adult insects were morphologically studied and described using binocular microscope . Body length measured along the mid-line from anterior margin of the frons to apex of elytron ; while the width measured through the widest part of body, length of Pronotum is measured over the mid-line ; Width

measured from the widest area which is usually at the hind angles of posterior pronotum .

The minute body parts were studied by the preparation of slides . They were put in a beaker containing water , when was warm to boiling for 10-12 minutes to soften their parts in order to facilitate of dissection process .

The preparation of the slides for microscopic examination was conducted by dissecting adult using dissecting tools, then the required parts (Head , Abdomen) were placed within KOH 10 % and heated on the heater with shaking for about 10-15 minutes to dissolving the lipid substance from the body, then it was washed under water for 5-8 minutes to reduce the effect of alkali, then placed in glass Petri-dish containing amount of water and dissected under microscope to obtain the required parts ; then these parts transferred to ethanol alcohol 25% , 50% , 75% and 100% , respectively for 2 minutes in each concentrations in order to dehydrate them . Then they were put in xylol for one minute to clear the parts which were mounted in Canada balsam on slides and were covered by cover slides to prepare the slides for description and examination under microscope ; After that the parts were photographed and illustrated then measured by using (Microscope Eye-piece camera – Dino-eye- Am-4023X)

RESULTS AND DISCUSSION

names of family Elateridae the subfamily and tribe placement for genus list under the follow (Bouchard et al., 2011)

Subfamily- Elaterinae Leach, 1815

Tribe- Agriotini Laporte, 1840

Genus- *Agriotes* Eschscholtz, 1829

Species Examined:

36 specimen () males , from Kurdistan region- Iraq. Duhok- Akre, Amedi, Zawita, Zaxo ; Erbil - Xabat, Shaqlawa, Suran ; Sulaimany- Dukan .

Distribution Of Species : This species was also founded in Turkey . (Cate, 2007).

Diagnostic Characters Of The Genus *Agriotes* (Figs. 2, 4, 5)

The second segment of antenna smaller than third segment . Molar area of mandible with one teeth . Precoxal groove narrow and mesocoxal cavity opened to mesepimeron and mesepisternum . First segment of metatarsus longer than other segments ; base of claws with out setae .

DESCRIPTION

Agriotes sameki Platia, 2003

(Platia 2003 : 21 ; Cate 2007 : 117)

Body- boat-shaped, slightly convex . The head and pronotum radden to brown, Elytron and abdomen brown; integument semi-shiny ; body length (9.12-9.46 mm), width (2.5–2.8 mm) .

Head-(Fig.1) Moderately steep, compound eyes large notable clearly black; Frons oblate among to eyes, slightly concave prior the anterior margin , end point not thickening and sub-straight; fronto-clypeal area sloping to the basal of clypeus; frontal carina incomplete across of frons; labrum rounded and exposed in shape; surface of head overall panctate, covered with dense, short, yellow-fulvous hairs .

Antennae-(Figs. 2, 4) The length 4.2-4.5 mm, exceeded by nearly 2 segments of apex from posterior angles of pronotum, serrate-type sub-triangular from fourth segment to tenth segment ; last segment elongate semi-oval ; Second and third segment were small , second segment sub-conical 1.4 times longest than width , third sub-triangular 1.2 times longest than wide, second and third segments closely similar in length but third segment was wider than second segment and combined together were clearly shortest than fourth segment .

Pronotum-(Figs. 1, 3) slightly convex , length 2.2-2.5mm , as long as wide , contain a trace of midline, depressed from basal slope ; sub-parallel sides extend the middle to anterior margin, concave before the posterior angles , acuminate and separate, carina parallel with lateral margins very fine and visible , removal from middle ; punctures distributed partly regulated ; punctuation from the dorsal umbilical , with changeable spacing in average smallest than diameters, denser gradually across the sides , contiguous almost from the sides of extremities .

Scutellum- (Fig. 6) semi-oval, shield liked , fluted at base, oblate, high densely punctured with short, dense, yellow hairs. posterior margin of mesosternum cavity extended in distance posterior shortly cavity deep; mesocoxal longer than wide once time ; mesocoxal cavity deeply open to mesepimeron and mesepisternum ; mesosternum and metasternum separately by distinguish external suture .

Elytra- Elongate, convex, elytran 2.3 times longest than pronotum, and 2.6 times longest than width, parallel sides at apex to middle then tapered gradually to apex part, the surface with deeply striate regularly marked and punctured, engraved, with high dense, short, yellow hairs. Abdomen- (Fig. 7) semi-oval, punctuate, with many short yellow hairs, abdominal sternites 1-4 oblong-shaped, fifth abdominal sternite subtriangulate with circularly post margin, the ninth tergum of abdomen cup-shaped, anterior margin at middle dented deeply to inside, the last

abdominal tergum triangulate-shaped so the two last abdominal segments very important to identification the species of this family (Akrawi, 2010).

Male genitalia- (Fig.8) Parameres astraddle, conical-shaped, triangulated at apex; distinct, with distal tooth pointed and directed contrarily; Aedeagus (median lobe) cylindrical shaped, tapered apex, length 1.2-1.4 mm, longer than parameres; Phallobase C-shaped, broad at the base, acuminate from the sides.

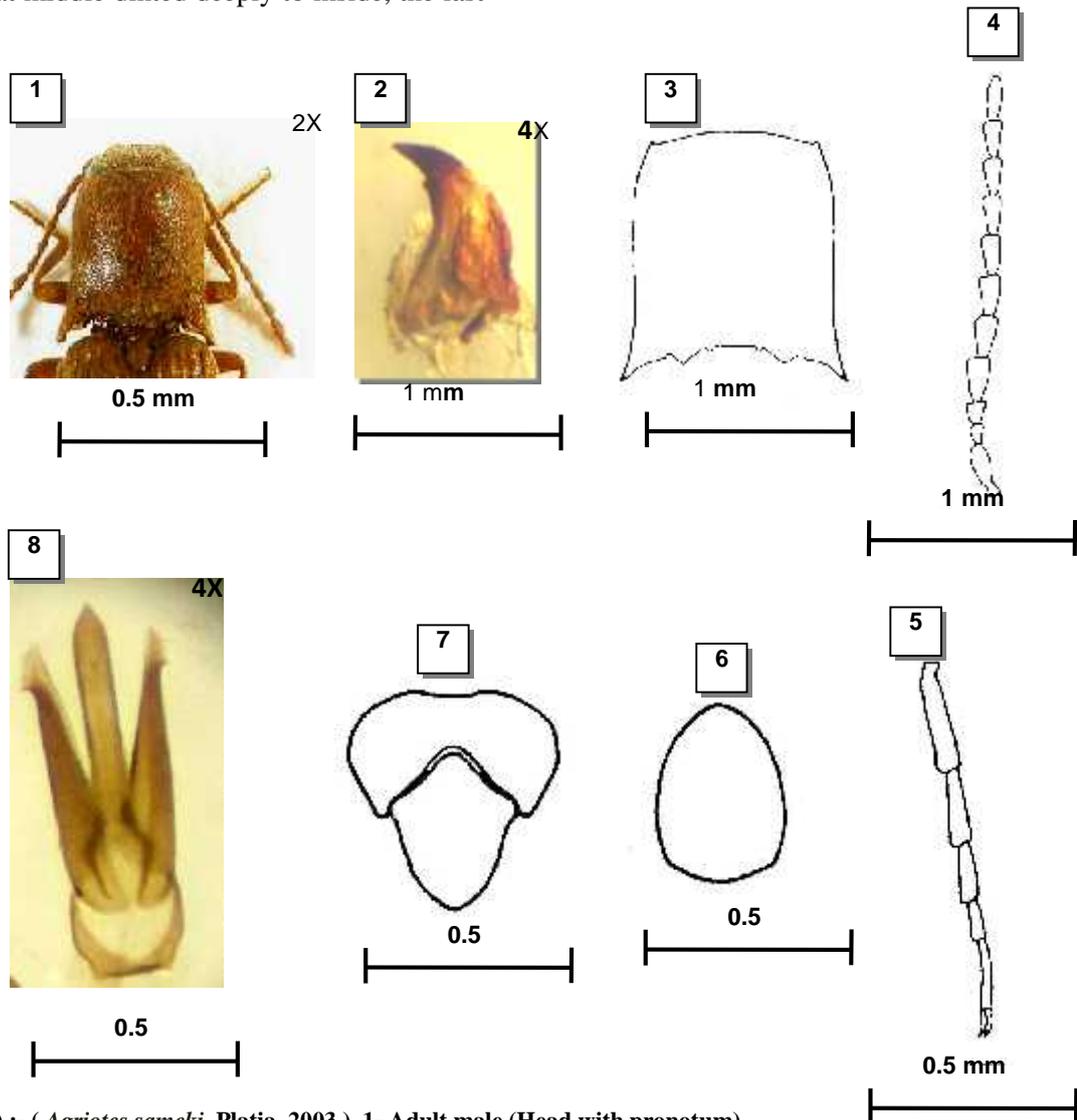


Fig.(1-8) :- (*Agriotes sameki* Platia, 2003) 1- Adult male (Head with pronotum)
 2- Mandible 3- Pronotum
 4- Antenna 5- Metatarsus with claws
 6- Scutellum 7- Tergum 9th & 10th of Abdomen
 8- Male genitalia

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OCCURRENCE OF MAJOR FUNGAL AND BACTERIAL DISEASES ON STONE FRUITS IN DUHOK PROVINCE, KURDISTAN REGION, IRAQ

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ABSTRACT

During spring 2013 to autumn 2014, systematic survey of diseased stone fruit trees was carried out in orchards of Duhok province, Kurdistan Region, Iraq. Bacterial canker & gummosis was the most common bacterial disease observed on peach and apricot in (41) and (17) locations by the incidence rate of 27.7% and 34.41% respectively. On plum, almond and cherry disease was also occurred in 7, 5, 1 locations, respectively. Shot hole was second more common disease, where recorded on peach, apricot, plum, almond and cherry in 17, 10, 4, 3 and 1 location while disease incidence reached 20.95, 36.25, 53.7, 22.5 and 70% respectively. The major fungal diseases recorded during this study were peach leaves curl observed in 4 locations on peach with moderate infection & one location in apricot with slightly infection and powdery mildew recorded on peach.

KEYWORDS: stone fruits, survey, bacterial & fungal diseases.

INTRODUCTION

Stone fruits specially peach, apricot, almond and plum are among of the most important fruits known in Kurdistan region of Iraq. They are very preferable fruits and attractive to consumers due to solid contents which are carbohydrates, organic acids, pigments, phenolic, vitamins, volatiles, antioxidants, and trace amounts of proteins and lipids that make them (Kader and Mitchell, 1989; USDA, 2003).

The most common diseases of stone fruits worldwide causes major economic losses occur from diseases that directly infect the fruit and reducing marketability of them or that weaken or kill trees. Brown rot caused by the fungus *Monilinia fructicola* causes major losses as fruit are ripening. The bacterial canker and gummosis caused by *Pseudomonas syringae* pv. *Syringae*, and shot-hole caused by *Xanthomonas* spp. were also distractive and effects fruit, leaves, and twigs and causes major fruit loss on susceptible cultivars also (NCSU, 2005). Stone fruits are vulnerable to several fungal & bacterial diseases in Iraq specially Kurdistan region which is include most stone fruits growing area. The most common diseases observed on these fruits in Kurdistan region include Shot-hole, Canker and gummosis, Brown rot, peach leaves cur, and Powdery mildew.

The aim of this survey project is to assess disease incidence and severity of major diseases which attack stone fruits trees grown in the different locations in Duhok, Kurdistan region – Iraq to obtain a clear idea and up-to-date information about present these diseases.

MATERIALS AND METHODS

Asystematic survey of stone fruit orchards in Duhok province was conducted during early spring 2013 to autumn 2014 in cooperation with the monitor's staff in General Directorate of Agriculture, Ministry of Agriculture to assess the prevailing, severity, incidence and distribution of the diseases in major growing area of stone fruit trees (N 36.860, E 42.980). More than 100 nurseries and orchards were inspected randomly located in different area of Duhok province, Duhok center, distracts, Akre, Bardarash, Amedi, Sumel with their sub-distract and their village the percentage of disease incidence and scores of disease severity were recorded at each location. The disease records were taken using 0 -5 rating scale, 0 = healthy and 5 = destructive (+++++) infections. Diseased samples of infected parts (stem, leaf and fruit) of stone fruits trees were collected from each surveyed location and brought to laboratory of Plant Protection Department-college of Agriculture-University of Duhok, for isolation and further identification. Short

description of field observing symptoms were documented and supported with diagnostic photos of the damaged plant parts. Duration of progress and development of each disease and disease host range were also recorded.

RESULTS & DISCUSSION

Field symptomatology of the major diseases on stone fruits:

1. Shot hole = Pathogen *Xanthomonas Spp.* (Smith, 1903; Vauterin, Hoste, Kersters & Swing 1995.) Diagnosed and identified according to

EPPO (2006). Circular to irregular, water-soaked spots about on leaves are the earlier stage of this disease. Later on, those spots turn to purple or brown in color. Usually, halos and cracks can be seen between spots and around the healthy tissue. Affected area breaks away from the surrounding healthy tissue, drop out, and give a shot-ridden appearance, known as shot hole (Fig.1-A, B), Each leaf may have one to numerous holes or combination of hole and spots (Scortichini, 2010).

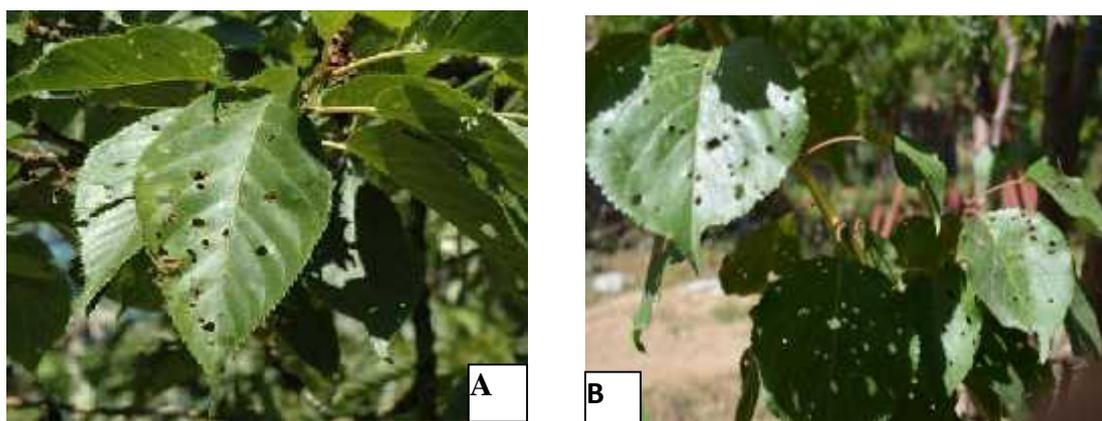


Fig.(1):- Shot hole symptoms on cherry (A) and apricot (B).

2. Bacterial canker & gummosis on stone fruits :

pathogen *Pseudomonas syringae pv.syringae* Molecular and Biochemical Identified in Duhok by (Wazeer A. Hassan *etal*, 2004).The most characteristic symptom of this disease is canker formation accompanied by gum exudation (Fig. 2- B, C). Cankers usually develop at the base of infected spurs, in pruning wounds, and at the bud union. Infected areas are slightly sunken and

darker brown than the surrounding healthy bark (Fig.2-A). The cortical tissues of the cankered area are bright orange to brown. Under effect of cankers and exudate gums many leaves show curling and drooping and turn light green and then yellow in the fields. Dormant bud blast great numbers of buds are killed especially serious on Peach, cherry, apricot, and plum (Scortichini, 2010).



Fig.(2): - cankers on stem of peach tree (A) gum exudation on cherry (B) and almond(C).

3. Peach Leaf Curl: pathogen *Taphrina deformans* (Berk.) Tul., 1866.) Identified according to Mix (1956). Affected leaves are thickened, distorted, and curled downward and inward (Fig. 3-B).

Leaves at first appear reddish or purplish (Fig.3-A), but later, they appear reddish yellow or powdery gray, turn yellow to brown, and may drop (Agrios, 2005).



Fig.(3): -Curled reddish or purplish leaves (A), thickened, distorted and curled leaves (B)

4. Powdery Mildew :

Pathogen *Podosphaera leucotricha*, Identified according to Paul F. C. and P. M. Kirk,(2007). The fungus attacks leaves and twigs, Infected leaves curl upward. Newly developed leaves on new shoot growth become progressively smaller, are generally pale, and are somewhat

distorted. By disease progress the whitish fungus can be seen growing over the leaves and shoots, sometimes in patches and other times covering most of the new growth (Fig.4- A). Also sometimes fruits are covered by fungal whitish growth (Fig.4- B) (Marion and Diane, 2011).



Fig.(4): -powdery mildew on peach leaves curl upward & covered White powdery (A) White powdery fungus growth on peach fruit (B).

Incidence, severity, and distribution of major diseases:

Occurrences, time, incidence and location of fungal and bacterial disease of peach are demonstrated in (Table 1).

Most common disease of peach recorded during this survey were Bacterial canker & gummosis on stone fruits (*Pseudomonas*

syringae pv.*syringae*), Shothole, (*Xanthomonas campestris* pv. Pruni), peach leaf curl(*Taphrina deformans*) and Maximum incidence of Bacterial canker & gummosis on peach reached 60 % with severe symptoms were occurred in Zakho-Batifa followed by 50% in Bardarash-Drisha then by 40% in Amedy-Spindare with moderate severity.

The minimum incidence 4% observed in (Mangesh-Kosa) and 5% in (Akre and Duhok-Chamane). Second widespread disease of peach was Shot hole which recorded higher incidences 60% in Sumel-Grshin and Amedy-Mangesh-Mjimkhite with severe symptoms. 5% incidence was recorded in (Akre/Dzok) and (Zakho-bedare),

with minimum (1 and 2%) in Amedi-Harika shekha.

Peach leaf curl observed only in four location during this survey with its highest incidence 40% in Zakho-Batifa while the lowest 15% incidence in (Shekhan-Qasrok) and (Bardarash,dareto). Powdery mildew only observed in Amedi-Jalok 3% with slight score.

Table (1): -Distribution, disease incidence and occurrence period of major fungal and bacterial diseases of peach in Duhok province.

Host	Disease	Location	Occurrence Time	% Incidence	Severity scores
Peach	Bacterial canker & gummosis	Zakho-Batifa	6/4/2014	60	Severe +++
		Akre	7/4/2014	5	Slight +
		Bardarash	15/4/2014	10	Slight +
		Bardarash-Drisha	20/4/2014	50	Severe +++
		Akre-Kelaby	20/4/2014	10	Slight +
		Akre	27/4/2014	5	Slight +
		Duhok-Chamane	15-5-2014	5	Slight +
		Akre-Shrmn	25-5-2014	25	Moderate ++
		Zawita-Kamaka	15-5-2014	20	Slight +
		Shekhan-Qasrok	7-5-2014	6	Slight +
		Amedi-Sarsink	28-5-2014	10	Slight +
		Bardarash, Rovia	4-5-2014	15	Slight +
		Shekhan-Qasrok	30-7-2013	25	Slight +
		Zakho -Batifa-Dahk	28-7-2013	30	Moderate ++
		Amedi-Chamanke	24-7-2013	10	Slight +
		Mangesh-Kosa	18-7-2013	4	Slight +
		Duhok center	16-7-2013	15	Moderate ++
		Bardarash-Efkhorde	29-9-2013	10	Slight +
		Akre-Bosl	22-10-2013	10	Slight +
		Shekhan-Qasrok	22-10-2013	25	Slight +
	Amedi-Spindare	22-10-2013	40	Moderate ++	
	Bardarash- Darato	27-10-2013	10	Slight +	
	Akre-Bajer joor	29-10-2013	35	Moderate ++	
	Shot hole	Sumel-Grshin	25-5-2013	60	Severe +++
		Zakho -bedare	11-6-2013	5	Slight +
		Bardarash-rovia	2-6-2013	30	Moderate ++
		Amedi Sarsink-Sarhildan	11-6-2013	30	Moderate ++
		Amedi Mangesh-baroshkasaddun	20-6-2013	30	Moderate ++
Amedi Mangesh-Mjilkhte		25-6-2013	60	Severe +++	
Zakho/Grek- sendy		4/8/2013	30	Moderate ++	
Zakho/alwa Zakho		4/8/2013	20	Moderate ++	
Akre/Dzok		13/8/2013	5	Slight +	
Akre/Bgel		18/8/2013	17	Moderate ++	
Amedi/Chamanke		19/8/2013	40	Severe +++	
Sumel/Dlb sufly		19/8/2013	30	Severe	

				+++
Peach Leaf Curl	Amedi-Harika shekha	29-7-2013	2	Slight +
	Akre-Grdasin	11-7-2013	10	Slight +
	Akre-Grdasin	9-7-2013	60	Severe +++
	Amedi-Harika shekha	29-7-2013	1	Slight +
	Shexan/xns	13/8/2013	5	Slight +
	Berdarash-Dareto	27-10-2013	5	Slight +
	Zako-Batifa	7-7-2013	40	Severe +++
	Shekhan-Qasrok	30-7-2013	15	Moderate ++
	Dohuk, bardarash, derat	25/9/2013	15	Moderate ++
	Akre-Bedry	22-10-2013	18	Moderate ++
Powdery Mildew	Amedi-Jalok	23-7-2013	3	Slight +

Fungal and bacterial diseases of apricot are shown in (Table. 2), higher disease incidence of Bacterial canker & gummosis on apricot were 50% in Amedi-Sarsang-Tajeka and Akre-Warmel and 45% Sumel-Dulobsofi, while the minimum was 5% in Akre-Kelabi with slight symptoms.

Maximum disease incidence of Shot hole (70%) recorded in Zakho-Sharansh with severe symptoms, while minimum (25%) recorded in both location of Zakho-batefa and Sarsng-Dhik. leaf curl disease recorded in Zakho -Batifa with disease incidence reached 3%.

Table (2): - Distribution, disease incidence and occurrence period of major fungal and bacterial diseases of apricot in Duhok province.

Host	Disease	Location	Occurrence Time	% Incidence	Severity scores
Apricot	Bacterial canker & gummosis	Sumel-Marina	2/4/2014	30	Moderate ++
		Akre-Kelab	20/4/2014	5	Slight +
		Akre-Dinarta	20/4/2014	10	Slight +
		Sumel-DulBsofi	22-5-2014	45	Severe +++
		Sumel-Dulbsofi	30-5-20114	45	Severe +++
		Atrosh-Azakh	4-6-2013	30	Moderate ++
		Amedi-Sarsing-Tajeka	10-6-2013	50	Severe +++
		Amedi-Bamarne	21-7-2013	10	Slight +
		Akre-Warmel	17-7-2013	50	Severe +++
		Duhok-Gavarke	15-7-2013	15	Slight +
	Shot hole	Bardarash-Zngl	4-7-2013	35	Moderate ++
		Amedi, mangesh, kotel	17/9/2013	30	Moderate ++
		Amedi-Maye	23-10-2013	41	Moderate ++
		Amedi-Deralok	25-5-2014	40	Moderate ++
		Sumel-Dulbsofli	20-6-2013	40	Moderate ++
		Sarsink-Kindk	22-6-2013	30	Moderate ++
		Zakho/Grk sndy	4/8/2013	60	Severe +++
		Zakho/Sharansh	5/8/2013	70	Destructive ++++
		Amedy/Dore	20/8/2013	45	Moderate ++
		Zakho, batefa	4/9/2013	25	Moderate ++
Leaf Curl	Sarsng/Dhik	27/8/2013	25	Moderate ++	
	Duhok, mangesh, Baroshkasaadon	11/9/2013	30	Moderate ++	
	Zakho-Batifa	7-7-2013	3	Slight +	

On Plum, (Table. 3) Bacterial canker & gummosis on stone fruit with maximum incidence 40% (Amedi-Warmel) and minimum 5% (Akre-Dinarta), fruits Shot hole maximum 75% (Zakho-Grk sndy) with minimum incidence 30% in (Amedi-Hrore).

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Table (3):- Distribution, disease incidence and occurrence period of major fungal and bacterial diseases of plum in Duhk province.

Host	Disease	Location	Occurrence Time	% Incidence	Severity scores
Plum	Bacterial canker &gummosis	Akre- Dinarta	20/4/2014	5	Slight +
		Akre center	22/4/2014	10	Slight +
		Amedi-Warmel	23/7/2013	40	Moderate ++
		Amedi-Spinadara	21/7/2013	25	Slight +
		Zakho/alwa Zakho	4/8/2013	20	Moderate ++
		Duhok/Mangeshk	20/8/2013	10	Slight +
	Shot hole	Amedi- serseng-Maye	23/10/2013	20	Moderate ++
		Zakho/Grk sndy	4/8/2013	75	Moderate ++
		Akre/Dinarta	21/8/2013	70	Moderate ++
		Amedi/Dargal Mosa bag	25/8/2013	40	Moderate ++
	Amedi/Hrore	26/8/2013	30	Moderate ++	

Bacterial canker &gummosis on stone fruits and Shot hole are only bacterial diseases observed on Almond in Duhok province during this survey (Table. 4), maximum disease incidence of bacterial canker &gummosis (55%) observed in

Amedy-Dargal Mosa bag and minimum (5%) in Duhok-Bade.

Shot hole disease noticed by the rate of 10 and 30% in each of Akre-Dinarta and Akre, mzrenkan respectively.

Table (4): -Distribution, disease incidence and occurrence period of major fungal and bacterial diseases of Almond in Duhok province.

Host	Disease	Location	Occurrence Time	% Incidence	Severity scores
Almond	Bacterial canker &gummosis	Duhok-Bade	18-5-2014	5	Slight +
		Duhok- Sumel-Chambarekat	26-5-2014	25	Moderate ++
		Amedi-Sarseng-Sarheldan	11-6-2013	30	Moderate ++
		Amedi-Spindari noz	21-7-2013	50	Severe +++
		Amedi/Dargal Mosa bag	26/8/2013	55	Moderate ++
		Duhok center	25-5-2014	20	Slight +
	Shot hole	Akre-Dinarta	20-5-2014	10	Slight +
		Akre-mzrenkan	3/9/2013	30	Moderate ++

In Cherry, bacterial canker &gummosis recorded only in Zakho--Rzgary with disease incidence reached 40% and Shot hole by disease

incidence 70% in Zawita-Bajelor with destructive symptoms (Table. 5).

Table (5):- Distribution, disease incidence and occurrence period of major fungal and bacterial diseases of Cherry in Duhok province.

Host	Disease	Location	Occurrence Time	% Incidence	Severity scores
Cherry	Bacterial canker &gummosis	Zakho--Rzgary	8/4/2014	40	Moderate ++
	Shot hole	Zawita-Bajelor	10-5-2014	70	Destructive ++++

Location and distribution of most common diseases of stone fruits in Duhok province:

Bacterial canker & gummosis and shot hole were most common disease on stone fruits in

Duhok province (Table. 6) which recorded in all stone fruit genera.

Bacterial canker & gummosis are come over in the first grade where observed in 41 and 17 locations on each of peach and apricot with

disease incidence 27.7 and 34.41% respectively as well as this disease was recorded on each of plum, almond and cherry in 7, 5 and 1 location respectively. The existence and deployment of this disease on stone fruits was also reported by Hartman and Bachi (2005).

The most appearance of this disease was in peach orchards then apricot, Plum, almond and cherry. These results agree with Ritchie and Clayton (1981) who indicated that bacterial canker & gummosis was a major disease on stone fruits especially on peach.

In general numerous factors can predispose stone fruits tree to infection and development of bacterial canker.

These factors include low soil pH, rootstock, frost damage, soil type (more common in light, sandy soils), tree age, inappropriate cultural practices such as early pruning, deep disking that damages roots, and environmental factors such as an excess rainfall in autumn and winter and temperature extremes that injure the trees. (Davis and English 1969; Scortichini, 2010).

The winter frost in Kurdistan region may also contribute in higher incidence and severity of bacterial canker, the high effect of frost was reported by Kennelly *et al.*(2007). The initial distribution of bacterial canker might be due to the introduction of the pathogen on latently infected trees randomly planted in the orchard which act as source of inoculum for secondary infection. New infections found on the nearby affected tree. Moreover, the disease spreads preferentially to trees down-wind of the infected tree (Martins and Scortichini, 1998).

Shot hole was second more common disease on stone fruit in Duhok provinces, this disease observed in 17 orchards with 20.95% mean of

disease incidence on peach trees followed by 10 locations with 36.25% as well as on apricot, on plum, almond and cherry in 4, 3 and 1 location respectively, with disease incidence 53.7, 22.5 and 70% (Table, 6).

Bacterial shot-hole, caused by the bacterium *Xanthomonas arboricola* pv. pruni (Smith) Vauterin et al., previously named *Xanthomonas campestris* pv. pruni (Smith) Dye is widely distributed on susceptible cultivars of peaches, nectarines, almonds, apricots, plums, prunes, and cherries (University of Illinois, 1988). During this study, fruits were affected in the late season, with lower incidence and severity comparing to leaf infection. This could be contributed to the lower density of stomata on the fruit surface compared to leaves (Saccardi and Goio, 1990).

In addition, fruits are not subject to water congestion because the somatic chamber is less influenced by the hydrostatic pressure of the xylem. A delay in fruit infection has been previously reported by (Shepard and Zehr, 1994). peach and apricot are most susceptible to bacterial canker & gummosis and shot hole, since recorded in most surveyed orchard (table, 6), but beside that there are fact that both of peach and apricot are most common stone fruits growing in Duhok province followed by plum then almond which is mostly naturally distributed in mountainous area but bacterial canker & gummosis only recorded in one location on cherry with 40% means of disease incidence, but reason on recording this disease only in one orchard isn't means that cherry trees are not susceptible but may due to the fact that farmer in Duhok province recently begin to establishing cherry orchards and there are few cherry orchards in Duhok.

Table (6): -Means of most common disease incidence and number of locations that disease recorded on stone fruits in survey during 2013-2014 in Duhok province.

Disease	Host	Means of Disease incidence (%)	No. of Locations
Bacterial canker & gummosis	Peach	27.7	41
	Apricot	34.41	17
	Plum	22.5	7
	Almond	37.5	5
	Cherry	40	1
Shot hole	Peach	20.95	17
	Apricot	36.25	10
	Plum	53.7	4
	Almond	22.5	3
	Cherry	70	1

However, the frequency and degree of severity for these diseases depend on such various conditions as altitudes, climates, cultivars, plant age, and management practices. The latter are remarkable factor for breeding vigourously trees defend pathogen's attack because these diseases require integrated management for reducing as possible the wind or soil – borne inoculum of either fungal or bacterial pathogens (Agrios , 2005). It is possible that such trees may be infected with other fungal and bacterial didn't observe or not covered during this survey.

Results from table (7) demonstrate that major stone fruits disease in Duhok province (Bacterial canker & gummosis and shot hole) were mostly observed during April to September, in peach means of bacterial canker & gummosis disease incidence in September-2013 was highest 24%

moderate severity while, most severe infection by shot hole disease recorded in May-2013 above 60%. Peach leave curl (27.5%) was most distractive on peach in July-2013 its consider hot month in summer of Duhok province which made appearance of this disease most distractive. In apricot 45% observed as bacterial canker & gummosis incidence during May -2014 and shot-hole was more sever in August-2013(58.3%). Bacterial canker & gummosis disease in plum was 32.5% in July-2013 but shot hole was 53.7%.

In Almond means of incidence was 55% in August-2013 for bacterial canker & gummosis and 30% moderate in October-2013for shot-hole.

From result of disease incidence means through the survey months we can see that in warm to hot month disease incidence increased in condition of Duhok province.

Table (7): - Distribution of major stone fruits diseases under condition of Duhok province.

Host	Disease	Occurrence Time	Means of disease Incidence%		
Peach	Bacterial canker & gummosis	4/2014	23.3		
		5/2014	13.5		
		7/2013	16.8		
		9/2013	10		
		10/2013	24		
	Shot hole	5/2013	60		
		6/2013	31		
		7/2013	18.2		
		8/2013	23.6		
		10/2013	5		
	Peach Leaf Curl	7/2013	27.5		
		9/2013	15		
		10/2013	18		
Apricot	Bacterial canker & gummosis	4/2014	15		
		5/2014	45		
		6/2013	40		
		7/2013	27.5		
		9/2013	30		
	Shot hole	10/2013	41		
		5/2014	40		
		6/2013	35		
		8/2013	58.3		
		9/2013	27.5		
Plum	Bacterial canker & gummosis	4/2014	7.5		
		7/2013	32.5		
		8/2013	15		
		10/2013	20		
	Shot hole	8/2013	53.7		
		Almond	Bacterial canker & gummosis	5/2014	15
				6/2013	30
7/2013	50				
8/2013	55				
9/2013	30				
Shot hole	5/2014	15			
	9/2013	30			

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EVALUATION OF DIFFERENT METHODS FOR DETECTION OF SEED-BORNE FUNGI ON LOCAL WHEAT CULTIVARS FROM DUHOK PROVINCE, KURDISTAN REGION, IRAQ

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ABSTRACT

The study aims to evaluate different methods for detection of seed-borne fungi on local wheat cultivars grown in Duhok province, Kurdistan region, Iraq. Agar plate method, blotter method, deep freezing method, seed washing test and embryo count method were used to assess the associated fungi. The first four techniques were found efficient for isolation of *Alternaria alternata*, *Arthrinium phaeospermum*, *Aspergillus flavus*, *A. niger*, *Cladosporium herbarum*, *Ulocladium atrum* and *U. alternariae*. Agar plate method was efficient for detection of ascomycetes viz. *Chaetomium elatum*, *C. globosum*, *Coniocessia annadra*, *Corynascella sp.*, *Emericella rugulosa* and *Eurotium herbariorum*. *Tilletia spp.*, were detected only by seed washing technique. Embryo count technique showed negative result.

KEYWORDS: Seed-borne fungi, Wheat, detection method, Iraq

INTRODUCTION

Wheat is the most important cereal in the world and was one of the first crops that could be easily cultivated on a large scale giving about one third of total production followed by rice (Wiese, 1987).

Fourteen species of wheat (*Triticum* spp) have been recognized (Bowden, 1959, 1966; Kimberled and Sears, 1987). However the major cultivated species are: 1-The common wheat or bread wheat (*Triticum aestivum* L.) .A hexaploid species (2n = 42), that is the most widely cultivated in the world. 2- Durum wheat (*T. durum* Desf, *T. turgidum* L.). Domesticated free threshing species (2n= 28 chromosome). This is cultivated as hard wheat .it has a high amount of proteins (12-16%) which is good for pasta products/macaroni, spaghetti and other noodles (Beuerlein, 2001).

There are a number of fungi which can invade and cause damage to grains and seeds. Fungal infection from spores can occur at any of the various stages of crops production. It can begin in the field, or on the crop itself. It can infect healthy products during transportation and storage. The spores can lay dormant (inactive) in the soil or accumulate in storage. In general terms, these fungi can be divided into two groups: field fungi and storage fungi (Christensen and Kaufman, 1969, 1974).

Field fungi many affect the appearance and quality of seed or grain. Most field fungi are more prevalent when rainfall is above normal during grain fill and harvest. The major genera are *Alternaria* , *Absidia* , *Bipolaris* , *Cladosporium* , *Chaetomium* , *Fusarium* , *Rhizopus* and others (Einkuomehin , 2005).

Storage fungi are usually not present to any serious extent before harvest. Small quantities of spores of storage fungi may be present on grain going into storage or may be present on spilled grain present in harvest, handling and storage equipment or structures. Under improper storage conditions this small amount of inoculums can increase rapidly leading to significant problem (Christensen and Kaufman, 1969). Factors that predispose for the development of storage fungi include moisture, temperature, length of storage time and insect and mite activity in the grains. (Sauer et al. 1984, Shetty , 1993 , Malaker et al .2008).

Sulaiman and Hassan (1985) surveyed the mycoflora associated with wheat grains collected from sixteen silos located in different sites in Iraq. Fifteen genera were reported from wheat grains. *Aspergillus* , *Rhizopus* , *Alternaria* were predominant , followed by those of *Penicillium*, *Cladosporium*, *Ulocladium* and *Fusarium*. Juber and Salahi (2006) evaluated the fungal contamination of six samples of imported wheat grains to Iraq. A total of 30 species belonging to

22 genera were detected. *Alternaria alternata*, *Aspergillus flavus* and *Penicillium* spp., were the most predominant, followed by *Alternaria* sp., *Chaetomium globosum*, *Cladosporium cladosporioides*, *Trichothecium roseum* and *Nigrospora* spp. The highest percentage of contamination was in Argentina wheat which was 1.6×10^4 spores / g, while the lowest was in Australian wheat which was 6×10^2 spores / g. They also reported the existence of the mycelium of *Ustilago tritici* in 83% of the tested samples. Al-Maarouf *et al* (2006) reported that common bunt of wheat is one of the most important diseases of wheat in Al jazera and Northern part of Iraq. They reported yield losses up to 70% in most wheat fields. *Tilletia tritici*, *T.laavis*, *T.intermedia* and *Tilletia* sp. were identified in all infected samples. The highest frequency was reported for *T.tritici* (38.4%) in the north, while both *T.laavis* and *T.intermedia* were more frequent in the south (34.5 and 8.9% respectively) followed by *Tilletia* sp (25.3%) in the middle of Iraq. Hassan and Shames -Allah (2010) recorded *T.lavis* was the most frequent in the middle and southern zone followed by *T.intermedia* in the southern zone and *Tilletia* spp in the middle zone of Iraq. More recently, Abdullah and Atroshi (2014, 2016) analyzed the mycobiota associated with soft wheat grains from Kurdistan region of Iraq. They

identified several newly recorded fungi to Iraqi mycobiota.

The objective of this study was to evaluate different methods for detection of seed-borne fungi on local wheat cultivars grown in Duhok province, Kurdistan region, Iraq.

MATERIALS AND METHODS

Samples collection

A total of 26 wheat samples were collected from four major official sources of wheat in Duhok governorate. Each sample consists of 250-500 gm from each source. Samples of known cultivars of wheat were obtained from Department of field crops, College of Agriculture and Forestry, University of Duhok and from the Directorate of Agricultural Research, Duhok. These include five cultivars of soft wheat (*Triticum aestivum* L) and five cultivars of durum wheat (*Triticum durum* Desf.) In addition to unknown cultivar samples obtained from silos of shekhan and zakho. A working sample of each cultivar was obtained according to the International Rules of Seed Testing Association (ISTA 2009). The details for the cultivar name and their sources are presented in Tables 1, 2.

Table (1): - List of Cultivar of soft wheat (*Triticum aestivum* L.) and their sources .

NO	Cultivar	Source
1-	Iba	Directorate of Agriculture Research, Duhok.
2-	Iba 99	Department of Field crops, Faculty of Agriculture.
3-	Abu – Ghraib	Department of Field crops, Faculty of Agriculture.
4-	Abu – Ghraib	Directorate of Agriculture Research, Duhok
5-	Azadi	Department of Field crops, Faculty of Agriculture.
6-	Azadi	Directorate of Agriculture Research, Duhok
7-	Razgary	Department of Field crops, Faculty of Agriculture.
8-	Razgary	Directorate of Agriculture Research, Duhok
9-	Tamoz 2	Department of Field crops, Faculty of Agriculture.
10-	Tamoz 2	Directorate of Agriculture Research, Duhok
11-	Uuknow cultivar 1	Shekhan Silo.
12-	Uuknow cultivar 2	Shekhan Silo.
13-	Uuknow cultivar 3	Shekhan Silo
14-	Uuknow cultivar 4	Zakho Silo .

Table (2):- List of Cultivar of durum wheat (*T durum.*) and their sources.

NO	Cultivar	Source
15-	Acsad	Department of Field crops, Faculty of Agriculture
16-	Acsad	Directorate of Agriculture Research, Duhok
17-	Creso	Department of Field crop, Faculty of Agriculture
18-	Creso	Directorate of Agriculture Research, Duhok
19-	Sham 3	Directorate of Agriculture Research, Duhok
20-	Doar	Department of Field crop, Faculty of Agriculture
21-	Simeto	Department of Field crop, Faculty of Agriculture
22-	Simeto	Directorate of Agriculture Research, Duhok
23-	Uuknow cultivar 1	Shekhan Silo
24-	Uuknow cultivar 2	Shekhan Silo
25-	Uuknow cultivar 3	Zakhu Silo
26-	Doar	Directorate of Agriculture Research, Duhok

DETECTION OF SEED-BORNE FUNGI

Agar plate method

Fifty seeds were taken randomly from each working sample of each cultivar and then were surface disinfected with 1% sodium hypochlorite in beaker for 5 minutes, washed twice with sterilized water. Potato dextrose agar (PDA) and oat meal agar (OTA) were used in this method for isolation of fungi. These seeds were dried on sterilized filter paper and plated on the two media in five replicates, each replicate contains ten seeds (ISTA, 2009). Plates were incubated at 25°C for 6-10 days under near ultraviolet (NUV) light at 12 hours interval of alternation with darkness (Mathur and Kongsdal, 2003; ISTA, 2009).

Blotter method

Fifty seeds were taken randomly from each working sample of each cultivar and surface disinfected with 1% sodium hypochlorite for 5 min. Disinfected seeds were sown in Petri dishes (Plate diameter 9 cm.) or in other suitable containers on moistened absorbent paper (blotter), usually in three layers to provide enough moisture during test. The plates were incubated for 7-10 days at 25 °C under regime of 12 hours light and 12 hours darkness. (Mathur and kongsdal, 2003; ISTA, 2009). Recording of the fungal growth was

made by a low power stereomicroscope equipped with two opposite light sources to visualize the growth of pathogens.

Deep freezing method

Samples of 50 seeds from each cultivar according to ISTA rules (ISTA, 2009) on blotter paper in Petri dishes. Ten seeds per plate were placed on a three layers of well soaked moist filter papers as described in blotter method and incubated for 24 hours at 20°C and then transferred to -20°C in a freezer for 8 hours. Seeds incubated for 7-10 days at 25°C in incubator under near ultraviolet (NUV) light at 12 hours interval of alternation with darkness until the fungal colonies are developed (Mathur and Kongsdal, 2003; ISTA, 2009). Observations were performed with stereoscopic microscope to record the development of fungal colonies in the seeds.

Seed washing test

Fifty grams of seed from each sample were taken in a 200 ml beaker containing 50 ml sterilized distilled water and 1-2 drops of tween20, shaken for 10 minutes over a mechanical shaker. The suspended spores were concentrated by centrifugation at 3000 rpm for 15 minutes. The supernatant was discarded and the deposit suspended in 500 ul distilled water (Mathur and kongsdal, 2003). This suspension examined under

a compound microscope for the presence of teliospores which identified on the basis of teliospores morphology (Castlebury and Farr, 2011).

Embryo count method

Fifty grains from each cultivar were soaked in 1 liter of water and then mixed with 50 g NaOH and 0.1 g trypan blue stain at 25°C. After 24 h, the seeds were transferred to a sieve of 3.5 mm diameter which was placed over sieve of 2 and 1 mm diameter and then were washed using hot water (water bath) (60-70°C) until the embryos passed through sieves of 1mm diameter. The embryos and chaffs were transferred to a beaker containing 90 ml of lactic acid, glycerol and water (30:30:30 v/v). The floated embryos were separated and transferred to grooving plates (Mathur and kongsdal, 2003). The number of infected embryos enumerated in each sample under a binocular microscope and infection rate of the seed was determined.

Pure cultures from growing colonies by all detection methods were obtained by transferring fungal colonies individually on different fresh media plates for identification.

Fungal Identification

All species identifications were according to the keys and descriptions provided by Ellis (1971, 1976); Arx *et al.* 1986; Hoog and Guarro, 1995; Samson *et al.* (2000); Klich (2002); Watanabe (2002); Leslie and Summerell (2006); Asgari and Zare (2010); Castlebury and Farr (2011) and Guarro *et al.* (2012).

Results and Discussion

A total of 30 species belonging to 18 genera have been isolated from grains of soft wheat (14 samples) and durum wheat (12 samples) using different isolation techniques. Among the common genera, were *Alternaria*, *Aspergillus* and *Penicillium* (3 species each), followed by *Bipolaris*, *Chaetomium*, *Cladosporium*, *Fusarium* and *Ulacladium* (2 species each). Other genera such as *Acremonium*, *Arthrinium*, *Coniocessia*, *Corynascella*, *Curvularia*, *Emericella*, *Eurotium*, *Microdochium* and *Nigrospora* were represented by a single species (Table 3,4).

A total of 21 species assigned to 11 genera have been isolated and identified from soft wheat using different isolation methods (Table 3).

Fourteen species were recorded from soft wheat grains using the agar plate method and 11 species of these were also isolated by the deep freezing method. In addition to 8 species were

isolated by blotter method. Species such as *A.alternata*, *A.phaeospermum*, *A.flavus*, *A.niger*, *C.herbarium*, *Cladosporium sp.*, and *U.atrum* have been detected by the four isolation methods. Agar plate method detected species such as *A.chlamydospora*, *Cheatomium globosum*, *Coniocessia anandra*, *Emericella rugulosa*, *P.brevicompectum*, *P.citrinum* and *U.alternariae*.

Table (4) show the results of fungi isolated from grains of durum wheat using different isolation methods. A total of 24 species belonging to 15 genera have been isolated and identified. Eleven species were recorded from durum wheat grains using each of agar plate method and deep freezing method and 9 species of these were also isolated by the blotter method. *A.alternata*, *A.niger* and *U.alternariae* were detected by all isolation methods. *A.chlamydospora* and *B.sorokiniana* were detected only by blotter method, whereas, *B.spicifera* was detected only by deep freezing method.

The majority of Ascomycetes species such as *Ch.elatum*, *C.globosum*, *Corynascella sp.*, *E.rugulosa*, *Eurotium herbariorum* were detected only by agar plate method.

The variation in detected number and species composition in relation to isolation method was reported by several investigators (Habib *et al.* 2011, Hajihassani *et al.* 2012). However, Fakhrunnisa *et al.* (2006) regarded blotter method as efficient and economically reliable method. Limonard (1968) demonstrated antifungal antagonism during working with agar plate method.

Seed washing techniques (ISTA, 2009) revealed the detection of *Tilletia* spp. from 4 samples of soft wheat cultivars and 5 samples of durum wheat cultivars. It is evident from Table 5, that *Tilletia* spp., were detected from unidentified soft wheat cultivars (samples numbers 11-14) and from unidentified durum wheat cultivars (samples 23-25) obtained from shekhan and Zakho silos, except for two known durum wheat cultivars Creso (sample no,17) and Smeto (sample no,21).

Tilletia species are the causal pathogens of common bunt which is very common and distributed throughout the world on wheat (Wilcoxson and Saari, 1996). This disease is found throughout the country and considered as the most important disease of wheat in Al-Jazeera and North Iraq. Yield losses were estimated to 70% in the most wheat fields (Al-Maarroof *et al.*, 2006). Three species of the pathogen were

identified from Iraq viz. *T.intermedia*, *T.laevis* and *T.tritici* (Al-Maaroof *et al*, 2006; Hassan and Shames-Allah, 2010).

Embryo test was used (ISTA, 2009), for detection of loose smut pathogen (*Ustilago nuda*). All the tested samples were negative.

Conclusion: The results revealed the grains of soft and durum wheat cultivars grown in Duhok province were contaminated with a diversity of fungi. There is a variation in the species composition as well as in the total number of detected species according to cultivar type, source and detection method.

Table (3):- Detection methods for seed –borne fungi from soft wheat grains, number of samples infected and cultivar source.

Fungal Species	Detection method				No. of infected samples	Cultivar*
	PDA	OT	DM	BM		
<i>Alternaria alternata</i>	+	+	+	+	11	1-3, 5-11,13
<i>Alternaria chlamydospra</i>		+			1	1
<i>Alternaria tenuissima</i>		+	+		2	1,6,8,11
<i>Arthrinium phaeospermum</i>	+	+	+	+	5	1,3,6,11,14
<i>Aspergillus flavus</i>	+	+	+	+	10	1,3-5,7,9-14
<i>Aspergillus niger</i>	+	+	+	+	10	2-5,8-10,12-14
<i>Aspergillus terreus</i>				+	1	12
<i>Bipolaris sorokiniana</i>	+	+			1	7
<i>Chaetomium elatum</i>		+			3	7,8,13
<i>Chaetomium globosum</i>		+			1	8
<i>Cladosporium herbarum</i>	+	+	+	+	4	6,7,9,13
<i>Cladosporium sp.</i>	+	+	+	+	8	1,2, 8-12, 14
<i>Coniooecia anandra</i>		+			1	8
<i>Curvularia sp.</i>			+			1,8
<i>Emericella rugulosa</i>	+					9
<i>Penicillium brevicompactum</i>	+					9
<i>Penicillium chrysogenum</i>	+					9
<i>Penicillium citrinum</i>	+		+			9
<i>Penicillium spp.</i>	+		+		10	1-3,6-10,12-14
<i>Ulocladium atrum</i>	+	+	+	+		1-4, 12
<i>Ulocladium alternariae</i>	+					7
Total	14	13	11	8		

*1,2 Ipa; 3,4 Abu Ghraib; 5,6 Azadi; 7,8 Rezgary; 9,10 Tamouz 2; 11-14 unknown cultivars

Table (4):- Detection methods for seed - borne fungi from Durum wheat grains, number of sample method and cultivar source.

Fungal Species	Detection method				No. of infected samples	Cultivar*
	PDA	OT	DM	BM		
<i>Acremonium strictum</i>	+				1	24
<i>Alternaria alternata</i>	+	+	+	+	9	16 – 24
<i>Alternaria chlamydospra</i>				+	1	16
<i>Alternaria tenuissima</i>		+	+	+	5	16 - 19, 21
<i>Arthrinium phaeospermum</i>		+	+		7	15-16,18, 21, 23, 25
<i>Aspergillus flavus</i>	+		+	+	7	15-18, 21, 22, 24
<i>Aspergillus niger</i>	+	+	+	+	7	16 - 18, 21- 24
<i>Aspergillus terreus</i>	+					17, 23, 24
<i>Bipolaris spicifera</i>			+		1	15
<i>Bipolaris sorokiniana</i>				+	1	21
<i>Chaetomium elatum</i>		+			3	15, 17, 19
<i>Chaetomium globosum</i>		+				24
<i>Cladosporium herbarum</i>		+	+		9	15 -19, 21, 23, 25,26
<i>Cladosporium sp.</i>		+	+		3	20, 22, 24
<i>Corynascela sp.</i>	+					15
<i>Emericella rugulosa</i>		+			1	15
<i>Eurotium herbariorum</i>	+					20
<i>Fusarium graminearum</i>	+					22
<i>Nigrospora state of khuskia</i>	+				1	21

<i>oryzae</i>					
<i>Penicillium citrinum</i>					
<i>Penicillium spp.</i>	+	+	+	11	15-18, 20, 26
<i>Ulocladium atrum</i>		+	+	6	16, 19, 20, 22-25
<i>Ulocladium alternariae</i>	+	+	+	5	19-22, 26
Total	11	11	11	9	

*15,16 Acsad; 17,18 Creso; 19 Sham 3; 20 Doar; 21,22 Simeto; 23-25 unknown cultivars; 26 Doar

Table (5):- Detection of *Tilletia* species from soft wheat and durum wheat cultivars by seed washing test technique

Soft wheat		Durum wheat	
Cultivars *	Result	Cultivars	Result
(1)	Negative	(15)	Negative
(2)	Negative	(16)	Negative
(3)	Negative	(17)	Positive
(4)	Negative	(18)	Negative
(5)	Negative	(19)	Negative
(6)	Negative	(20)	Negative
(7)	Negative	(21)	Positive
(8)	Negative	(22)	Negative
(9)	Negative	(23)	Positive
(10)	Negative	(24)	Positive
(11)	Positive	(25)	Positive
(12)	Positive	(26)	Negative
(13)	Positive		
(14)	Positive		

*1,2 Ipa; 3,4 Abu Ghraib; 5,6 Azadi; 7,8 Rezgary; 9,10 Tamouz 2; 11-14 unknown cultivars; 15,16 Acsad; 17,18 Creso; 19 Sham 3; 20 Doar; 21,22 Simeto; 23-25 unknown cultivars; 26 Doar

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SOME BIOCHEMICAL INDICATORS OF INDUCED SYSTEMIC RESISTANCE IN CUCUMBER SEEDLING AGAINST DAMPING OFF PATHOGENS BY LOCAL BOKASHI AND FERMENTED PLANT EXTRACTS (FPE)

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ABSTRACT

This study was carried out to evaluate the efficiency of fermented plant extracts (FPE) with effective microorganisms EM1, and fermented organic fertilizers (Bokashi) in cucumber seedling against *Pythium aphanidermatum* (Pa) and *Rhizoctonia solani* (Rs) causative agents of seedling damping off during 2009-2010 season. The results revealed that treatment with FPE and Bokashi induced significant reduction in damping off. The healthy seedling were attained to 85.7 and 81% after 7 days, 75% and 83.3% after 30 days of germination with FPE treatments, 95.2% and 76.2% after 7 days, 50% and 75% after 30 days of germination with Bokashi treatment in the presence of *P. aphanidermatum* and *R. solani*, respectively compared to 66.7% and 64.2% after 7 days, 50% and 38.3% after 30 days of germination in *P. aphanidermatum* and *R. solani* contamination treatment respectively. The treatment with FPE and Bokashi increased significantly Phenylalanine ammonia-lyase (PAL) and Peroxidase (PO) activities. PAL activity (mg cinamic acid / hr. / g fresh weight) was found to be 0.403, 0.274, 0.238 with FPE, FPE + Pa, FPE + Rs treatments respectively compared with 0.088, 0.096, 0.120 for previous treatment without FPE respectively. PAL activity was attained to 0.147, 0.144, 0.101 with Bokashi, Bokashi + Pa and Bokashi + Rs compared to 0.088, 0.096, 0.120 for previous treatment without Bokashi respectively. The treatment induced significant increase in peroxidase activity (Absorption variation / min / g fresh weight) which attained 26.56, 23.23, 26.46 with FPE, FPE + Pa and FPE + Rs compared with 14.11, 29.40, 23.54 for the previous treatments without FPE respectively. PO activity was significantly increased to 24.62, 19.72, 26.60 with Bokashi, Bokashi + Pa and Bokashi + Rs compared to control treatments. FPE and Bokashi treatments increased significantly plant content of proteins 0.190, 0.177, 0.171 mg / gm fresh weight with FPE, FPE + Pa and FPE + Rs compared with 0.168, 0.166, 0.168 in control treatment respectively. The activity attained 0.181, 0.196, 0.177 mg / gm fresh weight with Bokashi, Bokashi + Pa and Bokashi + Rs respectively.

KEY WORDS: *Pythium aphanidermatum*, *Rhizoctonia solani*, PAL, Peroxidase, Bokashi.

INTRODUCTION

Plants possess various defense mechanisms to protect themselves against pathogen attack forming barriers to preventing pathogen penetration into plant tissues. Some of these mechanisms are constitutive include preexisting chemicals referred to phytoanticipins (Phenolic compounds, steroids, Terpenoids, Glycosides, Saponins and others) (Agrios, 2005; Karthikeyan et al., 2005; Dube, 2010). Other defense mechanisms are inducible and become activated after pathogen infection or induced after treating plants with variety of agents, (Pathogenic or non-pathogenic, natural and synthetic chemicals) rendering the plant resistance to subsequent pathogen attack both locally and

systemically (Hammerschmidt and Kuc, 1982; Agrios, 2005; Walters et al., 2005).

It has been reported that the systemic resistance may be acquired after infection by necrotizing pathogen rendering distant uninfected plant parts resistance to broad spectrum of pathogens. This type of resistance is referred to as systemic acquired resistance (SAR) characterized by accumulation of Salicylic acid (SA) associated with activation of specific genes encoding pathogenesis-related protein (PRP), Peroxidase (PO), Phenylalanine ammonia-lyase (PAL), Polyphenol oxidase (PPO), B-1,3-glucanase and Chitinase (Kloepper et al., 1992; Hammerschmidt, 1999; Van loon et al., 2006). It was reported that treating the plants with SA

induced SAR and activated PR-Proteins genes (Hammerschmidt, 1999).

Another type of resistance induced by non-pathogenic microorganisms or chemical independent of SA accumulation and PR gene activation referred to as Induce Systemic Resistance (ISR) was reported. ISR is characterized by Jasmonic acid (JA) and ethylene accumulation and induced the production of proteins different from that of SAR; the resistance induced promote plant growth through restriction of pathogen growth and suppression of disease symptoms development compared with non-Induced plant Infected with the pathogen (Van loon, 1997; Van loon et al., 1998; Pieterse and Van loon, 2007).

For obtaining agriculture products without chemicals and maintaining natural biotic equilibrium in the soil, the study was conducted to evaluate the efficiency of beneficial microorganisms Mixture (EM1) fermented organic matter (Bokashi) and fermented plant extract (FPE) to Induce Systemic resistance in cucumber plant against *Pythium aphanidermatum* and *Rhizoctonia solani* causative agent of damping off disease.

MATERIAL AND METHODS

Isolation and identification of fungi :-

Pythium aphanidermatum was isolated from infected cucumber fruit while *Rhizoctonia solani* was isolated from infected cucumber plants in plastic house – College of Agriculture – University of Baghdad, 2009. Pieces of cucumber fruit were surface sterilized with 2% sodium hypochloride for two min., then rinsed thoroughly with sterile water, dried on filter paper and distributed on potato dextrose agar (PDA) in 9 cm Petri plate diameter. The plates were maintained at 25 + 2 °C and the growing fungi were purified, identified and Pathogenicity of Isolates were determined as described by Al-Jarah, 2011.

The effective microorganisms (EM1) :

The EM1 is the abbreviation for Effective Micro-Organisms, which consists of 80 different kinds of effective, and disease-suppressing microorganisms. it was obtained from Maple company / India and activate by mixing with molass and warm crude (without chloride) water at 5: 5: 90 (V: V: V). The molass was first dissolved in sterile warm water, then EM1 was mixed well in plastic container which maintained in shadow warm place for 10 days in summer (35 – 40 °C),

30 days in winter (15 – 20 °C) associated with opening the container several times. The formation of precipitate in container bottom indicate the activation of the Mixture at pH 3.5 – 4, it should be used within 30 days (Anonymous, 1995). The fermented organic matter (local Bokashi) consist of wheat bran with rice husks and sheep manure were mixed at 1: 1: 1 (W: W: W). Solution of water: EM1: Molass, 98: 1: 1 (V: V: V) was added successively with mixing until attaining a relative humidity 30-40%. The mixture was transferred into plastic sacs and maintained in shadow warm place for 30 days. The appearance of white growth at the surface indicates that the mixture is ready to use (Anonymous, 1995).

Local EM-fermented plant extract (LFPE):-

Three kg of Neem Leaves (*Azadiracht indica*), 250 g of onion (*Allium cepa*), 250 g of garlic (*Allium sativum*), 250 g of cinnamon (*Cinnamomum cassia*), 250 g of hot pepper (*Capsicum annum*), 250 g of Cauliflower leaves (*Brassica oleracea*), and 250 g of tobacco leaves (*Nicotiana tabacum*) were mixed and chopped to small pieces (0.5 – 1 cm), Supplemented with 250 g of curcuma (*Curcuma lenga*) and placed in netlike sac. The sac was closed and soaked in a solution of EM1 with molass in warm water (5: 5: 90 (V: V: V)) without chloride (by keeping the water in open plastic container for 1-2 days) in plastic container, tight closed and maintained in shadow place for 10-25 days. The mixture was passed through muslin cloth in small containers for the next experiment (Anonymous, 1995).

Biochemical indication of cucumber seedling resistance to *P. aphanidermatum* and *R. solani* :-

A mix soil: vermiculate (2: 1 V) was autoclaved at 121 °C and 1.5 kg / cm² for two successive days in heat resistance sacs. The sacs were assigned to two groups (3 sacs for each (replicates)), to the first sac Bokashi was added at 8% and suspension of the FPE in water (1: 500) was added weekly to the second group at 50 ml / kg soil and maintained closed at the Lab. condition for one week. One sac of each group was contaminated with *P. aphanidermatum*, the second sac of each group was contaminated with *R. solani* from new culture of 3 days old (1/4 fungal mycelium growth in PDA plate of 9 cm diameter / kg soil). The 3rd sac was left without contamination as control. After two days of contamination, the soil was distributed in pots in Randomized Complete Block Design (RCBD) with 3 replicates / treatment. The LSD (P<1%)

was calculated for treatments, time and treatment × time. The pots were seeded with cucumber seeds (Al-Moktar) 7 seeds / pot and watering at any time they need. The percentage of infection was evaluated after 7 and 30 days. Samples of plants were taken weekly for Peroxidase and Phenylalanine ammonialyase activities and total protein determination during 3 and 4 successive weeks respectively. The treatments were as following:-

- 1- Non-treated soil (control).
- 2- Soil contaminated with *P. aphanidermatum*.
- 3- Soil contaminated with *R. solani*
- 4- Soil and the cucumber seedling sprayed with FPE+ water (1:500 V) twice weekly (50 ml/pot).
- 5- Soil treated with FPE and contaminated with *P. aphanidermatum*.
- 6- Soil treated with FPE and contaminated with *R. solani*.
- 7- Soil treated with Bokashi (8%).
- 8- Soil treated with Bokashi (8%) and contaminated with *P. aphanidermatum*.
- 9- Soil treated with Bokashi (8%) and contaminated with *R. solani*.

Determination of PAL activity:-

Samples of cucumber leaves 0.5 g were homogenized with 10 ml of 0.2 M sodium borate buffer pH 7.5. The homogenate was centrifuged at 8000 rpm in cooling centrifuge (4°C) for 20 min. In sterile glass tubes one ml of phenylalanine 0.1 M and 2.5 ml of disodium borate pH 8.7 were added to 0.2 ml of the supernatant in glass tube and maintained at 38 °C for one hour. The reaction was stopped by addition 0.5 ml of Trichloro acetic acid (TAC) 1 M and the absorption of the samples of UV light was determined at 290 nm. Standard curve of UV absorption at 290 nm to cinnamic acid solution at 1, 2, 3, 4, 5, 10 µg /ml in sodium borate buffer pH 8.7 was traced. The enzyme activity was expressed as mg cinnamic acid / hour / g fresh weight (Narwal et al., 2009) according to the Equation:-

$$Y = 0.0278 X - 0.0047$$

Y = absorption value at 290nm, X = concentration of cinnamic acid in samples.

Determination of PO activity: -

Samples of cucumber leaves (0.5 g) were homogenized with 2 ml of 0.2 M phosphate buffer pH 7.5 in mortar and pestle. The homogenate was centrifuged at 6000 rpm in glass tubes at 4°C for 10 min. 0.2 ml of the supernatant was added to three ml of the reaction mixture (0.5 M Guicol: 0.02 M Hydrogen peroxide 30% : (0.04 M Tris base and 1 M NaCl, pH 7-7.2) + distilled water (1:1:1+ 7 V)). The absorption of the samples to UV Light at 420 nm was determined every 30 second for 3 minutes and the variation in absorption was determined as following :-

whereas : (A / T) ÷ g. Fresh weight

A = Variation in absorption (A6-A1) and T = Variation in Time (T6-T1)

(Whitaker and Bernhard, 1972).

Determination of total soluble protein:-

0.1 g of cucumber leaves were homogenized with 2 ml of 0.1 M phosphate buffer, pH 7.2 and centrifuged at 8000 rpm for 20 min. at 4°C, 0.5 ml of supernatant were added to 0.5 ml of 10% TCA and centrifuged at 8000 rpm for 20 min. The precipitate was dissolved in one ml of 0.1 M NaOH. 0.5 ml of the solution were added to 5 ml of Bradford indicator and the absorption was evaluated at 595 nm. (Bradford 1976). Standard curve of serum albumin solution at 0, 50, 100, 120, 140, 160, 180, 200, 220, 240, 260 µg/ml absorption was traced and the concentration of total soluble protein was calculated as following:
 $Y = 0.0008X - 0.0053$

Where as : Y = Absorption value, X = Protein concentration in the samples.

RESULTS

Fungi isolation and identification:-

Pythium aphanidermatum

Cottony white growth was appeared around the pieces of infected cucumber fruit after 3 days of incubation on PDA. The microscope observation of a sample of the fungal growth showed non-separated hyphae with finger shaped sporangia and sexual reproductive gametes, Antheridia (male) and Oogonia (female) as well as oospores characterized with a spacing of oogonia wall, after 7 days of incubation on PDA (Fig. 1). These characters were in accordance with those described in Waterhouse key (1967) concerning *Pythium aphanidermatum*.

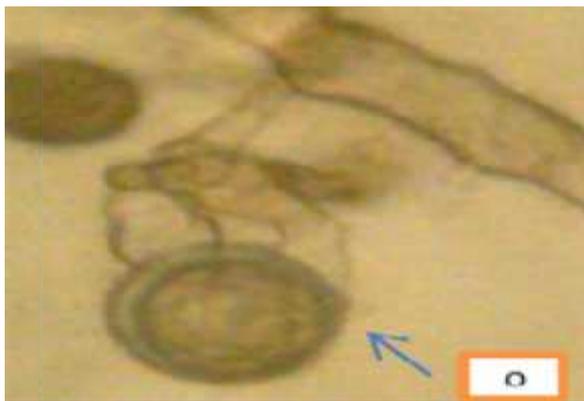


Fig. (1) ; -o= oospore of *Pythium aphanidermatum* 40x.

Rhizoctonia solani

White colonies around the infected parts of diseased seedling were appeared on PDA after 3 days of incubation, transformed progressively to

brown associated with formation of small sclerotia. The microscopic observation of fungal branched hyphae at right angle with a septa near the branching point (Fig. 2).

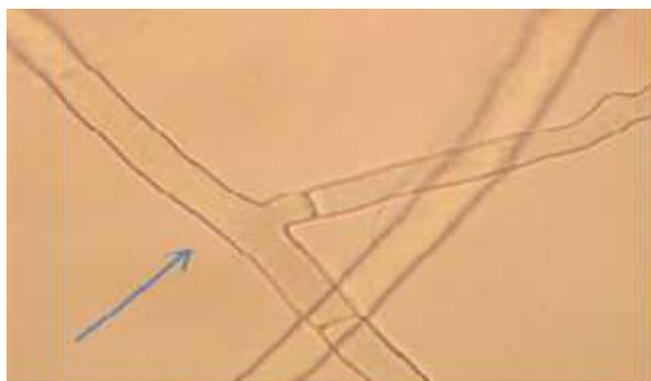


Fig. (2):- *Rhizoctonia solani* branched hyphae at right angle with a septa near the branching point. 40x.

Similar results concerning *Rhizoctonia solani* were previously reported (Staplers and Anderson, 1987). The microscopic observation of new hypha tips showed the presence of 8 nucleus (Fig. 3) indicated that the current isolates are

multinucleate and belong to *R. solani*. It has been reported that the presence of 2 nucleus in the hyphal tips indicate that isolate is not of *R. solani* (Herr, 1995; Ross et al., 1998).

The pathogenicity tests revealed that all isolates of both *P. aphanidermatum* and *R. solani* obtained were pathogenic and causing seedling damping off when cucumber seeds were sown in contaminated soil.

Effect of local FPE AND Bokashi on seed germination:-

It has been found that all treatment induced reduction in pre and post emergence damping off compared with control (Pathogens only). The addition of FPE to the soil with spraying the seedling with its suspension caused significant reduction in seedling damping off. The percentage of healthy plant in treated soil and contaminated with *P. aphanidermatum* and *R. solani* separately



Fig. (3):- The hyphal tips of *R. solani* with 8 nucleus. 40x.

were attained to 85.7% and 81.0% after 7 days respectively compared with 66.7% and 64.2% in contaminated but non-treated soil respectively. Lower effect of Bokashi on seed germination enhancement was observed, although the positive effect of Bokashi on plants growth promotion the percentages of healthy plants were 95.2 and 76.2% in soil contaminated with *P. aphanidermatum* and *R. solani* respectively.

The role of Bokashi on

Table (1):- Percentage of grown in greenhouse after 7

Treatment	Healthy seedling after		Mean
	7 d.	30 d.	
Control	92.9a	92.9a	92.9ab
Pa	66.7b	50.0b	58.4d
R s	64.2b	38.3b	51.3d
FPE	95.2a	91.7a	93.5a
FPE + Pa	85.7a	75.0a	80.4bc
FPE +Rs	81.0ab	83.3a	82.1abc
Bokashi	95.2a	91.7a	93.5a
Bokashi + Pa	95.2a	50.0b	72.6c
<i>Bokashi +Rs</i>	76.2ab	75.0a	75.6c
Mean	83.59a	71.99b	

healthy cucumber seedlings and 30 days.

Pa = *Pythium aphanidermatum*, Rs = *Rhizoctonia solani*, FPE = fermented plant extract with effective microorganisms (EM1). LSD (P < 1%). Different letters within each column show significant differences.

Activity of phenyl alanine ammonialyase (PAL):-

Results showed that the addition of FPE to the soil and sprayed the seedlings caused significant increase in PAL activity. The average PAL activities were found to be 0.403, 0.274 and 0.258

disease development may be due to that Bokashi require more time for the microorganisms contained to grow and restrict the pathogens growth as well as to decompose the organic matter to be more available to plant roots (Table 1).

µg cinnamic acid / hr. / g.f.w of leave tissue in FPE, FPE + *P. aphanidermatum* and FPE + *R. solani* treatments compared with 0.088, 0.096 and 0.120 in non-treated soil, non-treated soil + *P. aphanidermatum* and non-treated + *R. solani* treatments respectively (Table 2).

Table (2):- PAL activity (µg cinamic acid / hr. / g fresh weight) during 4 successive weeks for cucumber plants grown in greenhouse.

Treatment	Weeks				Mean
	1 st	2 nd	3 rd	4 th	
Control	0.071c	0.033f	0.057h	0.189f	0.088i
Pa	0.092a	0.072e	0.012i	0.207e	0.096h
R s	0.084b	0.072e	0.065g	0.218d	0.120f
FPE	0.086b	0.193c	1.032a	0.304c	0.403a
FPE + Pa	0.064d	0.361a	0.305d	0.366b	0.274b
FPE +Rs	0.063de	0.180d	0.324c	0.386a	0.238c
Bokashi	0.081bc	0.022g	0.451b	0.035h	0.147d
Bokashi + Pa	0.057e	0.240b	0.158f	0.122g	0.144e
Bokashi +Rs	0.045f	0.071e	0.281e	0.006i	0.101g
Mean	0.072d	0.138c	0.298a	0.204b	

Pa = *Pythium aphanidermatum*, Rs = *Rhizoctonia solani*, FPE = fermented plant extract with effective microorganisms (EM1). LSD (P < 1%). Different letters within each column show significant differences.

Similar increase in the average PAL activity were observed when Bokashi added to the soil, 0.1474, 0.1441, and 0.1010 µg cinnamic acid / hr. / g. fresh leaf tissue in plants grow in soil containing Bokashi, Bokashi + *P. aphanidermatum*, Bokashi + *R. solani* respectively.

Peroxidase (PO) activity:-

Significant increase in Peroxidase activity in plants grown in soil containing FPE evaluated as variation in absorption / hr. / g fresh leaf tissue was observed. The average Peroxidase activities were found to be 26.56, 23.23, and 26.46 in FPE, FPE + *P. aphanidermatum* and FPE + *R. solani* respectively compared to 14.08 in control (Table 3).

An increase in PO activities in the presence of Bokashi were observed, 24.62, 19.72, and 26.6 in Bokashi, Bokashi + *P. aphanidermatum* and Bokashi + *R. solani* respectively compared to 14.11 in control (Table 3).

Table (3):- Peroxidase activity (Absorption variation / min / gm fresh weight) during 3 successive weeks in cucumber plants grown in greenhouse.

Treatment	Weeks			Mean
	1 st	2 nd	3 rd	
Control	7.78d	12.33i	22.13h	14.11g
Pa	18.5b	20.31g	49.37b	29.40a
Rs	0.89h	17.77h	51.96a	23.54d
FPE	7.27f	38.40a	34.00d	26.56b
FPE + Pa	6.51g	30.27d	32.90e	23.23e
FPE + Rs	6.43g	35.69b	37.26c	26.46b
Bokashi	17.76c	31.57 c	24.52g	24.62c
Bokashi + Pa	8.90e	24.70f	25.56f	19.72f
Bokashi + Rs	25.33a	28.78e	25.71f	26.6b
Mean	10.33c	26.65b	33.7a	

Pa = *Pythium aphanidermatum*, Rs = *Rhizoctonia solani*. FPE = fermented plant extract with effective microorganisms (EM1). LSD (P < 1%). Different letters within each column show significant differences.

Effect of FPE and Bokashi on plant protein content :-

The treatment with FPE and Bokashi induced significant increase of plant content in protein during the first to third weeks of germination compared to control. The concentration of protein in plants in soil containing FPE, FPE + *P. aphanidermatum*, FPE + *R. solani*, Bokashi,

Bokashi + *P. aphanidermatum* and Bokashi + *R. solani* were found to be 0.190, 0.177, 0.171, 0.181, 0.196, 0.177 mg/g fresh leaf tissue respectively compared to 0.167, 0.166, 0.168 mg / g fresh leaf tissue in control (Table 4). The higher protein content was registered in Bokashi with the Pathogen treatment.

Table (4):- Protein contain (mg / g fresh leaf tissue) during 3 successive weeks in cucumber plants grown in greenhouse.

Treatment	Weeks			Mean
	1 st	2 nd	3 rd	
Control	0.155c	0.169g	0.180f	0.168f
Pa	0.149d	0.173f	0.176g	0.166g
Rs	0.145e	0.166g	0.193b	0.168f
FPE	0.158a	0.2192b	0.193b	0.190b
FPE + Pa	0.160a	0.193d	0.178h	0.177d
FPE + Rs	0.150d	0.182e	0.182e	0.171e
Bokashi	0.155c	0.196c	0.192c	0.181c
Bokashi + Pa	0.156b	0.222a	0.210a	0.196a

Bokashi +Rs	0.159a	0.182e	0.190d	0.177d
Mean	0.154c	0.189 a	0.188 b	

Pa = *Pythium aphanidermatum*, Rs = *Rhizoctonia solani*. FPE = fermented plant extract with effective microorganisms (EM1). LSD (P < 1%). Different letters within each column show significant differences.

DISCUSSION

Results of this study demonstrated that FPE and Bokashi enhance seed germination and promote plant growth, and this could be attributed to substances produced during fermentation by microorganisms that act as growth promoters as well as other substances became more available to uptake by plants. It was reported that microorganisms induce decomposition of organic compounds to and easily absorbed by plant roots (Kremer et al., 2000).

The introduction of Bokashi and FPE into the soil may stimulate the growth of more effective and benefit microorganisms that promote seedling emergence through suppressing soil-borne pathogens, the suppression of soil-borne pathogens. This suppression may be directly through competition for nutrients, siderophore, mediated, competition for Iron, antibiosis, or secretion of lytic enzymes (Pieterse and Van Loon, 2007).

The restriction of pathogens' growth and reduction of disease incidence may be directly through inducing systemic resistance in the plant to subsequent pathogen attack. Several previous studies reported that treatment of soil or plants with biotic and non-biotic agents can lead to induction of systemic resistance effective against further pathogen infections (Hammerschmidt, 1999; Walters et al., 2005). The high contents of FPE and Bokashi of organic matter could encourage to induce systemic resistance. It was suggested that high microbial activity in the soil with high organic matter content may have led to high degree of resistance (Walters, 2010).

The indications of inducing systemic resistance in this study were the increase of PO and PAL enzymes activities. These two enzymes have been correlated with resistance in many plant species (Zheng et al., 2005). PO and PAL enzymes have been implemented in phenol oxidation, lignin accumulation reducing some compounds to more toxic substances for the pathogens like quinine and

Hydrogen peroxide releasing OH⁻ and O² acts as elicitor of resistance gene producing substances including Pathogenesis-related (PR) proteins (Peng and Klug, 1992; Van Loon et al., 1998; Lavani et al., 2006; Chen et al., 2009).

We conclude that the use of FPE and Bokashi for soil treatment to enhance germination and promote plant growth and restrict pathogen growth in the soil as well as inducing systemic resistance in the plants against the pathogens may be promising for managing seed rot and seedling damping-off caused by *P. aphanidermatum* and *R. solani* on cucumber.

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SCEEING OF DIFFERENT SOIL-BORNE FUNGI AND THEIR DISEASE SEVERITY OF YOUNG ROBINIA (*Robinia pseudoacacia*) SEEDLINGS

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ABSTRACT

Six locations (Erbil , Minara, and Shanadar recreation parks, 40 and 60 metre road side plantations, and conference palace's road)) planted with Robinia (*Robinia pseudoacacia*) in Erbil Province, Kurdistan Region-Iraq, were selected for investigation of pathogenic fungi attacking these trees. Sampling of robinia plant roots and rhizosphere soil were taken for fungal isolation. The results showed the presence of *Rhizoctonia solani*, *Verticillium dahliae*, *Fusarium solani* and *Fusarium oxysporum* in all locations. The highest disease incidence was in Minara park (83%) and the lowest was in Erbil park (37%). The pathogenicity of these fungi was evaluated and their disease severities were measured at two timing stages which included three-month old and one-year old seedlings. The results of disease severity on 3-months old seedlings revealed that *Verticillium dahliae* was superior in causing symptoms of yellowing, leaflet drop, leaf drop, and dead tip with disease severity scores of 2.9, 3, 2.8, and 2.3, respectively. On 1-year old seedlings, *Fusarium solani* was caused the highest score of yellowing (2.5) and leaflet drop (5.83), while the wilt fungus *Fusarium oxysporum* was the most pathogenic in causing leaf drops (4.8). The highest score of dead tips was recorded by *Rhizoctonia solani* (2.17).

KEYWORDS: Soil-borne fungi, Robinia pseudoacacia, Disease severity

INTRODUCTION

Robinia (*Robinia pseudoacacia* L.) also called black locust, Purple Robe, Common Locust, is a forest tree grown worldwide due to its fast growth and rapid maturity. It is reproduced either by seeds or vegetatively (Gilman and Watson, 1994). Black locust is also considered a nitrogen-fixing tree which contribute in enhancing soil fertility (Taniguchi et al., 2009) and has important roles in forest succession (Boring and Swank, 1984). However, growing robinia in our region is primarily for shading in side road plantations, recreation parks and for decorations. Robinia trees also have fragrant flowers and attractive foliage.

Robinia trees are vulnerable to many pests and diseases. Vascular wilts which caused by soil-borne fungi considered a major impediment in persistence of this tree. Permanent wilts which are caused by soil-borne microorganisms such as fungi, bacteria and nematodes. Investigations revealed that more than 50 fungal species are causing soil-borne diseases. The later wilt disease is caused by several fungi including *Verticillium* spp., *Fusarium* spp., *Rhizoctonia* spp., *Pythium*

spp., and *Phytophthora* (Hood and Shew, 1997). *Verticillium* wilts considered the most important disease on a variety of plants worldwide (Horst, 2013b, Horst, 2013a). Two species of *Verticillium* which are *V. dahliae* and *V. albo-atrum* are the commonest species of the pathogen. *Verticillium* wilt symptoms, dieback and defoliation; appear slowly within few months or years on one branch or few branches of the trees. The appearance of these symptoms will be conspicuous during summer times, in which the leaf margins become yellow and then turn brown and dry (Hiemstra and Harris, 1998, Bhat and Sbarao, 1999).

Several species of *Fusarium* exist in the soil as soil-borne pathogens in which both *F. oxysporum* and *F. solani* are widespread pathogens. The first species is responsible for vascular diseases of several plants in different families (Alabouvette et al., 2009). It remains in the soils as resistant chlamydospores and as mycelium. It infects seedlings in nurseries and also in permanent plantations. However, the second species, *F. solani*, the cause of root rots of plants and remain in the soil as saprophytes on plant debris (Halász, 2002). *Rhizoctonia solani* is another common soil-borne pathogen which also has several plant hosts.

It persists in a wide range of temperatures. The fungus usually infects root tips and crown area causing girdling to the seedlings. The fungus can remain in the soils as mycelium for more than one year and as sclerotia for up to 6 years (Brown and Wylie, 1991, Ogoshi, 1987, Wright, 1944).

Disease severities (proportion of the total area of plant tissue affected by disease) differ among plant pathogens according to the genetic make-up of these microorganisms and also by the effects of environmental factors such as plant nutrition, humidity, soil pH and soil structure (Schafer, 1994). Measuring disease severities are usually expressed as the percentage or proportion of plant area or fruit volume destroyed by a pathogen. More often, numeric disease assessment scales (from 0 to a particular point such as 0 to 10) are used to express the relative proportions of affected tissue at a particular point in time (Agrios, 2005).

$$\text{Disease incidence (\%)} = \frac{\text{No. of diseased plants} \times 100}{\text{Total No. of plants included in the survey}}$$

Fungal isolation and identification

Isolation from diseased seedlings

Fungal pathogens were isolated according to the method used by (Agnihotri, 1971) in which the root samples were washed by running water for 1 h to remove the soil debris then the roots cut to small pieces of 0.5 cm and surface sterilized with 1% of NaOCl solution for 2-3 minutes. The sterilized pieces were then washed three times with sterilised distilled water (SDW) to remove the effects of NaOCl and dried by placing them between sterilised filter papers. The dried pieces placed on the surface of fresh Potato Dextrose Agar (PDA) containing 50 mgL⁻¹ streptomycin sulphate in 9 cm Petri plates and incubated at 25°C for 1 week alternating 12 h of lightening and darkness. The single colonies were sub-cultured and purified and then identified depending on cultural appearance of colonies and microscopical characteristics depending on the classification and identification keys (Watanabe, 2010, Booth, 1971, Leslie and Summerell, 2006).

Isolation from soil using serial dilution

One gram of each soil sample was placed in 9 ml of SDW in a glass tube and then hand-shacked until even mixing of the soil in the water and from this stock solution a serial dilution from 1⁻¹ to 10⁻⁵ was made and then from each respective dilution 1 ml is taken and spread over the surface of fresh

This research is undertaken to detect major soil-borne fungi and to determine the differences in their virulence to cause variable disease severities on robinia seedlings.

MATERIALS AND METHODS

Sampling

Robinia root samples were collected from six locations of Erbil city including three recreation parks (Erbil, Minara, and Shanadar) and three road side plantations (40 metre road, 60 metre road, and conference palace's road). Samples were taken based on the visibility of symptomatic plants. Soil samples were also taken within rhizosphere (0-30 cm). Samples were kept in sterilized polyethylene bags and stored in refrigerator for later use.

Disease incidence was calculated according to the following formula used by (Khan et al., 2004):

PDA in Petri plates with the aid of sterilised glass spreaders. The inoculated plates were incubated and single colonies were sub-cultured and then identified.

Study of disease severity of soil-borne fungi

To determine disease severities, the pathogenicity tests were performed for previously isolated fungi which included: *Rhizoctonia solani*, *Verticillium dahliae*, *Fusarium solani* and *Fusarium oxysporum* on Robinia seedlings at two timing stages; 3-month-old and 1-year-old seedlings.

Assessment of disease severity on the potted 3 month-old seedlings

A complete randomised design with three replications was designed by planting robinia seeds in pots (16 cm) containing 2 kg of sterilized soil. Before planting the seeds, the soil was inoculated with each fungus grown on millet seeds (*Panicum miliaceum*) according to the procedure of (Brbetti, 1989) in which 50 g of millet seeds were soaked in D.W in 250 ml flasks for 12 hours, then the excess water was poured off and autoclaved three times at 121°C for 20. The autoclaved millet seeds were then inoculated with plugs of 5 mm of the isolated fungi grown on agar in a rate of 15 pieces into each flask. Flasks were then incubated at 25°C for two weeks and been shacked every day to ensure equal colonisation.

The prepared soil then mixed with the inoculated millet before planting in a rate of 0.5% (w/w). Control treatment for comparison was planted in non-inoculated soil. After inoculations, the soil was watered for two days and then robinia seeds were planted in a rate of 10 seeds per pot and before that, the seeds were surface sterilised and soaked in warm water for 24 h. The untreated

control was included growing seeds in sterilised soil without inoculation. The plants were watered as required. Data, of assessment the evidence symptomatic seedlings, was taken after 60 days from planting according to the following disease severity categories described for each symptom (Campbell, 1994):

1- Disease evaluation scale for yellowing:

Disease category	Description
0	healthy plant, no yellowing
1	1-5 leaves yellowed
2	6-10 leaves yellowed
3	11-15 leaves yellowed
4	16-20 leaves yellowed
5	More than 21 leaves yellowed-plants dead

2- Disease evaluation scale for leaflet drops:

Disease category	Description
0	Plant healthy, no leaflet droppings
1	1-5 leaflets dropped
2	6-10 leaflets dropped
3	11-15 leaflets dropped
4	16-20 leaflets dropped
5	20-25 leaflets dropped
6	26-30 leaflets dropped
7	31-35 leaflets dropped
8	36-40 leaflets dropped
9	41-45 leaflets dropped
10	46-50 leaflets dropped
11	Plants dead

3- Disease evaluation scale for leaf drops:

Disease category	Description
0	Plant healthy, no leaf droppings
1	1-5 leaves dropped
2	6-10 leaves dropped
3	11-15 leaves dropped
4	16-20 leaves dropped
5	20-25 leaves dropped
6	26-30 leaves dropped
7	Total leaves dropped and plants dead

4- Disease evaluation scale for dead tips:

Disease category	Description
0	Plant healthy, no deaths of tips
1	1 plant tip is dead
2	2 plant tips is dead
3	3 plant tips is dead
4	4 plant tips is dead
5	More than 5 tips dead and plants dead

Assessment disease severity on the 1-year-old seedlings

Seedlings (one-year old) grown in 20 cm plastic pots containing 5 kg of sterilised soil were inoculated using the same procedure of previous section. Each treatment replicated six times in complete randomized design (CRD), each pot

contained 1 plant. Disease severities (plant yellowing, leaflet drop, leaf drop, and dead tips) were measured after 2 months from inoculations using the same disease evaluating scales as mentioned previously in 3 months old seedlings.

Data analysis

STATGRAPHICS Centurion XV.I was used for statistical analysis as one-way analysis of variance and for pairwise comparisons. The treatment means were compared using least significant difference (LSD) at P 0.05.

RESULTS AND DISCUSSIONS

Fungal isolation and identification

The results showed that the highest disease incidence was in Minara park (83%) and the lowest was in Erbil park (37%). However, there was variability among other locations in disease incidences (table 1).

Table (1):- Disease incidence percentage in six locations of Erbil city.

No.	Location	Disease incidence %
1	Erbil Recreation Park	37
2	Minara Recreation Park	83
3	Shanadar Recreation Park	55
4	40 metre road side plantation	40
5	60 metre road side plantation	55
6	conference palace's road side plantation	63

Four major soil-borne fungi of *R. solani*, *V. dahliae*, *F. solani* and *F. oxysporum* isolated from the samples collected in six locations of Erbil city. There was also variability in isolating different fungi among locations (table 2). For fungal isolation frequency in rhizosphere, the highest one (55%) was for *V. dahliae* in Conference palace's road side plantation, while the lowest percentage

(15%) for this fungus was in 40 meter road side plantation. *Fusarium oxysporum* was the most frequent in soils of 40 metre road side plantation (50%) and the lowest were in 60 metre road side plantation, and no isolation observed in soils of Erbil Recreation Park. Nevertheless, the isolation frequencies for *R. solani* and *F. solani* were variable among the locations.

Table (2):- The frequency of isolated fungi from rhizosphere soil and robinia roots of six locations in Erbil city.

Location	Fungi	Frequency (%) from soil	Frequency (%) from roots
Erbil Recreation Park	<i>R. solani</i>	35	30
	<i>V. dahliae</i>	45	40
	<i>F. solani</i>	20	0
	<i>F. oxysporum</i>	0	30
Minara Recreation Park	<i>R. solani</i>	15	10
	<i>V. dahliae</i>	20	20
	<i>F. solani</i>	35	25
	<i>F. oxysporum</i>	30	45
Shanadar Recreation Park	<i>R. solani</i>	30	25
	<i>V. dahliae</i>	20	15
	<i>F. solani</i>	20	30
	<i>F. oxysporum</i>	30	30
40 metre road side plantation	<i>R. solani</i>	15	30
	<i>V. dahliae</i>	15	20
	<i>F. solani</i>	20	25
	<i>F. oxysporum</i>	50	25
60 metre road side plantation	<i>R. solani</i>	35	20
	<i>V. dahliae</i>	20	15

Conference palace's road side plantation	<i>F. solani</i>	40	20
	<i>F. oxysporum</i>	5	45
	<i>R. solani</i>	10	10
	<i>V. dahliae</i>	55	40
	<i>F. solani</i>	10	15
	<i>F. oxysporum</i>	25	35

Disease severity of soil-borne fungi

The pathogenicity tests of four pathogenic fungi on 3-months old robinia seedlings revealed that *V. dahliae* was the most virulent fungus causing yellowing, leaflet drop, leaf drop, and dead tip with disease severity score of 2.9, 3, 2.8, and 2.3, respectively. It has showed a considerable difference (significant at $P=0.05$) with *R. solani*, *F. solani* and *F. oxysporum* (figure 1). However, no such differences found among the later three fungi.

The disease severities on 1-year old robinia seedlings were of varying extent. *Fusarium solani*

showed the highest virulence causing severe yellowing and leaflet drop with disease severity score of (2.5) and (5.83), respectively, with noticeable differences (significant at $P=0.05$) with other pathogenic of fungi (figure 2). On the other hand, *F. oxysporum* was the most pathogenic fungus in causing leaf drops (disease severity score of 4.8). The highest disease severities of dead tips were recorded with *R. solani* (disease severity score 2.17) with no considerable differences with other fungi.

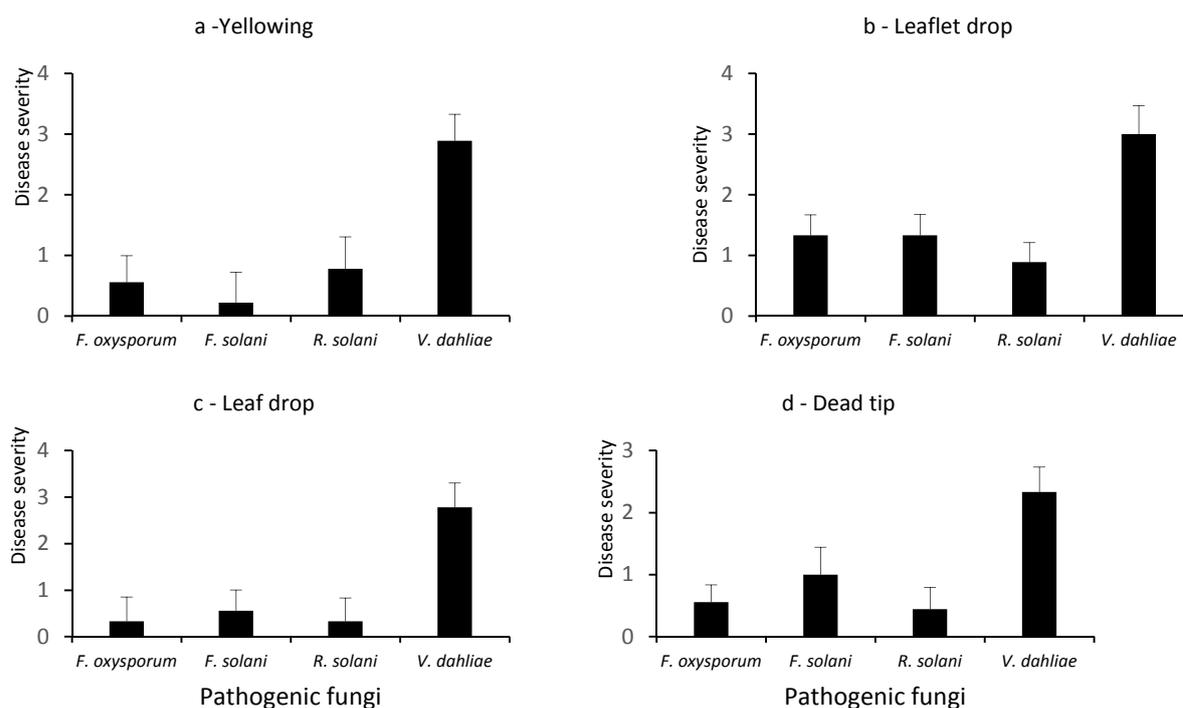


Fig. (1):- disease severity of pathogenic fungi on 3-month old symptomatic robinia seedlings. Error bars represent standard deviations. Means compared with least significant differences (LSD) at $P=0.05$ and the LSD values for yellowing, leaflet drop, leaf drop, and dead tips were 1.36, 1.37, 1.41, and 1.004, respectively.

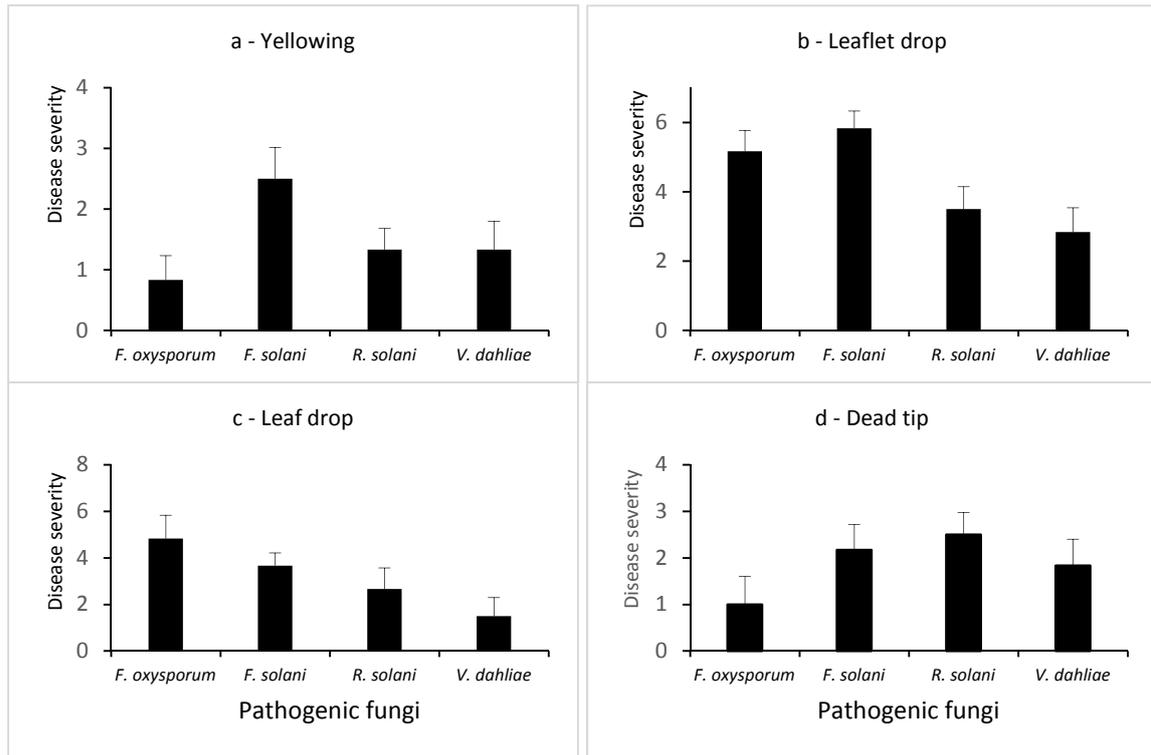


Fig. (2):- disease severity of pathogenic fungi on 1-year old symptomatic robinia seedlings. Error bars represent standard deviations. Means compared with least significant differences (LSD) at $P=0.05$ and the LSD values for yellowing, leaflet drop, leaf drop, and dead tips were 1.04, 2.35, 1.89, and 1.67, respectively.

Disease incidence and disease severities were variable among locations and also among the soil-borne pathogenic fungi. This is may be due to the differences in soil biota such as mutualists and antagonists that interact with soil-borne fungi and invaders (Callaway et al., 2011) and also may refer to the differences among these locations in soil type, texture, acidity, and soil organic matter (Six et al., 2004). Different soils exhibit variable suppressive effect to soil borne plant pathogens and this owes to the differences in activity of individual or select groups of microorganisms (Weller et al., 2002). Several soilborne pathogens develop well and cause severe diseases in some soils known as conducive soils, whereas they develop much less and cause much milder diseases in other soils, known as suppressive soils (Agrios, 2005).

The results revealed that *R. solani*, *V. dahliae*, *F. solani* and *F. oxysporum* are principal fungal pathogens on robinia trees. Similar to our results, (Goud and Termorshuizen, 2002, Hiemstra and Rataj-Guranowska, 2003) stated that *V. dahliae* is the commonest fungal species that attack ornamental plants and forest trees including black locust causing wilting and entire death. (Zaspel et

al., 2007) also confirmed that *Fusarium* species causing damages at different stages of tree development as well as they are involved in many complex diseases of forest ecosystems. The most impact is on seedlings in forest nurseries causing diseases with symptoms of foliage withering and dieback of branches as well as bark necrosis and canker. Szabó (2000) also stated that species of *Fusarium* are more common in the last years particularly on the neophytic tree species *Robinia pseudoacacia*. Similar results were found by (Halász, 2002) when he performed a pathogenicity tests on one-year old robinia seedlings showing typical symptoms of wilting of the foliage or canker of the bark caused by different species of *Fusarium*.

The differences in the disease severities among these soil borne pathogens may owes to several factors including mycoparasitic interactions with host plant, other soil borne microorganisms, penetration and growth within the host (Van den Boogert et al., 1989). For instance, hyphae of *V. dahliae* penetrate the roots of host plant seedlings and induce the deposition of lignitubers between the host plasmalemma and cell wall. Lignitubers prevent further colonization by the fungus which

undergoes protoplasmic lysis within the lignituber. Evidence is also present to suggest that lignituber formation results from the extrusion of vesicles by the host (Griffiths, 1971). Another unique feature of many phytopathogenic organisms is their ability to produce a collection of degraded enzymes and this feature differs greatly among plant pathogens (Bateman and Basham, 1976). The differences in the disease severities of the same pathogens among locations may also refer to the host nutrition. There are for sure differences in soil fertilizers such as phosphorus and nitrogen content and this affects positively or negatively on the disease severity. Nitrogen considered an essential requirement for plant growth and its shortage in the soil will affect directly on the plant cell size and thickness and therefore affects the host-parasitic interactions (Huber and Watson, 1974). The genetic variability in microorganisms and environmental factors such as humidity and other soil properties are additional factors that cause the differences in disease severity of plant pathogens (Schafer, 1994).

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EFFECT OF MIXING RATIO OF INDOXACARB WITH SOME PLANT OILS ON ITS EFFICACY TO CONTROL THE LARVAE OF *Trogoderma granarium* Everts. (Coleoptera: Dermestidea)

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ABSTRACT

The current study aimed to test the effect of five seeds plant oils, Sesame, Peanuts, Soybean, Sunflower and Almond with insecticide (Indoxacarb), using four different mixing ratios (pesticide: plant oil) (1: 0.5), (1:1), (1: 2), and (1: 3) and four different concentrations 50, 100, 150, and 200 ppm for each mixing ratio, and mixture ratio in the proportion of activation, synergy and potentiation on the % mortality of grain beetle larvae *Trogoderma granarium*. The study results showed that the highest mortality at mixture peanut oil and Soybean oil with Indoxacarb were reached for each them 95.24% in mixing (1: 0.5), while the effect of mixture peanut oil by mixing (1:3) highest toxicity to the revitalization of the pesticide in the grain beetle larvae of the third instar at a rate of 2.96, which was the rate of activation synergistically and potentially 2.68, 0.28, respectively, and followed by same mixture by mixing (1: 0.5) which reached 2.16. The Sesame oil, Peanut oil and Almond oil gave a mixture with the pesticide Indoxacarb by mixing (1: 1) ratio less toxicity pesticide antagonism reached 0.399, 0.85, 0.87 respectively.

KEY WORDS: Mixing ratio, Vegetable oil, Activation, Synergy, Potentiation, Grain beetle, Indoxacarb, insecticide.

INTRODUCTION

The extensive and uncontrolled pesticides application has led to appearance of numerous species of resistance insect to pesticides, this reach to 460 species in 2003 (Al Mallah and Al Jubury, 2012).

The side effects of adding pesticides led many environmentalists to call to stop use of pesticides preventing its production, but unfortunately, this call that unrealistic evidence that there is an increase in the production and use of pesticides in the world, which of course indication that pesticides are still the means adopted by man to control the pests. (Meister, 2010).

The most realistic alternative to reduce the use of pesticides is to rationalize the use and follow the correct methods in order to reduce collateral damage, in addition to reduce the damage of side effect.

The addition of doping substances of pesticides to increase their effectiveness at low concentrations and use other methods and strategies that helps in this direction.

Therefore, the present study aimed to protect the environment from the negative effects of pesticides through the study of the dynamic influence of some vegetable oils in response grain beetles larvae for some modern pesticides through the study of the influence of type of oil and the mixing ratio of oil with new groups of insecticide as a pesticide Indoxacarb rate of activation, synergy, and potentiation of the pesticide. Determine the mechanism of activation in the Indoxacarb pesticide, whether synergy or potentiation.

MATERIALS AND METHODS

Four different combination ratios (pesticide: vegetable oil) (1:0.5), (1:1), (1:2), and (1:3) were tested. Indoxacarb insecticide, belongs new group called Oxadiazine, active ingredient was, Indoxacarb brand name Avanut SL 15%, (MeisterPro, 2005) with different seed oils. Five seed plant oils; sunflower (*Helianthus annuus* L.), sesame (*Sesamum indicum* L.), peanut (*Arachis hypogea* L.), soybean (*Glycine max* L.), and

almond (*Prunus amygdalus* L.) were used 300 g of seeds from each one were added to 500 ml of organic solvent (Diethyl ether) and kept for 5 days at room temperature. The mixtures were filtrated by filter papers and separated by rotary evaporator at 45°C and then added to the Indoxacarb pesticide (Rahman and Talukder, 2006). All mixtures were diluted in Acetone to get different concentrations of 50, 100, 150, and 200 ppm. Three replicates with ten 3rd instar larvae of *T. granarium* Everts. were treated by the mixed ratios. Control was treated by Acetone only. All larvae were placed inside Petri dishes (9 cm diameter) and kept at an incubator at 30°C and 65-70% R.H.

Mortality rates of the larvae were recorded after 24 h and corrected using Abbott's formula (1925). Extract values of LC50 were corrected using Finney (1952). Activation ratio as well the interactive between the activation, synergy, and potential of each mixing ratio was measured using the Metcalf (1972) equation.

Synergistic and relay ratios caused by stimulants were represented as % mortality through the following steps:

-Correction of mortality rates of each mixture was made according to Al Mallah and Al-Jubury (2011). They represented the proportion of relay and humble to keep the synergistic impact only, as in the equation:

$$\% \text{ mortality corrected (pesticide)} = (\% \text{ mortality of a mixture} - \% \text{ mortality of anabolic substance}) / (100 - \% \text{ mortality of anabolic substance}) * 100.$$

-Lines of toxicity for the pesticide and its mixtures were separately used by the corrected % mortality calculated for each LC50 of the pesticide and its mixture.

-Calculate the proportion of synergistic effect using the Metcalf (1972) equation, which requires no toxic effect of the adjuvant.

-Ratio of synergistic effect = LC50 value of the pesticide / LC50 value of the pesticide apron (mixture corrected).

-Total expense ratio of activation = LC50 value of the pesticide / LC50 value of the mixture.

-Potential ratio = ratio of activation - ratio of synergistic effect.

RESULTS AND DISCUSSION

1- The effect of mixing ratio of seed plant oils with Indoxacarb insecticide and % mortality in the *Trogoderma granarium* larvae .

The results showed that the average of % mortality in *Trogoderma granarium* larvae treated with mixture pesticide plant oils (1: 0.5) has varied depending on the type of oils and the concentration used in the mixture, and mixing of peanut oil and insecticides and soybean oil with insecticide were gave the highest average mortality rate reaching 95.24% for each of them at 200 ppm, and the lowest number at a concentration of 50 ppm by mixing sesame oil with insecticide reached 28.57%. And showed that the best mixing type is peanut oil and insecticide which gave higher mean and lower LC 50 value was 70.1 , 52.62 ,respectively, which indicates the toxicity of the oil mixture as in Table (1).

The results showed that the average % mortality in the larval treated with mixing ratio (1 :1) a mixture oil and pesticide has varied depending on the oils type and the concentration used in the mixture, and the highest average % mortality was 90.5% when using soybean oil mixed with the pesticide at 200 ppm while the lowest % mortality was 6.66% at the mixing sesames oil and insecticide at 200 ppm. Also shown that the best mixing type is soybean and pesticide, where given highest mean and less value LC50 reached 61.9 ,78.53, which confirms the toxicity of the oil mixture as shown in Table (2).

While Mohammed (2009) mentioned that the sesame oil was best oils activation with pesticide Phenam activated by 1.9% and the relative effectiveness of 47.61 and the evidence did not show the toxicity of 100 clove oil activation against *C.maculates* F. with mixing (1:1).

The results also show that the average of % mortality in the larval treated with a mixture ratio (1:2) has varied depending on the oil kind and the concentration of mixture, and the highest mortality rate 95.23% when using soybeans oil mixed with the pesticides at 200 Ppm, and less mortality ratio reached 28.57% for each mixing sunflowers oil with insecticide and almond oil with pesticide at concentration of 50 ppm. Also shown that the best mixing is soybean oil and insecticide where given less value amounted to 59.747 LC50 where the overall average of 73.8

and killed by confirming the toxicity of the oil mixture, Table (3).

The results also showed that the average of % mortality in larvae with a mixing ratio of (1:3) has varied depending on the oils kind and the concentration, and mixing of soybean oil: pesticide gave the highest average of mortality reached to 95.2% at 200 ppm and less % mortality at a concentration 50 ppm by mixing sunflower oil: pesticide, amounted to 14.28% as showed in Table (4). The results in the same table showed that the best long mixing kind is peanut oil: pesticide followed by mixing soybean oil : pesticide, where given the lower value LC50 amounted to 40.46, 63.691 and the % mortality reached to % 73.84 , 73.77 respectively, and this indicates that the toxicity of the oil mixture.

The results showed also that the type of oil and the mixing ratio has varying effect in the average of the larvae % mortality table (5), It was found that the highest average in the % mortality in the larvae resulting from the interaction between the type of oil and the mixing ratio with the pesticide reached 73.8% when the mixing ratio of (1:2) to the mixture of soybean oil and pesticide, followed by the same mixture of oil, with mixing ratio(1:3) reaching to 73.77 %, and compared to less average ratio was when treated with a mixture of sesame oil and pesticide at mixing (1:1), reached to 18.33%, followed by the mixture of almond oil and pesticide by mixing (1:1), reaching to 40.47 %, this result is contrary to what the Mohammed (2009) mentioned that the sesame oil was best activating at 1.9% and 47.61 relative effectiveness and toxicity of evidence 100, while the Clove oil did not show activation, the reason for the superiority of soybean oil in activating the mortality rate that the density of soybean oil was high. Shahidi (2005) mentioned that the density of soybean oil ranges between 0.916 - 0.926, and viscosity range from 58.5 – 62.2 cp. (Shaaban and Al Mallah 1993) and (Abu Shanab, 2011) mentioned that the density of oil increased the stability on the body of the insect and thereby prevents the process of breathing insect which led to insects dies by suffocation and thus explain the high rate of mortality to a mixture of soybean oil and pesticide. Dawood (1991) stressed also that the soybean oil and kernel dates oil, mineral oils, Thanite, and Phenobarbital with pesticide Deltametherin in studying the effect of activation of the pesticide against adult beetle cowpea South

C. maculatus, when used mixture 5:1 pesticide: oil, while the mixture of pesticide with sesame oil gave the lower activation as shown in Table(5).

2- The effect of oil type and mixing ratio in the proportion of activation and synergy and potentiation in pesticide Indoxacarb .

Synergy ratios of mixtures oils and pesticide varied in our study depending on the type of oil and the mixing ratio. The results of the statistical analysis presence significant differences in the rates of activation at the level % 0.05 depending on the factors, the highest synergy 2.68 gave by the mixture pesticide with peanut at mixing ratio of (1:3), and followed by same mixture with mixing ratio (0.5:1) reaching 2.16, then followed by mixture soybean and pesticide 3:1 and 2:1 which reaching to 1.95, while the less synergy ratio 0.399 appeared when mixing ratio 1:1 and mixture of sesame oil as shown in table (6). The results showed also wide variation in the potentiation rate for mixtures of oils and pesticide depending on the type of oil and the rate of mixing it was found that the higher proportion 0.4 in a mixture of pesticide and sesame oil, at the mixing ratio 2:1 and 3:1, while the potentiating was zero in the same mixture at mixing ratio 1:1 also the mixture of the pesticide with soybean oil at the ratio 3:1 as shown in table (7).

Finally, and as the activation result is the sum of Synergy ratio and potentiation ratio, the results showed wide variation in the rates of activation of mixtures, the higher activation found in the mixture pesticide with peanut oil where reached to 2.96 at the mixing ratio 3:1, while the lowest activation 0.399 rate shown at the sesame oil at mixing 1:1 compared to as shown in Table (8) which was the effect of sesame oil antagonism on insecticide Indoxacarb action.

In general, the mixing ratio 3:1 was the best, followed by the mixing ratio of 0.5:1, where the overall average for the activation 1.886 and 1.704, respectively. Finally, the results of this study showed that the vegetable oils were used in this study has synergistic effect on the pesticide, and this is consistent with several studies that show the synergistic effect of the material added to a pesticide. Shaaban and Al Mallah (1993), Sun and Johnson (1960). Reported that The synergies mainly depends on the materials that may be motivating or inhibitory the enzymes and thus on the chemical composition of pesticides. O'Brien (1967). Mentioned that the increased of toxicity

pesticides by adding synergies materials depends on several factors, like increased speed of entry into force of the pesticide through the body and the speed of arrival at the target sites, Wilkinson (1979), reported that the additives materials can inhibitory the enzyme which responsible for the removal of toxic pesticides within the body of the insect, which leads to the accumulation of the active ingredient of the pesticide and the speed of the killings. Karso and Nazar(2015), mentioned when used some vegetable oils mixed with the pesticide Acetamprid against larvae of the Khapra beetle *Trogoderma granarium* Everts ,the mixture of soybean oil with Acetamprid, at the ratio of (1:3) showed highest mortality percentage of *T. granarium* larvae, a synergistic ratio reached 2.4, and the highest antagonism effect to Aceptamprid reached 0.56. when used sunflower oil. Karso(2012). Confirmed that the influence of

activation shown by vegetable oils in some pesticides due to the mechanism of synergism more than what is due to the mechanism potentintion, although rates of activation and antagonism shown by the results of the study did not only rely on type of oil used in the study, but had a mix proportions important role in this area, results of the study showed that the rates of increase of oil led to the activation contrast ratio and the ratio of 1:0.5 gave the best rates of activation. Also Karso and Nazar (2013) found that the best mixture was peanut oil by mixing 3 Oil:1 pesticide toxicity to the revitalization of the pesticide in the grain beetle larvae of the third instar of poetry at a rate of 1.62, which was the rate of activation synergistically1.57 ,The sesame oil gave a mixture with the insecticide Alpha-Cypermtherin by mixing oil 2: 1 ratio less insecticide antagonism reached 0.15 .

Table(1): Illustrated the effect of oil type ,oil and Indoxacarb insecticides mixture concentrations of mixture ratio(0.5oil:1insecticide)on the Mortality percentage of grain beetle larvae reared on wheat grain.

Oil type	Conc. Ppm.	Mortality %		Value LC50	Slop	Confident layout	
		Mean	Average			Lower	Upper
Sunflower	50	42.857					
	100	57.142	59.5	71.638	1.319	47.33	90.457
	150	66.66					
	200	71.43					
Sesame	50	28.571					
	100	42.857	49.99	113.167	1.80	95.80	133.80
	150	57.142					
	200	71.428					
Peanut	50	42.38					
	100	57.142	70.10	52.62	2.34	40.03	63.00
	150	85.714					
	200	95.24					
Soybean	50	42.857					
	100	57.142	69.04	72.076	2.33	59.33	83.20
	150	80.951					
	200	95.24					
Almond	50	42.857					
	100	57.142	64.28	69.869	1.90	54.00	84.00
	150	71.428					
	200	85.714					

Table(2): Illustrated the effect of oil type , oil and Indoxacarb insecticides mixture concentrations of mixture ratio (1oil : 1insecticide) on tme Mortality percentage of grain beetle larvae reared on wheat grain.

Oil type	Conc.	Mortality %		Value LC50	Slop	Confident layout	
		Mean	Average			Lower	Upper
Sunflower	50	14.68					
	100	42.85	52.37	106.00	3.40	95.80	116.94
	150	61.9					

	200	90					
Sesame	50	33.33					
	100	22.22	18.33	300.40	-1.69	143.83	14.00
	150	11.12					
	200	6.66					
Peanut	50	23.8					
	100	33.3	42.82	140.90	1.80	119.00	174.00
	150	52.3					
	200	61.9					
Soybean	50	42.8					
	100	52.3	61.9	78.53	1.10	47.11	103.10
	150	61.9					
	200	90.5					
Almond	50	14.28					
	100	33.33	40.47	138.00	2.57	111.00	190.00
	150	42.85					
	200	71.42					

Table(3): Illustrated the effect of oil type, oil and Indoxacarb insecticides mixture concentrations of mixture ratio(2oil:1insecticide) on the Mortality percentage of grain beetle larvae reared on wheat grain.

Oil type	C;onc.	Mortality %		Value LC50	Slop	Confident layout	
		Mean	Average			Upper	Lower
Sunflower	50	28.57					
	100	42.85	49.99	112.226	1.83	94.90	132.70
	150	57.14					
	200	71.42					
Sesame	50	42.85					
	100	57.14	59.51	69.789	1.20	43.40	89.45
	150	66.66					
	200	71.42					
Peanut	50	42.85					
	100	57.142	57.13	72.919	1.00	37.74	98.00
	150	61.9					
	200	66.66					
Soybean	50	42.85					
	100	71.42	73.80	59.747	2.80	49.40	67.00
	150	85.71					
	200	95.23					
Almond	50	28.57					
	100	42.85	49.99	111.219	1.70	93.50	132.20
	150	57.14					
	200	71.42					

Table (4): Illustrated the effect of oil type, oil and Indoxacarb insecticides mixture concentrations of mixture ratio(3oil :1insecticide) on the Mortality percentage of grain beetle larvae reared on wheat grain.

Oil type	Conce. ppm	Mortality %		value LC50	Slop	Confident layout	
		Mean	Average			Upper	Lower
Sunflower	50	14.28					
	100	42.8	46.42	124.501	2.60	111.10	140.5
	150	57.14					
	200	71.42					
Sesame	50	42.85					

	100	57.14	59.51	69.785	1.30	44.4	89.10
	150	66.66					
	200	71.4					
Peanut	50	58.14					
	100	66.9	73.84	40.466	1.10	12.70	61.00
	150	75.42					
	200	94.9					
Soybean	50	42.8					
	100	71.4	73.77	63.691	2.80	53.30	73.00
	150	85.7					
	200	95.2					
Almond	50	42.8					
	100	57.14	61.88	66.63	1.80	50.30	80.00
	150	61.9					
	200	85.7					

Table (5): The effect of oil type mixed with Indoxacarb insecticide (Avaunt) on the main average mortality of grain beetle larvae.

Oil Type	Mixture ratio (pesticide : oil)			
	1-0.5	1-1	1-2	1-3
Sunflower	59.50	52.37	49.99	46.42
Sesame	49.99	18.33	59.51	59.51
Peanut	70.1	42.82	57.13	73.84
Soybean	69.04	61.9	73.8	73.77
Almond	64.28	40.47	49.99	61.88

Table (6): Effect of plants oils and pesticide mixture ratio on the Synergism on Grain beetle larvae.

Type of oil	Mixing ratio			
	1:0.5	1:1	1:2	1:3
Sesame	0.76	0.399	1.32	1.32
Peanut	2.16	0.579	1.35	2.68
Almond	1.55	0.657	0.88	1.48
Sunflower	1.18	0.90	0.79	0.77
Soybean	1.66	1.304	1.95	1.95
Average	1.462	0.7678	1.258	1.64

Table (7): Effect of plants oils and pesticide mixture ratio on the Potentiation on Grain beetle larvae.

Type of oil	Mixing ratio			
	1:0.5	1:1	1:2	1:3
Sesame	0.30	0.00	0.40	0.40
Peanut	0.12	0.28	0.30	0.28
Almond	0.17	0.22	0.20	0.32
Sunflower	0.50	0.23	0.28	0.32
Soybean	0.12	0.23	0.06	0.00
Average	0.242	0.192	0.248	0.264

Table (8): Effect of plants oils and pesticide mixture ratio on the activation on Grain beetle larvae.

Type of oil	Mixing ratio			
	1:0.5	1 :1	: 21	1 :3
Sesame	1.06	0.399	1.72	1.72
Peanut	2.28	0.85	1.65	2.96
Almond	1.72	0.87	1.08	1.80
Sunflower	1.68	1.13	1.07	1.00
Soybean	1.78	1.53	2.01	1.95
Average	1.704	0.9558	1.116	1.886

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كارليكرنا هندهك زهيتين رووهكى ل سهر كاركرنا ناقبرين ميش وموران (Indoxacarb) دژى كيزا گهنمى
(خابرا) (*Trogoderma granarium* Everts. (Coleoptera: Dermestidea)

پوخته

ژئه نجامى خواندنا دياربوو كو هندهك كارليكه رين زهيتيت توفى رووهكى وهك (زهيتا كونجى، فستق، فولاً سويا، كول بهروژ و باهيفى) كارليكى دكه نه سهر ناقبرى ميش وموران Indoxacarb، بكارئينا چار ريژين تيكه لين ژيك جودا (ژناقبرى: زهيت) 1:3، 2:1، 1:1، 0.5:1 و چار تيراتين جودا 150، 100، 50 و 200 پارچهك ژ مليوناً بو ههر ريژه كا تيكه لى، ب ريژهك چالاكرنى وتى زر وبهيز كرنا بوناقبرا دريژا كوشتنا كرما دژى سى دا كيزا گهنمى (خابرا) *Trogoderma granarium*. تيكه لى ههر ئيك ژ زهيتا فستقا وزهيتا فولاً سويا و ناقبرى اندوكساكارب (ئافانت) كو ديبته ئه گهرى بلند ترين ريژا كوشتنى كو گه هشته 95.24 ل ريژا تيكه لى 0.5:1 به لى با كارليكا تيكه لى زهيتا فستق و ناقبرى بريژا 3:1 كو بلند ترين ريژا ناقبر گه هشته 2.96 ويت كو تيكرا چالاكى بالتى زرو ب هيزكرناوى گه هشته 0.28، 2.68 دويف ئيك، ودا ههر ئيك ژقان تيكه لان دا زهيتا كونجى و فستق و باهيف و ناقبرى Indoxacarb بريژا 1:1 بكارليكا كيمكرى بوناقبرى گه هشته بهايى 0.87، 0.85، 0.339 لدويف ئيك.

تأثير بعض الزيوت النباتية في فاعلية المبيد الحشري (Indoxacarb) ضد خنفساء الحبوب الشعيرية (الخابرا)
Trogoderma granarium Everts. (Coleoptera: Dermestidea)

الخلاصة

اظهرت نتائج دراسة تأثير بعض زيوت البذور النباتية (زيت السمسم، فستق الحقل، وفول الصويا، زهرة الشمس واللوز) بالمبيد الحشري Indoxacarb، بأستخدام أربعة نسب خلط مختلفة (مبيد: زيت) 1:0.5، 1:2، و 1:3 وأربعة تراكيز مختلفة 50، 100، 150 و 200 جزء في المليون لكل نسبة خلط، في نسبة التنشيط والتأزر والتقوية للمبيد في نسبة القتل ليرقات العمر الثالث لخنفساء الحبوب الشعيرية *Trogoderma granarium*. أن خليط كل من زيت فستق الحقل وزيت فول الصويا والمبيد اندوكساكارب (افانت) قد اعطى اعلى نسبة قتل بلغت 95.24 عند نسبة خلط 1:0.5، بينما كان تأثير خليط زيت فستق الحقل والمبيد بنسبة خلط 3:1 اعطى اعلى نسبة تنشيط للمبيد بلغت 2.96 والتي كان معدل التنشيط بالتأزر والتقوية لها 0.28، 2.68 على التوالي، واعطى خليط كل من زيت السمسم وفستق الحقل واللوز والمبيد Indoxacarb بنسبة خلط زيت 1:1 تأثير تثبيطي للمبيد بلغت قيمة 0.399، 0.85، 0.87 على التوالي.

FIRST RECORD OF THE EUROPEAN FRUIT LECANIUM *Parthenolecanium corni* BOUCHE' (HOMOPTERA :COCCIDAE) IN IRAQ

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ABSTRACT

The European fruit lecanium, *Parthenolecanium corni* (Homoptera:Coccidae). Is recorded for the first time as a new species in Duhok city, Kurdistan region, Iraq. *P. corni* infect the leaves, twigs and branches of rubber fig *Ficus elastica* plants. The infestation eventually led to heavily damaged plants. The average number of scales was 39.90 scale/branch, and main infestation was on leaves with the highest number as 50.66 scale recorded on May 2013.

KEY WORDS : *Parthenolecanium corni*, Soft scales , First record, *Ficus elastica*, Iraq.

INTRODUCTION

Soft scale insects (Homoptera: Coccidae) are the most prevalent and difficult to control in urban landscapes in the world. The European fruit lecanium *Parthenolecanium corni* is one of the most commonly encountered soft scale species infesting ornamentals and shade trees in urban landscapes (Jonson and Lyon 1991). *P. corni* (Bouche) belongs to the most important pest of over 350 plant species (Kawecki 1958), Japoshvili et. Al. 2008, mentioned that the soft scale is harmful to its host plant trunks and branches especially *Fraxinus* spp and some other ornamental and fruits. Robayo Comacho, 2015 reported that *P. corni* is found in mixed populations as a pest of oak trees (*Quercus* spp.) in southern United States and is an important pest of willow oak trees *Quercus phellos* L. (Barman 2004). The heavy infestation, due even to plant die and plants often defoliated due to the accumulation of sooty moulds growing on the honeydew (Borchsenius, 1957 ; Khadzhibeili, 1983 ; Kosztarab and Kozar, 1988).

Bijardi (1981) demonstrated a positive correlation between the volume of *P. corni* fecundity [fecundity = 236.66+35.23 (volume)].

Eggs hatched between mid April to early June. After exclusion, crawlers dispersed and fed on nearby leaves. First instars of *P. corni* are known to settle on the underside of leaves (Kosztarab 1996).

According to the project of Agro Atlas 2003-2009, the *P. corni* distributed in Europe (except polar territories) Northern Africa, Iran, Afghanistan, China, Korea, North America, Argentina, Australia and New Zealand.

MATERIALS AND METHODS

In July 2013, branches with mature adult scales were collected from rubber fig *Ficus elastica* grown in plastic houses in Duhok city. The samples were placed in transparent nylon bags, making fine pores to allow transpiration and avoid an excess of moisture and sent for identification at Iraqi Natural Research Center and Museum in Baghdad University.

The estimation of the scales density was calculated as the mean number of adult coccids per branches and leaves of rubber fig plants. Five branches (20-25 cm length) with one leaf were randomly selected every two weeks. Then the number of scales was counted on leaves and twigs to determine the scales population density. The sampling was done from June 2012 to July 2013. A binocular Genex microscope 03206 (U.S.A) with 20x magnification were used to describe the adults. Adult measurements were taken by a graticule micrometer slide inserted into the eyepiece of the microscope. A Nikon camera (Japan) was used to take photographs.

RESULTS AND DISCUSSIONS

The examined *Parthenolecanium corni* specimens that collected from the branches of rubber fig *Ficus elastic* collected from plastic houses in Duhok city is recorded as a new species in Iraq. The soft scale specimens (Fig 1) were identified by the Iraqi Natural Research Center and Museum under the *P. corni* (Bouche') by D. Mohammed Salih Rasoul In 8-7-2015.

At the plastic houses in Duhok city, were the present study was carried out, in general the total number of scales was 3389.35 (from 100 branch samples with a length of 20-25 cm), with an average of 33.90 scale/branch (Fig.1 A,B).



Fig. (1): A= early infestation
 B= heavy infestation in the late season

The number of scales was varied , ranging from 12.20 to 405 scale/branch and 27.27% of branch had 150-200 scales .The average number of scales on twigs and leaves of rubber fig branches was 13.14 and 95.67 scale, respectively.

The highest average number of scales/twig reached to 36 scales recorded on September 2012 and the lowest average number of scales/twig was 5.44 scales recorded on December 2012. While the highest number of scales on leaves reached to 50,66 scale recorded on May 2013 and the lowest number was 2.40 scales recorded on June 2013 (Fig 2 A and B).

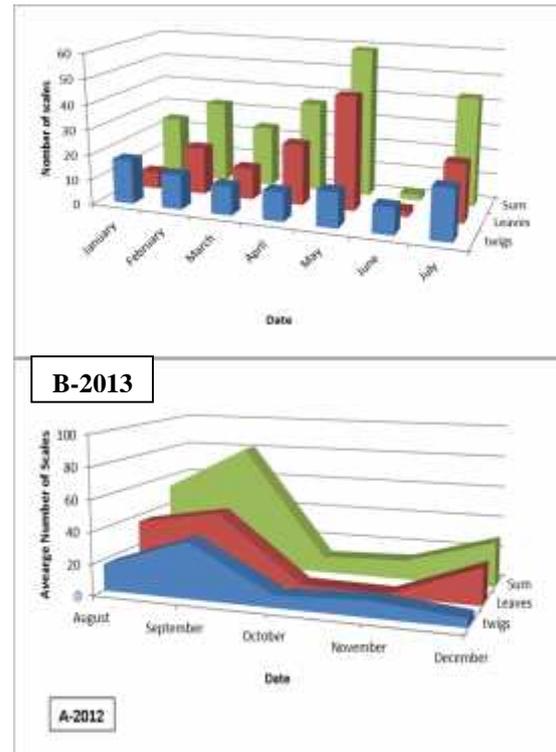


Fig.(2): Population dynamic (Average) of *P. corni* scales on *Ficuselasticus* in plastic houses, Duhok city.

In general the scale population density in 2013 on 20-25 cm length branches was less than that found in 2012. Cause we didn't use any control method otherwise suitable circumstances for development and increasing population of scale insects.

The results showed that the *P. corni* infestation percentages on rubber fig reach to 100%. as one generation per year and over winter as second-stage nymphs on the branches and trunks of the host plant.

The female are initially flattened and with a smoth, hemispherical shaped body , that is about 6 mm long. During growth ,the body is soft , but as they mature , they become hardened and round brown shell , fastened loosely to the bark , and serves as a covering for several hundred white eggs. Crawlers are initially white, but turn yellow as they mature.



Fig.(3): A= Nymph , B= Adult

Wardlow and Ludlam, 2007 who studied the *P. corni* (Bouche') biology on red currant bushes in a plantation in Kent, mentioned that the scales matured between the end of May and the second week of June and added that the eggs were first found at the end of June and hatched during the first week of August each year. Robayo Camacho, 2015 reported that the *P. corni* eggs hatched between mid-April and early June, second instars began to occur in October, and third instars and adults appear mid-March to early April. Ben-Dov et al. reported that this *P. corni* is present mainly in the Palearctic and Nearctic regions, although sporadic detections have been reported elsewhere. Borchsenius, 1957 mentioned that *P. corni* has one to three generations in Russia.

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THE EFFECT OF SOIL FERTILITY ON ABOVE-GROUND APHID (*Myzus persicae* S.) DEVELOPMENT VIA CHEMICAL AND MORPHOLOGICAL CHANGES IN THE PLANT

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ABSTRACT

Plant food) Osmocote (was used to investigate its influences on above-ground salad rocket *Eruca sativa* Miller growth and green peach aphid *Myzus persicae* Sulzer development.

In this study five levels (0, 5, 10, 15, 20gm.) of Osmocote were added to the plants. All plant parameters (leaf surface, leaf area index and plant biomass) except plant height showed significant differences among treatments. Nitrogen concentration was increased in the plant by adding Osmocote to the soil.

M. persicae development was also affected by the amount of Osmocote added to the pots; daily nymph production, fecundity and numbers of adults showed significant differences between control and other levels of treatments in both generations.

The influence of soil fertility on plant growth and aphid development are shown to be modified by increasing the amount of fertilizer in the soil.

KEYWORDS :Green peach aphid ·Osmocote ·Salad rocket ·Nymph

INTERODUCTION

The role of fertiliser additions in soil management and nutrient availability are well mentioned (Glover *et al.* 2000., Andrews and Carroll, 2001). In apple orchards, adding composts enhance soil health, hence increasing the production (Doran and Zeiss, 2000., Reeves, 1997).

Bell *et al.* (2008) suggested that compost application positively affected soil moisture and nutrients, which are in the benefit of plants. Also the positive effect of soil nutrient on barley *Hordeum vulgare* performance has been assessed (Rowntree *et al.*, 2010).

The wheat (*Triticum aestivum*) biomass increased by using plant food riches with nitrogen to the soil (Schutz *et al.*, 2008). The direct effect of fertilization on plant performance causes indirect effect on above-ground herbivores, since plant defences against above-ground herbivory depends on soil nutrients (Glynn *et al.*, 2003), in particular nitrogen availability which has a great role in plant metabolic processes, hence in plant and herbivore growth (Mattson, 1980).

Several studies mentioned the role of soil nutrient on the relationship between plant and aphid performances. (Rowntree *et al.*, 2010,

Schutz *et al.*, 2008), found the positive effect of soil nutrient in aphid development.

Also (Honek, 1991) mentioned the relationship between changes in the plant characteristics and above-ground aphid development, where the addition of fertilizer results in changes in leaf area and biomass and this affects positively on the presence of aphids and their development. (Honek 1992) found that this relationship depends on aphids species, where *Metopolophium dirhodum* development affected positively by changes in the plant characters, while *Sitobion avenae* was not responded to these changes which related to aphid growth.

In contrast (Brown and Tworowski., 2004, Bell *et al.*, 2008) pointed the negative role of compost on aphid reproduction via increased the numbers of predators.

The aim of this study is to investigate how *M. persicae* growth affects by changing the amount of Osmocote in the soil and the role of plant in the relationship between below and above ground community.

MATERIALS AND METHODS

Experimental Design

The experiment was conducted in the greenhouse. Each experimental unit consisted of a

two-litre plastic plant pot. Salad rocket seeds were sown and germinated approximately one week later.

Three weeks later individual aphid nymphs (third instar) were transferred from cultures to leaves of the growing plants.

The experimental design consisted of the following treatments: 0, 5, 10, 15 and 20 gm. Osmocote (Nitrogen 14%, Phosphate 14%, and Soluble Potash 14%). Aphids *M. persicae* were monitored and accounted weekly. By the end of experiment (plant harvest) the following parameters were quantified; Plant height, leaf surface area, leaf area index (LAI), plant biomass and nitrogen concentration.

Aphid Monitoring

Salad rocket plants were exposed to aphid nymph when 4 weeks old using a needle to transfer them from culture. Aphids monitored, counted daily and the new generation was transferred to new leaf within the same plant.

The aphid nymphs were enclosed in small clip-cages (20 mm diameter and 100 mm height). The clip-cage consisted of two transparent PVC tubes, covered at one end by 200 μ m mesh and held together by a clip (Scheu, *et al.*, 1999).

Statistical Analysis

All results are expressed as mean values \pm standard error (\pm SE). Data analysis was performed using one-way ANOVA. Post-hoc Tukey test was used to detect the significant differences between the means. The P value was fixed at 0.05. Statistical analyses were conducted using Minitab software v.16.

RESULTS AND DISCUSSION

1- Plant growth

One-Way ANOVA (Fig. 1) revealed that; leaf surface area and LAI were affected by adding Osmocote. The result showed a substantial increase in all traits when plants grown in the 5, 10, 15 and 20 gm of Osmocote with significant differences ($P < 0.05$) between control and all other treatments (Fig. 1 a-b).

While the result of plant height showed no significant differences ($P > 0.05$) between control, 5, 10, 15 and 20 gm treatments (Fig. 1. c).

In addition to morphological changes, plant biomass and nitrogen concentration also were positively affected by increasing the amount of fertiliser. Post-hoc Tukey tests showed a substantial increase in plant biomass in the plants

grown in the 15 and 20 gm compared with 0, 5 and 10 gm treatments with significant differences between them (Fig. 2 a). Similarly, nitrogen concentration within plant leaves was also substantially higher in plants grown in the 5, 10, 15 and 20 gm treatments compared with the control (Fig. 2. b).

Fig. (1): The effect of different amount of Osmocote on *E. sativa* morphology, (A) Leaf surface area. (B) LAI. (C) plant height.

Fig. (2): The effect of different amount of Osmocote on *E. sativa* biomass

Fig. (3): The effect of different amount of Osmocote on nitrogen concentration in *E. sativa*

2- Aphid development

The development of aphid populations in the different levels of Osmocote in the first generation is shown in (Table 1). Post-hoc Tukey tests showed a substantial increase in the numbers of daily nymph production and the fecundity. Daily nymph production significantly increased ($P < 0.05$) in the 10 gm treatment, compared to 20, 15, 5 and 0 gm, with no significant differences ($P > 0.05$) between 5, 15 and 20 gm treatments. While the fecundity significantly increased in 5, 10, 15 and 20 gm treatments compared with the control. Honek, (1992) found increasing the number of aphids with increasing soil fertilizer. William and Mattson, (1980), also mentioned the positive effect of nitrogen on insect growth, while Brown and Tworowski (2004), found the negative role of compost on aphid development via increasing the numbers of predators above-ground.

In addition to the first generation, aphid development was also affected by increasing fertiliser in the second generation (Table 2). Post-hoc Tukey tests showed higher daily production of

nymphs in the 10, 15 and 20 gm treatments compared to the 5 gm and control treatments with no significant ($P > 0.05$) differences between 10, 15 and 20 gm treatments. There was significant ($P < 0.05$) differences between 5 gm and control treatments. Similarly, the fecundity was also substantially higher in the plants grown in the 10 gm Osmocote compared with other treatments with no significant differences ($P > 0.05$) between 5, 15 and 20 gm treatments (Table 2).

This investigation confirmed that *E. sativa* positively responded to the soil nutrient changing, this was also confirmed by Arumugam. (2012). This may be related to the increase of the nitrogen supply in the soil (Schutz *et al.*, 2008). The quality of soil has a role in plant growth (Glover *et al.*, 2000). These modifications in the soil cause changing in nitrogen concentration which is in the benefit of plant (Ingham *et al.*, 1985).

Furthermore, within this study, the results have shown that there were some significant differences in the aphid development depending on the amount of fertilizer added to the pots. However, these differences in the development were not consistent between the two generations, suggesting that there were some factors affecting the development. It was suggested that the short plant life cycle or decreasing the nutrient in the soil with time may have affected the development. Rowntree *et al.* (2010), Sackett *et al.*, (2010) and Megahed, (2005) mentioned the positive effect of soil nutrient on plant and above-ground insect growth. Aphid growth responded to the physical and medical changes in the plant (Setala & Huhta, 1991; Pescod *et al.*, 2007). These chemical changes in the plant can occur in any part of plant (Bezemer & Van Dam, 2005). Also, Hanley *et al.*, (2007) mentioned the role of plant structure in the defences against insects.

Table (1): The effect of different amount of Osmocote on daily and fecundity of aphid in the first generation

Treatments	Nymph/aphid/daily	Nymph/aphid/fecundity
Control	0.98 ± 0.04 ^a	15.6 ± 0.6 ^a
5 gm.	1.25 ± 0.08 ^b	20.0 ± 1.3 ^b
10 gm.	1.45 ± 0.09 ^c	20.0 ± 1.9 ^b
15 gm.	1.12 ± 0.09 ^b	18.0 ± 1.5 ^b
20 gm.	1.10 ± 0.08 ^b	17.6 ± 1.3 ^b

Table (2): The effect of different amount of Osmocote on daily and fecundity of aphid in the second generation

Treatments	Nymph/aphid/daily	Nymph/aphid/fecundity
Control	1.29 ± 0.04 ^a	20.6 ± 0.6 ^a
5 gm.	1.57 ± 0.08 ^b	25.0 ± 1.3 ^b
10 gm.	1.77 ± 0.10 ^c	28.4 ± 1.6 ^c
15 gm.	1.74 ± 0.09 ^c	23.0 ± 1.5 ^b
20 gm.	1.71 ± 0.08 ^c	22.6 ± 1.3 ^b

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ROLE OF POTASH FERTILIZATION IN REDUCTION OF WATER STRESS IN MUNGBEAN (*Vigna radiate* L.), WATER USE EFFICIENCY AND YIELD

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ABSTRACT

A field study was conducted during autumn seasons of 2012 and 2013 at Al Jazera city/ Al-Anbar province to determine the actual consumptive use by mungbean crop (*Vigna radiata* L.) under water stress conditions and potassium fertilizer, as well as the assessment of field water use efficiency and yield. Four treatments of irrigation were used I₁ represent among irrigation which were done after 50% of available water depletion (control); I₂, I₃ and I₄ represent the depletion of (25, 50 and 75) % of available water of control treatment, respectively. Rather than using four levels of potassium (K₀= 0.0, K₁=40, K₂=80 and K₃=120) kg K ha⁻¹ using K₂SO₄ fertilizers (41.5 %K). A split plot in randomized complete block design was used with three replications. The local mungbean seeds were planted, depth and date of irrigation were determined according to consumed soil moisture. The results show that: the actual water consumptive use (ET_a) was varied with irrigation treatment. ET_a reached (382.06 and 338.75) mm season⁻¹ for I₁ treatment and decreased in I₄ treatment to (220.02 and 183.53) mm season⁻¹, in first and second season respectively. The ET_a values were (315.14 and 272.64) mm for first and second seasons, respectively in K₀ treatment, and decreased to (310.23, 304.03 and 298.49) mm.season⁻¹ for K₁, K₂ and K₃, respectively in first season and (268.69, 262.66 and 252.72) mm.season⁻¹ for K₁, K₂ and K₃, respectively in second season. The crop water use efficiency (water productivity) were (2.83, 2.69), (3.02, 3.01), (1.99, 2.04), (1.63, 1.47) kg.ha⁻¹.mm⁻¹ for I₁, I₂, I₃ and I₄ treatments, respectively. Crop water use efficiency were (1.81, 1.73), (2.24, 2.17), (2.54, 2.51), (2.87, 2.79) kg.ha⁻¹ mm⁻¹ for K₀, K₁, K₂ and K₃ treatments in the first and second seasons, respectively. The field water use efficiencies were (2.74, 2.63), (2.94, 2.94), (1.94, 2.01), (1.58, 1.43) kg.ha⁻¹.mm⁻¹ for I₁, I₂, I₃ and I₄ treatments in the first and second seasons, respectively, while it was (1.76, 1.71), (2.18, 2.13), (2.47, 2.46), (2.78, 2.72) kg.ha⁻¹ mm⁻¹ for K₀, K₁, K₂ and K₃ treatments in two seasons, respectively.

KEYWORDS: Irrigation, Potassium Fertilizers, Water Use Efficiency, Mungbean

INTRODUCTION

Mungbean (*Vigna radiate* L.) is an important short-duration grain legume crop with wide adaptability, low input requirements and its ability to improve the soil by fixing atmospheric nitrogen (Sadeghipour, 2009). Low precipitation in the studied area (less than 250 mm) along with its uneven temporal and spatial distribution led agronomists to select the most effective irrigation methods or drought tolerant cultivars. Grain legumes are a major source of protein in arid and semiarid region of world and play a key role in economy of these regions (Singh and Patal, 1996). Mung bean is a short-season summer growing grain legume grown as dry land crop in the center and northeast of Asia (Majnon Hoseini, 2009). Mung bean is a drought tolerant crop and performs well under

conditions of low soil moisture (Kochaki and Benayanol, 1990).

Drought stress is the most common form of a biotic stress and plants are likely to encounter periods of water shortage in their life cycle (Cruz de Carvalho, 2008). Water is essential to plant growth because it provides the medium within which most cellular functions take place (Condon et al., 2004). Water stress causes membrane damage, and stimulates molecular signal transduction and hormone activation, leading to a reduction in plant growth and productivity (Ghassemi-Golezani et al., 2008, 2009). Jalilian et al. (2005) reported that the effect of water stress in yield reduction was more in reproductive growth stage than others. Mohammadzadeh et al. (2011) and Bayat et al. (2010) indicated that, water stress significantly reduced the pods number in plant, seeds number in pod and seed yield, but the amount of seed protein increased.

Potassium (K) is the third macronutrient required for plant growth, after nitrogen (N) and phosphorus (P). Unlike N and P, K is not introduced component of cell structure. It exists in plants mobile ionic form, and acts primarily as a catalyst (Wallingford, 1980). K has an important osmotic role in plants. It exerts significant effects on disease resistances through specific metabolic functions that alter compatibility relationships of the host-parasite environment (Kafkafi et al., 2001). Potassium has special role in rain fed agriculture as its optimum nutrition is associated with crop tolerance to water stress conditions, however its application in rain fed crops is meager. Potassium it was pointed out that to improve water relations as well as productivity of different crops under water stress conditions (Baligar, et al., 2001). Ali et al. (1996) reported that number of pods per plant, seeds per pod, seed yield and seed protein contents were increased significantly with potassium application and maximum seed yield was obtained with 90 Kg potash per hectare. Also they observed significant difference of protein contents in different mung bean cultivars due to application of potassium. The present study aims to investigate the role of potassium fertilizers and water stress on mungbean (*Vigna radiate* L.) productivity and water use efficiency.

MATERIAL AND METHODS

The experiment was conducted in 2012 and 2013 seasons at the Farm in Al Jazera city/ Alanbar province, Iraq (Latitude 33°15' N, Longitude 44°07' E). The experiment was arranged as split-plot, based on RCBD with three replications. Soil samples were collected from the depth of 0-0.2 and 0.2-0.4 m and were then analyzed (Table 1). Irrigation scheduling organized based on soil moisture content. Soil moisture content calculated as the difference between field capacity and permanent wilting point determined by gravimetric method. This study included following treatments:

1. Irrigation treatments (as main plot):
 - a. Irrigation at 50% depletion of available water (control) (I₁).
 - b. Irrigation at 25% depletion from control treatment (I₂).
 - c. Irrigation at 50% depletion from control treatment (I₃).
 - d. Irrigation at 75% depletion from control treatment (I₄).

2. Potassium fertilizers treatments (as sub plot):

- a. K₀ (0 kg. K ha⁻¹).
- b. K₁ (40 kg. K ha⁻¹).
- c. K₂ (80 kg. K ha⁻¹).
- d. K₃ (120 kg. K ha⁻¹) using K₂SO₄ fertilizers (41.5 %K).

Planting took place on 15/7/2012 and 17/7/2013 for first and second season, respectively in 0.3 m spaced rows with net plot size of 3 m × 6 m, in a randomized complete block design with three replicates. Each experimental unit included of 6 rows. All plots were irrigated with river water (EC_i = 1.3 dS.m⁻¹). Irrigation were scheduled when soil water content in the root zone was depleted by the crop to specific levels of available water. The soil depth of the effective root zone increased from 0.20 m at planting to 0.40 m in flowering and grain formation stages. NP mineral fertilizer as urea, and calcium super phosphate were applied to all treatment, as they are commonly used for growing wheat plants and recommended by Ministry of Agriculture. Weeds were frequently controlled manually during crop growth and development stages. The amount of water consumed from the root zone between two successive irrigations as a water depth in cm, was calculated from the following equation (Allen et al., 1998):

$$d = D \times P_b \times (Q_2 - Q_1) / 100 \quad (1)$$

Where:

d = Depth of water added

D = irrigation root zone depth (cm)

P_b = Bulk density of soil (μg.m⁻³)

Q₂ = Percentage of soil moisture at field capacity

Q₁ = Percentage of soil moisture before irrigation

At maturity stages, plants harvested at different dates depending on irrigation treatments from 25/9 to 11/10/2012 in the first season and 23/9 to 10/10/2013 in the second season. Plants in 1 m² of the middle part of each plot were harvested and grain yield per unit area was determined. The obtained data were analyzed and the significant compared at p 0.05 using GenStat software. Field Water Use Efficiency (WUE_f) or irrigation water use efficiency (IWUE) calculated as follows:

$$WUE_f = \frac{Yield}{Water\ applied} \quad (2)$$

Table(1):- Some chemical and physical soil properties

Properties		First Season	Second Season
pH	---	7.8	7.6
EC	dS m ⁻¹	3.06	2.85
Organic matter	gm kg ⁻¹	5.80	5.60
Available K	mg kg ⁻¹	144	135
Available N		40	42
Available P		12	11
Sand	gm kg ⁻¹	389	388
Silt		533	536
Clay		76	74
Texture		Silty loam	Silty loam
Bulk density	Mg m ⁻³	1.33	1.34
Water content at FC	cm ³ cm ⁻³		0.32
Water content at WP			0.15
Available water			0.17

RESELUT AND DISSCUSION

Results presented in Table 2 and 3 show the factors of water balance equation for irrigation and potassium fertilization treatment. The highest ET_a reached (382.06 and 338.75) mm.season⁻¹ for I_1 treatment which received number of irrigation 15 and 14, and decreased in I_4 treatment to (220.02 and 183.53) mm.season⁻¹ which received number of irrigation 7 and 6, in first and second season respectively. The decreased percentage in ET_a with different irrigation treatments, were (8.95, 27.26 and 42.41) % for I_2 , I_3 and I_4 , in first season, respectively while the decreased percentage (13.06, 28.45 and 45.82) % in second season, respectively compare with I_1 (Figure 1). Low ET_a value in I_2 , I_3 and I_4 treatment compared to the I_1 may be due to the difference in available water amounts for the plant, the consumption water increases with increase moisture content of the soil. As the low water amounts added in I_2 , I_3 and I_4 led to reduce evaporation, the increases in consumption use of full irrigation treatment compared with water stress treatment, was nearly to field capacity, as well as solar radiation arriving over the soil surface evapotranspiration components, because it raises the surface temperature, and that more than 70% of this energy is used to change the water case of liquid to vapor (Bidinger, 1980).

Figure 2 shows the ET_a which were (315.14 and 272.64) mm for first and second seasons, respectively in K_0 treatment, and decreased to (310.23, 304.03 and 298.49) mm season⁻¹ in first season and (268.69, 262.66 and 252.72) mm season⁻¹ in second season for K_1 , K_2 and K_3 , respectively. An application of potassium fertilizer to soil reduced the water consumption by plant

(1.56, 3.53 and 5.28) % for potassium fertilization treatment K_1 , K_2 and K_3 compare to K_0 in the first season, while the decreased percentage were (1.45, 3.66 and 7.31) % for the same treatment in the second season. this decrease may be due to the presence of potassium in sufficient quantities in the plant (Table 4), that control opening and closing mechanisms of stomata and then reduces water loss through transpiration, especially when moisture stress occurrence (Taiz and Zeiger, 2010). Or may be due to impact of potassium fertilizer help which improve the root system efficiently nutrients, since led to improve the plant growth, increases plant height, and leaf area, causing an increases in the shading soil surface, finally reduce evaporation. The reason of positive interaction between potassium fertilizer and water stress, due to the role of potassium in water absorption by reducing the tension of osmotic cells, In the water shortage conditions, available potassium increases crop susceptibility to tolerate water stress through using higher amount of soil moisture efficiency than plants which suffer from deficient potassium.

Table (2):- The factors of water balance equation for irrigation and potassium fertilization treatment for the first season (2012)

ETa mm.season ⁻¹	S (mm)	Drainage water (mm)	Ground water (mm)	Depth of rain (mm)	Depth water mm.season ⁻¹	NO. irrigation	Potassium fertilizers treatment	irrigation treatment
389.74	13.72	0	0	0	403.46	15	K ₀	I ₁
384.90	13.60	0	0	0	398.50	15	K ₁	
379.20	13.40	0	0	0	392.60	15	K ₂	
374.46	13.24	0	0	0	387.7	15	K ₃	
382.08					395.57		Mean	
356.15	9.04	0	0	0	365.19	12	K ₀	I ₂
350.83	9.57	0	0	0	360.40	12	K ₁	
345.00	9.35	0	0	0	354.35	12	K ₂	
339.45	10.75	0	0	0	350.20	12	K ₃	
347.87					355.29		Mean	
286.25	6.10	0	0	0	292.35	9	K ₀	I ₃
282.92	5.57	0	0	0	288.67	9	K ₁	
274.17	7.31	0	0	0	281.48	9	K ₂	
268.34	8.19	0	0	0	276.53	9	K ₃	
277.72					284.76		Mean	
228.40	5.72	0	0	0	234.12	7	K ₀	I ₄
222.25	6.25	0	0	0	229.50	7	K ₁	
217.74	5.39	0	0	0	223.13	7	K ₂	
211.70	7.05	0	0	0	218.75	7	K ₃	
220.02					226.38		Mean	

The irrigation water use efficiency (IWUE) were (2.74, 2.63), (2.94, 2.94), (1.94, 2.01), (1.58, 1.43) kg.ha⁻¹.mm⁻¹ for I₁, I₂, I₃ and I₄ treatments in the first and second seasons, respectively, while it was (1.76, 1.71), (2.18, 2.13), (2.47, 2.46), (2.78, 2.72) kg.ha⁻¹ mm⁻¹ for K₀, K₁, K₂ and K₃ treatments for both seasons, respectively (figure 3 and 4). The results Figure 3 show low water use efficiency by mungbean with increasing water stress, the low water use efficiency in the treatment I₄ and I₃ and lower production compared

with the treatment I₂ in the first and second season, may refer to low vegetative growth, plant height, number of branches, number of leaves, leaf area, as well as lower production and its components and the flower losses because of water stress conditions, and the low water use efficiency in the treatment I₁ refer to increases in the amount of added irrigation water in spite of no significant difference between them in the sum seeds.

Table(3):- Factors of water balance equation for irrigation and potassium fertilization treatment for the second season (2013)

ETa mm.season ⁻¹	S (mm)	Drainage water (mm)	Ground water (mm)	Depth of rain (mm)	Depth water mm.season ⁻¹	NO. irrigation	Potassium fertilizers treatment	Irrigation treatment
344.18	8.38	0	0	0	352.56	14	K ₀	I ₁
339.99	8.28	0	0	0	348.27	14	K ₁	
337.56	7.90	0	0	0	345.46	14	K ₂	
333.28	7.13	0	0	0	340.41	14	K ₃	
338.75					346.68		Mean	
304.71	5.05	0	0	0	309.76	11	K ₀	I ₂
299.25	5.75	0	0	0	305.00	11	K ₁	
291.60	6.65	0	0	0	298.25	11	K ₂	
282.50	7.60	0	0	0	290.10	11	K ₃	
294.52					300.78		Mean	
250.67	2.26	0	0	0	252.93	8	K ₀	I ₃
245.94	3.21	0	0	0	249.15	8	K ₁	
239.22	4.14	0	0	0	243.36	8	K ₂	
233.75	4.50	0	0	0	238.25	8	K ₃	
242.40					245.92		Mean	
191.00	2.80	0	0	0	193.82	6	K ₀	I ₄
189.55	4.82	0	0	0	194.37	6	K ₁	
182.24	4.16	0	0	0	186.40	6	K ₂	
171.35	5.80	0	0	0	177.15	6	K ₃	
183.54					187.94		Mean	

An increase in water use efficiency for irrigation water (IWUE) to potassium fertilization treatment, may be due to the role of potassium in increasing soil fertility, and increasing the availability of many nutrients (Tawfik, 2008), as well as increased soil water content that led to increase mungbean production compared to the control. The added potassium lead to raise the water use efficiency as a result of potassium effect in increasing the water and nutrients availability

for plant growth development and reduces the rate of water loss through evaporation, then maintaining the soil water content, as shown in Tables 2 and 3, which appear that decreased significantly in the depth of the different water which potassium fertilization and irrigation treatments compared to control. This was due to the effect of potassium in the soil increase water holding capacity at different water stress condition.

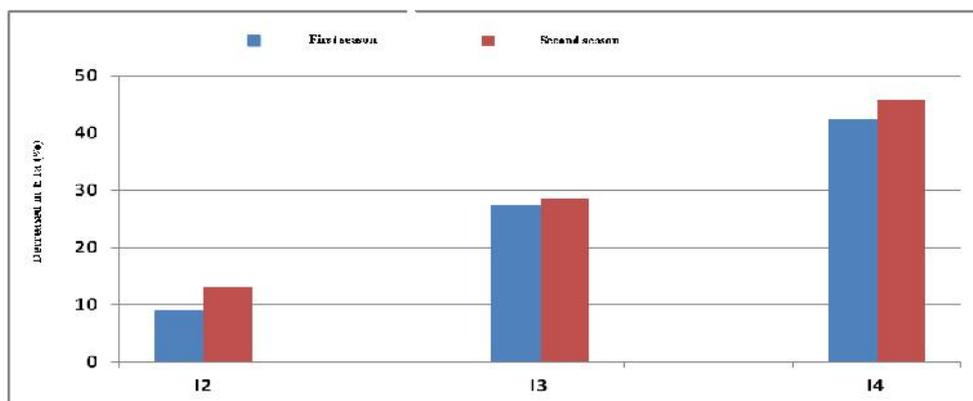


Fig. (1):- The decrease percentage in ETa irrigation treatment I₂ and I₃ and I₄ compared to the I₁.

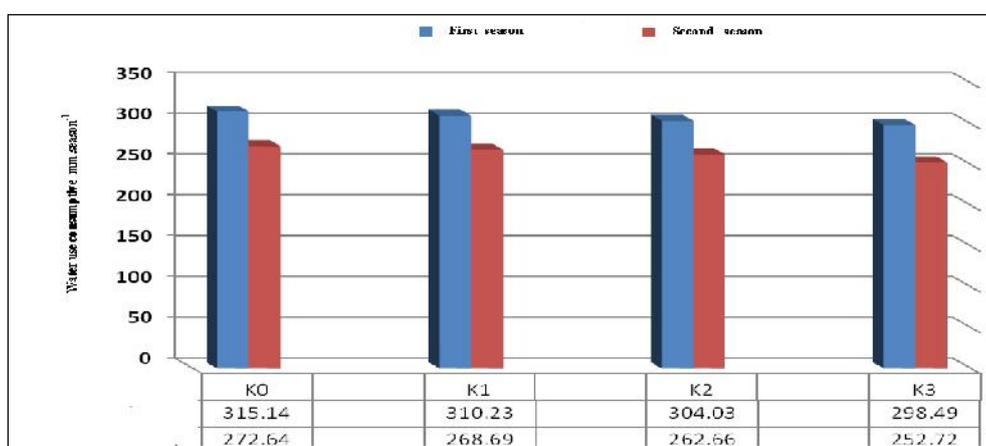


Fig. (2):- Actual water consumption of potassium fertilizers treatment.

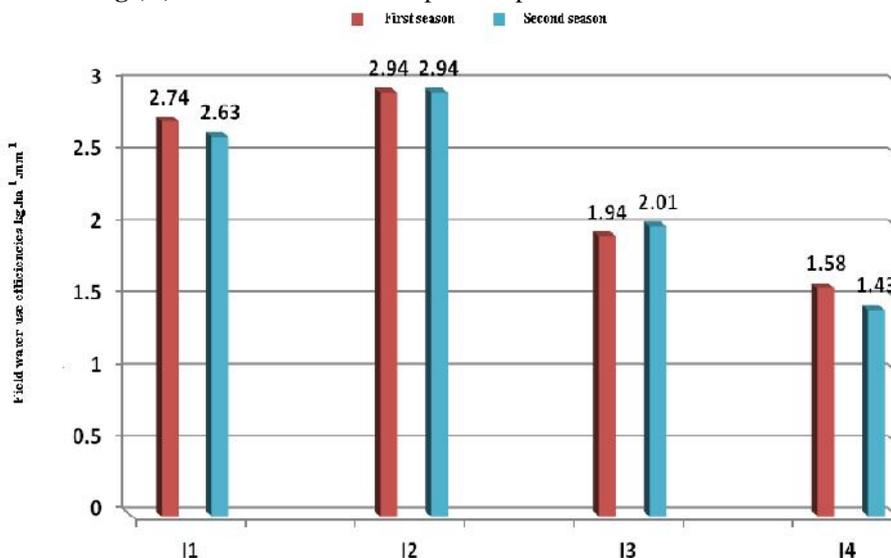


Fig. (3):- The average field water use efficiency of irrigation treatment

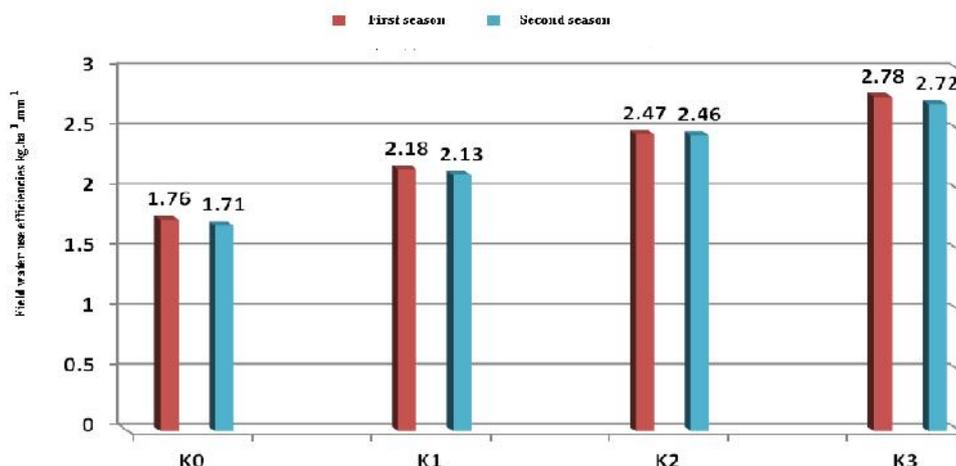


Fig. (4):- The average field water use efficiency of potassium fertilizers treatment

Table (4):- Effect of irrigation and potassium fertilization in potassium uptake by plants for both seasons (2012 and 2013)

Total uptake potassium (kg. h ⁻¹)										
Mean	First season				Mean	Second season				Potassium fertilizers treatment
	Irrigation treatment					Irrigation treatment				
	I ₄	I ₃	I ₂	I ₁		I ₄	I ₃	I ₂	I ₁	
27.80	10.19	21.78	38.69	40.55	31.66	12.47	24.33	43.33	46.51	K ₀
33.65	16.29	27.73	44.60	45.96	41.35	18.20	33.95	53.42	59.82	K ₁
35.99	16.18	27.52	48.21	52.05	47.35	19.68	37.43	64.77	67.53	K ₂
39.92	21.45	28.79	53.38	56.07	52.73	25.79	39.94	71.58	73.62	K ₃
LSD 0.05 Potassium fertilizers	4.698				LSD 0.05 Potassium fertilizers	6.149				LSD 0.05 interaction Mean irrigation
1.911	16.02	26.45	46.22	48.66	2.718	19.04	33.91	58.28	61.87	LSD 0.05 irrigation
	2.597					3.623				

CONCLUSION

The potential of irrigation scheduling to improve yield and to save water has been demonstrated in this work, obtained under actual farming condition, which support the practicality and the usefulness of using the Soil Water Balance (SWB) scheduling method by FAO to optimize irrigation efficiency in arid regions. Irrigation water use efficiency (IWUE) was highest for mungbean plants when treated with (I1). This experiment results showed that saving (9.67-14.78) % of irrigation water can be achieved with a corresponding increase in the yield.

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IMPACT OF ION PAIRS AND ACTIVITY ON ASSIFFICATION OF GROUNDWATERS FOR IRRIGATION PURPOSE IN ARBIL PLAIN *

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ABSTRACT

The chemical analysis of 48 wells in Erbil plain, Kurdistan region, Iraq were done from July, 2013 to June 2014, in order to classify them before and after correcting (ion pairs and ion pairs+activity). The main results were summarized as follow: Depending on Scofield's classification (1935) only water of 10 wells located within harmful class, while the water of other wells were suitable for irrigation, while depending on Richards (1954) water of (6) wells located within (C₂-S₁) class, water of (25) wells were have (C₃-S₁) class, while the water of (17) wells have (C₄-S₁) class. While relying on Wilcox classification (1955) the water of all wells have probably safe class. Considering salinity potential only water of wells (36 and 39 to 48), (33 to 48) and (18 to 48) have bad class for high, medium and low permeable soils respectively. Depending on Ayers and Westcot classification (1994) the water of wells (39 to 48) have severe degree of restriction use for irrigation. Depending on concentration of (Fe, Zn and Cu) the water of all wells were suitable for irrigation. Depending on Doneen classification (1954) correcting ion pairs and activity caused changes in water classes of wells (29 to 35 and 38) from moderate to good class and changed water quality of wells (36, 39 to 44) from bad to moderate class. Correcting ion pairs and activity caused an increase in SAR values of water, the range of SAR*/SAR and SAR**/SAR ratios were (1.11- 1.25) for water samples respectively. The dominant ion pairs in the studied water were (CaSO₄)⁰, (MgSO₄)⁰.

KEYWORDS: Groundwater, ion pairs, ion activity, water classification.

INTRODUCTION

Ground water has become common source in many arid and semiarid regions worldwide compared with traditional surface water for irrigation purpose. Groundwater offers more reliable supplies, less vulnerable to droughts, and ready accessible for individual users. Economic forces influence the groundwater sector and its development (Zektser and Everett, 2004). There are more than 10000 groundwater wells in Erbil plain, most of them are using for irrigation and drinking purpose (Esmail and Rajab, 2015). Some soluble cations and anions differ in charges in water approach to each other by columbic force for a distance Less than 5 Angstrom (A⁰), both connected ions keep their hydration shell, this phenomenon called ion pairs (Adams, 1971).

Adams (1971) summarized the general principles of ion pairs as follow:

1. There are no ion-pairs of cations with chloride.
2. Ion pairs of cations with NO₃⁻ are small enough to be neglected.
3. Ion pairs with SO₄⁻² are general; it is slight with

univalent cations, but extensive with multivalent cations.

4 - Ion pairs of univalent cations with H₂PO₄⁻ or HPO₄²⁻ is slight and can be ignored, while ion pairs between H₂PO₄⁻, HPO₄²⁻ and multivalent cations are significant but not extensive.

5 - Ion pairs between HCO₃⁻ and univalent cations are significant, ion pairs of multivalent cations with HCO₃⁻

are significant at high pH or at above normal CO₂ pressure.

Numerous classifications were used to classify water for irrigation purposes depending on (pH, EC, TDS, SAR, Na⁺%, Chloride...etc.), the most important global classifications of water for irrigation are: Scofield classification (1936), Doneen classification (1954), Richards classification (1954) and Wilcox (1955) depending on residual sodium carbonate (RSC) value. Pakshina and Rabochev (1987) have shown that all reactions which take place in soil solution, as well as nutrients absorption by plants are depending on the activity rather than concentration of ions.

Activity is linked to concentration via activity coefficient as described by Esmail and Salih (2014) as follow:

$$a = X \cdot \gamma \quad \text{..... (1)}$$

Where: a = Ion activity. X = Activity coefficient.

C = concentration (mol.l⁻¹).

Since the ion pairs and activity affect on water classifications, when depend on Sodium adsorption ratio (SAR), Salinity potential (SP) and residual sodium carbonate (RSC). For above reasons the aim of this investigation was to study the effect of ion pairing and activity on irrigation water classification.

MATERIALS AND METHODS:

a- Water sampling:

The seasonal water samples were collected from (48) locations in Erbil plain during (July 2013 to June 2014) which equivalent to (192) samples the study area was about 850 Km², the depth of wells ranged from (150-200)m, figure (1) shows the map of the studied area.

b- Water chemical analysis:

The chemical analysis of water samples (concentration of cations anions EC, pH, Fe, Zn and Cu) were conducted according to APHA (1989) (Table 1).

c-Determination of Ion pairs: Determined according to Esmail and Salih (2014) then type and amount of ion pairs were shown in table (1).

d- SAR, SP and RSC (mmolc.l⁻¹) values were calculated as follow:

$$SAR = \frac{Na^+}{\sqrt{\frac{Ca^{2+} + Mg^{2+}}{2}}} \quad \text{.....(2)}$$

$$(SP) = (Cl + 1/2 SO_4^{2-}) \quad \text{.....(3)}$$

$$RSC = (CO_3^{2-} + HCO_3^-) - (Ca^{2+} + Mg^{2+}) \quad \text{.....(4)}$$

RESULTS AND DISCUSSION

According to Scofield classification (1935), and depending on sulphate SO₄²⁻ concentration, correcting ion pairs caused the change in water quality of numerous wells towards the better class. This conversion in water quality to better classes was due to high contributing of SO₄²⁻ in ion pairing (0.141 -19.80) mmolc.l⁻¹ and its low activity coefficient (0.43). On other hand depending on Na% correcting ion pair and activity caused conversion of water quality towards the worse class (Table, 2) this change is due to high activity coefficient of Na (0.90) and its low contribution in ion pairs (0.005-0.49) mmolc.l⁻¹

Depending on Richards classification (1954) (Table, 3), correcting ion pairs and activity caused increase in SAR value without change in water class, this may be due to low initial SAR value (0.50-7.40) in the studied water (Table, 1) and depending on this classification the SAR values of the studied waters were less than 10 it means they have S1 class.

Relying on Ayers and Westcot (1994) the above corrections caused change of water class for 3 wells from non severe class (SAR less than 6) to (slight to moderate severe class) (SAR from 6 to 9), this may be due to high contributing of calcium and magnesium in ion pairing and low contributing of sodium in addition to low activity coefficient value of calcium and magnesium with the mean of (0.51 and 0.53) and high activity coefficient value of sodium (0.90), similar results were obtained by Bawa (2010).

Referring to water classification depending on RSC value (Wilcox, 1955) as shown from table (4) all the studied waters have the safe class before and after correcting ion pairs and activity, because the studied waters have negative RSC value due to high concentration of Ca and Mg in comparing with CO₃²⁻ and HCO₃⁻, and if RSC is less than 1.25 mmolc.l⁻¹ the water has safe class, similar results were recorded by Salih (2008).

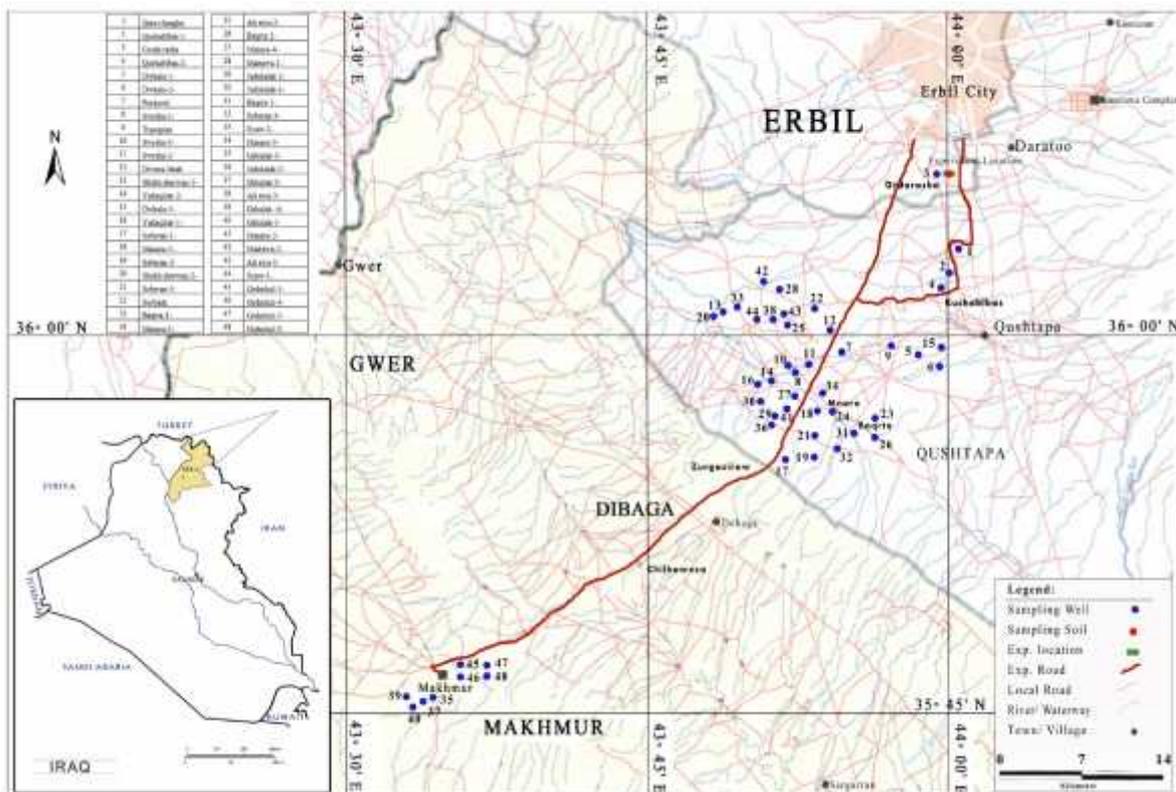


Fig.(1):- Map of the studied wells.

Table (1):- The range some chemical properties of the studied waters.

Properties	Range	Mean ± SE
EC (dS. m ⁻¹)	0.40 - 9.23	2.33 ± 0.01
pH	7.09 - 7.69	7.36 ± 0.03
Ca ⁺²	1.56 - 30.26	8.04 ± 0.06
Mg ⁺²	0.78 - 44.71	8.29 ± 0.10
K ⁺	0.02 - 0.44	0.07 ± 0.01
Na ⁺	0.46 - 30.08	6.93 ± 0.02
Cl ⁻	0.29 - 42.35	4.84 ± 0.02
SO ₄ ⁻²	1.10 - 57.03	14.14 ± 0.98
HCO ₃ ⁻	1.94 - 7.04	4.36 ± 0.03
NO ₃ ⁻	0.02 - 0.84	0.51 ± 0.21
Fe	0.00 - 0.15	0.02 ± 0.001
Zn	0.00 - 1.22	0.10 ± 0.01
Cu	0.00 - 0.03	0.00 ± 0.00
SAR	0.50-7.40	0.01-0.46
SAR**	0.62 -11.20	0.21-1.89
RSC	-0.17 to 68.52	0.00'-3.80
RSC ⁻	0.21 -19.92	0.02-0.94
SP	1.80-68.30	0.03-3.10
SP ⁺	0.66-47.14	0.15-2.10
(CaSO ₄) ^o	0.046 - 5.012	0.001-0.16
(CaHCO ₃) ⁺	0.019 -0.197	0.001-0.007
(MgSO ₄) ^o	0.021- 5.779	0.001-0.003
(MgHCO ₃) ⁺	0.008- 0.246	0.00-0.003
(NaSO ₄) ^o	0.008- 0.246	0.00-0.002
(NaHCO ₃) ^o	0.001 - 0.041	0.00-0.001
(KSO ₄) ⁻	0 -0.017	0.00-0.001
X _{Ca²⁺}	043-059	0.51-0.07
X _{Mg²⁺}	041-0.60	0.53-0.06

X_{Na^+}	0.88-0.94	0.90-0.20
X_{K^+}	0.84-0.88	0.87-0.11
$X_{SO_4^{2-}}$	0.40-0.47	0.43-0.10
$X_{HCO_3^-}$	0.68-0.79	0.72-0.13
X_{Cl^-}	1.00-1.00	1.00-0.0

** = values after correcting ion pairs plus activity for SAR, RSC and SP.

X = activity coefficient.

Table (2): -Effect of ion pairs and activity on water classification of 48 wells according to (Scofield, 1935).

Water class	Before correcting ion pairs and activity	After correcting ion pairs + activity	Water class	Before correcting ion pairs and activity
	SO_4^{2-}	Na%		SO_4^{2-}
Number of wells				
Very good	10	13	22	4
Good	10	33	14	18
Can be use	11	2	10	24
Can be use with caution	7	---	2	2
Harmful	10	---		

Table (3):- Effect of ion pairs and activity on water classes depending on Richards (1954) Classification.

Water class	before correcting ion pairs and activity	After correcting ion pairs and activity
C_2S_1	6	6
C_3S_1	25	25
C_4S_1	17	17

Table (4):- Effect of correcting ion pairs and activity on water class depending on (SP) value (Doneen, 1954).

Water class	Before correcting ion pairs and activity			After correcting ion pairs and activity		
	Soil permeability					
	High	Moderate	Low	High	Moderate	Low
Number of wells						
Good	28	17	9	31	22	17
Moderate	10	15	8	9	6	12
Bad	10	16	31	8	20	19

As shown from table (4) correcting ion pairs plus activity caused conversion of water classes towards the better class for soils having high, moderate or low permeability, due to high contributing of SO_4^{2-} in ion pairing and its low activity coefficient with the mean of (0.49) as

mentioned before while the mean of Cl^- was (1.00) because it not contribute in ion pairs, which were caused decrease in salinity potential values (SP) of the studied water then converting the water class towards the better class, Similar results were obtained by Salih (2008).

Table (5):- Effect of correcting ion pairs and activity on water classes depending on (RSC) value (Wilcox,1955).

Water class	After correcting ion pairs and activity	Before correcting ion pairs and activity
	Number of wells (water samples)	
Safe	48	48

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AQUACROP MODEL APPLICATION FOR FULL IRRIGATED MAIZE GENOTYPES PRODUCTION IN SEMI-ARID AREA, DUHOK-IRAQI KURDISTAN

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ABSTRACT:

Simulation models that clarify the effects of water and crop genotype on grain yield and biomass of crop, are useful tools for improving farm level water management and optimizing water use efficiency and obtaining high production. The case study was conducted during spring season in 2014 and 2015 at Duhok governorate to assess and evaluate the utilizing of the AquaCrop model in predicting the grain yield and final above dry biomass, and also comparing results of simulated and measured yield and biomass of processing three maize genotypes, with full irrigation in semi-arid region of Duhok Iraqi Kurdistan. In this research, the potential of Aqua Crop model in full irrigation practice for maize genotypes for spring seasons, were studied. The results of simulated grain yield and final above ground biomass were 7.92 and 15.53 t/ha; 9.75, 19.94; 11.94, and 22.24 t/ha for Sangaria, Symanni, and Synthetic-1 genotypes respectively while measured grain yield and final above ground biomass for same maize genotypes were 7.82, 18.42; 9.66, 22.54, and 12.59, 23.76 t/ha for first season (2014), but for the second season the results of same mentioned genotypes regards to simulated were 5.79, 12.10; 5.13, 12.51 and 6.23, and 13.62 t/ha while measured grain yield and final above ground biomass were 5.93, 12.90; 5.77, 14.81, and 6.53 and 15.10 t/ha. The difference was more obvious between grain yield and biomass of two seasons (2014 to 2015), the production parameters of first season were much higher than the second one and this difference is related to critical period of water stress and delaying irrigations which led to a negative effect on grain yield and dry biomass of different maize genotypes in second season. The results of reliability indices which determined for second year for RMSE, d, E, ME, and CRM, for water moisture content were 43.36 mm, 0.946, 62.8%, 2.059, 0.065, and for canopy cover were 9.17, 0.973, 99.6%, 19.645, -0.015; 11.843, 0.961, 96.3%, 18.469, -0.093; 9.067, 0.971, 98.3%, and -0.04, for maize genotypes of Sangaria, Symanni, and Synthetic-1 respectively, and 1.125 to 1.985 t/ha, 0.941 to 0.953, 52.8 to 82.6%, 4.632 to 11.547, 0.199 and -0.494; 1.582 to 2.407 t/ha, 0.878 to 0.937, 57.9 to 90.4%, 20.581 to 4.541, and 0.337 to -0.075; 1.913 to 2.207 t/ha, 0.896 to 0.96, 65.7 to 90.4%, 9.89 to 17.862, and 0.678 to -0.056 for grain yield and final above ground biomass respectively and for each maize genotype of Sangaria, Symanni and Synthetic-1, respectively, and. The model provided excellent simulations of canopy cover, grain yield, above ground biomass and water productivity.

KEY WORDS: Aqua Crop, Maize genotype, statistical indices

INTRODUCTION

Water has been always the main factor limiting crop production in most of the world when the rainfall is not ample with recent increases in demand of agricultural commodities and ensuing food crisis in poor development countries, the need to improve the efficiency of water use in crop production is never more apparent (Theodore C Hsiao et al, 2009).

The FAO AquaCrop model predicts crop productivity, water requirement, and water use efficiency (WUE) under water-limiting conditions. A set of conservative parameters [calibrated and validated for maize (*Zea mays* L.) (Heng, L.K Lee,

et al., 2009). Test of AquaCrop model in simulating biomass and yield of irrigated Maize genotypes in environmental of semi-arid region.

Maize is a C4-plant, and produces more biomass with less water than C3 crops. Usually, reflections from maize crops using remote sensing techniques are brighter than C3 plants. Maize is grown in spring to autumn, with the harvest usually in October. (Iraqi Salinity Project Technical Report 8). Corn is one of the most important cereal crops in Iraq, and is cultivated in vast areas, as consequence of high potential for production it comes after wheat and rice in the terms of area and production. Corn grown principally during the

spring and autumn in Iraq. (Alafalahi, et al., 2015).

The first crop chosen to parameterize and test the new FAO AquaCrop model is maize (*Zea mays* L.). Working mainly with data sets from 6yr of maize field experiment at Davis, CA, plus another 4yr of Davis maize canopy data a set of conservative (nearly constant) parameters of AquaCrop, presumably applicable to widely different conditions and no specific to a given crop cultivar, was evaluated by test simulations and used for long periods (Theodore C. Hsiao et al., 2009). As a part of its efforts toward this goal, the Food and Agricultural Organization (FAO) of the United Nations developed a crop simulation model named AquaCrop. The model strikes between accuracy, simplicity, robustness, and ease of use and is aimed at practical end users such as extension specialists, water manager, personal of irrigation organization (Theodore C Hsiao et al., 2009).

Before any model can be used, calibration, parameterization and evaluation should be performed (Addiscott, T., et al 1995). For parameterization calibration, one changes model parameters and even coding in order to obtain accurate prediction versus observed data. On the other hand, validation is the process whereby the model is run against independent data, without any modification of model parameters or code (Raes, D., et al, 2009). The FAO AquaCrop model predicts crop productivity, water requirement, and water use efficiency under water-limiting conditions. This model has been tested for maize, (Heng, L.K Lee, et al., 2009; Hsiao, T. C., et al., 2009; Steduto, P., et al., 2009), under different environmental conditions. All of them have illustrated that the model could accurately simulate the crop biomass and yield as well as soil water dynamics under full irrigation (Bitri, M Bitri1, et al., 2014)

The aim of this study was to evaluate AquaCrop model under full irrigation on three genotypes of maize (production Sangria, Symanni, and Synthetic-1) in a semi-arid region of Duhok Iraqi Kurdistan Region in two spring season 2014-15.

II. MATERIALS AND METHODS

A. ACUACROP MODEL DESCRIPTION

AquaCrop is a crop water productivity model developed by the Land and Water Division of FAO. It simulates yield response to water of

herbaceous crops, and is particularly suited to address conditions where water is a key limiting factor in crop production. AquaCrop is a companion tool for a wide applications including yield prediction under climate change scenarios. As in other models, aqua-crop model structures its soil-crop atmosphere continuum by including (i) the soil, with its water balance; (ii) the plant, with its growth, development, and yield processes; and (iii) the atmosphere, with its thermal regime, rainfall, evaporative demand, and carbon dioxide concentration. Additionally, some management aspects are explicit, with emphasis on irrigation, but also the levels of soil fertility as they affect crop development, water productivity, and crop adjustments to stresses, and therefore final yield. Pests and diseases are not considered. The growth engine of AquaCrop is water-driven, and calculate transpiration first in that is and translated into biomass using a conservative, crop-specific parameter (Raes et al, 2009), the biomass water productivity, normalized for atmospheric evaporative demand and air CO₂ concentration. The normalization is to make AquaCrop applicable to diverse locations and seasons. Simulations are performed on thermal time. The model uses canopy ground cover instead of leaf area index (LAI) as the basis to calculate transpiration and to separate soil evaporation from transpiration. Crop yield is calculated as the product of above-ground dry biomass and harvest index (HI). Although grounded on basic and complex biophysical process (Smith, 2000). AquaCrop uses a relatively small number of explicit parameters and largely-intuitive input variables.

B-DESCRIPTION OF STUDY LOCATION

The field experiment was established in 2014-2015 at research farm of agriculture college at Sumail, 13 km west of Duhok city (36°51'N, 52°02'E) and at an altitude of 473.0 m above sea level. The test area had a relatively constant south facing slope of about 1%. Table (1) shows the details of climate of study area in two years of 2014 and 2015.

The climate of study area is semiarid. According to the scheme proposed by Koeppen, the climate is classed as Interior Mediterranean, mild winter, dry and hot summer. The 20-average annual rainfall is 485 mm distributed uniformly throughout the months from October to May.

Average annual potential evaporation (Class-A pan) at this location is 1287mm. The recorded annual is 19.8°C, with an average maximum of 32°C. An automated weather station inside the research center measured daily values of

minimum and maximum air temperature and relative humidity, precipitation, solar radiation, sunshine and wind speed at 2 m height.

Table (1.1):- Growing season (1/4/2014–31/8/2015) weather summary for

Year	Station	crop genotype	Planting Date	Harvesting Date
2014	Agric. College	Sangaria		
		Symanni	30/3/2014	30/7/2014
		Syntic1		
2015	Agric. College	Sangaria		
		Symanni	#####	31/7/2015
		Syntic1		

Study area, (Sumail).

The dominant soil series at the site is which is a silty clay with 1% slope. The soil was well drained, in general, with a deep water table. The

weather data for the experimental site is presented in Table (1.2).

Table (I.2):- Some selected soil properties of experimental site.

Depth (cm)	Soil texture class	P S D (%)			Bulk density Mg/m ³	F.C vol%	P.W.P vol %	AW cm/m	Sat. HC (m/d)
		sand	silt	clay					
0-30	SIC	4.48	51.52	44.00	1.29	41.1	26.1	0.15	0.0667
30-60	SIC	5.23	46.81	47.96	1.27	49.9	27.7	0.14	0.0628
60-90	SIC	4.49	49.62	45.89	1.28	41.4	26.6	0.15	0.0655
90-120	SIC	3.75	53.50	42.75	1.30	40.6	25.0	0.16	0.0729

*PSD=particle size distribution, F.C= Field Capacity, P.W.P=Permanent Wilting Point. Available Water, Sat. HC=Saturated Hydraulic Conductivity, and SIC=Silty Clay.

D. CROP MANAGEMENT

The planting dates were 30 March 2014, 1 April 2015 and the planting densities were 7.3, 7.8, and 9.8 plants m⁻² for Sangaria, Symanni and Synthetic-1 respectively (Table 1.3). Weeds

were effectively controlled using herbicides, and no pests or disease infestations were observed during the plant growing seasons. It was fertilized with 105.8 kg/ha, 96.96 kg/ha and 158.72 kg /ha of nitrogen, phosphorus and potassium, respectively.

Table (2):- Growing season (1/4- 30/8) weather summary for location study (Sumail).

Table (1.3):- Agronomic information for (Zea mays L.) genotypes .

Year	Station	crop genotype	Planting Date	Harvesting Date
2014	Agric. College	Sangaria		
		Symanni	30/3/2014	30/7/2014
		Syntic1		
2015	Agric. College	Sangaria		
		Symanni	#####	31/7/2015
		Syntic1		

E. USER-SPECIFIC PARAMETERS

For convenience, Hsiao et al. [11] grouped site-, management-, and crop-specific parameters such as soil water characteristics, maximum rooting depth, plant density, sowing date,

irrigations, and phenology all under the heading of user-specific input parameters. These parameters for our study are presented in Table (1.4).

Table (1.4) :- Experimental and agronomic information's.

Calendar	(Zea mays L.) Genotypes		
	Sangaria	Symanni	Synthetic-1
From day one after sowing 30/March /2014	Day		
Emergence	07-April	06-April	08-April
Max. canopy cover	23-May	14-May	23-May
Max. root depth	16-Jul	15-Jul	16- Jul
Flowering	10-May	17-May	04-Jun
Start canopy senescence	15- Jul	14- Jul	15- Jul
Maturity	19- Jul	23- Jul	25- Jul
From day one after sowing 1/April /2015			
Emergence	#####	08-April	10-April
Max. canopy cover	25-May	16-May	25-May
Max. root depth	18- Jul	17- Jul	18- Jul
Flowering	12-May	19-May	06- Jun
Start canopy senescence	17- Jul	16- Jul	17- Jul
Maturity	21- Jul	25- Jul	27- Jul

F. CONSERVATIVE PARAMETERS

Out of all the crop parameters in AquaCrop model, 6 of them were demonstrated or assumed to be conservative (constant) in this study. The same values of this set of 6 parameters (Table 1.5)

were used in the validation reported here to further evaluate the performance and robustness of aqua-crop model. These parameters include canopy cover growth.

Table (1.5):- Conservative parameters used to simulation runs.

Growing season	Crop genotype		
	Sangaria	Symanni	Synthetic-1
Planting density, plant m ⁻²	7.3	7.8	8.9
Sowing date	30 March, 2015		
Emergence	7-Apr	6-Apr	8-Apr
Physiological maturity	10-Jul	13-Jul	15-Jul
Harvest date	31 July, 2015		
CCX %	87	94	91
Water Productivity, WP g l ⁻¹ n ⁻⁴	32		

Seasonal Rainfall	1200		
Seasonal Reference, Eto mm	876.00		
Max, Rooting depth, m	0.70	0.50	0.77

*CCX (%)= Maximum Canopy Cover in (%).

G. MODEL VALIDATION

Validation is an important step of model verification. It involves a comparison between independent field measurements (data) and output created by the model. Soil water content over the root depth, above-ground dry biomass and grain yield were considered in this study for model evaluation. To evaluate model accuracy five statistical indices were applied as follows:

- 1- Absolute root mean square error (RMSE) .
- 2- Agreement index (D-index).
- 3- Coefficient of efficiency, E.
- 4- Maximum

$$RMSE = \sqrt{\frac{1}{n} \sum_{i=1}^n (S_i - M_i)^2}$$

$$E = 1 - \frac{\sum_{i=1}^n (M_i - S_i)}{\sum_{i=1}^n (M_i - \bar{M})^2}$$

2-

$$d = 1 - \frac{\sum_{i=1}^n (S_i - M_i)^2}{\sum_{i=1}^n (|S_i - \bar{M}| + |M - \bar{M}|)^2}$$

3-

$$ME = \text{Max} |S_i - M_i| \cdot \frac{100}{M}$$

4-

$$CRM = \frac{\sum_{i=1}^n M_i - \sum_{i=1}^n S_i}{\sum_{i=1}^n M_i}$$

5-

Error, ME.

5- Coefficient of Residual Mass, CRM. (Willmott, C.J, 1985).

These indices were employed for comparison of simulated against observed data, by using the following equations:

where S_i and M_i are the simulated and observed (measured) values as samples taken along the season (e.g., biomass and CC), or at the end of the season (e.g., grain yield), n is the number of observations, and M is the mean of the observed variable. The RMSE in Eq. (1) represents a measure of the overall, or mean, deviation between observed and simulated values, that is, a synthetic indicator of the absolute model uncertainty. In fact, it takes the same units of the variable being simulated, and therefore the closer the value is to zero, the better the model simulation performance. E shows efficiency of the model in simulation of the parameters.

The D- index of agreement is a measure of relative error in model estimates.

It is a dimensionless number and ranges from 0 to 1.0, where 0 describes complete disagreement and 1.0 indicates that the estimated and observed values are identical. ME, is max. error, CRM presents model tendency to over-estimate or under-estimate measured values of parameters, The negative CRM shows that, the model over-estimates it. Positive values of CRM shows that, the model under-estimates this parameter.

IV. RESULTS AND DISCUSSION

A. SOIL WATER CONTENT

The results (Table 1.6) showed that the model performed very well for simulating water dynamics. The calculated RMSE, D-Index, Efficiency of model, Maximum Error, coefficient of Residual Mass were 43.36 mm, 0.63 and 98.3% ,2.059, and 0.065 for full irrigation .

Table (1.6) :-Statistical indices of soil water content in mm

Statistical Indices				
Soil Property	RMSE	D-Index CRM	E%	ME
Soil Water Content (mm)	3.36mm	0.63 98.3	2.059	0.065

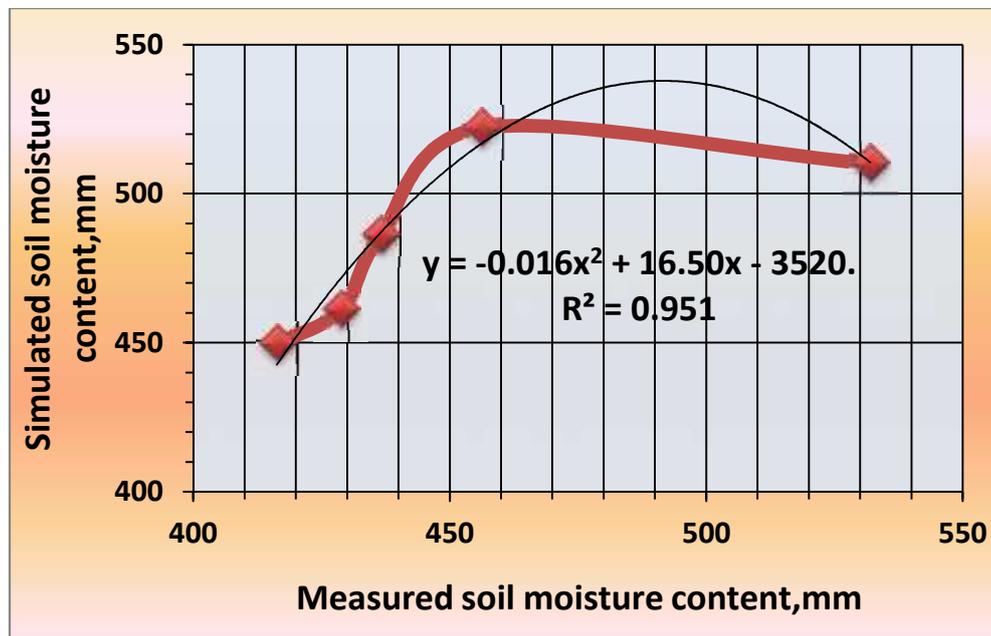


Fig.(1.1):-Relationship between simulated and measured soil water content.

The relationship between simulated and measured soil water content illustrated in Fig. 1.1, and shows that the relation is polynomial with ($R^2=0.951$).

B. CANOPY COVER DEVELOPMENT

AquaCrop was able to simulate accurately the canopy cover (CC) development in irrigated treatments (Fig. 1.2). The simulated canopy cover was close to the measured values from planting to flowering, but after flowering there was a slight

mismatch in the last senesced CC measurement, with measured CC declining slightly faster compared with simulated CC. This discrepancy could be related to increase environmental temperature abruptly in dry condition high temperature from anthesis onward which was resulted in faster senescence and decline of CC in Drithas condition.

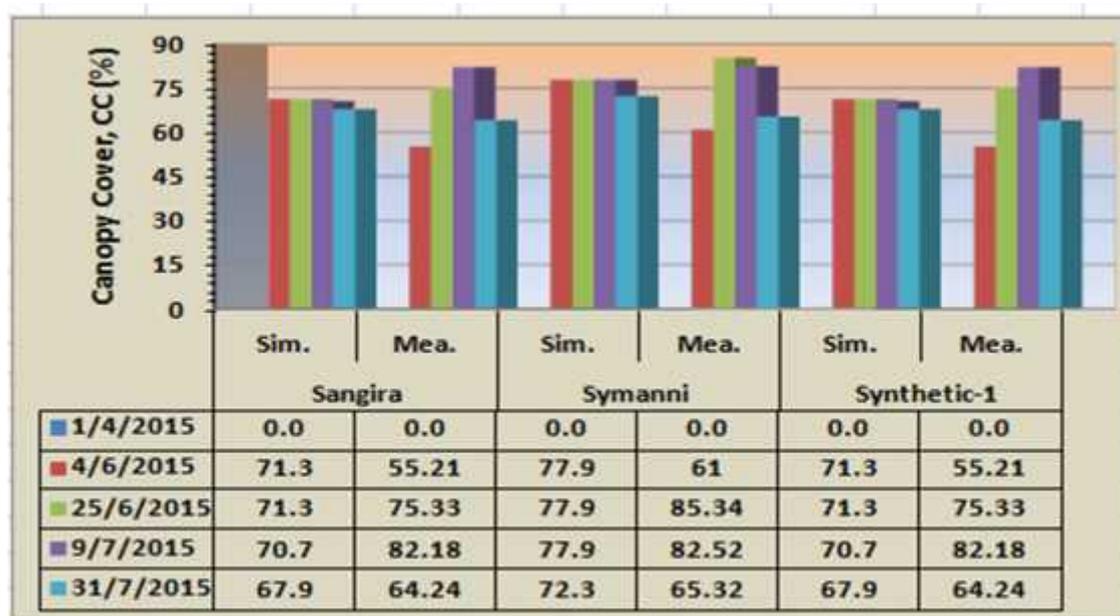


Fig.(1.2):- Simulated and measured canopy cover for three maize genotypes expressed in percentage, (%).

C. ABOVEGROUND BIOMASS

Table(1.7) shows the simulated and observed sequential aboveground dry biomass for the three genotypes of maize in full irrigated. The simulated above-ground dry biomass agrees well with observed values, not withstanding a slight overestimation by the model. This discrepancy might have been caused by error in measured data and/or the manner which the model simulates crop growth. In AquaCrop model aboveground biomass is derived from the crop transpiration by means of the crop water productivity.

Table (1.7):- simulated and measured sequential above ground biomass for maize genotypes.

Crop	Grain Yield									
	(t/ha)		6/5/2015		6/24/2015		7/9/2015		7/31/2015	
	Sim.	Mea.	Sim.	Mea.	Sim.	Mea.	Sim.	Mea.	Sim.	Mea.
Sangaria	0.000	0.000	0.601	0.000	1.981	3.702	3.640	5.369	5.793	5.932
Symanni	0.000	0.000	0.222	0.000	1.611	4.434	3.348	5.369	5.128	5.769
Synthetic-1	0.000	0.000	0.043	0.000	0.537	3.804	2.441	5.186	6.226	6.533

D. FINAL ABOVE-GROUND BIOMASS

There was generally a good agreement between the model predictions and measured biomass data (Table 1,8; Fig.3). The model

predicted biomass values at harvest quite well. The results of model evaluation are shown in table (1.8).

Table(1.8):- Statistical indices derived for evaluating the performance of AquaCrop model in predicting biomass and grain yield.

Index value	Crop	Grain Yield			
		(t ha ⁻¹)		Above Ground Biomass (t ha ⁻¹)	
	Genotype	Sim.	Mea.	Sim.	Mea.
	Sangaria	5.793	5.932	12.100	12.900
RMSE		1.125		1.985	
E%		52.8		82.6	
D-Index		0.941		0.953	
ME		4.632		11.574	
CRM		0.199		-0.494	
	Symanni	5.128	5.769	12.508	14.181
RMSE		1.582		2.407	
E%		57.9		90.4	
D-Index		0.878		0.937	
ME		20.581		4.541	
CRM		0.337		-0.075	
	Synthetic-1	6.226	6.533	13.621	15.104
RMSE		1.913		2.207	
E%		65.7		90.4	
D-Index		0.896		0.96	
ME		9.890		17.862	
CRM		0.678		-0.056	

E. GRAIN YIELD

The simulated grain yields showed a good agreement with measured maize genotypes yields (Table 1.8; Fig.3). The simulated maize genotypes yield varied from 5.8, 5.13, to 6.23 t/ha for Sangaria, Symanni, and Synthetic-1, while the

measured yield varied from 5.93, 5.77 to 6.53 t/ha for full treatments . The calculated model evaluation criteria between simulated and measured yield were RMSE = 1.13 t/ha, Efficiency of model, E% = 52.8%, D-index = 0.94 and Max. Error, ME=4.63, and Coefficient

Residual Mass=0.2;1.58, 57.9%, 0.88, 20.58, 0.34;1.91, 65.7%, 0.9, 9.89, 0.68 for Sangaria, Symanni, and Synthetic-1 . The AquaCrop model

could very well predict top-weight biomass and grain yield of maize genotypes .

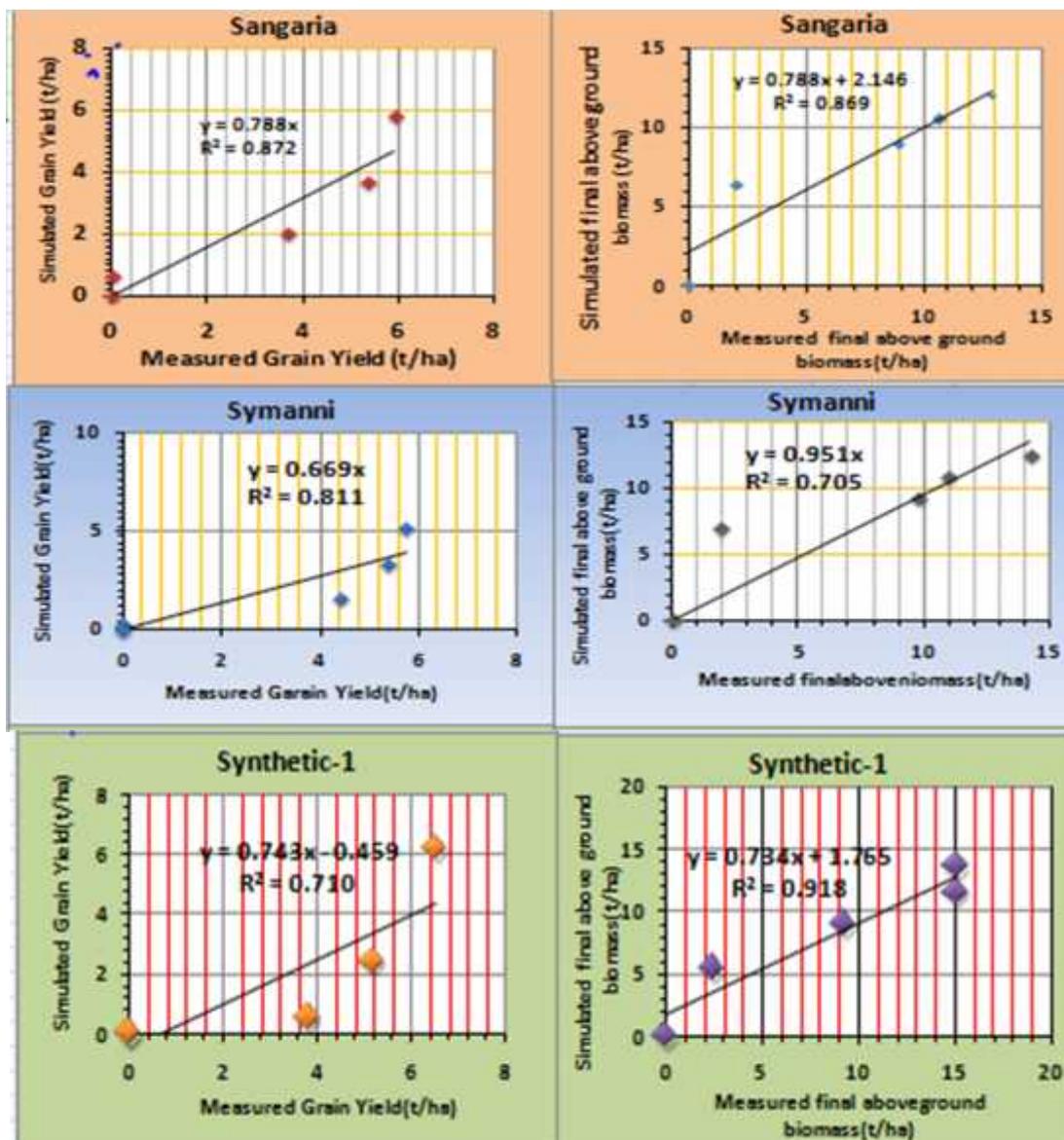


Fig.(1.3):- Comparison of simulated and measured biomass production and grain yield, /t ha.

F-Comparison of grain yield and dry biomass for maize genotypes in during two spring seasons:

Table(1.9) Shows the simulated and measured grain yield and final above ground dry biomass express in t/ha for the two seasons of 2014 and 2015. The difference is very obvious between the production parameters of the two growing periods, and at same irrigation water depth which was equal to about 1200 mm /season. The production parameters of grain yield, final biomass of the

second year are much less than first season for the same production biomass. The maize genotypes in the field face critical stage of water stress. The reason of lower production for second season is related to delaying the periods of application of irrigation water and technical problems out of our control, which lead to undesired effects on reducing the production parameters of grain yield and dry biomass.

Table (1.9):- Simulated and measured grain yield and final above biomass for maize genotypes for two spring seasons

Crop Genotype /	Year	Grain Yield (t/ha)		Above Ground Biomass(t/ha)	
		Sim	Mea.	Sim	Mea.
Sangaria	2014	7.92	7.82	15.53	18.43
	2015	5.79	5.93	12.10	12.90
Symani	2014	9.75	9.66	19.94	22.54
	2015	5.13	5.77	12.51	14.81
Synthetic-1	2014	11.94	12.59	22.25	23.76
	2015	6.23	6.53	13.62	15.10

G- Crop Water Productivity(CWP) and Irrigation Crop Water Productivity (ICWP):

Table (1.10) Shows the crop water productivity and irrigation water productivity of production parameters of grain yield and final above ground dry biomass in kg.m³ for maize genotypes

through growing seasons of 2014 and 2015, which demonstrate the effects water stress on crop water productivity and irrigation crop water productivity the second season, even though amount of irrigation for both season were equal.

Table (1.10):- Crop water productivity and irrigation water productivity for grain yield and dry biomass for maize genotypes for two spring seasons.

Cropxwater Productivity and	Irrigation Water Productivity, WP (kg/m ³)					
	Type	2014			2015	
	Grain	Dry matter	Biomass	Grain	Dry matter	Biomass
Crop WP	0.711	0.73	1.441	0.593	0.597	1.19
irrigation WP	0.635	0.653	1.289	0.53	0.534	1.065
Crop WP	0.878	0.925	1.811	0.488	0.684	1.09
irrigation WP	0.785	0.827	1.62	0.436	0.612	0.975
Crop WP	1.144	1.015	2.16	0.539	0.75	1.225
irrigation WP	1.023	0.908	1.931	0.482	0.67	1.095

V. CONCLUSIONS

The validation of the AquaCrop model illustrated that the model was able to simulate soil water content of root zone, crop biomass and grain yield accurately. The simplicity of AquaCrop due to its required minimum input data, which are readily available or can easily be collected, has made it user-friendly for users.

One important application of aqua-crop model would be to compare the attainable against actual yields in a field, farm, or a region, to identify the constraints limiting crop production and water productivity (benchmarking tool). It can also be very useful for scenario simulations and for planning purposes for use by economists, water administrators and managers. It is suited for perspective studies such as those under future climate change scenarios. Overall, it is particularly

suited to develop agricultural water management strategies for a variety of objectives and applications.

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DEVELOPMENT OF PROBABILITY DIAGRAM FOR AN OBSERVED ANNUAL RAINFALL IN (DUHOK AND SARTANG-SUMMEL) IRAQI KURDISTAN

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ABSTRACT :

The estimation of probability diagram with regression analysis for an observed of annual rainfall is commonly required for the design of hydraulic project, water resources, water harvesting and engineering control structures. Observed series of rainfall data was collected during 40 years, for the period between (1975-2015) at both Sartang agro-meteorology center and Duhok meteorology station which has (WMO code, 606). Occurrence of regression of annual rainfall analysis data was used to development probability diagram with regression line for annual rainfall totals of Duhok governorate. A straight line was fitted to the plotted observations data. The probability diagram recommended to prediction of rainfall storms for given return period (T).

KEY WORDS: probability, return period, rainfall, regression line, occurrence.

INTRODUCTION

It is commonly required for probability diagram with regression analysis for an observed of annual rainfall to design of hydraulic projects, water resources, water harvesting and engineering control structures. When planning for soil and water management systems. It is necessary to availability of the expected rate and depth of rainfall, as well as the frequency of occurrence, in addition availability of provides recording rain gages which give the amount and rate of rainfall. It is necessary and useful to collect daily precipitation records which were kept in many areas at several years. A rainfall records of at least 20 years were recommended for a statistically representative sample (Serrano, 1977). A number of empirical equation have been developed by American society of civil engineers or designate by equation of (Gumbel, 1954). Statistical analyses of these records allow the prediction of a storm, with a given probability of occurrence. Same amounts of rainfall maps showing of equal rainfall had been prepared by the many meteorological stations 1-24 hr, duration and return period of 2 to 50 years (Hershfield, 1961) and (Sulaiman, 2014). Weiss (1962) developed procedure map for rainfall intensity to predict varying probability of occurrence in given return periods. The purpose of this paper is to estimate the probability of future

storm events depending on historical precipitations data for specific return periods (Haan et al., 1994).

Methodology:

The research was conducted on collected available series of recorders rainfall data during long period between 1975-1990 incessantly from both of Sartang Agro-meteorology station 13 km west Duhok center and Duhok meteorological station between (1990-2015), (Table, 1 and Fig. 1). Geographical information rainfall recorder and standard deviation was shown in Table (2). Isohyetal map of the rainfall distribution of Iraqi Kurdistan region as shown in (Fig. 2) (FAO, 2001). The mean annual precipitation of the study period 533.84 mm. The mean minimum and maximum monthly temperatures are ranged from 8.8 to 33.7 °C in January and July respectively. The average Annual Evaporation was about 1647 mm, the observed average annual wind velocity was 1.98 m / sec. (Resource, Duhok meteorological station). For determining the probability or frequency of occurrence of yearly or seasonal rainfall was use after the following steps (Critchely and Siebert, 1991)

1-Obtaining long term recorders of annual rainfall from 1975-2015 from both of Sartank and

Duhok stations (Table, 1)

2-Ranking the annual rainfall data in descending order from highest to lowest.

3-The probability of occurrence percent can be estimate by applying the plotting position formula P (%), (Table, 3)

4-plotting the ranked observations against the corresponding probability.

5- Fitting the curve to the plotted observations using the method of moment.

A plotting position (frequency) can be determined by (Bedient and Huber,2002), (Reining et al., 1989) which was calculated by the following recommended equation

$$P\% = [(m-0.375)/(N+0.25)]*100. \quad (1)$$

Where P = probability in (%) of the observation of the rank (m)

m = the rank of observation

N = Total number of observations

used

To determine the magnitude of storm events for specific return periods (Haan et al.,1994).

The return period is sometimes called recurrence interval or frequency of the rainfall be expressed by event .The relationship between retune period T in years and probability of occurrence P can be expressed is

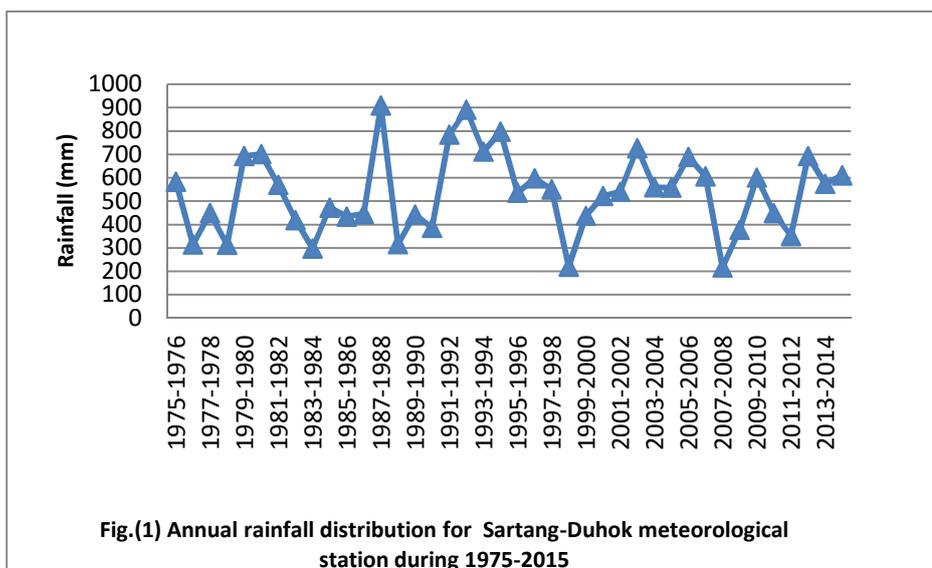
$$T = 100/P \text{ Years} \quad (2)$$

Where T is Retune period

P is probability (%)

Table (1):- Rainfall depth during year (1975-2015)

Year	Rainfall	Year	Rainfall	Year	Rainfall
1975-1976	583.1	1989-1990	443.3	2003-2004	559.7
1976-1977	314.9	1990-1991	386.8	2004-2005	558.1
1977-1978	448.9	1991-1992	784.7	2005-2006	688.9
1978-1979	313.8	1992-1993	891.4	2006-2007	606.6
1979-1980	693.1	1993-1994	712.1	2007-2008	216.2
1980-1981	701.9	1994-1995	797.3	2008-2009	377.6
1981-1982	570.4	1995-1996	536.4	2009-2010	601.3
1982-1983	419.1	1996-1997	597.4	2010-2011	449.2
1983-1984	298	1997-1998	550.1	2011-2012	351
1984-1985	472.9	1998-1999	220	2012-2013	692.8
1985-1986	434.6	1999-2000	437.5	2013-2014	574.1
1986-1987	445.4	2000-2001	522.4	2014-2015	610.5
1987-1988	909.5	2001-2002	539.9		
1988-1989	316.1	2002-2003	726.6	Mean Rainfall	533.84
				mm	



Table(2):- Some important source information on both meteorology station .

Station	Latitude	Longitude	Altitude	Annual Rainfall mm	Stander Deviation S.D	Period	year
Sartang	36° 51' N	42° 52' E	473m	491.00	167.4	1975-1990	15
Dohuk	36° 50' N	43° 00' E	569m	559.54	168.4	1990-2015	25
<i>Dohuk-Sartang</i>	-	-	-	533.84	171.3	1975-2015	40

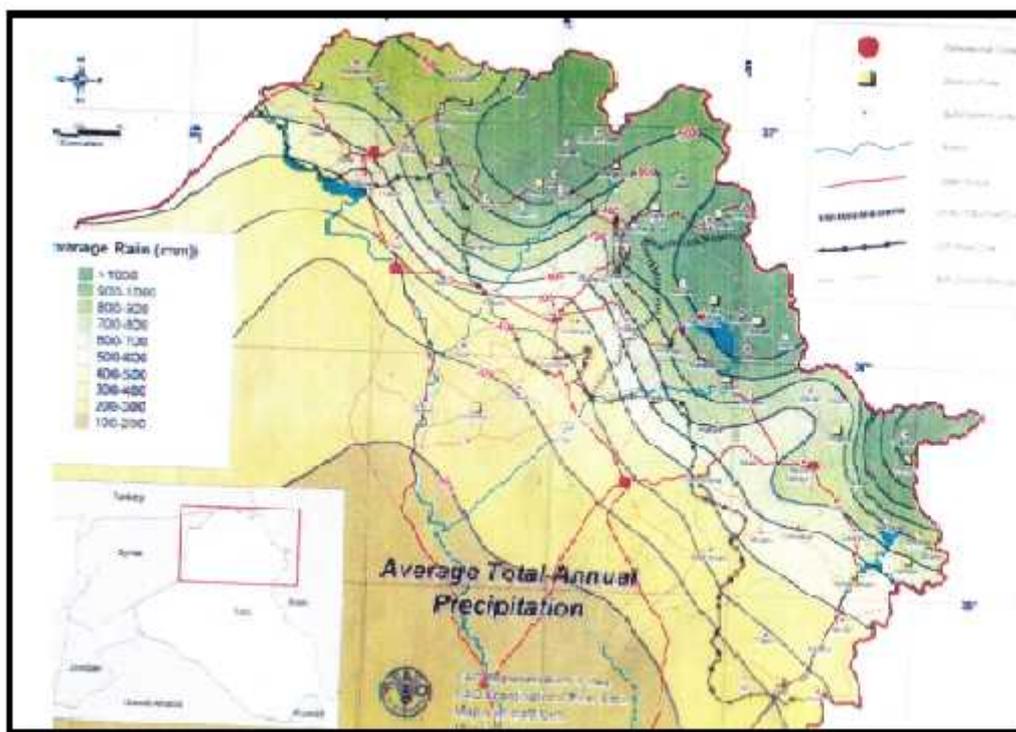


Fig (2):- Isohyetal map for Iraqi Kurdistan region After FAO (2001) show in Duhok city

Table(3) :-Ranked annual rainfall data for Duhok city.

Year	Rain(mm)	m	P(%)	(T)Year
1987-1988	909.5	1	1.55	64.40
1992-1993	891.4	2	4.04	24.77
1994-1995	797.3	3	6.52	15.33
1991-1992	784.7	4	9.01	11.10
2002-2003	726.6	5	11.49	8.70
1993-1994	712.1	6	13.98	7.16
1980-1981	701.9	7	16.46	6.08
1979-1980	693.1	8	18.94	5.28
2012-2013	692.8	9	21.43	4.67
2005-2006	688.9	10	23.91	4.18
2014-2015	610.5	11	26.40	3.79
2006-2007	606.6	12	28.88	3.46
2009-2010	601.3	13	31.37	3.19
1995-1996	597.4	14	33.85	2.95
1975-1976	583.1	15	36.34	2.75
2013-2014	574.1	16	38.82	2.58
1981-1982	570.4	17	41.30	2.42
2003-2004	559.7	18	43.79	2.28
2004-2005	558.1	19	46.27	2.16
1997-1998	550.1	20	48.76	2.05
2001-2002	539.9	21	51.24	1.95
1995-1996	536.4	22	53.73	1.86
2000-2001	522.4	23	56.21	1.78
1984-1985	472.9	24	58.70	1.70
2001-2002	449.2	25	61.18	1.63
1977-1978	448.9	26	63.66	1.57
1986-1987	445.4	27	66.15	1.51
1989-1990	443.3	28	68.63	1.46
1999-2000	437.5	29	71.12	1.41
1985-1986	434.6	30	73.60	1.36
1982-1983	419.1	31	76.09	1.31
1990-1991	386.8	32	78.57	1.27
2008-2009	377.6	33	81.06	1.23
2011-2012	351	34	83.54	1.20
1988-1989	316.1	35	86.02	1.16
1976-1977	314.9	36	88.51	1.13
1978-1979	313.8	37	90.99	1.10
1983-1984	298	38	93.48	1.07
1998-1999	220	39	95.96	1.04

2007-2008	216.2	40	98.45	1.02
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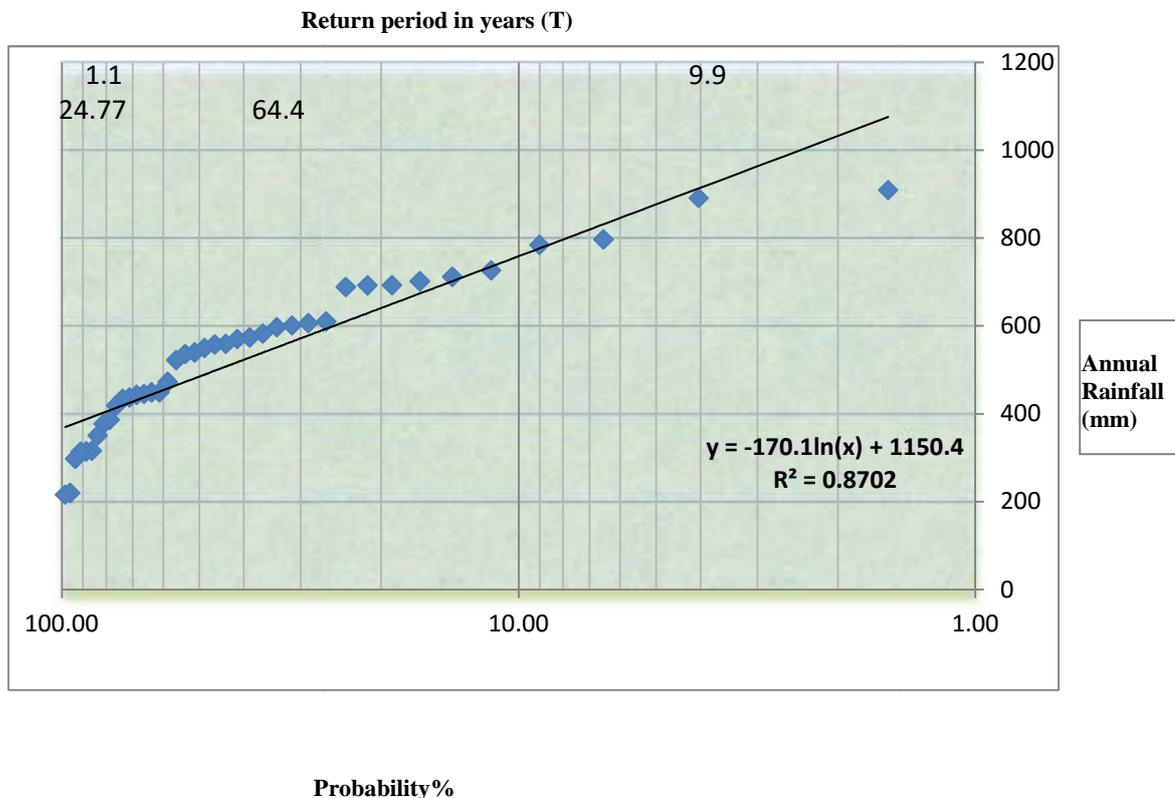


Fig.(3):- probability diagram with regression line for an observed series of annual rainfall totals of Duhok.

RESULT AND DISCUSSION

Variability of annual rainfall show that in arid and semi-arid climates increase ratio from maximum to minimum of annual amounts is much greater and the annual rainfall distribution becomes increasingly twisted with increasing aridity. At more arid location it is not uncommon to experience several consecutive year with no rainfall (GROW,2003).Diagram with regression analysis for an observed series of annual rainfall is illustrated (Fig.3). It is possible to obtain the probability of occurrence of a rainfall depth for a specific amount. Inversely, also it is possible to obtain the magnitude of the rain corresponding to a given probability using equation (1) and the return period (in years) can be easily derived once to the occurrence probability P(%) which is recognized from the equation (2) .

Table (3) is shown the distribution of the annual rainfall data on a semi-log probability paper as seen in Figure (3). Weibull plotting position was used for deterring the probability of

accidence or the probability of value been greater than or equal to the ranked value after ranking the annual rainfall data in descending order table(3). The plotted of the annual rainfall data for Sartank-Duhok on an a semi-log probability paper was produced straight line as of the equation (3):

$$Y = -170 \ln(x) + 1150.4 \text{ with } R^2 = 87\% \dots (3)$$

Where: Y is represented the annual rainfall.

X is probability %

It can be observed for Figure (3) that the observed data points fell close on the fitted curve . Significant deviation can be observed for the lower and upper line of the data points .

As well, it can be noticed from Figure (3) that the annual rainfall value of 67 percent is 435.2mm,this shows, on the average is 67 percent of time (2 years out of 3 years) annual rainfall of 435.2 mm is equal or exceeded. The rainfall depth which is means to a probability of occurrence or accidence is referred to as the design rainfall.

$T_{67} = 100/67 = 1.5$ (years) (or about 2 years)

Also $T_{50} = 100/50 = 2$ (years)

Where probability of occurrence of 50%, as corresponding value of the annual rainfall is 485 mm or more (equation ,2) which can be expected in 1 year out of 2 years

And for probability of occurrence of 33%, the corresponding value of the annual rainfall is 555.6 mm or more (equation ,2) which can be expected in 1 year out of 3 years, as show in equation (3) :
 $T_{33} = 100/33 = 3$ (years).

GROW,2003 has used the same procedures which obtained by FAO to Mogadishu Somalia (and obtain same results) (Reining et al., 1989).

CONCLUSIONS

Probability diagram with regression line for an observed series of annual rainfall necessary for hydrologists, engineers and Agricultural projects for planning and design of water resources and ponds. Historical rainfall records obtained from both Sartang Agro-meteorology and Duhok metrological station were used to generate the probability diagram for Duhok Governorate. From the previously mentioned equation it is possible obtain the probability of occurrence of rainfall depth for a limited; inversely it is also possible to obtain the rainfall depth corresponding to given probability. The estimate of rainstorm can be used to evaluate the quantity of discharge hence, the design of hydraulic structures or water harvesting projects.

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VARIABILITY OF HEAVY METALS IN SURFACE SOILS USING GEOSTATISTICS TECHNIQUE SURROUNDING ATRUSH DISTRICT IN DUHOK-IRAQI KURDISTAN

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ABSTRACT

Nowadays, soil pollution by heavy metals is a big concern for the environment, because of toxicity and stability also physiological effects on live organism. Therefore it's necessary to assess the distribution of these elements to monitor soil pollution and maintain the quality of ecosystem. Since there is no information about heavy metals distribution (Cd, Pb, Zn and Ni) in Atrush district soils in Duhok province, Iraq, this research is focused on spatial variability of heavy metals by geostatistic method in surface soils (0-25 cm) based on 15 soil samples by a randomized methodology of soil sampling. Amount of available concentration of heavy metals by diethylenetriamine penta-acetic acid (DTPA) with some soil physical and chemical properties were measured in laboratory. Average concentration of available heavy metals (mg/kg) were as follows: Cd (0.20), Pb (30.64), Zn (11.59) and Ni (1.73). Results indicated that there was no heavy metals pollution in the soils. Due to modelling spatial variability of studied parameters kriging method in GS⁺ was applied. Results indicated that the concentration of all metals had strong spatial dependence (nugget semivariance < 25%) and the best fitted model for them was spherical. Kriging maps showed all studied heavy metals were under normal levels and indicated the source of heavy metals is mainly from natural source of weathering parent material specially limestone.

KEYWORDS: Heavy metals, Kriging, Pollution, Spatial distribution

INTRODUCTION

Nowadays increasing heavy metals accumulation in the soil is one the important threat for human life, environment and natural resources (Kheir, 2010). Soil and vegetation cover have special function in water, nutrition and temperature balance. Although through these processes, soil pollutants such as heavy metals maybe decrease or increase in the soil, but soil has very complicated structure with different properties which can change from one place to another place (Morton-Bermea et al., 2009). One of the important soil pollutants are heavy metals which can decrease soil quality and function. Heavy metals can be very hazardous and toxic even in small amount. In recent years they are considered as environmental pollutants which effects on human health, live organism and ecosystem. There is two sources of soil heavy metals: natural and anthropogenic sources. Natural sources relates to geology which includes accumulation of heavy metals by weathering parent materials and anthropogenic source include industrialization, road transportation, fuel

production, waste disposal, use of fertilizers and chemicals in agriculture that produce heavy metals into the environment (Hansen et al., 2002, Pereira et al., 2008). Heavy metals pollution not only effect on soil physical, chemical properties and decreasing soil biological activity, but also effect on human health as well (Boisson et al., 1999).

Due to heavy metal storage process is an irreversible process which cause decreasing soil quality in agricultural lands during long term. Therefore to obtain sustainable agriculture, it's necessary to get information about environment and soil resources. In this regard, soil pollution investigation by heavy metals is necessary in areas with special lithology, industrial activities or farming. Because of spatial extend of heavy metals and also problems for collecting soil samples to determine pollutant areas, applying geostatistics is so useful (Jiachun et al., 2007 and Sengupta, 2002). Therefore, to get more information about soil pollution area by heavy metals, having spatial distribution of them is necessary. Geostatistics technique can simplify pollution source identification and spatial distribution in the environment. This method is so

ideal to evaluate heavy metals interactions based on spatial distribution source of pollution, effective process on pollutant distribution and accumulation (Poggio and Vrscaj, 2009). Kriging methods has high potential to estimate spatial variability of soil heavy metals and it's recommended as a suitable method for interpolation and obtaining soil pollution maps (Juang, et al., 2001 and Webster, 2002).

In many areas, heavy metals input to the soil is natural and human activities. Parent materials is one of the important sources to increase heavy metals in the soil (fackchili, 2001). Bloster et al., (2000) expressed by weathering parent material and soil forming process, heavy metals concentration depends on lithology of parent material increased gradually. Surface crust is composed by igneous and metamorphic rocks by 95%, while 5% by sedimentary rocks which is included 80% shale and 15% limestone (Kabala and sing 2001). Generally, sandstones due to make from quartz have less concentration of metals, in comparison to clay sediments and shale because of high capability of ion absorption can store more quantity of such elements.

There are a lot of researches in different countries about interpolation and determining spatial distribution of heavy metal concentration in soil. Lado et al (2008) studied on modelling spatial variability of eight sensitive heavy metals (As, Cd, Cr, Cu, Hg, Ni, Pb and Zn) in European surface soil by using 1588 georeferenced soil samples and applying kriging-regression method. Results of interpolation accuracy were evaluated by cross-validation technique (19). Jiachun et al., (2007) investigated on spatial distribution of Cr, As, Cu, Pb, Cd and Hg in china in 655 soil samples. They applied geostatistics method and GIS and obtained maps by log normal and ordinary kriging. Also, Juang et al (2001) and Rodriguez et al (2009) applied geostatistics to get maps of spatial distribution of heavy metals concentration.

Since there is no detailed studies have been done to estimate the heavy metals in Atrush district of Duhok province, Kurdistan region of Iraq. Thus, the main objectives of this research are to estimate available concentration of Cd, Pb, Zn and Ni in the top soil and also spatial distribution of heavy metals by geostatistical technique to map the environmental quality and risk assessment.

MATERIALS AND METHODS

1. STUDY AREA

The study area is located in Atrush district, near Duhok province, in Kurdistan Region of Iraq. Geographically, this area is enclosed between latitude 36°50'11" N and longitude 43°20'08" E. It has mountainous area with elevations ranging from 800 to 1200 meters. The climate is semi-arid with 962 mm average annual rainfall during the preceding ten years. However the topography has a great effect on rainfall distribution. The region is typified by cold and snowy winters, (especially in the elevated mountains) and warm and dry summers. Summer temperatures can be very high with a maximum recorded temperature of 35 °C in July and minimum winter temperatures reach 1 °C in January based on data recorded in Sarsink sub-district meteorological station. Study area consists of uplifted mountains with compacted vegetation cover and rock exposure. Atrush vegetation is natural vegetation and it is composed of a variety of trees scattered over the expanse of grassland. The main geomorphology of Atrush region is defined largely by its lithology of limestone, dolomite and depositions of soluble salts.

2. LABORATORY ANALYSIS

In May 2015, a total 15 surface soil samples were taken at a depth 0-25 cm using auger and trowel. Soil sampling were selected randomly. All soil samples came from rural and undisturbed areas. For each location the position of soil samples was recorded by GPS. After transporting soil samples to laboratory, they were air dries then the sieved soil through a 2 mm sieves. The available heavy metals (Cd, Ni, Pb and Zn) in the soil samples were extracted using the diethylenetriamine penta-acetic acid (DTPA) method and then were quantified (Lindsay and Norvell, 1978). Available concentration of Cd, Zn, Ni and Pb was measured by Atomic absorption instrument.

GEOSTATISTICS

Geostatistics is a field of statistics which investigate spatial variability of data. This method works by considering space conjunction with the dependence on a quantity. Also it can connect different amount of quantity by distance and angle of data. In classic statistics, each sampled data and components cannot connect with the other data around and doesn't have any spatial information. As a result, measured parameter will not present

any information about the same parameter at a specific distance. While, in geostatistics in addition to specific amount of the parameter, spatial variability of data will be considered. (Fig 1).

Therefore, geostatistics is an interpolation method which works by estimation and minimizing amount of estimation variance (Hohn 1998).

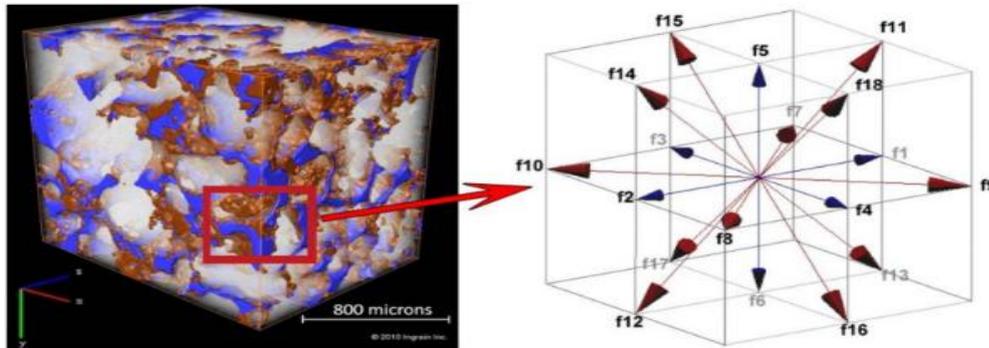


Fig. (1):- Communication and spatial structure of the estimated quantities in blocks (Tolke, 2011)

2.1. VARIOGRAM THEORY

Geostatistics estimation includes two parts: first part includes determining and modeling spatial structure of parameter that investigate continuity, homogeneity, heterogeneity and spatial structure by variogram. Second part is estimating by kriging method depends on fitted variogram model in the first step. The most important properties of variogram in comparison to other statistical methods, is simplifying variable structure which is lead to widespread use in many related groundwork. Variogram parameters include: (i) Nugget: If the empirical variogram is discontinuous at the origin, then the height of the jump C_0 is called the nugget, or nugget effect respectively, representing the value which could

be caused by measurement error or some microscale variation. (ii) Sill: Limit of the variogram tending to infinity lag distances. (iii) Range: The distance in which the difference of the variogram from the sill becomes negligible (Fig. 2). According to variogram calculation, it is determined by distinct lag distance as follows:

$$\gamma(h) = 1/2N(h) \sum_{a=1}^{N(h)} [z(u_a) - z(u_a+h)]^2$$

Where: $\gamma(h)$ is the average sample semi variance to the distance h ,
 $N(h)$ is the number of sample pair of points separated by the distance h and
 $Z(u_a)$ is the value of variable in the point of sampling u_a .

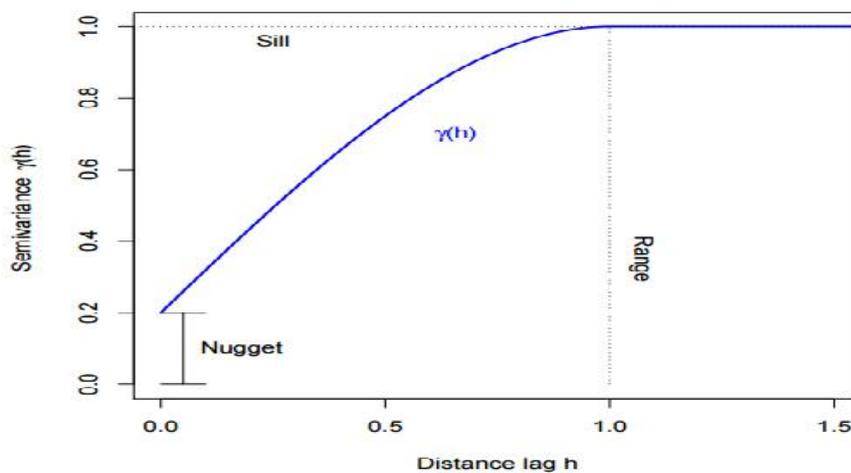


Fig. (2):- Variogram parameters nugget, sill and range (Hasanipak, 1998)

KRIGING METHOD

Geostatistics include six steps. First step is specifying statistical population in study area. Second step doing statistical calculation and obtaining a descriptive graph. Third step is experimental variogram estimation and determining theoretical spatial structure of studied parameter. Fourth step is implementation of a standard model to obtain the parameters of the variogram curve. In the fifth step, kriging method will be applied to determine spatial distribution of parameter in study area. The final step include inputting uncertainty effects in kriging results by applying statistical methods (Hasanipak, 2001).

Kriging method is an optimal interpolation based on regression against observed z values of surrounding data points which can calculate data from unsampled points according to surrounding sampled points. This method is based on weighted calculation. If data has normal distribution, kriging method is defined as best linear unbiased estimator (BLUE). Kriging method is weighting the values of parameters and obtaining an unbiased estimation by using the effects of data information on surrounding points and deleting systematic errors of estimation. (Hasanipak, 1998). Kriging estimator in this research is ordinary kriging and defines as the following equation:

$$Y_{st}^*(X_0) = \sum_{i=1}^n \lambda_i Y_{st}(x_i)$$

Where: Y_{st} : is the estimated kriged value of Y_{st} at the point x_0 and λ_i refers to weighing factors.

In this research, The Geostatistical Software Package, Gamma Design Software, version 5.1.1, (GS⁺) was applied to perform kriging method.

3. MODEL EVALUATION

To measure model performance two statistical approaches were used in this research. MAE (mean absolute error) and MBE (mean bias error). When the results of MAE and MBE methods are equal to zero or near to the nugget, it represents close simulation of reality and by receding to zero, kriging prediction will have high precision with less error. The calculation of MAE and MBE are as follows:

$$MBE = \frac{\sum_{i=1}^n (R_s - R_0)}{n}$$
$$MAE = \frac{\sum_{i=1}^n |R_s - R_0|}{n}$$

Where, R_s : Estimated data, R_0 : Observed data, n : Number of data.

4. STATISTICAL ANALYSIS

Descriptive analysis such as mean, median, standard derivation, skewness and kurtosis, also normal distribution properties of heavy metals and physical and chemical soil properties were done by SPSS program. Kolmogorov-Smirnov test was applied to analyze normal distribution for each soil parameter. Logarithmic method was used if the data didn't have normal distribution.

RESULTS AND DISCUSSION

1. DESCRIPTIVE STATISTICS

The monitoring results of four heavy metal elements of this study, the background values (Huang *et al.*, 1989) and the average contents soil samples in Atrush area are shown in Table 1. Also, the results of descriptive analysis of soil variables and test of normality are shown in table 2. To analyze test of normality kurtosis and skewness should be between 2 and -2 and significance difference in normality test should be more than 0.05. According to test of normality, all soil properties in Atrush area had normal distribution.

The minimum and maximum concentration of Cd (0.16, 0.38 mg Kg⁻¹), Ni (0.30, 2.70 mg Kg⁻¹), Pb (18.20, 54.40 mg Kg⁻¹) and Zn (1.80, 19.50 mg Kg⁻¹) obtained from Atrush area. Results indicated that there was no heavy metals pollution in the most soil samples (Table 2). Mico *et al* (2006) reported the total concentration of heavy metals such as Ni and Zn in the soil are controlled by parent materials and there is high correlation relationship among these elements in the soil with the other soil properties such as organic matter content, clay content and carbonates. Such elements have weak relationship with the other soil characteristics. Fakchinli *et al.*, (2001) investigated on multivariate geostatistical analysis on heavy metals and showed amount of Cr, Ni and Co have strong relationship in the soil and have similar sources.

Table (1):- Contents of heavy metals in the Atrush area, Duhok Province (mg/kg)

Sampling site	Cd	Pb	Zn	Ni
1	0.36	26	9.8	2
2	0.38	27.1	10.4	2.5
3	0.21	50.3	2.2	0.3
4	0.23	54.4	2.6	0.4
5	0.2	41	12.3	1.62
6	0.19	41.5	11.1	1.7
7	0.17	37	9.8	1.8
8	0.19	18.2	1.8	0.6
9	0.19	18.9	2	0.7
10	0.17	23.1	18	2.1
11	0.17	24.4	18.6	2.2
12	0.16	24.2	17.5	2.4
13	0.16	22.9	19.2	2.5
14	0.17	24.9	19.5	2.7
15	0.17	25.8	19.1	2.5
Average	0.20	30.64	11.59	1.73
Background value ^a	0.72	31.4	55	25.4

^a Huang et al., 1989

Table (2): -Descriptive analysis and test of normality of soil properties in studied area

Variable	Mean	Median	Max	Min	Std. Deviation	Skewness	Kurtosis	Normality sig.
Cd	0.20	0.19	0.38	0.16	0.06	1.99	1.89	0.16
Ni	1.73	2.00	2.70	0.30	0.83	-0.73	-0.97	0.72
Pb	30.64	25.80	54.40	18.20	1.1	-0.30	-1.40	0.16
Zn	11.59	11.10	19.50	1.80	6.90	-0.30	-1.46	0.56
pH	7.28	7.30	8.04	6.84	0.29	1.01	2.00	0.84
EC (ds/m)	0.41	0.43	0.54	0.20	0.10	-0.69	-0.31	0.70
%OM	4.28	4.43	6.12	2.02	1.01	-0.70	1.29	0.71
%Sand	29.36	27.50	45.00	13.00	9.16	0.28	-0.51	0.42
%Silt	33.80	33.00	43.00	25.00	5.89	0.21	-0.98	0.21
%Clay	36.36	38.00	47.50	23.00	8.85	-0.30	-1.64	0.054

2. GEOSTATISTICS RESULTS

In environmental studies, it is so important to recognize anisotropy in Kriging method and understand the spatial variability of each parameter. To determine isotropic or anisotropic distribution of studied elements, semivariogram models can be applied. Fitted semi-variograms models and Parameters derived from the geostatistical analysis for heavy metals presented in fig. 3(a)-(d) and table 2 respectively. To assess

spatial dependence corresponding to each standardized variable the proportion of nugget semivariance/total semivariance ($C_o/C+C_o$) was used. This ratio expressed as a percentage, was used to classify spatial dependence (Ogunyemi, et al., 2008) a ratio less than 25% indicated strong spatial dependence, between 25% and 75% indicated moderate spatial dependence and more than 75% indicated weak spatial dependence. Under that proportion Cd, Zn and Ni (nugget

semivariance = 0.00 %) and Pb (nugget semivariance = 0.12 %) showed strong spatial dependence. Cambarrdella et al (1994) showed strong spatial dependence can be effected by intrinsic resources of soil and weak spatial dependence could be controlled by non-intrinsic changes in soil. It could be concluded that variability of soil and plant production is related to soil formation. In this study, based on the spatial pattern for each soil parameters, different ranges of spatial dependence were obtained. All studied

heavy metals had correlation larger than 8.5 km. The different ranges of spatial correlation between soil properties relates to different response to many environmental factors such as erosion and sediment factors, slope, parent material and human activity (Awofolu., 2005). In the other hand, it's necessary to use different semivariogram models to describe the semivariograms. Spatial patterns of soil all heavy metals were described by spherical model (Fig. 3).

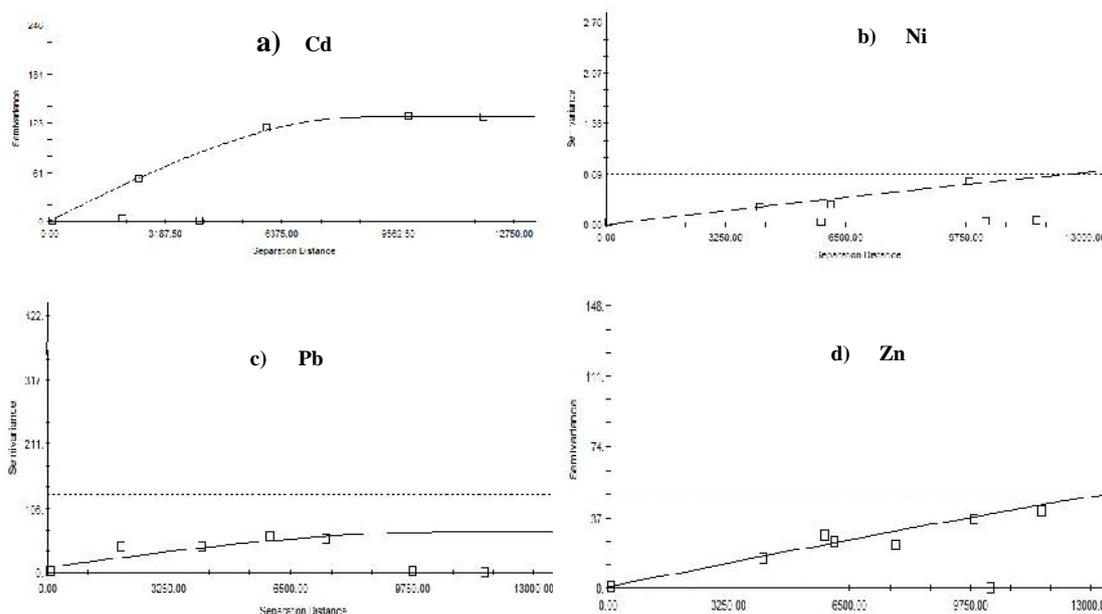


Fig. (3): - Semivariogram and spatial models for each soil heavy metals

Table (2):- Models and results of semivariogram for heavy metals

Parameter	Best model	Range (km)	Sill (m) (C+C ₀)	Nugget (C ₀)	Proportion C ₀ /C+C ₀	Spatial dependence
Cd	spherical	8.5	130	0.10	0.00	Strong
Ni	Spherical	31	1.20	0.00	0.00	Strong
Pb	Spherical	10.77	67.30	8.5	0.12	Strong
Zn	Spherical	31.10	80.90	0.40	0.00	Strong

Fig. 4 (a)-(d) presented prediction kriging maps for each individual spatial pattern of soil heavy metals. From the spatial distribution of Cd values, it distributed in high amount in south east,

low values were located in the west. High amount of Ni and Zn were near in the east and west. Low values of Pb was in the center.

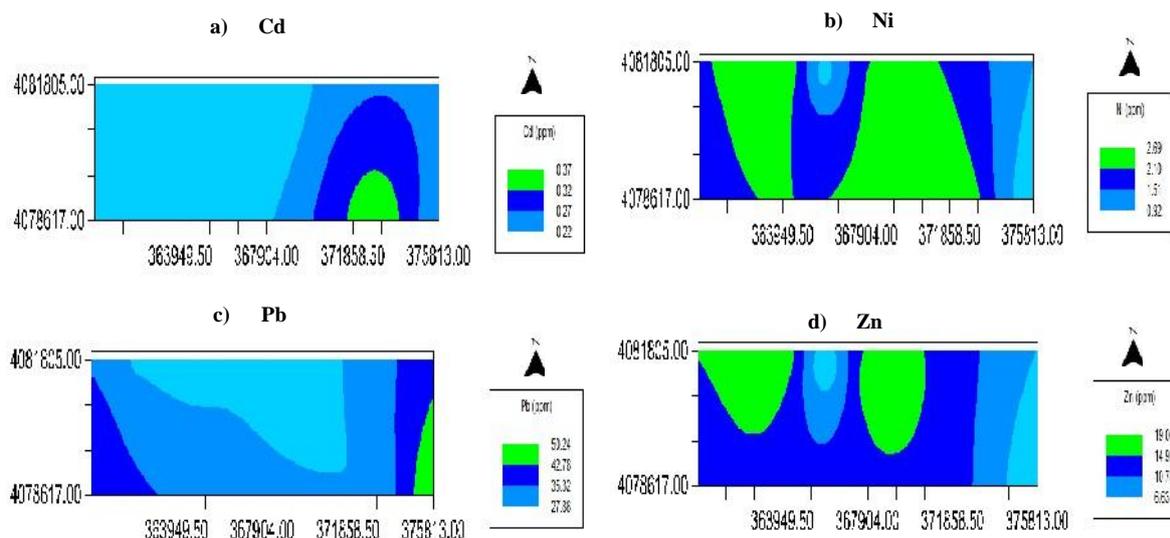


Fig (4):- Kriging prediction maps for soil heavy metals

Kriging cross validation results are shown in table 3. Based on MAE and MBE results, Cd and Ni had most accurate predictions with the lowest error.

In the other hand, the lowest precision to predict values in un-sampled points with high amount of MAE and RMSE relates Pb and Zn.

Table (3):- Cross validation statistics for soil chemical properties in study area

Parameter	MBE	MAE
Cd	0.00	0.01
Ni	-0.11	0.24
Pb	-0.22	3.74
Zn	-0.77	1.60

CONCLUSION

In this research spatial variability of four heavy metals, Cd, Ni, Pb and Zn in Atrush area, Duhok Province was done by geostatistics method. Based on 15 soil samples available concentration of studied metals were measured. The most important results of heavy metals content to assess soil quality condition indicated the average concentration of studied elements were lower than threshold effect concentration (Huang, et al., 1986). It could be concluded the source of heavy metals related to parent materials. Also, the kriging prediction maps gives a spatial distribution and changes of soil heavy metals in study area.

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PHYTOEXTRACTION OF LEAD FROM POLLUTED SOIL BY OLEANDER (*Nerium oleander*)

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ABSTRACT

Pot experiment was carried out on oleander (*Nerium oleander*) to investigate its potential to remove lead (Pb) from polluted soil. Rotted cuttings of oleander were grown in pots contaminated with different levels of Pb (25, 75, 125, 225, 425, 825, and 1225 mg. kg⁻¹ soil) either alone or with (0.5 gm of EDTA.kg⁻¹soil). Result indicated that the Pb combined with 0.5gm.kg⁻¹ soil EDTA reduced significantly chlorophyll percent compared with plants treated with no EDTA. Total biomass decreased significantly as Pb concentration in the soil increased and highest dry weight observed in control plant (9.12 g) and the lowest in plants sampled from pots treated with 1225 mg.kg⁻¹ of Pb. There were no significant differences in total dry weight by application of EDTA. Absorption of Pb by oleander plants increased with the increments in Pb concentration in the soil, also plants treated with EDTA accumulated significantly more Pb than those plants treated with no EDTA, in general concentration of Pb was in order of that roots > stems > leaves. Translocation and bioaccumulation factor didn't exceed 1; it means that the oleander plants in under these circumstances can be considered a phytostabilizer plant. Removal Pb ranged from 0.16 mg.pot⁻¹ in samples grown in pots contained 25 mg.kg⁻¹ of Pb to 0.69 mg.pot⁻¹ in plants treated with 1225 mg.kg⁻¹ of Pb and 0.5gm.kg⁻¹ EDTA.

KEY WORDS: lead, EDTA, *Nerium oleander*, phytoextraction.

INTRODUCTION

Lead belongs to heavy metals that have atomic number greater than 20 with metallic properties, these metals cannot be easily degraded or destroyed and the clean up from the environment usually require removal (Lasat 2002). Automobile in the urban areas considered the main source of Pb exhaust which lead to atmospheric pollution (Paivoke, 2002; Pirzada *et al.*, 2009). Human exposure to Pb causes great health effect such as mental retardation and behavioral disorder. Human exposure to Pb occurs through different pathway such as inhalation of air, drinking water, and through food chain via plants (Shafiq *et al.*, 2008).

Cleaning of soil polluted with Pb by traditional methods such as excavation or application of chemicals requires huge monetary cost and efforts. Phytoremediation of such soils is more economic than other remedial techniques by about 40 %. Oleander (*Nerium oleander* L.) is a plant adapted to a range of stressor and tolerates drought, poor drainage, and high salt content in soil such as heavily trafficked roadsides, seashores or in the beds of the Mediterranean riverbeds, so these characteristics make it suitable species for the

phytoremediation investigation (Grieve *et al.*, 1981). It is known that *Nerium oleander* L. is a species suitable to use as a biomonitor. Plants are very important factor for minimizing and stabilizing the effects of pollutants in the environment, oleander is a useful plant to fix Pb by roots accumulation and there are a positive relationship between Pb contents in their roots and shoots and the soil grown in it, in addition to the absorption of Pb by roots it can uptake atmospheric Pb by leaves. Oleander acts as excluder for Pb. (Rossini Oliva *et al.*, 2007). *Nerium oleander* L. sampled from a soil contained 602 mg. kg⁻¹ Pb in Gaziantep-Turkey, accumulated 2820 mg. kg⁻¹ d. wt. (Kaya *et al.*, 2010). The roots are the main accumulation site of Pb in oleander plants, in Greece, Kadukova, *et al.*, (2006) observed 131 and 10 mg. kg⁻¹ d. wt. of Pb respectively in roots and shoots of oleander grown in soil contained 800 mg. kg⁻¹ of Pb, in other hand roots accumulated 93% of total Pb accumulated by plant.

Chelates such as Ethylene diaminetetraacetic acid (EDTA) enhanced absorption and translocation of Pb from roots to shoots in different plants (Shen *et al.*, 2002). EDTA enhanced desorption of lead from soil to the soil

solution and hence increased ability of plants to absorb and accumulate metals (Luo *et al.*, 2005 and Komárek *et al.*, 2007). The aim of this study was to investigate ability of oleander plant for remove of Pb from the soil and the role of EDTA to assist the absorption and translocation of Pb from roots to above ground tissues.

MATERIALS AND METHODS

The present study was a pot experiment conducted under lath house condition during the period (April-September, 2015) at the college of Agriculture, University of Duhok, Kurdistan Region, Iraq.

Preparation of the soil and addition of Pb

Top soil (from farms of college of Agriculture-university of Duhok) and loam were air dried, sieved through 4-mm sieve and mixed together with (3 part soil: 1 part loam), the mixture distributed in 5 kg plastic pots and contaminated with seven levels of lead (25, 75, 125, 225, 425, 825, and 1225 mg. kg⁻¹ soil) by dissolving analytical grade Pb(NO₃)₂ in distilled deionized water (25 mg. kg⁻¹ soil represent background level of total Pb in the mixture).

Pots were kept at field capacity by irrigation with distilled deionized water during a period of six weeks (incubation period to enable added Pb(NO₃)₂ to reach a steady state) (Blaylock *et al.*, 1997). The physical and chemical properties of mixture were as following; texture: clay (clay 45.2%, silt 24.8%, sand 30%), moisture (3.27%), pH (7.76), EC (0.378 dS.m⁻¹), total Pb (25 mg.kg⁻¹).

Source of cuttings

During the October-2014 period, stem cuttings of one-year-old shoots from oleander plant were collected from gardens of college of Agriculture, University of Duhok, in Duhok city, Kurdistan Region-Iraq, stems were cut at uniform length and diameter (20 × 1.5 cm) then planted in wooden box contained sand under natural conditions.

Planting and addition of EDTA

Pots were planted on the April 02, 2015 with oleander stem cuttings that have fine root (one plant per pot) that were pre-grown in sandbox. Ethylene diaminetetraacetic acid disodium salt (Na₂EDTA) was applied to pots with two concentrations (0.0 and 0.5 g. kg⁻¹) at (September 03, 2015).

Total chlorophyll percentage in leaves.

Total chlorophyll was measured directly in the field by Chlorophyll meter; model SPAD – 502, Konica, INC. Made in Japan. Chlorophyll percent was measured in three leaves in each of bottom, middle and top level in each pot.

Harvesting and digestion

After two weeks of application of EDTA (on September 16, 2015) plants were uprooted, washed carefully with tap water then with distilled water, each plant separated into roots, stems and leaves. Plant parts were putted in paper bags, air dried then dried in the oven at 70±2 °C for a period of 48 hrs. plant parts were grounded by stainless grinder. 0.5 gm of powder was wet digested by a mixture of 2:1 (V:V) of nitric acid and perchloric acid (HNO₃/HClO₄) (Tandon, 1999). The digested samples were diluted with distilled deionized water to final volume (50 ml volumetric flask) and filtered. Lead concentration in samples was measured by Atomic Absorption Spectrophotometer type (GBC) in laboratories of research center in College of Agriculture, University of Duhok.

Biological accumulation factor (BAF)

Refer to the concentration of a metal in plant tissues to the concentration of same metal in the soil, the higher the BAF the more efficient phytoextraction (Qu *et al.*, 2011).

$$BAF = \frac{Pb\ plant}{Pb\ soil}$$

Translocation factor (TF)

Translocation factor (TF), is a ratio between the total metal concentrations in the shoots and roots (Qu *et al.*, 2011).

$$TF = \frac{Pb\ shoots}{Pb\ roots}$$

Removed lead

Removed lead is the quantity of metal in tissues of plant and calculated by multiplying metal concentration in plant tissues by its biomass (Pivetz, 2001).

Removed lead = Pb in plant part × Plant part biomass

Experimental design

The experiment was factorial (two factors; lead level and EDTA levels) the randomized completely block design (R.C.B.D.) was used for

statistical analyses (Al-Rawi and Khalaf-Alla, 2000), by using the Microsoft (SAS 2002). Analysis of variance (ANOVA), the differences between various treatments means were tested with Duncan Multiple Range test at 5% level (Duncan, 1955).

RESULTS

Phytoremediation of Pb by oleander plants Effect of Pb and EDTA on chlorophyll content (ChC) in leaves of oleander

Figure (1) shows total chlorophyll content in leaves of oleander plants grown in pots artificially polluted with different Pb concentrations (25-1225 mg.kg⁻¹ soil) and their interaction with 0.0 and 0.5 g EDTA.kg⁻¹ soil.

Total chlorophyll decreased in the leaves with increasing Pb concentration. Highest ChC was in control (57.90 %) in (25Pb) which was significant with lowest chlorophyll content (49.37 %) in (1225Pb+0.5EDTA).

Pots contaminated with only Pb when no EDTA added indicated that ChC in control plants

leaves were significant only with 825Pb and 1200Pb plants and insignificant with all other treatments of Pb (75, 125, 225, and 425 mg.kg⁻¹). Except for (75+0.5EDTA) all other treatments of Pb in combination with EDTA were significant with control plants. In other side all interactions of Pb with EDTA didn't differ significantly in their ChC.

Reduction of chlorophyll was significant in plants treated with 0.5g EDTA.kg⁻¹ soil compared to the plants didn't treat with EDTA. In accordance mean ChC reduced from (54.18) in leaves of plants grown in pots polluted with Pb alone to (50.20). These due to that the lead has negative effects on photosynthesis and reductions in the activity of phosphates and enzyme-bound ATPase (Koepe, 1981), also Pb decreases photosynthetic rates by reducing synthesis of chloroplast, changing chloroplast ultra structure, impairing Mg and Fe uptake and inhibition of electron transport chain in the photosystem I and II (Sharma and Dubey, 2005).

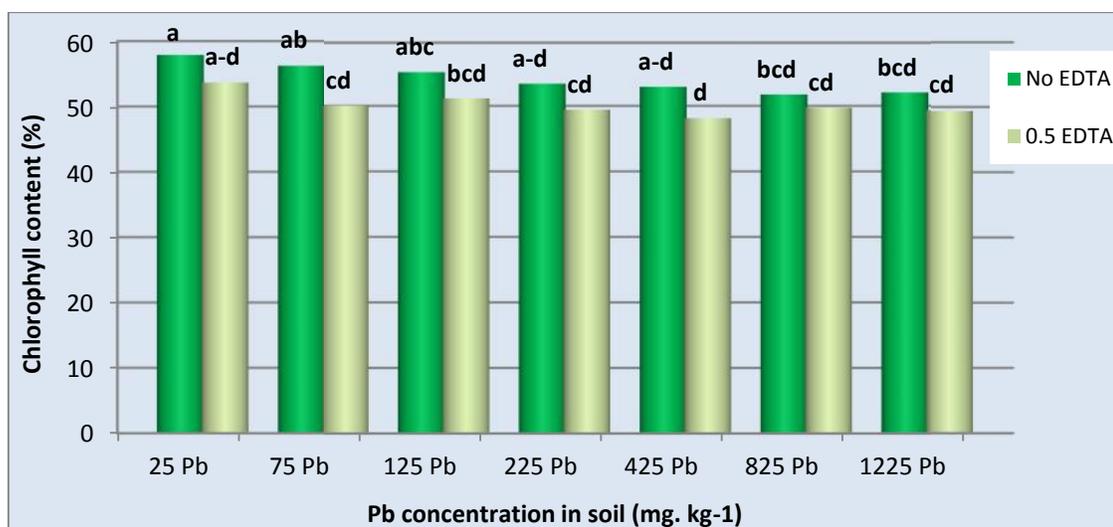


Fig.(1):- Effect of Pb and EDTA on chlorophyll percentage in leaves of oleander.

Means, with same letters, are not significantly different at 5% level based on Duncan's multiple range Test

Effect of lead and EDTA on oleander biomass

Results regarding to the effects of lead and EDTA on oleander biomass are presented in table (1).

Roots biomass

Higher roots dry weight (1.41 g) was recorded in control plants compared with lowest roots dry weight (0.99) in (825Pb). No significant differences were recorded among 25Pb, 75Pb, and 125Pb treatments as well as among all of 225Pb, 425Pb, 825Pb, and 1225Pb. EDTA didn't affects

significantly on roots dry weight of oleander, which can be seen from the insignificant differences between the mean of roots biomass of 1.16 g of treated plants with Pb alone and 1.19 g in plants treated with Pb+ 0.5EDTA.

Stems dry weight

Dry weight of stems reduced from 2.77 g in control plants to 1.45g in (1225Pb+0.5EDTA). The differences among 25Pb, 75Pb, and 125Pb treatments were insignificant either with or without EDTA, also all treatments (225Pb, 425Pb, 825Pb, and 1225Pb) shows insignificant differences on roots biomass under two

concentrations of EDTA. However, the mean dry weight of stems (2.03 g) from all treatments of Pb alone was higher than that of Pb in combination with EDTA (1.99 g) but they didn't differed significantly from each other.

Leaves dry weight

Leaves of oleander plants sampled from 25Pb showed highest dry weight (4.98 g) which was significant with lowest leaves dry weight (2.75 g) in 1225Pb. Maximum leaves biomass of oleanders treated with EDTA was in treatment 25Pb+0.5EDTA (4.74 g), in other hand minimum leaves biomass (3.11) was in 825+0.5EDTA.

Table (1):- Effect of lead and EDTA on biomass of oleander (g).

Pb (mg. kg ⁻¹ soil)	Plant parts		
	Roots	Stems	Leaves
25	1.41 ^a	2.77 ^a	4.93 ^a
75	1.28 ^{ab}	2.67 ^{ab}	4.98 ^a
125	1.30 ^{ab}	2.28 ^{abc}	3.97 ^{a-e}
225	1.11 ^{bc}	2.01 ^{b-e}	3.66 ^{b-f}
425	1.00 ^c	1.50 ^{de}	3.01 ^{ef}
825	0.99 ^c	1.50 ^{de}	2.94 ^{ef}
1225	1.00 ^c	1.51 ^{de}	2.75 ^f
Mean	1.16 ^a	2.03 ^a	3.75 ^a
25+EDTA	1.35 ^a	2.64 ^{ab}	4.74 ^{ab}
75+EDTA	1.33 ^{ab}	2.39 ^{ab}	4.27 ^{abc}
125+EDTA	1.31 ^{ab}	2.09 ^{b-e}	4.32 ^{abc}
225+EDTA	1.20 ^{abc}	2.23 ^{a-d}	4.14 ^{a-d}
425+EDTA	1.04 ^c	1.56 ^{cde}	3.43 ^{c-f}
825+EDTA	1.04 ^c	1.56 ^{cde}	3.11 ^{def}
1225+EDTA	1.05 ^c	1.45 ^e	3.38 ^{c-f}
Mean	1.19 ^a	1.99 ^a	3.91 ^a
Total mean	1.17	2.01	3.83

In each column means, with same letters, are not significantly different at 5% level based on Duncan's multiple range Test.

Total dry weight

Total dry weight of oleander plants (figure 2) demonstrated significant decreasing in response to the increments in Pb concentration either with or without EDTA. Highest dry weight observed in control plant (9.12 g) and the lowest total dry weight recorded in plants from 1225Pb. There were no significant differences in total dry weight by application of EDTA.

Mean dry weight of oleander plants sampled from pots polluted with Pb alone was 6.94 g and

for those amended by 0.5 g of EDTA the mean dry weight was 7.090 g. however, the differences were insignificant, but it is obvious that EDTA increased the total weight of oleander plants unlike decreasing effects of EDTA in all other tested plants. We noticed that the addition of EDTA induced a slight increase of biomasses production.

Reduction of oleander biomass occurred because of reduction in photosynthesis rate due the inhibition of the chloroplast formation (Habash *et al.*, 1995). In other hand lead reduces the dry

weight of plants by reducing the absorption of nutrients in plants, such as P, Ca, Mg, Fe, Mn, and Zn, inhibition of the formation of root hairs, and decreasing the number and diameter of vascular bundles (Mukhopadhyay and Maiti, 2010). Lead inactivate several enzymes by binding

with SH groups also lead ions increases the reactive oxygen species (ROS) production (Pinho and Ladeiro, 2012).

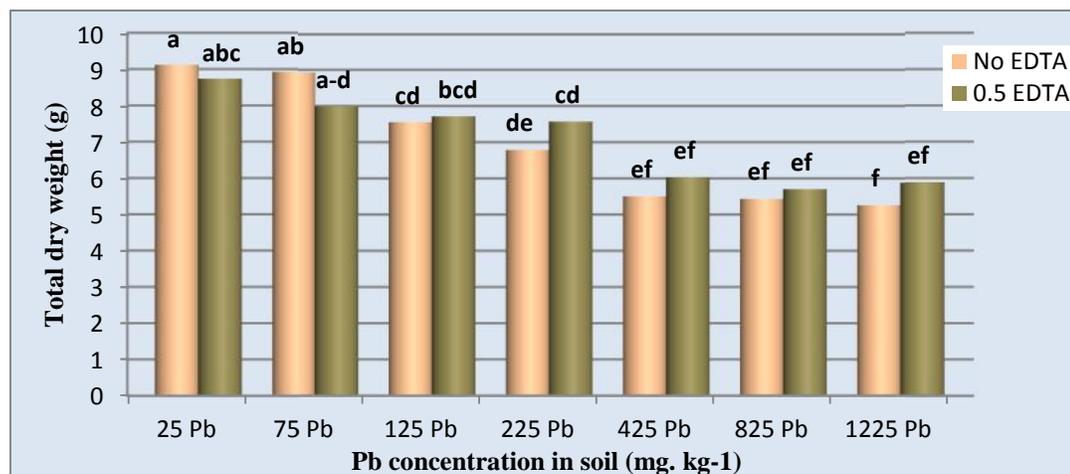


Fig. (2):- Effects of lead and EDTA on total biomass of oleander (g).

Means, with same letters, are not significantly different at 5% level based on Duncan's multiple range Test

Phytoremediation of lead by oleander

Data presented in table (2) shows the phytoextraction of Pb by oleander plant from artificially polluted soils with different Pb concentrations (25-1225mg.kg⁻¹) and their interaction with 0.0 and 0.5 g EDTA. kg⁻¹ soil.

Lead content in roots

In roots the highest Pb content (166.53 mg. kg⁻¹ d. wt) was found in 1225+ 0.5EDTA treatment, which differed significantly lowest concentration of Pb (35.55 mg. kg⁻¹ d. wt) in roots of control plants. The differences in treatments of Pb alone showed insignificant differences among 225Pb, 425Pb, and 825Pb treatments, other treatments differed significantly from each other as well as with three mentioned treatments.

The combination effects of lead with EDTA were insignificant between 1225Pb+0.5EDTA and 825Pb+0.5EDTA, as well as between 425Pb+0.5EDTA and 225Pb+0.5EDTA, but other three treatments showed significant differences between each other. A significant interaction found between Pb and EDTA in Pb accumulation in oleander roots, hence Pb mean concentration in roots increased significantly from 104.61 mg. kg⁻¹

¹d. wt in the absence of chelant, to 117.223 mg. kg⁻¹ in plants received Pb+EDTA.

Lead content in stems

Lead extraction by oleander stems increased spontaneously with increased Pb concentrations in the soil. Lead concentration in stems of plants treated with Pb ranged from 21.93 mg. kg⁻¹d.wt in control plants to 63.47 mg. kg⁻¹d.wt in 1200Pb. Lead concentration in stems of plants amended with the chelate ranged from 30.13 mg. kg⁻¹d.wt in 25Pb+0.5EDTA to 123.07 mg. kg⁻¹d.wt. In addition Pb concentration in stems in both of 825Pb+0.5EDTA and 1225Pb+0.5EDTA treatments was insignificant. Also 225Pb+0.5EDTA and 425Pb+0.5EDTA were insignificant. Effect of EDTA on stems mean content of Pb was very significance, lead concentration in roots ranged from 40.93 mg. kg⁻¹d.wt in the absence of EDTA to 86.90 mg. kg⁻¹d.wt when EDTA applied to the soil.

Lead content in leaves

The analysis of leaves material indicated that the addition of Pb to the soil increased the concentrations of Pb in leaves of the oleander. Significant differences are obvious between leaves from 1225Pb and those from 25Pb, 75Pb and

125Pb. There were no significant differences between the treatments (225Pb, 425Pb, 825Pb, and 1225Pb). Plant uptake of Pb was particularly enhanced after addition of EDTA (0.5g kg⁻¹ soil), the concentration of Pb in leaves increased from 18.63 mg. kg⁻¹d.wt in control to 35.60 mg. kg⁻¹d.wt in 25Pb+0.5EDTA, also from 106.53 mg. kg⁻¹d.wt

in 1225Pb to 161.40 mg. kg⁻¹d.wt in 1225Pb+0.5EDTA. EDTA effect are obvious in the mean of Pb concentration in leaves which increased significantly from 76.61 mg. kg⁻¹d.wt to 98.78 mg. kg⁻¹d.wt in the presence of 0.5 g of EDTA.

Table (2):- Effect of lead and EDTA on Pb accumulation in oleander plant (mg. kg⁻¹ d. wt).

Pb (mg. kg ⁻¹ soil)	Plant parts		
	Roots	Stems	Leaves
25	35.55 h	21.93 f	18.63 h
75	70.00 g	27.87 f	36.87 g
125	88.90 ef	32.00 ef	78.93 ef
225	127.80 d	41.65 de	91.77 de
425	130.83 cd	48.80 d	100.83 d
825	132.33 cd	50.82 d	102.70 d
1225	146.85 b	63.47 c	106.53 cd
Mean	104.61 b	40.93 b	76.61 b
25+EDTA	40.77 h	30.13 ef	35.60 g
75+EDTA	82.47 fg	51.80 d	73.77 f
125+EDTA	96.70 e	72.73 c	79.07 ef
225+EDTA	130.83 cd	104.80 b	98.67 d
425+EDTA	144.90 bc	105.45 b	119.70 cd
825+EDTA	158.37 ab	120.30 a	123.23 b
1225+EDTA	166.53 a	123.07 a	161.40 a
Mean	117.22 a	86.90 a	98.78 a
Total mean of plant organs	110.92	63.92	87.69

In each column means, with same letters, are not significantly different at 5% level based on Duncan's multiple range Test.

Total Pb content in oleander plants

Total lead concentration in oleander plants is presented in figure (3). It is obvious that the oleander plants subjected to different levels of Pb accumulated high concentration of Pb compared to control plants, also a significant interaction between Pb and EDTA application was found. Total concentration of Pb 156.72 mg. kg⁻¹d.wt in 1225Pb+0.5EDTA was much higher Pb concentration recorded in oleander plants, compared with lowest Pb concentration in control plants.

EDTA enhanced phytoextraction of Pb by oleander plants even at low Pb concentration in the soil. It can be seen from the figure (3) that all

treatments of Pb alone was significant with corresponding treatments of the same concentration of Pb in combination with 0.5 g of EDTA, as example 1200Pb was significant with 1225Pb+0.5EDTA. Significant effect of EDTA can be seen even in the mean concentration of Pb in all treatments of Pb which was 74.05 mg. kg⁻¹d.wt in the absence of EDTA compared to 100.96 mg. kg⁻¹d.wt in the presence of EDTA.

Results of several authors indicated that the uptake of heavy metals increased after addition of EDTA, for example the absorption of Pb by addition of EDTA increased by about 100-folds compared with plants received no EDTA (Gr man *et al.*, 2001). EDTA increase Pb availability in the

soil by enhancing the desorption of Pb ions and thereby increasing Pb concentration in soil

solution, also EDTA increases the translocation of Pb from roots to shoots (Evangelou *et al.*, 2007).

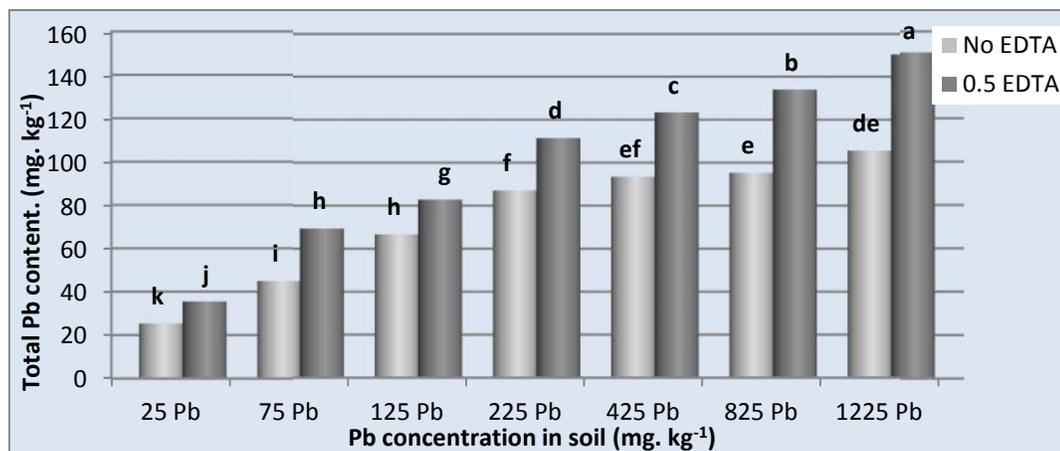


Fig. (3):- Effects of lead and EDTA on total lead accumulation (mg. kg⁻¹d. wt) in oleander tissues. Means, with same letters, are not significantly different at 5% level based on Duncan's multiple range Test

Translocation factor TF of lead from roots to shoots

The amount of Pb translocated from roots to shoots in table (3) indicated that not all Pb absorbed by roots reached to the shoots of oleander. Highest TF (0.85) was recorded in 1225Pb+0.5EDTA compared with lowest (0.479) in 75Pb treatments. It is obvious from the table (3) that no significant differences were recorded among plants received Pb alone nor between those amended with EDTA. Translocation factor of Pb in all treatments of Pb alone differet significantly from all corresponding treatments of Pb+EDTA except TF of 0.62 in 125Pb was insignificant with most treatments of Pb+EDTA. EDTA enhanced significantly TF of Pb in shoots of oleander from 0.56 when no EDTA added, to 0.79 after addition of EDTA.

Biological Accumulation Factor (BAF) of lead

The ratio of Pb concentration in the dry biomass to the initial concentration of Pb in the soil (BAF) ranged from 0.07 in 1225Pb to 1.10 in 25Pb+0.5EDTA treatment (table). It can be noticed that the BAF of Pb by oleander shoots decreased as Pb concentration increased in the soil. BAF of treatment 25Pb was (0.68) differed significantly from BAF of all other treatments that polluted with Pb alone. Same trend was obvious in all treatments of Pb in combination with EDTA, hence BAF of 25Pb+0.5EDTA was significant

from all other combination treatments of Pb+EDTA. Biological accumulation factor of Pb increased significantly from 0.30 in plants treatments of Pb alone to 0.60 in plants treated with Pb+EDTA.

Removed lead by oleander plants

The successful of phytoremediation process of any metal depends on shoots biomass and metal concentration in the shoots. The removed metal by plant shoots is very important index because it is useful for the practical application of phytoremediation (Usman and Muhamed, 2009).

Removed Pb increased as Pb concentration in the soil increased, this is obvious in table (23). The highest amount of removed Pb (0.69 mg. pot⁻¹) was from (1225Pb+0.5EDTA) that was significant with all other treatments and with lowest Pb removed (0.156 mg. pot⁻¹) from 25Pb treatment. Removed Pb by oleander in 25Pb was significantly less than all other treatments of Pb alone except from 75Pb which was insignificant. However the amount of removed Pb by oleander plants was insignificant among most treatments of Pb+EDTA, but they significantly removed larger amount of Pb from the pots the corresponding treatments of Pb alone. Effect of 0.5 g of EDTA was significant for increasing the amount of removed Pb from pots from 0.31 mg. pot⁻¹ when no chelate used to 0.15 mg. pot⁻¹ from pots amended with 0.5 g of EDTA. kg⁻¹ soil.

Oleander plant in this study can't be considered a hyperaccumulator plant because Pb it concentrates most of absorbed element in the roots (TF less than 1), but it can be considered as a Pb

phytostabilizer plant, phytostabilization of toxic contaminants results within the root zone either by immobilization within root tissues or precipitation in the soil around roots (Wani et al., 2011).

Table (3):- Effect of lead and EDTA on TF, BAF, and removed Pb by oleander plant.

Pb (mg. kg ⁻¹ soil)	Calculated parameters		
	TF	BAF	Removed Pb (mg. pot ⁻¹)
25	0.57 ^c	0.68 ^c	0.16 ^g
75	0.48 ^c	0.40 ^e	0.25 ^{fg}
125	0.62 ^{bc}	0.43 ^e	0.35 ^{ef}
225	0.52 ^c	0.29 ^f	0.38 ^e
425	0.57 ^c	0.17 ^g	0.34 ^{ef}
825	0.58 ^c	0.09 ^{hi}	0.34 ^{ef}
1225	0.58 ^c	0.07 ⁱ	0.36 ^e
Mean	0.56 ^b	0.30 ^b	0.31 ^b
25+EDTA	0.82 ^a	1.10 ^a	0.24 ^{fg}
75+EDTA	0.77 ^{ab}	0.78 ^b	0.42 ^{de}
125+EDTA	0.79 ^a	0.58 ^d	0.49 ^{cd}
225+EDTA	0.78 ^{ab}	0.44 ^e	0.65 ^{ab}
425+EDTA	0.78 ^{ab}	0.26 ^f	0.55 ^{bc}
825+EDTA	0.77 ^{ab}	0.15 ^{gh}	0.57 ^{bc}
1225+EDTA	0.85 ^a	0.12 ^{ghi}	0.69 ^a
Mean	0.79 ^a	0.60 ^a	0.52 ^a
Total mean	0.68	0.45	0.41

In each column means, with same letters, are not significantly different at 5% level based on Duncan's multiple range Test.

CONCLUSIONS

Pb decreased the biomass of oleander plants, plants treated with EDTA accumulated significantly more Pb than those plants treated with no EDTA. Under circumstances of this study oleander plants can be considered as Pb phytostabilizer plants because it concentrated more Pb in roots than shoots.

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RESPONSE OF *Cynodon dactylon* L. AND *Lolium perenne* L. TO MAGNETIZED WATER AND FOLIAR APPLICATION OF DIAMMONIUM PHOSPHATE

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ABSTRACT

In the engineering parks nursery two plastic house experiments were conducted on 5-11-2014 till 26-3-2015. Two grasses *Lolium perenne* L. and *Cynodon dactylon* L. were used in this study separately in two experiments, each experiment were sprayed with different levels of Diammonium phosphate (0, 0.25, 0.50 and 0.75ml.l⁻¹), and irrigated with magnetized water under different intensities (0, 1500, 3000) Gauss. Each grass was mowed three times. *Lolium perenne* L. is rapid growth in early stages; therefore the first mowing time (26-12-2014) gave the best results of studied parameters. Moreover, magnetized water affected negatively on the most (*Lolium perenne* L.) growth characters even with the levels of DAP interactions when the plants that irrigated with tap water gave the best plant height and leaf area. Significantly highest studied parameters were obtained by *Cynodon dactylon* L. in the third times of mowing when was done on (26-3-2015), grow at all DAP levels. While, the magnetic level of 3000Gauss gave best results of growth parameters.

KEYWORDS: *Lolium perenne* L. and *Cynodon dactylon* L., Magnetic water, DAP, Growth parameter.

INTRODUCTION

Grasses, in natural green areas, act as long fulfilling ornamental functions. With time, grass began to be introduced to gardens, generally as lawns. Together with the development of architecture, their practical meaning gradually started to increase. In recent time, grass lawns have been treated as one of the most important components of green areas (Kleiber and Komosa, 2011).

Perennial ryegrass (*Lolium perenne* L.) also called English ryegrass, is a cool-season perennial bunchgrass native to Europe, temperate Asia, and North Africa. It is widely distributed throughout the world, including North and South America, Europe, New Zealand, and Australia (Hannaway *et al.*, 1999). *Lolium perenne* L is a dominant forage species of Europe and other humid and semi-arid parts of the world. Photosynthesis is one of the basic processes in the nature because 90 – 95% of the plant organic mass is created through photosynthesis. The most significant indices of photosynthetic activity are crop index, utilisation of photosynthetically active radiation and net photosynthesis productivity. When plant tissue is combusted the residual ash represents those mineral elements taken up from the soil via the roots. In grasses they generally make up about 6 to

9 % of the plant dry weight. Leaf photosynthesis is influenced by the dominant environment (Bumane and Adamovics, 2002).

Bermudagrass (*Cynodon* spp.) grow on a wide range of soil types as long as if there is adequate drainage and plenty of sunlight. Bermuda grass is not a shade tolerant turf grass. Full sun light is requiring for it to thrive. Other attractive features include rapid recovery from traffic damage and good drought tolerance. Bermuda grass will turn brown during extended dry periods but recover after the first significant rainfall. Durability and the ability to recover quickly make it the first choice for high traffic areas (Calendar, 2015).

The main tools to manipulate grass quality are regrowth duration, N application rate and cutting height, which have been the subject of many studies. (Hoekstra *et al.* (2008) found that the ratio between nitrogen fractions is rather constant and that all fractions seem to follow the total N content of herbage (with the exception of cuts under high N application rates during late season) could have positive implications for modelling herbage quality. Bumane (2010) referred to that the grass quality indices were mostly influenced by the rate of N fertilizer, by N application the protein content in grass dry matter and its total yield per hectare increased considerably. An increasing N fertilizer rates contributed more in increasing of

crude protein level and yield than to the increase of grass dry matter yield. The Foundation recommends fertilizing with phosphorus and potassium (K) based on soil test results. These recommendations are based on field research studies for a particular location and are superior to general fertilizer recommendations. Using soil testing as a basis for determining the need for these nutrients is cost-effective and prudent.

Plants need different amounts of water at different stages of their growth cycle. In addition, local climatic and soil conditions influence the availability of water. Good irrigation scheduling requires knowledge of water demand at different growth cycles, moisture content of the soil and soil water capacity, weather conditions (Vital Water Graphics, 2008). Proper irrigation may prevent or reduce pest problems and environmental stress in the summer (Patton and Boyd, 2015). Magnetized water has been tested on chick-pea seed growth by Nasher (2008) the seeds were irrigated plants with magnetized water, plants height are taken daily up to the day 18, length results showed that plants irrigated with magnetized water were taller than seeds irrigated with tap water.

The magnetic fields facilities water absorption, the sensitivity to a given magnetic fluid (composition and concentration) seems to be dependent on the plant species (Blaga and Cuza, 2009). Hozayn and Abdul Qados (2010) found that plants when irrigated with magnetic water exhibited marked increases in the most of vegetative growth, chemical constitute i.e. photosynthetic pigments (chlorophyll a, chlorophyll b and carotenoids), total phenols and total indole over the control plants. Also, the magnetized water treatment exhibited an increase in the protein content as compared to the control. Moreover, the magnetized water treatment increased yield and yield component. Hozayn *et al.* (2011) studied the response of some food crops to magnetized water used for irrigation purpose under green house condition. Monocotyledonous such as wheat and flax and dicotyledonous such as chick-pea and lentil plants, they founded that the magnetized water treatment increased yield and yield component traits of all crops.

The present study, investigated the effects of different intensities of magnetic water and Diammonium phosphate on growth of *Cynodon dactylon* L. and *Lolium perenne* L grasses in plastic house condition.

MATERIALS AND METHOD

-Description of cultivation

Pots of 35 cm in height, 26 cm in top diameter and 23 cm in bottom diameter were used in this study was carried out at the engineering parks nursery plastic house; they were seeded with two grasses (*Lolium perenne* L. and *Cynodon dactylon* L.) at a rate of (1.77 g/pot) were sown in loamy soil (Haby *et al.*, 2007); on November 5th, 2014 till March 26th, 2015. They were used in this study separately in two experiments, each one sprayed with Diammonium phosphate (DAP) contain 18%N, 44% P₂O₅ and 0.0 K₂O in different concentrations (0, 0.25, 0.50 and 0.75%), and were irrigated with magnetized water at different intensities (0, 1500, 3000 Gausses), the amount of irrigated water was 1.445 liters for (each pot) to adjust the soil moisture at about the field capacity and irrigated when needed gravimetrically.

The first experiment seeds of *Lolium perenne* L. were germinated on 16-11-2014 it was the earliest growth grass. The grass was mowed four times (the first one was neglected) and the three times of mowing started on 26-12-2014 and the others were with 16 days interval.

In the second experiment was for *Cynodon dactylon* L., was a late germination grass date of germination was in 16-11-2014; its rapid growth was started in February. Four times of mowing were done (the first one was neglected), the three times of mowing started on 22-2-2015 with 16 days interval between each mowing. Climatic data were taken through the experiments period from Agriculture Research Center –Ministry of Agriculture of Kurdistan Region.

-Soil Sampling Preparation and Analysis

Bulk soil samples of disturbed soil were collected from the (0.0-30) cm depth of local soil. The soil air-dried lightly ground to pass through a 2-mm sieve mixed with peatmoss, and the mixture ratio of the (soil to peatmoss) in each treatment was (1:5) by volume Table 2 represents some selected physio- chemical properties of the studied soil and the magnetized water.

Bulk density of the soil samples were measured by core method as outlined by Black and Hartae (1986). Soil particle size analysis was performed by hydrometer method as described by Bowles (1976). Water retention at field capacity and wilting point were calculated according to the models proposed by Karim, 1999.

The pH of the saturation extract was measured after 24 hrs. of equilibrium according to Black and

Hartae (1986). The electrical conductivity of the saturation extracts (EC_e) and adjusted to 25 °C according to Hesse (1972). Organic matter content of the soils was determined wet oxidation method according to (Allison, 1965) procedure.

-Treatment of water

Water was treated magnetically using a small magnet (0, 1500 and 3000 Gauss), the magnet devices was connected to the water pipes, while the other part of the pipe was used for normal watering, so that, water for all treatments were irrigated with same water resource.

-Experimental design

Both experiments were carried out as factorial completely randomized design each ONE with 36 treatments with four replicates. The data were submitted to analysis of variance (F test) and the means compared using least significant

differences test (L S D) at the 5% probability level (Al –Rawi and Khalaf –Allah, 1980). Static graph system was used for analyzing data statistical analyses (Statigraphic version 4.0, 1999).

- Plant parameters

Plant height, leaf area, chlorophyll content and relative water content (RWC) were calculated three times (one day before every mowing).

Chlorophyll content in the leaves determined by chlorophyll meter SPAD 502 (Coste *et al.*, 2010 and Hardin *et al.*, 2012). Evaluating of water relative content (RWC) determined by moisture meter L606 Wagner. While the leaf area was measured by digital planometer placom KP 90N. Dry weight of vegetative part was placed in the oven until constant dry weight obtained (three times, after every mowing).

Table (1): Maximum and minimum air temperatures and humidity throughout the experiments period.

Year	Month	Air temperature C°		Relative humidity%	
		maximum	minimum	maximum	minimum
3	November	26	7	99	12
	December	21	0	98	17
4	January	19	0	99	18
	February	22	0	97	16
	March	25	4	95	10

Table (2): some selected physio- chemical properties of the soil of the two experiments.

Contents	(g kg ⁻¹)			Texture name	Bulk density (g kg ⁻¹)	Electrical conductivity (dS m ⁻¹)	pH	Calcium carbonate content (g kg ⁻¹)	Organic matter content (g kg ⁻¹)
	Sand	Silt	Clay						
Amounts	479.48	353.24	167.28	Loam	1.46	0.77	7.80	312.50	6.30

RESULTS AND DISCUSSION

Lolium perenne L. experiment

- Effect of mowing time:

Significant differences were recorded due to mowing time on plant height (table 3). Leaf area, dry matter, total chlorophyll and relative water

content (RWC) in table 3. The highest values of plant height, leaf area, dry matter and total chlorophyll were (20.16cm, 1.67cm², 6.99g and 8.54%) recorded at the mowing time on 26-12-2014.

Table (3): Effect of mowing time on studied parameters of *Lolium perenne* L.

Mowing time	Plant height (cm)	Leaf area (cm ²)	Dry matter (g)	Chlorophyll (%)	RWC (%)
26-12-2014	20.16	1.67	6.99	8.54	14.89
11-1-2015	13.31	1.57	5.37	6.09	13.60
27-1-2015	10.57	1.46	5.77	5.69	13.02
L.S.D.<0.05	0.78	0.11	0.43	1.45	N.S.

- Effect of DAP:

Data in table (4) showed that the foliar fertilization of *Lolium perenne* L. with DAP affected significantly on plant height, leaf area and chlorophyll content. The highest value of plant

(15.17cm) was measured in the treatment of 0.75 (ml.l⁻¹), while the greatest leaf area and chlorophyll content were (1.75 cm² and 8.00% respectively) obtained from the control treatment.

Table (4): Effect of DAP on studied parameters of *Lolium perenne* L.

DAP concentration (ml.l ⁻¹)	Plant height (cm)	Leaf area (cm ²)	Dry matter (g)	Chlorophyll (%)	RWC (%)
0.00	14.68	1.75	6.07	8.00	15.76
0.25	13.90	1.53	5.73	6.12	13.24
0.50	14.96	1.39	6.16	6.56	13.30
0.75	15.17	1.60	6.22	6.41	13.05
L.S.D.<0.05	0.91	0.13	N.S.	1.69	2.22

- Effect of magnetized water:

Tap water had significant effect on plant height and leaf area when it was recorded the highest values (16.97cm and 2.01cm² respectively). However, the other parameters were not affected significantly (table 5). The results showed that the

tap water was more effective especially on the morphological characters, this may be due to that *Lolium perenne* L. is a rapid growth grass in the early stages of its life cycle in the spring with few water supply.

Table (5): Effect of magnetized water on studied parameters of *Lolium perenne* L.

magnetized water (Gauss)	Plant height (cm)	Leaf area (cm ²)	Dry matter (g)	Chlorophyll (%)	RWC (%)
0	16.97	2.01	6.21	7.37	14.51
1500	13.73	1.38	6.22	7.31	13.90
3000	13.33	1.30	5.71	5.64	13.10
L.S.D.<0.05	1.57	0.23	N.S.	N.S.	N.S.

- Interaction effects between mowing time and DAP:

Data presented in table (6) showed that the interaction between mowing time and foliar fertilization with DAP caused significant differences on most studied parameters. The highest values were recorded from the first

mowing time, for plant height and dry matter (20.54cm and 7.28g) which recorded in the interaction between 0.75 and 0.50 ml.l⁻¹ DAP respectively, however the other highest studied parameters were recorded at 0.0 ml.l⁻¹DAP. The lowest values were observed in the two other times of mowing with different DAP

concentrations. Increased N fertilizer rates contributed more to the increase of crude protein level and yield than to the increase of grass dry matter yield (Bumane, 2010).

Table (6): Interaction effects between time of mowing and DAP on studied parameters of *Lolium perenne* L..

Mowing time	DAP concentrations (ml.l ⁻¹)	Plant height (cm)	Leaf area (cm ²)	Dry matter (g)	Chlorophyll (%)	RWC (%)
26-12-2014	0.00	20.15	1.80	6.88	10.53	18.67
	0.25	19.63	1.64	6.62	6.88	13.96
	0.50	20.31	1.49	7.28	7.40	13.08
	0.75	20.54	1.74	7.17	9.33	13.83
11-1-2015	0.00	13.17	1.73	5.54	7.30	15.21
	0.25	12.17	1.58	5.20	6.33	13.25
	0.50	13.81	1.41	5.37	6.09	13.39
	0.75	14.09	1.56	5.38	4.63	12.56
27-1-2015	0.00	10.73	1.71	5.79	6.15	13.42
	0.25	9.90	1.37	5.36	5.13	12.50
	0.50	10.77	1.27	5.84	6.19	13.42
	0.75	10.88	1.49	6.10	5.27	12.75
L.S.D.<0.05		1.57	0.23	0.87	2.92	3.84

- Interaction effects between mowing time and magnetized water:

Results presented in table (7) indicated that the interaction between time of mowing and irrigation exhibited significant effects on the studied characters. The best results of plant height and chlorophyll content were (21.31 cm and 9.51% respectively) recorded from the first time of mowing and irrigation with tap water. Otherwise the significant increase in RWC and dry matter were exhibited in the same time of mowing when treated with different intensities of magnetized water (1500 and 3000 Gauss respectively). The greatest leaf area (2.06 cm²) was observed in the treatment of second time of mowing and tap water interaction. The nutritive value of perennial

ryegrass varies throughout the growing season (McEvoy *et al.*, 2011).

- Interaction effects of DAP and magnetized water:

The comparison values of growth characteristics as affected by the interaction of DAP and magnetized water presented in (table 8). The highest plant height, leaf area and dry matter were (17.87cm, 2.36cm² and 6.95g) respectively found in the control treatment, which was unexpected record. The highest chlorophyll content (8.73%) was obtained from both treatments (control and 0.75ml.l⁻¹ DAP with 1500 gauss magnetized water). While, the highest RWC (17.07) was measured in the interaction of 0.25ml.l⁻¹ DAP with 1500 gauss magnetized water.

Table (7): Interaction effects between mowing time and magnetized water on studied parameters of *Lolium perenne* L.

Mowing time	magnetized water (Gauss)	Plant height (cm)	Leaf area (cm ²)	Dry matter (g)	Chlorophyll (%)	RWC (%)
26-12-2014	0	21.31	2.03	6.46	9.51	15.28
	1500	19.80	1.57	7.21	9.39	16.53
	3000	19.36	1.39	7.30	6.71	12.84
11-1-2015	0	16.38	2.06	5.99	6.25	15.28
	1500	12.25	1.35	5.69	6.61	12.29
	3000	11.29	1.30	4.44	5.41	13.24
27-1-2015	0	13.22	1.94	6.19	6.35	12.97
	1500	9.14	1.23	5.76	5.93	12.88
	3000	9.34	1.21	5.37	4.78	13.22
L.S.D.<0.05		1.36	0.20	0.75	2.53	3.33

Table (8): Interaction effects between DAP and magnetized water on studied parameters of *Lolium perenne* L.

DAP concentrations (ml.l ⁻¹)	magnetized water (Gauss)	Plant height (cm)	Leaf area (cm ²)	Dry matter (g)	Chlorophyll (%)	RWC (%)
0.00	0	17.87	2.36	6.95	8.73	16.30
	1500	15.51	1.98	5.79	5.84	14.33
	3000	17.56	1.63	6.14	6.51	13.70
0.25	0	16.94	2.07	5.98	8.39	13.70
	1500	13.72	1.61	5.95	8.60	17.07
	3000	13.28	1.30	5.93	7.53	12.73
0.50	0	13.76	1.29	6.43	7.213	12.80
	1500	14.16	1.34	6.56	5.89	13.01
	3000	12.45	1.27	5.31	6.66	13.93
0.75	0	12.90	1.31	5.46	4.98	12.65
	1500	13.58	1.24	5.92	8.73	13.40
	3000	14.40	1.38	6.11	5.84	12.43
L.S.D.<0.05		1.57	0.23	0.87	2.92	3.84

- Interaction effects among time of mowing, DAP and magnetized water:

Data presented in table (9) showed that the interaction among mowing time, DAP and magnetized water levels caused a significant effects on plant height, leaf area, dry matter, chlorophyll and RWC. The highest value of plant height was (21.68cm) obtained from the first time

of mowing, 0.50 ml.l⁻¹ DAP and tap water. The highest leaf area and dry matter were (2.44cm² and 7.80g) respectively measured from the control of the third time of mowing. While, the highest chlorophyll content was (14.01%) recorded at the treatment of first time of mowing, 0.0 DAP and 1500 Gauss. The highest

Table (9): Interaction effects among mowing time, DAP and magnetized water on studied parameters of *Lolium perenne L.*

Mowing time	DAP concentrations (ml.l ⁻¹)	Magnetized water (Gauss)	Plant height (cm)	Leaf area (cm ²)	Dry matter (g)	Chlorophyll (%)	RWC (%)
26-12-2014	0.0	0	21.31	2.32	6.44	8.71	18.00
		1500	20.06	1.76	6.96	14.01	13.50
		3000	18.81	1.31	7.22	8.87	14.00
	0.25	0	20.90	1.91	6.32	9.18	16.87
		1500	19.62	1.55	6.31	7.33	12.87
		3000	18.75	1.45	6.78	4.12	12.12
	0.50	0	21.68	1.71	6.67	9.02	13.25
		1500	19.87	1.38	7.61	6.18	13.00
		3000	19.37	1.36	7.56	6.97	13.00
	0.75	0	21.50	2.18	6.41	11.11	15.00
		1500	14.86	1.57	7.48	10.01	14.25
		3000	20.50	1.45	7.61	6.87	12.25
11-1-2015	0.0	0	19.72	2.32	6.62	7.68	18.90
		1500	12.16	1.53	5.68	7.77	13.32
		3000	10.67	1.32	4.32	6.45	13.40
	0.25	0	14.16	2.15	5.76	4.85	14.00
		1500	11.58	1.30	5.42	8.08	12.67
		3000	10.75	1.27	4.42	6.05	13.07
	0.50	0	18.17	1.69	5.86	4.85	15.35
		1500	12.08	1.30	5.75	7.34	12.00
		3000	11.17	1.24	4.48	6.09	12.83
	0.75	0	16.5	2.06	5.70	7.6	12.85
		1500	15.67	1.28	5.91	3.23	11.15
		3000	12.58	1.35	4.52	3.06	13.68
27-1-2015	0.0	0	15.38	2.44	7.80	9.80	14.00
		1500	8.94	1.53	5.21	4.00	11.88
		3000	7.88	1.17	4.36	4.68	14.38
	0.25	0	11.88	1.86	5.28	3.48	12.13
		1500	8.63	1.05	5.63	7.18	12.63
		3000	9.19	1.20	5.17	4.75	12.75
	0.50	0	12.81	1.50	5.87	5.65	12.50
		1500	9.31	1.18	5.93	8.11	13.38
		3000	10.19	1.13	4.72	4.80	14.38
	0.75	0	12.81	1.95	5.83	6.46	13.25
		1500	9.69	1.18	6.27	4.43	13.63
		3000	10.13	1.34	6.21	4.93	11.38
L.S.D.<0.05			2.72	0.39	1.50	5.06	6.65

water content was (18.90%) found in the control of 11-1-2016 mowing time. The *Lolium perenne L.* grass is rapidly grow at early stages of growth, therefore the first mowing time (26-12-2014) gave the best results. Moreover, magnetized water affected negatively on the most (*Lolium perenne L.*) growth characters even with the levels of DAP interactions when the plants that irrigated with tap water gave the best plant height and leaf area. This may be refer to the ionic composition of water.

Foliar fertilization with DAP gave the best results in different levels, these results correspond with Bumane and Adamovics (2006) when they mentioned that additional nitrogen fertilizer stimulated perennial ryegrass plant development

and growth increasing leaf area index, number of shoots per square unit, dry matter yield and seed yield. Also these results about DAP applications are going with those found by Jacek and Kazimierz (2015) when they found that the significantly highest dry matter yield was (6.88t DM·ha⁻¹) obtained by cultivation of *Lolium perenne* on the objects fertilized with mineral fertilizers and UG max as biological preparation.

***Cynodon dactylon L.* experiment**

- Effect of time of mowing:

Significant differences were recorded from time of mowing on plant height, dry matter, total chlorophyll and RWC (table, 10). The highest values were (34.46cm, 6.41gm, 10.97% and

14.06%) recorded in the third mowing time (26-3- 2015).

Table (10): Effect of mowing time on studied parameters of *Cynodon dactylon L.*

Mowing time	Plant height (cm)	Leaf area (cm ²)	Dry matter (g)	Chlorophyll (%)	RWC (%)
22-2-2015	27.65	2.27	5.92	10.90	13.31
10-3-2015	31.28	2.08	6.22	9.23	11.51
26-3-2015	34.46	2.21	6.41	10.97	14.06
L.S.D.<0.05	0.69	N.S.	0.25	1.24	1.05

- Effect of DAP:

DAP levels had significant effects on the leaf area, dry matter and chlorophyll content (table, 11). The highest value of leaf area was (2.43 cm²) obtained in the 0.75 ml.l⁻¹DAP treatment. While, the highest values of dry matter and chlorophyll

content were (6.45gm and 11.28%) obtained from 0.50ml.l⁻¹DAP, and for the lowest values of leaf area and chlorophyll content were recorded from the control, but for the dry matter was (6.05g) at 0.75 ml.l⁻¹DAP treatment.

Table (11): Effect of DAP on studied parameters of *Cynodon dactylon L.*

DAP concentration (ml.l ⁻¹)	Plant height (cm)	Leaf area (cm ²)	Dry matter (g)	Chlorophyll (%)	RWC (%)
0.00	30.87	2.08	6.06	9.58	12.51
0.25	30.97	2.11	6.18	10.62	13.01
0.50	31.20	2.13	6.45	11.28	13.44
0.75	31.48	2.43	6.05	9.98	12.51
L.S.D.<0.05	N.S.	0.33	0.29	1.44	N.S.

- Effect of magnetized water:

Cynodon dactylon L. plant height and dry matter were affected significantly by magnetized water levels (table, 12). The highest values of plant height and dry matter were (32.87cm and

6.80g) respectively measured at the level of 3000Gauss. However, the lowest values of plant height and dry matter were (29.21cm and 5.44g) respectively recorded at the irrigation with tap water.

Table(12): Effect of magnetized water on studied parameters of *Cynodon dactylon L.*

magnetized water (Gauss)	Plant height (cm)	Leaf area (cm ²)	Dry matter (g)	Chlorophyll (%)	RWC (%)
0	29.21	2.10	5.44	10.25	12.95
1500	31.30	2.15	6.31	10.51	13.18
3000	32.87	2.30	6.80	10.35	12.76
L.S.D.<0.05	0.69	N.S.	0.25	N.S.	N.S.

-Interaction effects between mowing time and DAP:

Table (13) showed significant differences among the average numbers of plant height, leaf area, dry matter, chlorophyll content and RWC, the highest values of plant height and chlorophyll content were (34.49cm and 13.10%) respectively recorded at the interaction between the first time

of mowing and 0.50 ml.l⁻¹. The greatest leaf area was (2.87cm²) observed in the interaction treatment of first time of mowing and 0.75 ml.l⁻¹DAP. While the best result of dry matter and RWC were (6.84g and 16.29%) respectively obtained at the interaction between third time of mowing and 0.50 ml.l⁻¹DAP.

Table (13): Interaction effects between mowing time and DAP on studied parameters of *Cynodon dactylon L.*

Mowing time	DAP concentrations (ml.l ⁻¹)	Plant height (cm)	Leaf area (cm ²)	Dry matter (g)	Chlorophyll (%)	RWC (%)
22-2-2015	0.00	27.65	2.07	5.96	8.61	13.69
	0.25	31.28	2.11	5.98	11.11	13.39
	0.50	34.49	2.01	6.05	13.10	12.67
	0.75	27.65	2.87	5.68	10.77	13.50
10-3-2015	0.00	31.28	2.01	6.07	8.55	11.06
	0.25	34.46	2.05	6.21	9.57	12.39
	0.50	27.65	2.11	6.45	8.65	11.38
	0.75	31.28	2.15	6.17	10.17	11.24
26-3-2015	0.00	34.46	2.15	6.14	11.58	12.79
	0.25	27.65	2.18	6.37	11.20	13.25
	0.50	31.28	2.25	6.84	12.09	16.29
	0.75	34.46	2.26	6.30	9.00	13.91
L.S.D.<0.05		1.40	0.57	0.50	2.49	2.11

- Interaction effects between mowing time and magnetized water:

Regarding time of mowing and magnetic water intensities interaction in the table (14) the results showed significant differences between studied characters of *Cynodon dactylon L.*. The highest increase of plant height and RWC were (35.66 and 14.28%) respectively measured at the third

mowing time with 3000Gauss of magnetized water. While, the best results of leaf area and dry matter were (2.64cm² and 6.96g) respectively obtained from the same last intensity of magnetic water but at the first mowing time. However, the lowest values for most studied characters were obtained from the irrigation with tap water.

Table (14): Interaction effects between mowing time and magnetized water on studied parameters of *Cynodon dactylon L.*

Mowing time	magnetized water (Gauss)	Plant height (cm)	Leaf area (cm ²)	Dry matter (g)	Chlorophyll (%)	RWC (%)
22-2-2015	0	25.21	2.06	4.67	10.74	13.50
	1500	27.21	2.10	6.13	11.01	13.33
	3000	30.50	2.64	6.96	10.94	13.10
10-3-2015	0	29.33	2.047	5.67	9.18	11.22
	1500	32.04	2.14	6.37	9.32	12.44
	3000	32.46	2.06	6.63	9.20	10.89
26-3-2015	0	33.09	2.19	5.99	10.82	14.13
	1500	34.63	2.22	6.43	11.19	13.78
	3000	35.66	2.21	6.80	10.89	14.28
L.S.D.<0.05		1.21	0.50	0.43	2.16	1.82

- Interaction effects between DAP and magnetized water:

The comparison values of studied characteristics as affected by DAP foliar application and magnetized water intensities interactions were present in (table 15). The best result were recorded at treatment of 0.75ml.l⁻¹ DAP with 3000Gauss magnetic water for plant height and leaf area (33.63cm and 2.83cm²), while with 1500Gauss the greatest value of dry matter and chlorophyll content were (7.18g and 12.12%) respectively and of the same treatment the best RWC was (13.57%) recorded at treatment of tap water and 1500Gauss.

- Interaction effects between mowing time, DAP and magnetized water:

Results in the table (16) indicated that the interaction between time of mowing, DAP doses and magnetic water intensities had significant effects on plant height, dry matter, chlorophyll and RWC. The highest values of plant height, dry matter and RWC were (37.00cm, 7.39g and 18.00%) respectively recorded from the interaction of third time of mowing, 0.50ml.l⁻¹ DAP and 3000Gauss magnetized water. While, the highest chlorophyll content was (16.57%) recorded from the interaction of the first time of mowing, 0.25ml.l⁻¹ DAP and the level of 1500Gauss of magnetized water.

Table (15): Interaction effects between DAP and magnetized water on studied parameters of *Cynodon dactylon L.*

DAP concentrations (ml.l ⁻¹)	magnetized water (Gauss)	Plant height (cm)	Leaf area (cm ²)	Dry matter (g)	Chlorophyll (%)	RWC (%)
0.00	0	28.83	2.03	5.33	8.99	11.79
	1500	28.99	2.12	5.36	10.67	12.03
	3000	29.82	2.10	5.89	11.08	14.18
0.25	0	29.21	2.14	5.20	10.25	13.79

	1500	31.42	2.09	6.19	10.38	14.22
	3000	31.20	2.08	6.42	10.32	13.43
0.50	0	31.00	2.14	6.28	10.65	12.58
	1500	31.58	2.30	6.36	10.68	12.50
	3000	32.35	2.10	6.65	9.37	11.53
	0	32.74	2.13	6.77	10.89	13.57
0.75	1500	32.78	2.14	7.18	12.12	13.57
	3000	33.63	2.83	6.58	9.00	12.36
	L.S.D.<0.05	1.40	0.58	0.50	2.49	2.11

Significantly highest studied parameters were obtained by *Cynodon dactylon L.* at third times of mowing (26-3-2015) and 0.5ml.l⁻¹DAP. While, the magnetic intensity of 3000Gauss gave best results of growth parameters. Magnetic water is considered one of several physical factors affects plant growth and its development. The stimulatory effect of the application of magnetic water on growth parameters reported in the second research of this study, this may be attributed to the major increases in photosynthetic pigments, protein

synthesis, IAA endogenous promoters, and they found also that the increases of protein contents in plants which irrigated with magnetic water was accompanied with increasing growth promoters (IAA) (El Sayed and El Sayed, 2014). The stimulatory impact of magnetic water may be also ascribed to the increasing the stomatal conductance and root growth which increase absorption and assimilation of nutrients (Abdul Qados and Hozayn, 2010).

Table (16): Interaction effects among mowing time, DAP and magnetized water on studied parameters of *Cynodon dactylon L.*

Time of mowing	DAP concentrations (ml.l ⁻¹)	Magnetized water (Gauss)	Plant height (cm)	Leaf area (cm ²)	Dry matter (g)	Chlorophyll (%)	RWC (%)
22-2-2015	0.0	0	25.67	2.04	4.62	7.35	12.75
		1500	27.92	2.09	6.10	8.23	16.75
		3000	30.25	2.08	7.17	10.23	11.58
	0.25	0	25.17	2.09	4.62	10.28	11.33
		1500	27.50	2.06	6.18	16.57	13.58
		3000	30.75	2.19	7.13	12.46	15.25
	0.50	0	25.58	1.96	4.97	13.19	14.17
		1500	26.33	1.75	6.14	13.76	11.92
		3000	30.08	2.08	7.15	12.36	11.92
	0.75	0	24.42	2.14	4.47	12.13	15.75
		1500	27.17	2.25	6.18	11.45	11.08
		3000	31.25	2.08	6.39	8.73	13.67
10-3-2015	0.0	0	27.83	1.96	5.64	8.76	11.00
		1500	32.17	2.03	6.17	9.00	10.67
		3000	32.25	2.05	6.38	7.90	11.5
	0.25	0	29.17	2.09	5.66	8.91	11.75
		1500	24.08	2.03	6.43	9.65	13.83
		3000	32.08	2.04	6.54	10.14	11.58
	0.50	0	31.25	2.09	6.03	7.59	10.75
		1500	32.17	2.20	6.26	7.86	12.58
		3000	31.25	2.05	7.01	10.51	10.79
	0.75	0	29.08	2.05	5.38	11.46	11.38

		1500	32.33	2.30	6.55	10.78	12.67
		3000	34.25	2.09	6.63	8.25	9.67
26-3-2015	0.0	0	33.00	2.10	5.72	10.83	11.63
		1500	34.25	2.16	6.29	13.91	15.25
		3000	34.88	2.18	6.41	9.99	11.50
	0.25	0	32.63	2.19	5.81	12.83	13.00
		1500	34.50	2.16	6.76	10.71	12.88
		3000	35.38	2.18	6.64	10.06	13.88
	0.50	0	32.63	2.25	6.66	12.46	17.63
		1500	34.50	2.21	6.47	10.33	13.25
		3000	37.00	2.30	7.39	13.49	18.00
	0.75	0	34.13	2.23	5.77	7.16	14.25
		1500	35.25	2.35	6.34	9.80	13.75
		3000	35.38	2.20	6.79	10.04	13.75
	L.S.D.<0.05		2.94	N.S.	0.86	4.31	3.65

CONCLUSIONS

Cynodon dactylon L had a long growth period and longest plants when compared with growth period of *Lolium perenne L.* and both of them are appropriate to cultivation in our condition. Greater frequency of mowing affected significantly on growth characters of *Cynodon dactylon L.* more than *Lolium perenne L.* Morphological parameters represented by plant height and leaf area were obtained with tap water in *Lolium perenne L.* experiment, otherwise *Cynodon dactylon L* was react with magnetized water in the highest level. It was observed negative effect of DAP levels on the growth and physiological condition of the *Lolium perenne L.* plants, when *Cynodon dactylon L.* responded to different levels of DAP.

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EFFECT OF WATER QUALITY ON K-RELEASE OF SOME CALCAREOUS SOIL IN ERBIL GOVERNORATE- KURDISTAN REGION-IRAQ

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ABSTRACT

A laboratory study was conducted to determine the effect chemical composition of irrigation water on potassium desorption kinetics in some calcareous soils. It was constructed by miscible displacement technique with natural un-disturbed soil columns using three water quality from (Chakhmera, Chilhaweza and Makhmur) via three different textured soils from Shawes, Melaomer and Ankawe location in Erbil governorate for ten irrigation epochs. Results indicated for higher values of desorbed potassium rate with increase of porosity volumes passed through soil columns. Chilhaweza water quality caused more desorption of potassium in comparison with Chakhmera except in Malaomer location. Desorption capacity rate were 410, 558 and 407 mg kg⁻¹ soil for Shawes, Melaomer and Ankawe respectively by using Chilhaweza, while desorbed K⁺ by Chakhmera water the same location were 266, 1008, and 276 mg kg⁻¹ soil, and the desorbed K⁺ by using Makhmur water quality was 120, 609 and 170 mg kg⁻¹ soil respectively by using the same location sample. Mathematical description for desorption process appeared harmony of power function equation and first order equation, while diffusion equation, zero order equation and Elovitch equation cannot describe desorption process with the same efficiency. K⁺ desorption rate due to power function equation by using Chakhmera water quality were 0.699, 0.789 and 0.765 mg kg⁻¹ min⁻¹ for Shawes, Melaomer, and Ankawe location respectively, while using Chilhaweza water desorption rate which were 0.712, 0.878 and 0.680 mg kg⁻¹ min⁻¹ and while desorption rate value for Makhmur water were 0.945, 0.560 and 0.590 Ln mg kg⁻¹ min⁻¹ for the same locations respectively.

KEY WORDS: different water quality, best kinetic model describe potassium release and potassium desorption rate.

INTRODUCTION

Recently studies in the potassium fertility of soil focused on estimation of amount of exchangeable potassium to measure the rate of K supplying. Most soil in Iraq are rich in K content, while the release of K is very slow however plant response to potassium fertilizer (Al-Obaidi 1996). Beside it exposed to the adsorption and fixed by soil mineral (Mam Rasul 2008, Akrawi, 2010). Al-Obaidi and Al-Zubaidi (2001) found that Iraqi soil is alkaline and contain high amount of carbonate which affected the availability of K in soil. Current interest tended to study the dynamic of release K⁺ and increase K supplying powers (Al-Obide and Hussain 2010, Shanwall 2006, Carcksi and Spark 1985). The chemical composition of water is differing among different water qualities, for this reason the water quality has great effect on potassium release (Du 2004). The investigations conducted by Esmail (1992), Salih (2008), Rajab (2015) explained that the chemical composition of groundwater are

differing from location to other at Erbil plain there for it is necessary to throw light on the role of chemical composition of water in K⁺ release. Since there are little or no studies in Kurdistan region about the role of water quality and chemical composition of irrigation water on K⁺ release in calcareous soil for this reason this investigation was selected to study the effect of water quality on K⁺ release of some calcareous soils in Erbil governorate Kurdistan region, then limiting the best model for description of K⁺ kinetic in calcareous soil. Therefore the present study attention the desorption kinetic of K⁺ by using three type of water quality and three soil sample collected from intensively cultivate farms.

MATERIAL AND METHODS

Three surface soil sample (0-30cm), and three type of water quality were collected from different location in Erbil government. The soil sample were taken at Shawes, Malaomer and Ankawe location. Three types of water were taken from

chakhmera, chilhaweza and makhmur location for the laboratory experiment. The soil sample were air dried and ground to pass through a 2 mm sieves for the laboratory analysis. Some chemical and physical properties of the soil and water quality were shown in (Table 1 and 2). Pipette method used to determine particle size distribution, soil pH and EC were measured in 1:5

soil to water suspension by using pH and EC meter (Rowell 1996). Organic carbon was determined by the wet oxidation method of Walkley and Blank (1934). Equivalent calcium carbonate was determined by titration method. Cation exchange capacity CEC were measured by the 1M NH₄OAc buffered at pH 7 (Rowell, 1996).

Table (1):- Some physical and chemical characteristics of studied soils.

Location	PSD g kg ⁻¹			Texture class	Bulk density g cm ⁻³	pH	EC dSm ⁻¹ at 25°C	CEC cmol _e kg ⁻¹	O M	CaCO ₃ equivalents	
	sand	silt	clay							Total	Active
Shawes	237.30	355.30	407.40	C	1.23	7.40	0.70	26.21	11.00	180	25
Malaomer	290.20	487.20	222.60	L	1.23	7.58	0.73	14.72	8.30	380	38
Ankawe	63.00	883.8	53.20	SiL	1.10	7.63	0.55	20.00	13.8	340	50

Table (2): -Some physical and chemical characteristics of irrigation water used.

Water quality	pH	EC dS m ⁻¹	Soluble ions								SP (Cl ⁻¹ +0.5SO ₄ ⁻²) mmoleL ⁻¹
			Ca ²⁺	Mg ²⁺	Na ⁺	mmolc L ⁻¹					
						K ⁺	HCO ₃ ⁻	Cl ⁻	SO ₄ ⁼	SAR	
Chakhmera	7.19	4.92	18.19	15.56	17.55	0.13	3.57	11.47	31.57	4.28	27.26
Chilhaweza	7.52	5.65	16.68	14.58	30.05	0.13	3.02	4.39	50.16	7.60	29.47
Makhmur	7.08	2.59	12.43	10.85	2.02	0.15	5.38	1.86	18.36	0.59	11.04

SP: Salinity potential

Desorption:

The K desorption studies were done by using miscible displacement technique described by Sparks (2003). A duplicate of soil column with length (0.3m) and diameter (0.065m) was leached by three type of water quality with depth 4 cm water at rate 1 ml min⁻¹ for 10 min (Mam Rasul and Al-Obaidi, 2011). The quantity of K⁺ in solution for desorption studies was measured by flame photometer.

Different kinetic models described in the following equation, were used to describe K⁺ desorption (Sparks, 1989):

Zero order models: $C_0 - C_t = C_0 - Kt$

First order equation as: $\log(C_t / C_0) = Kdt$

Parabolic diffusion models: $C_t = C_0 + Kt^{1/2}$

Power function models: $\ln C_t = \ln C_0 + Klnt$

Elovich models: $C_t = C_0 + Klnt$

Where:

C_t : cumulative potassium release at time t.

C₀ : maximum potassium release at zero time.

K: indicative the release rate coefficient of K⁺.

t : time of release

A relatively high coefficient of determination R² and low standard error of estimated SE value for

measured predicated K⁺ desorption data indicate that the model successfully describe the kinetics of K⁺ desorption by soil. Standard errors of the estimate calculated as follows:

$$SE = [(Ct - Ct^*)^2 / n-2]^{0.5}$$

Where:

Ct and Ct* are the measured and calculated concentrations of K⁺ adsorb at time.

n: number of data points evaluated.

RESULTS AND DISCUSSION

Figure (1) showed that the water quality affected significantly on the amount of K⁺ accumulation release, the highest values of K⁺ release were recorded from Malaomer location with using Chakhmera water qualities, while the lowest value were recorded for Shawes location with using Makhmur water quality. Regarding Chilhaweza water quality the amount of K accumulates release have been increase in both Shawes and Ankawe location when compared with Chakhmera and Makhmur water quality. This might be due to high concentration of ion SO₄⁻ (50.16 mmole L⁻¹)

table (2) in Chilhaweza water quality in compares with Chakhmera and Makhmur water quality (31.57 and 18.36 mmole L⁻¹) respectively.

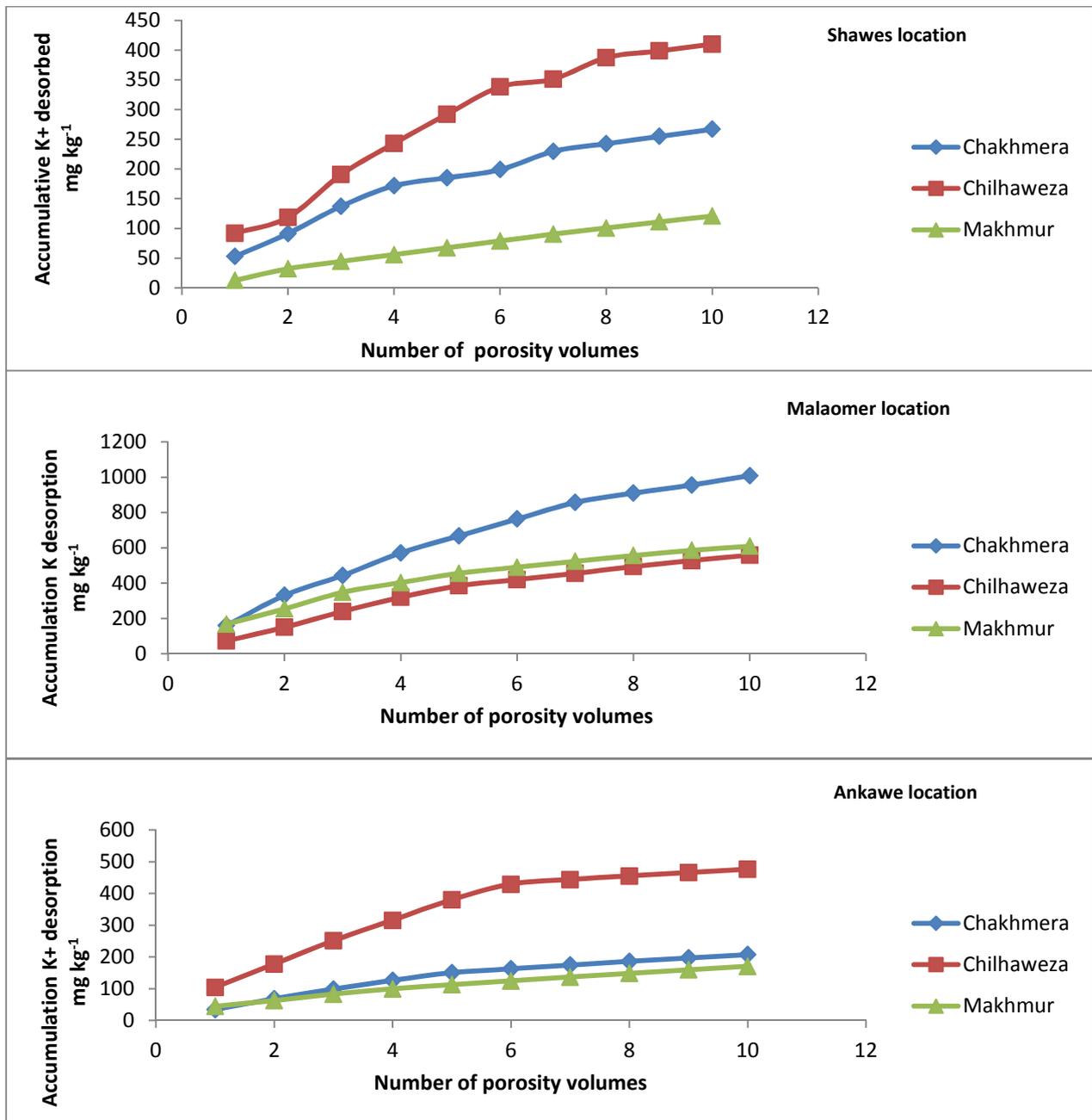


Fig. (1):- Relation between accumulations of potassium desorption and number of porosity volumes (PV) for different water qualities.

On the other hand the series of K⁺ release were as following.

Malaomer soil > Shawes soil > Ankaw soil for Chakhmera water quality,

Malaomer soil > Ankaw soil > Shawes soil for Chilhaweza water quality,

Malaomer soil > Ankaw soil > Shawes soil for Makhmur water quality.

This may be due to the initial adsorbed K⁺ and differing in soil chemical and physical properties of the studied soils (Table 1). Since the soil texture, type of clay minerals and soil structure are playing an important role in K⁺ release from the soil (Al- Samarraï and Al-Obaidi, 2005. and Ghosh and Singh, 2001).

Table (3):- shows the effect of water quality on accumulative K⁺ release for different soils.

Water quality	Maximus K ⁺ release cmole kg ⁻¹		
	Shawes	Malaomer	Ankawe
Chakhmera	266	1008	207
Chilhaweza	410	558	470
Makhmur	120	609	170
mean	265	725	284

As shown from Table (3) and Figure (1) the highest cumulative release of K⁺ were (1008, 558 and 609 mg kg⁻¹) for malaomer soil for studied water quality respectively, while the lowest value were (207, 470 and 170 mg kg⁻¹) for Ankawe soil and (266, 410 and 120 mg kg⁻¹) for Shawes soil for water qualities Chakhmera, Chilhaweza and Makhmur respectively. This may be due to Ec value and sum of cations in chakhmera water which caused release large amount of K⁺, in general increase in Ec and concentration of cation which causes increase in K⁺ release (Schneider, 1997 and Glover, 1996).

Depending on the highest value of coefficient of determination (R²) and the lowest value of standard error (SE) the best model of mathematical kinetic linear

equations was selected for description of K⁺ release for the studied location (Spark, 1992). As show in Table (4) the series of kinetic equation depending on the lowest value of SE were as following:

Power function> First order equation> Parabolic equation> Elovich equation> Zero order.

Its mean that the power function equation and First order equation are the best model to describe the kinetics of K-release phenomena from the studied soils for the studied water qualities due to the relatively high value of R² and the lower value of SE (Figure 2 and 4). The result agreed with the results founded by Galadima and Silvertooth (1998), Mehmedany (1999), Akrawi (2010) and Al-Kiki (2013).

Table (4): -Determination coefficient values R² and slandered error for potassium kinetic desorption equation

Water quality	Zero order eq		1 st order eq		Power function eq		Parabolic eq		Elovitch eq	
	R ²	SE	R ²	SE	R ²	SE	R ²	SE	R ²	SE
Shawes										
Chakhmera	0.95	17.37	0.82	0.23	0.98	0.07	0.99	7.567	0.98	9.693
Chilhawza	0.95	27.84	0.86	0.21	0.97	0.086	0.98	16.911	0.95	25.129
Makhmur	0.99	3.01	0.84	0.29	0.98	0.085	0.92	2.864	0.94	8.774
Melaomer										
Chakhmera	0.96	55.440	0.83	0.256	0.98	0.070	0.99	17.297	0.97	46.079
Chilhawza	0.95	36.330	0.80	0.304	0.97	0.101	0.99	14.550	0.97	24.699
Makhmur	0.94	36.131	0.84	0.177	0.98	0.044	0.99	14.485	0.99	15.337
Ankawe										
Chakhmera	0.94	14.558	0.80	0.275	0.97	0.091	0.98	6.229	0.98	6.645
Chilhawza	0.89	45.514	0.78	0.253	0.97	0.092	0.96	28.25	0.97	21.161
Makhmur	0.98	5.058	0.91	0.143	0.99	0.017	0.99	1.940	0.95	9.013

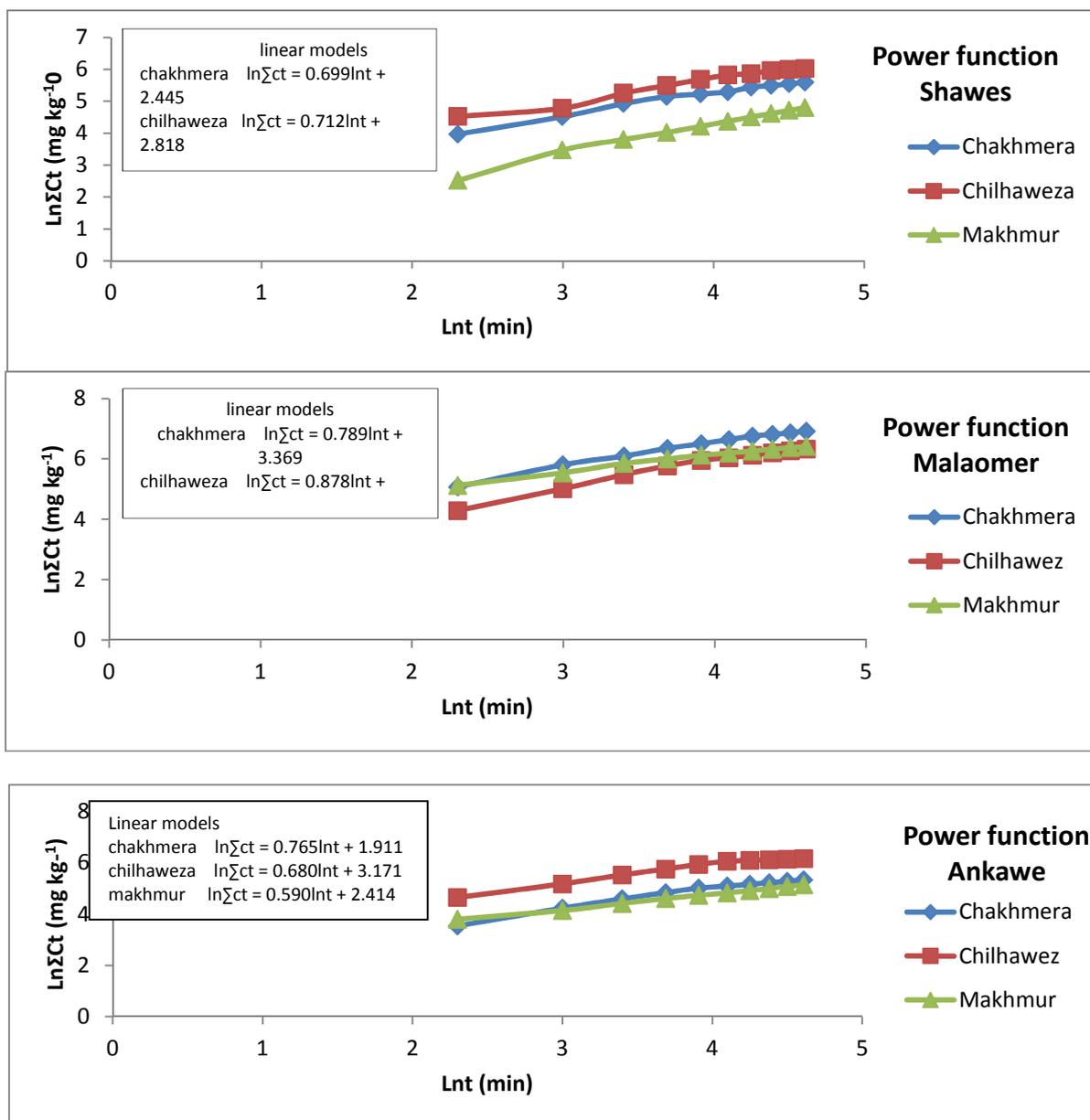


Fig. (2):- Linear models for power function equation kinetic of K⁺ desorption with miscible displacement technique.

Table (5) explained the values of desorption rate coefficient according to power function equation, the high value was recorded in Shawes location (0.945 mgkg⁻¹ min⁻¹) when using Makhmur water while the lowest value (0.560 mg kg⁻¹ min⁻¹) was recorded in Malaomer location by using Makhmur water. While the desorption rate

coefficient due to First order equation ranged from 0.012 to 0.019 min⁻¹ in all soils with using different type of water.

The large variation in the value of potassium desorption rate coefficient according to power function could be due to soil texture and water quality and there are multi order reaction (Al-Kiki 2013).

Table (5):- Value of desorption rate coefficient according to Power equation and First order equation

Type of water	Desorption rate coefficient according to power function equation $\text{Ln mg kg}^{-1} \text{Ln min}^{-1}$		
	Soil sample		
	Shawes	Malaomer	Ankawe
Chakhmera	0.699	0.789	0.765
Chilhaweza	0.712	0.878	0.680
Makhmur	0.945	0.560	0.590
Desorption rate coefficient according to First order equation			
Chakhmera	0.015	0.017	0.018
Chilhaweza	0.016	0.019	0.014
Makhmur	0.019	0.012	0.013

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كارى جۆرى ئاۋ لىكردنەۋەى بوتاسىيۆم لە ھەندى خاكى قەسپۆكى ھەولير / ھەرىمى كوردستان / عىراق
بوختە

تۆزىنە ۋە يەككى تاقىگەى ئىنجام درا بۆ زانىنى كارى جۆرى ئاۋ لە جولە لىكردنە ۋەى بوتاسىيۆم لە ھەندى خاكى قەسپۆك بەبەكارھىنانى سى جۆر ئاۋ (ئاۋى مەخمور، چل ھەویرە، چەغەمیرە) بو خاكى (شاۋيس، مەلا ئومەر، عىنكاۋە) كە دەجار ئاۋيان بۆ زیاد كرا بەشى ۋە يەككى بەردەوام و لە سەر خۆ گرنكتىرین ئىنجامەكان بەم شىۋەىە بوون: تىكرای توانای لى كردنەۋەى بوتاسىيۆم لە خاكى (شاۋيس، مەلا ئومەر، عەينكاۋە) (۰.۵۵۸، ۰.۴۱۰، ۰.۴۷۰) (ملگم/كگم بوو بۆ ئاۋى چل ھەویرە بەلام بۆ ئاۋى چەغەمیر و مەخمور بۆ ھەر سى خاكەكە (۰.۲۶۶، ۰.۱۰۸۸، ۰.۲۶) (ملگم/كگم و (۰.۱۲۰، ۰.۶۰۹، ۰.۱۷۰) ملگم/كگم بوو يەك لە دواى يەك. باشترىن مۆدىاى ماتماتىكى پاۋەر فانكشن و فېرست ئۆردەر بوون، بەپىى مۆدىلى يەكەم يەكەم تىكرای لىكردنەۋەى بوتاسىيۆم بە ئاۋى چەغەمیرە (۰.۶۹۹، ۰.۷۸۹، ۰.۷۶۵) (ملگم/كگم بۆ خاكى شاۋيس، مەلا ئومەر، عەينكاۋە بەلام ئەم برە بە ئاۋى چل ھەویرە و مەخمور بوو بە (۰.۷۱۲، ۰.۸۷۸، ۰.۶۸۰) و (۰.۹۴۵، ۰.۵۶۰، ۰.۵۹۰) (ملگم/كگم يەك لە دواى يەك.

تائير نوعية المياه في تحرر البوتاسيوم لبعض ترب الكلسية في محافظة اربيل اقليم كوردستان- العراق

الخلاصة

اجريت دراسة مختبرية لمعرفة تأثير نوعية مياه الري في حركيات و تحرر البوتاسيوم من بعض الترب الكلسية باستخدام طريقة الجريان المستمر الهادئ . اذا سمح لثلاث انواع من المياه (جاكهمير و جلهاوزا و مخمور) من الجريان في ثلاث ترب مختلفة النسجة لمواق شاويس و ملاعمر و عنكاوة في مدينة اربيل و لعشر دورات ري على اساس الحجم المسامي ، وقد اشارت النتائج الى زيادة كمية البوتاسيوم المتحرر بزيادة عدد الحجوم المسامية المار خلال اعمدة اتربة، مياه جاكهويز حررت اكبر كمية من البوتاسيوم مقارنة ب جاكهمير عدا منطقة ملاعمر. فقد بلغت سعة بوتاسيوم المتحرر كعمدل ۴۱۰ و ۵۵۸ و ۴۰۷ ملغرام كغم^{-۱} تربة لموقع شاويس و ملاعمر و عىنكاۋە على التوالي نتيجة استخدام مياه جاكهويز و كانت كمية البوتاسيوم المتحرر لنفس المواقع مع مياه جلهاوزا ۲۶۶ و ۱۰۰۸ و ۲۷۶ ملغرام كغم^{-۱} تربة على التوالي، و كانت كمية البوتاسيوم المتحرر باستخدام مياه مخمور ۱۲۰ و ۶۰۹ و ۱۷۰ ملغرام كغم^{-۱} تربة على التوالي و لنفس المواقع. وقد اظهر الوصف الرياضى لعملية التحرر تفوق معادلة دالة القوى و معادلة الرتبة الاولى ، في حين لم تصف معادلة الانتشار و معادلة الرتبة صفر و معادلة ايلوفج عملية التحرر بالكفاءة ذاتها، و قد بلغت سرعة تحرر البوتاسيوم وفق معادلة دالة القوى باستخدام مياه جاكهمير ۰.۶۶ و ۰.۷۸۹ و ۰.۷۶۵ ملغرام كغم^{-۱} دقيقة^{-۱} لمواقع شاويس و ملاعمر و عىنكاۋە على التوالي، اما باستخدام مياه موقع جاكهويز فكانت سرعة تحرر البوتاسيوم ۰.۷۱۲ و ۰.۸۷۸ و ۰.۶۸۰ ملغرام كغم^{-۱} دقيقة^{-۱} ، بينما كانت سرعة تحرر البوتاسيوم باستخدام مياه مخمور ۰.۹۴۵ و ۰.۵۶۰ و ۰.۵۹۰ ملغرام كغم^{-۱} دقيقة^{-۱} لنفس المواقع على التوالي.

LANDSAT LDCM IMAGERY FOR ESTIMATING AND MAPPING BURNED FOREST AREAS CAUSED BY JET ATTACKS IN DUHOK GOVERNORATE, KURDISTAN REGION-IRAQ

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ABSTRACT

Estimating fire damage in the forest areas is an important task and a main target for the forestry directorate. This paper presents an approach for estimating burned forest areas in Duhok Governorate that caused by Turkish jet attacks on July 2015. The presented approach is based on using Landsat Data Continuity Mission LDCM (Landsat-8) satellite images. The spectral bands of Landsat-8 imagery were analyzed and the most sensitive bands to the burned areas were identified. Moreover, spectral indices: Normalized difference vegetation index (NDVI) and Normalized Burned Ratio (NBR) were used to identify and determine the burned areas. As a result, a map of burned areas was created with 8981 hectares of the total areas. This approach can be applied for the whole Kurdistan region over multi-temporal interval to estimate burned areas that happened either by Turkish jet attack or by other sources.

KEYWORDS: Remote sensing, Landsat LDCM Satellite imagery, NDVI, NBR, Duhok Governorate.

INTRODUCTION

Forests fires are one of the most important factors that threaten forests and limit their growth. They consider a major problem in Mediterranean area especially in summer (Ireland and Petropoulos 2015).

In summer of 2015 many areas in Iraqi Kurdistan region have been burned due to several factors as burning grass-gorse or stubble (agricultural activities), throwing of burning cigarettes end or matches, hunting activities or military activities. The latest one is the interested case at this study as the Turkish jet attacks Kurdistan areas and especially in Duhok Governorate. These attacks have damaged villages including forests areas that had an influence of immigrating people from their villages. Moreover, these attacks will have a significant role in the environmental change and especially in decreasing of vegetation lands and vanishing of some species.

Decision makers and forest directory need to have precise information of how big the damage is. Such information is required in order of have a good strategy plan for regenerating the nature. One of the methods of getting precise information is through conducting field survey. However, it is hard, time consuming and not safe to achieve especially during jet attacks scenario. To overcome to this limitation remote sensing techniques consider an alternative method for getting the desired information (Lo 1986).

Satellite remote sensing helps to provide and assess the burned forest areas. Several satellites were used to map and assess the burned areas (Boschetti et al. 2015; Shimabukuro et al. 2015) as Landsat thematic Mapper (TM) and Enhanced Thematic Mapper plus (ETM+) imageries (Bastarrika et al. 2011; Mazher et al. 2012). In this study, we aim to use Landsat LDCM to detect and map burned forest areas which has not been explored and investigate in details yet.

The object of this study serves two-fold. First, is to utilize Landsat LDCM (known as Landsat 8) imagery for detecting and determining burned forest areas. Second, is to map and estimate total area of the burned forest areas in Duhok Governorate, Kurdistan Region-Iraq that caused by Turkish jet attacks in July of 2015.

STUDY AREA & Data

Study Area

Duhok Governorate is located in northwestern of Iraqi Kurdistan region between latitudes 36°10'42" – 37°23'21" N and longitudes 42°18'25" – 44°23'44" E (Fig.1). Governorate of Duhok has parallel mountain chains, inter-mountain plains and valleys in between. This is shown in Fig. 2 as the study area has a big variation that is between 400 m and 2500 m above sea level. Duhok Governorate has international borders with Turkey to the north and Syria to the west.

The climate of the study area has been classified as semi-arid continental. The annual

precipitation is 502.45 mm, and the average highest and the average lowest degree of temperature is about 38°C and -1°C, respectively (Directorate of Meteorology 2014).

Duhok Governorate consists of seven districts and 29 sub-districts. The districts are Zakho, Duhok, Semil, Amedi, Shikhan, Akra, and

Bardarash. The focus of this study was in three districts where the Turkish jet attacks happened. They are Zakho (with Darkar, and Batifa sub-districts), Amedi (with Kane-Mase, Bamarne, Sersenk, Amedi, Chmanke and Deralok sub-districts), and Akra (with Dinarte sub-districts) Fig. 1 (d).

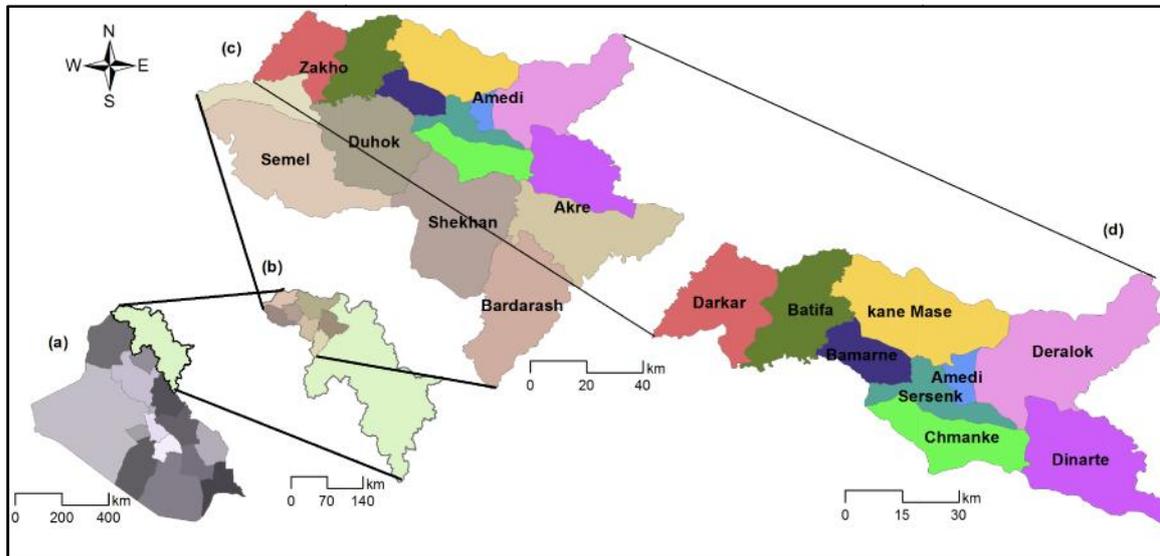


Fig. (1):- (a) Map of Iraq, (b) Map of Iraqi Kurdistan Region, (c) Map of Duhok Governorate, (d) sub-districts that have been attacks by Turkish jet.

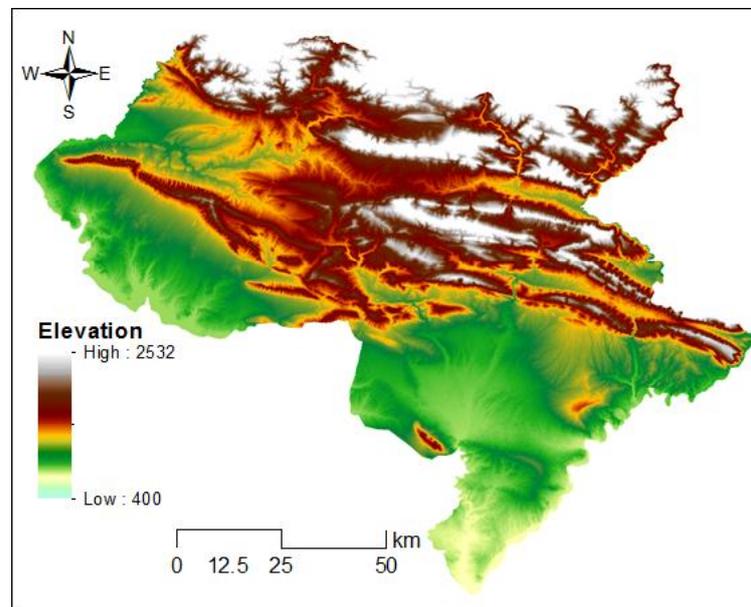


Fig. (2):- Digital Elevation Model (DEM) image of the study area with 30 m resolution retrieved from (ASTER-GDEM 2013). The elevation is in meters.

Field Data

The field survey is achieved for few locations as a sample. This is due to the risk situation in the study area. These samples include handheld GPS locations of the burned areas in order to use them

for verification and validation. The field visits include the following villages: Sarouro, Qumry, Baze, Beshile, Sargale.

Satellite-Remote Sensing Based Data

The LDCM imagery is used in this study. It has 11 bands as a spectral resolution and 30 m as a spatial resolution for Bands 1 to 7 and 9. While the spectrum band 8 has a 15 m spatial resolution (Table 1). The swath width is 185 km with altitude of 705 km.

Two Landsat images were selected and used for the study area. These images were cloud-free images acquired in July of 2015 before and after Turkish jet attacks (July 14, and July 30, respectively). However, second image includes smoke cloud due to increase fire smoke in the area.

Table (1): - Spectral resolution of Landsat LDCM imagery used in this study.

Band	Color	Spectral rang (μm)	Resolution (m)
1	Coastal aerosol	0.43-0.45	30
2	Blue	0.45-0.51	30
3	Green	0.53-0.59	30
4	Red	0.64-0.67	30
5	NIR	0.85-0.88	30
6	SWIR 1	1.57-1.65	30
7	SWIR 2	2.11-2.29	30
8	Panchromatic	0.50-0.68	15
9	Cirrus	1.36-1.38	30
10	TIRS 1	10.6-11.19	100
11	TIRS 2	11.5-12.51	100

METHODS

All analysis of the study was carried out using ENVI (v. 5.3, ITT Visual Solutions) and ArcGIS (v. 10.2, ESRI) software platforms. An overview of the methodology steps is depicted in Fig. 3:

Satellite Images Pre-Processing

This step was carried out for both images. First, radiometric calibration was implemented after the images were imported to ENVI. This step includes converting the spectral bands of the satellite data to top of the atmosphere reflectance (TOA) (Thome 2001), and it achieved according to the methodology described by Zanter (2015). Next, the retrieve surface reflectance was carried out using dark-object subtraction (DOS) to have atmospherically corrected images (Chavez 1988). All spectral bands images (except thermal infrared bands and panchromatic band) were layer stacked

to form a single image file. Topographic correction was not implemented as these image data were already terrain corrected when acquired. However, the acquired images (July 14, 30) were co-registered to a common spatial reference frame as the Landsat LDCM July 14, 2015 (pre-fire) was used as a base image. Further, the images were projected to the Universal Transverse Mercator (UTM) Zone 38 North with a World Geodetic System (WGS) 84 datum. This step is necessary to be achieved when the imagery from different dates is required to be analyzed (Ireland and Petropoulos 2015). Image-to-image registration was done using 23 Ground Control Points (GCPs). The nearest neighbour method of sampling was used to maintain and resample the images. A root mean square error (RMSE) obtained and was less than the Landsat LDCM pixel (≈ 0.43).

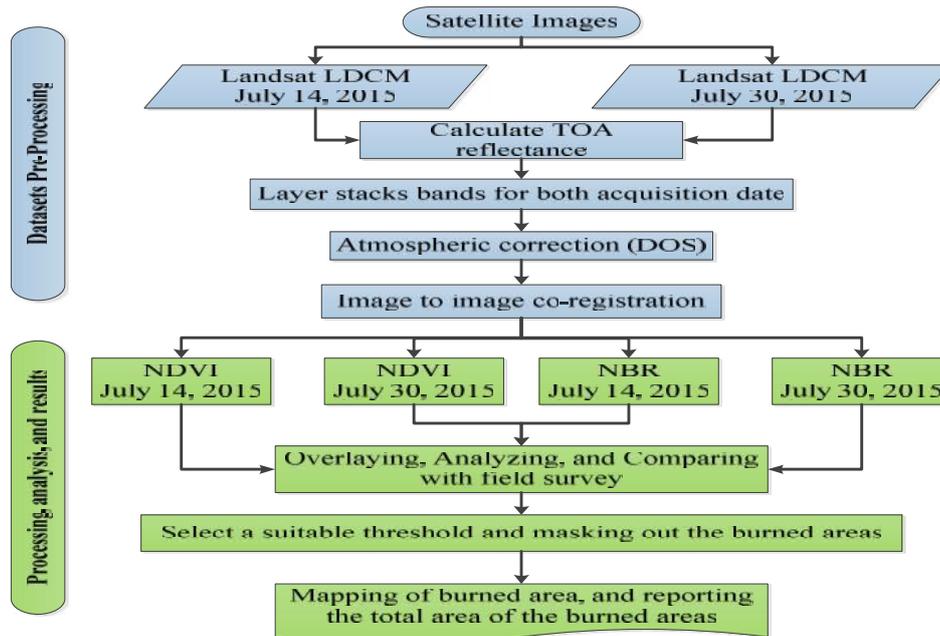


Fig. (3):- Overall methodology implemented in the study.

Satellite Images Processing

In this section we focused on analyzing spectral bands of Landsat LDCM and its spectral indices. Based on the previous studies of detecting and mapping burned areas, we focused on the spectral range among visible, near infrared to short-wave infrared spectral of the Landsat LDCM images. Most of the previous studies, however, explored spectral bands of Landsat 7 or 5 only and not Landsat LDCM (Bastarrika et al. 2011; Mazher et al. 2012; Boschetti et al. 2015; Ireland and Petropoulos 2015; Shimabukuro et al. 2015). Two spectral indices were employed in the analysis of this study in order to enhance the discrimination of burned areas. These indices are Normalized difference vegetation index (NDVI) (Rouse Jr 1974), and Normalized Burn Index (NBR) (Miller and Thode 2007). Those indices were calculated for both images pre-/post-fire.

Normalized Difference Vegetation Index (NDVI): This index has been the most widely used index in vegetation studies. The NDVI is traditionally used to extract vegetation abundance from remotely sensed data (Rouse Jr 1974; Fontana et al. 2012; Mustafa et al. 2015). Its values is between -1 to 1, where vegetated area is closed to one while others have low NDVI closed to zero and -1. To do so, the following equation (Fontana et al. 2012) was applied:

$$NDVI = \frac{NIR - Red}{NIR + Red} \quad (1)$$

where NIR and Red are the near infrared and Red-reflectance bands, respectively.

Normalized Burn Index (NBR): With this index we can highlight areas that have been burned and used as an indicator for the burns severity. This is due to its mathematical formula, as a ratio of the difference between near infrared and short-wave infrared reflectance shown in Equation (2) (García and Caselles 1991).

$$NBR = \frac{NIR - SWIR}{NIR + SWIR} \quad (2)$$

where NIR and SWIR are the near infrared and short-wave infrared reflectance bands, respectively.

RESULTS

Spectral Sensitivity for Burned Area Discrimination

After per-processing has been achieved for the Landsat images, the spectral bands of the post-fire image (that was acquired on July 30, 2015) is explored. We found that there is an opposite relation between NIR and SWIR for burned and non-burned area. In the burned area, values of NIR are lower than to those values of SWIR of the same location. While, NIR values in the non-burned area are higher that SWIR values for the same location. This is clearly shown in Fig. 4. From this analysis we notice that SWIR

reflectance band no.6 is sensitive more than SWIR reflectance band no.7. Therefore, SWIR reflectance band no.6 is used in Equation (2).

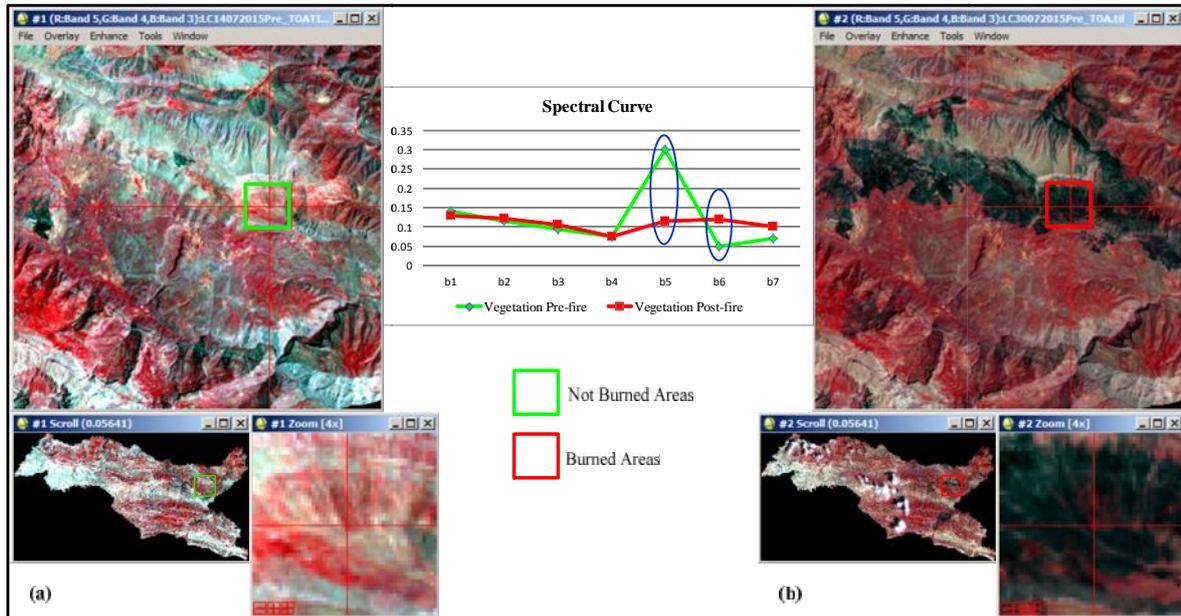


Fig. (4): Landsat LDCM images for a specific area showing the profile of the spectral curves of (a) pre-fire image, and (b) post-fire image

NDVI

Two images of NDVI were created for pre-/post-fire images by applying Equation (1) as shown in Fig. 5. Generally, NDVI shows and discriminate the vegetated area from non-vegetated area. By noticing Fig. 5 (for instance)

NDVI values of pre-fire image have value larger than to those of the post-fire image of the same burned location. Therefore, based on the NDVI properties we could initially identify the burned areas.

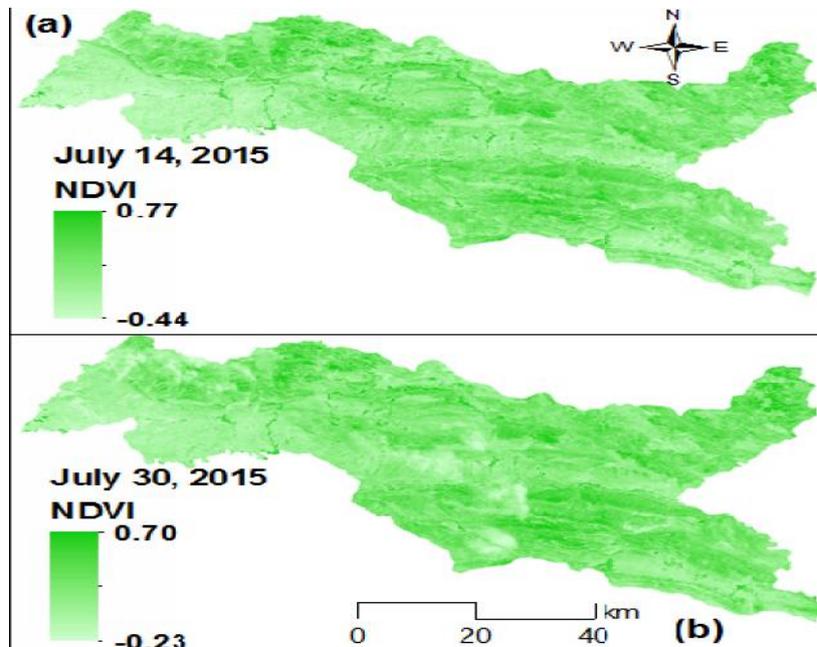


Fig. (5): -NDVI images of the study area. (a) pre-fire (b) post-fire.

NBR

Using the Equation (2) for both images (pre-/post-fire), new images were created which are the NBR images as shown in Fig. 6. It shows and discriminates the burned area from non-burned area. By linking both NBR images and comparing them with the Landsat images we could recognize the burned area clearly.

Next, a threshold was selected from NBR images in such a way we can distinguish the burned areas from the other non-burned areas. Based on this threshold, non-burned areas and any other objects were removed from the post-fire NBR image by masking out the non-burned areas.

Hence, it turns out to create an image with burned areas only (Fig. 6).

Mapping Burned Areas

Fig. 7 represents the burned areas map after the burned areas raster image converted to vector file. As shown in this figure several areas were identified and reported in Table 2. It has been found that the total area of the burned areas were 89.81 km² (8981 ha). This is also reported in Table 2, where the maximum burned areas were found in Deralok, while the minimum burned areas were found in Bamarne.

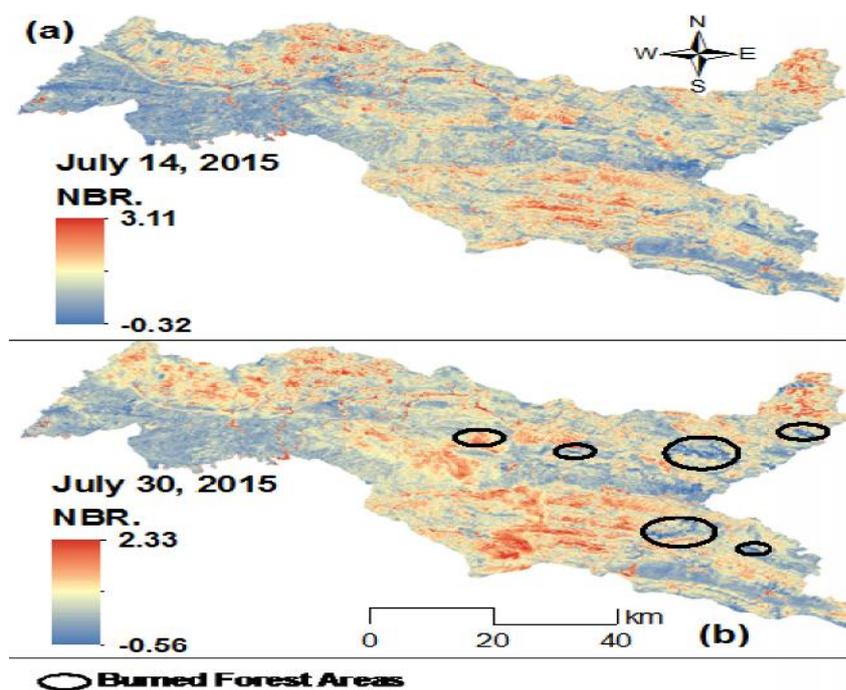


Fig. (6):-NBR images of the study area. The oval shapes indicate the burned areas. (a) pre-fire (b) post-fire.

Table (2): -Area of the burned areas in km² and ha of nine sub-districts in Duhok Governorate.

Sub-Districts	Area	
	Km ²	ha
Kane mase	9.2306	923.06
Bamarne	0.4337	43.37
Batifa	2.9512	295.12
Chmanke	1.7182	171.82
Dinarte	24.0888	2408.88
Deralok	40.1974	4019.74
Darkar	6.6784	667.84
Amedi	3.9662	396.62
Sersenk	0.5448	54.48
Total	89.81	8981

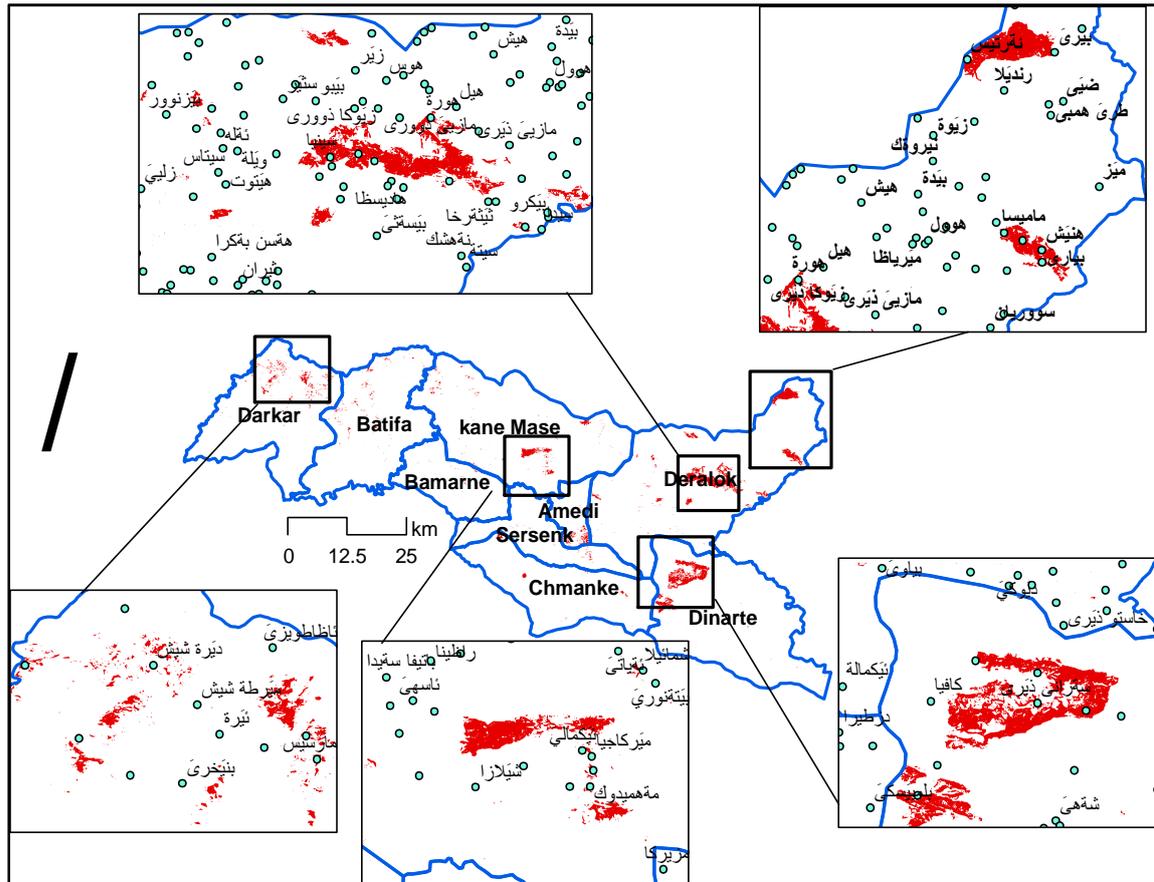


Fig. (7): Map of the estimated burned location areas in nine sub-districts of Duhok Governorate.

DISCUSSION

A major contribution of this study is to identify the location, and calculate the area of burned areas that have been caused by Turkish jet attacks.

The Landsat LDCM has been designed in such a way to have two SWIR bands, which is unlike the other previous Landsat series (Mazher et al. 2012; Boschetti et al. 2015). These bands were explored for detecting and determining the burned areas. It has been found that SWIR band no. 6 is more suitable than SWIR band no.7. This is shown in Fig. 4, where the divergence curves at band no. 6 between burned and not burned areas are larger than in band no. 7. This was a major role in detecting burned areas with the combination of NIR band as it has been formulated in Equation (2).

Based on the methodology that has been designed and implemented in this study, the maximum and minimum burned areas were determined. It was found that the maximum burned areas in Deralok. This is because of the intensely bombing of the Turkish jet happened in that area due to the presence of the Kurdistan

Workers' Party members (Partiya Karkerên Kurdistanê, **PKK**) in that region. Moreover, other factors; as those mentioned in the introduction section, may contributed in burning those areas.

A drawback of this study is that the presence of the clouds in the post-fire image due to the smoke fire. This may cause to either underestimate or overestimate of the burned areas. Although, pre-processing includes atmospheric correction, however, the effect of cloud cannot be ignored.

Furthermore, some other issues require further work. For instance, explore and study the discrimination of burn severity by utilizing some mathematical equations to work as a scaled index. Such an index may be used with NDVI index to evaluate the effect of burn severity on vegetation regeneration. In addition, it should be also pointed out that including high spatial resolution imagery may be a good alternative of the field survey especially in the jet attacks situation.

Results provided from this study confirm the potential of remote sensing in cost-effective support structure for post-fire rehabilitation programmes. Mapping spatial distribution of burned areas could assist planners and managers

to have a whole overview of the damaged areas and how big the damage is and looks for maintenance treatments programmes to maintenance those areas.

CONCLUSIONS

In this study burned areas were identified and mapped of nine sub-districts in Duhok Governorate, Kurdistan Region-Iraq. This is achieved using the latest series of Landsat imagery (Landsat LDCM) and an applicable methodology that served the objective of this study. The study leads to the following conclusions:

- 1) The spectral bands of the Landsat LDCM sensor have a great impact in detecting and recognizing of burned areas in Duhok Governorate.
- 2) The total estimated area of burned areas that caused by Turkish jet attacks in July 2015 was 8981 ha.

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EFFECT OF IRRIGATION WATER QUALITY INDICES OF GROUNDWATER ON SOME SOIL CHEMICAL PROPERTIES, GROWTH 'YIELD AND NUTRIENT CONTENT OF WHEAT IN ERBIL PLAIN.

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ABSTRACT

This study was conducted during 25/12/2013 to 20/5/2014 to study the effect of 15 water qualities (IWQI) on soil chemical properties, growth, yield and nutrient content of wheat, using Completely Randomized Design (CRD) with 4 replicates. The main results can be summarized as follows:

The electrical conductivity of the soil extract increased (1.28 - 2.35) times in comparing with initial ECe. An increase in the concentration of cations and anions in irrigation water caused a significant increase in their concentration in soil extract. The highest value of grain yield was 52.83 g pot⁻¹ recorded at W2, while the lowest value 36.00 g pot⁻¹ was recorded at W11.

IWQI had significant effect on concentration of, K⁺, Ca²⁺, Mg²⁺, Na and P in dry matter of wheat plant. Their highest values were (1.23, 5.46, 4.13, 11.51 and 2.96) mg g⁻¹ of them were recorded in W2, W5, W6 and W14 respectively. While the lowest values were (0.66, 2.83, 2.18, 2.55 and 0.72 mg g⁻¹) were recorded from W14, W2, W13, W1 and W2 respectively.

KEY WORDS: Irrigation water quality index, groundwater, *wheat*.

INTRODUCTION

Water is one of the most common and most precious natural resources on the earth's surface. It is essential for the existence of all kinds of life. 71% of the earth is covered with water. (Nasly et al. 2013). In Erbil city; more than 30% of the water supply is derived from wells. The history of ground water utilization in Iraqi Kurdistan region begins in antiquity (about 7000 year B.C.), (Al-Tamir, 2007).

Ground water is the most important source of water for irrigation, drinking, domestic; industrial uses (Singh et al. 2012). In last decades, the water quality index (WQI) was used to determine the suitability of the groundwater for drinking and irrigation purposes (Rokbani et al. 2011).

Water quality index is a form of average derived by relating a group of variables to a common scale and combining them into a single number. A water quality index summarizes in formations by combining several sub-indices of constituents (quality variables) into a univariate expression.

Oscarson, (2000) described Wheat (*Triticum aestivum* L.) as one of the most economically important cultivated plants. Also it is the dominant crop in temperate countries being used for human

food and livestock feed, however wheat is counted among the common

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cereal crops, with over 600 million tones being harvested annually as described by (Shewry, 2009).

Khlaif and Hassan (2013) and Al-Mussawi (2014) showed the increase in electrical conductivity, SAR, Sodium ion, Chloride ion from west-north to southeast of Iraqi western desert which caused decrease in IWQI

Mustasher (2013) showed that the water for Al-Husseinih river was ranked "low restriction" ; good for irrigation with some restriction at all stations, that means the river water quality is suitable to irrigated soils with light texture since the nature of soil in irrigated lands on both sides of the river is clay loam (heavy texture) so the problem of soil sodicity may occur, and this requires washing the salts from soil constantly. Also he showed the water was ranked "low restriction" ; then the farmers must avoid growing salt sensitive plants. And to control the sources of pollution from river water to be suitable for irrigate most types of crops and plants or cultivation of crops with highly or moderate tolerant to salt to obtain higher productivity.

Al-Mussawi(2014) founded the IWQI was decrease from west-north to southeast, So, the groundwater could be used in irrigation with some constrains in type of plant that are tolerance to salt.

Some studies have been done on water quality index for irrigation, since there are no or little studies in Kurdistan region and Iraq about effect of water quality index (WQI) of ground water on soil chemical properties and plant growth, for this reason this study was selected in order to:

- 1- Study the effect of water quality index (WQI) on some soil chemical properties.
- 2- Study the role of water quality index (WQI) in growth, yield and quantity of wheat.

MATERIALS AND METHODS

The study included the following steps:

Water samples were collected from (15) wells in Erbil plain for irrigating the pot experiment. The chemical properties of water samples were recorded in table (1), and Figure, (1) which shows the map of the studied area (wells). Water samples were taken and analyzed according to (APHA, 1989).

The soil samples were taken at the Grdarasha field Agriculture College at (0-30) cm depth, air dried, sieved through a sieve 4 mm in capacity. 13 kg of the sieved soil were packed in sacks which placed in plastic pots, in order to prevent drainage. The sieved soil through a 2 mm sieves was applied for determining some physical and chemical properties of the soil (table, 2).

The pot experiment was conducted at the Grdarasha field, College of Agriculture Salahaddin University with G.P.S. reading of (N=36°06' 49", E= 44° 00' 47" and Elevation=407m), during the winter growing season of 2013(from December 2013, to May 2014) to study the effect of 15 water qualities (table, 2 on growth yield and yield components of wheat. The water qualities were differing in EC, the Completely Randomized Design (CRD) with four replications was used.

On 25th of December, 2013, (15) seeds of wheat were planted in each pot at 4cm depth. Ten days after germination the plants were thinned to 10 plants per pot.

The soil in each pot was fertilized with 0.65 g diamonium phosphate pot⁻¹ which equivalent to (200) kg ha⁻¹ which contains 46% P₂O₅ and 18% N.

The irrigation was conducted depending on weighting (gravimetric) method, after depletion of 60-70% of available water. The pots irrigated with 15 different ground water qualities, half of the water was applied directly to the soil surface in pots and the other half of the water was applied through the cups to the bottom of the pots using injection method.

Plants were harvested on (20th of May, 2014) then the samples were stored for a chemical analysis. (Hay weight, spike weight, grain weight, weight of 100 grains and protein percentage) were measured.

After harvesting the soil samples were taken from all pots, then air dried, mixed, ground, and passed through a 2mm sieve; and oven dried at 105°C, then stored till analyzing. The EC, pH, concentration of main cations and anions were determined according to Jackson(1958) and Black (1965).

Plant samples were digested and analyzed according to Schuffelen and Schouwenburg (1961). The Ca⁺⁺ and Mg⁺⁺, Na⁺ and K⁺, Total nitrogen and Phosphate (P), were determined according to(Bray, 1951), (Toth *et al.*, 1948) and (Stanford and English, 1949), (Ryan *et al.*, 2001) and (Olsen and Sommers, 1982) respectively.

After 45 days from germination the chlorophyll content was determine weekly (27 readings per pot) using chlorophyll meter model (atL EAF, Vor 1.0).

Statistical analyses were don by Tukey's test.

Method for calculating IWQI :

IWQI =

Where: WQI= Water Quality Index for the characteristic. IWQI = Irrigation Water Quality Index. N= Number of samples.

Zi=..... (2). Where:

Zi = Standardized value of the analyzed characteristic.

x = Value of the characteristic evaluated at the water source.

x- = Mean value of the characteristic evaluated in the reference population.

= standard deviation of the characteristic valuated in the reference population.

Calculating the IWQI for the parameters main cations and anions, RSC, SP and the SAR) using the following equations:

WQIi=(3).

Where:

WQI= Water Quality Index for the characteristic.

Z_i = Standardized value of the variable.

Table (1): The mean of some chemical properties of the water used in pot experiment.

No.	irrigation water (well water)	pH	dS m ⁻¹		Concentration in mmol c . l ⁻¹									SAR	IWQI(Maia and Rodrigues 2012)	Class
			EC	Na ⁺	K ⁺	Ca ²⁺	Mg ²⁺	Cl ⁻	NO ₃ ⁻	HCO ₃ ⁻	SO ₄ ²⁻	RSC	SP			
1	Aweena	7.95	1.03	3.03	0.06	2.45	4.82	2.15	0.34	4.88	3.33	-2.40	3.82	1.59	0.19	excellent
2	Seberan 1	7.24	1.27	1.56	0.03	3.07	8.07	3.24	0.54	6.95	2.55	-4.19	4.52	0.66	0.67	excellent
3	Dusrafatah	7.56	1.43	2.28	0.05	5.05	6.93	3.15	0.30	7.25	3.91	-4.72	5.10	0.93	0.36	excellent
4	Sorbash kakallah 2	7.49	1.65	3.03	0.04	5.09	8.31	2.91	0.44	8.78	4.80	-4.63	5.31	1.17	0.40	excellent
5	Sorbash kakallah 1	7.38	2.04	4.94	0.05	8.25	7.14	3.41	0.39	10.10	6.87	-5.29	6.84	1.78	0.58	excellent
6	Jdedalak 1	7.40	2.46	5.43	0.03	4.96	14.15	4.78	0.29	9.33	10.47	-9.79	10.02	1.76	0.75	excellent
7	Seawy bchuk 2	7.73	2.46	9.35	0.06	6.54	8.68	3.36	0.43	7.83	13.44	-7.39	10.08	3.39	0.75	excellent
8	Seberan 2	7.58	2.57	9.41	0.06	13.36	2.84	4.79	0.37	7.78	13.11	-8.43	11.35	3.31	0.83	excellent
9	Baqrta 1	7.40	2.73	4.73	0.04	12.71	9.84	5.19	0.45	9.65	12.47	-12.89	11.43	1.41	0.90	excellent
10	Shoreja 3	7.83	3.16	14.41	0.12	8.18	8.90	9.03	0.57	4.16	18.42	-12.92	18.24	4.95	1.30	excellent
11	Shoreja 2	7.78	3.23	14.76	0.10	6.84	10.60	9.24	0.54	4.11	18.95	-13.33	18.72	5.00	1.29	excellent
12	Seawygawra	7.49	3.57	7.35	0.09	20.39	8.04	6.00	0.50	9.15	20.72	-19.29	16.36	1.95	1.28	excellent
13	Mastawa 1	7.31	3.74	8.59	0.08	24.12	4.63	7.80	0.16	9.20	20.42	-19.54	18.01	2.27	1.36	excellent
14	Aleawa shexan 1	7.69	5.45	14.98	0.08	17.47	21.93	11.01	0.43	7.58	35.88	-31.83	28.95	3.38	2.14	good
15	Seway bchuk 1	7.62	5.84	7.63	0.09	25.79	24.85	6.08	0.47	8.76	43.51	-41.87	27.84	1.52	2.19	good

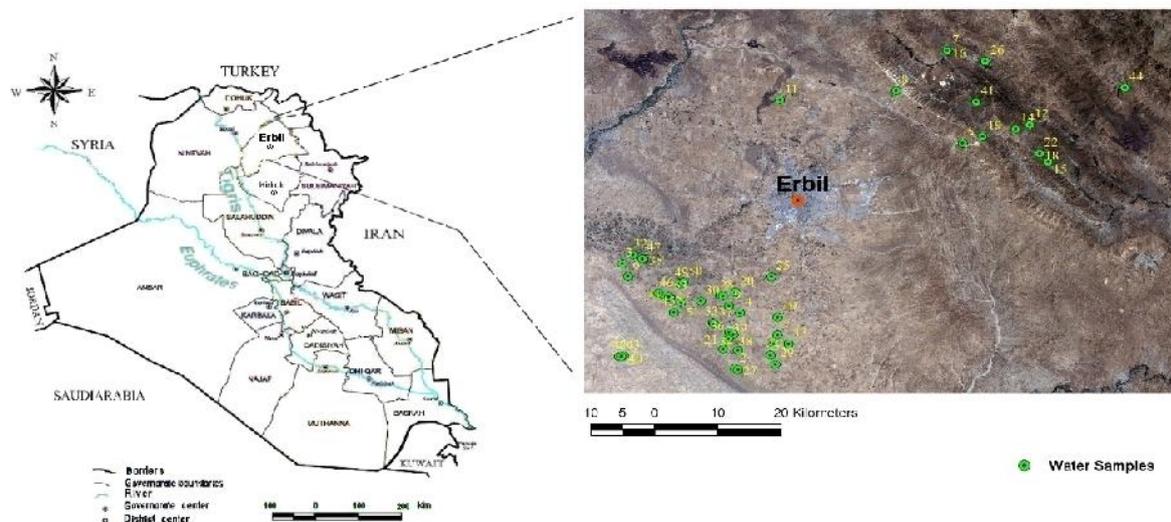


Figure (1): The map of the studied area

Table (2): Some chemical and physical properties of the Grdarasha soil before experiment.

pH		7.56
EC $dS\ m^{-1}$		0.61
Organic matter $g.kg^{-1}$		8.88
Total $CaCO_3\ g.kg^{-1}$		288.0
CEC $cmol_c.kg^{-1}$		26.50
Bulk density $Mg.m^{-3}$		1.20
Soil texture		SiCL
Partical Size Distribution $g.kg^{-1}$	clay	352.60
	Silt	526.40
	sand	121.00
water content %	Saturation percentage	60.83
	F.C	27.27
	W.P	16.91
Total water added per pot (l)		32.37
concentration $mmol_c.l^{-1}$	Ca^{2+}	3.10

Mg ²⁺	1.50
Na ⁺	1.30
K ⁺	0.16
Cl ⁻	1.00
HCO ₃ ⁻	2.41
NO ₃ ⁻	0.38
SO ₄ ²⁻	2.65
Mg ²⁺ /Ca ²⁺	0.48
Na ⁺ /Ca ²⁺	0.42
RSC	-2.19
SAR	0.86

Methods for calculating Sodium Adsorption Ratio (SAR), Residual Sodium Carbonate (RSC) and Salinity Potential (SP):

$$SAR = \frac{Na^+}{\sqrt{\frac{Ca^{2+} + Mg^{2+}}{2}}}$$

Where Na⁺, Ca²⁺ and Mg²⁺ = concentration of sodium, calcium and magnesium in mmol.c.l⁻¹
 Salinity potential = (Cl⁻ + 1/2 SO₄²⁻) mmol.c. l⁻¹
 RSC = (CO₃²⁻ + HCO₃⁻) - (Ca²⁺ + Mg²⁺).

Table (3): Depending on Maia and Rodrigues (2012) the irrigation water classified into four categories as follow:

Classes	(IWQI) value
Excellent	WQli or IWQI 1.96
Good	1.96 < WQli or IWQI 5.88
Average	5.88 < WQli or IWQI 9.80
(Poor)	WQli or IWQI > 9.80

RESULTS AND DISCUSSION:

Effect of irrigation water quality on some chemical properties of the soil:

Table(4) shows non-significant effect of WQI on pH value of soil at (p 0.01), this may be due to high buffering capacity of the soil, this result is similar to those recorded by Esmail(1986,1992), Dohuki(1997), (Mam Rasul, 2000), (Salih, 2008), (Baba,2010), (Kareem, 2010), and (Rekani, 2013).

The irrigation water affected significantly (p 0.01) on EC of soil extract table (4), the highest value was (9.68 dSm⁻¹) recorded from W14 and the lowest value was (1.78 dSm⁻¹) obtained for W1. IWQI have excellent and good class respectively depending on Maia and Rodrigues (2012),(table ,1). The irrigation water caused (1.23 - 2.35) times increase in Ec_e of soil extract.

Table (4) ; The mean of some chemical properties of soil after harvest.

water sampl e	pH	dS m ⁻¹	The concentration of ions in mmol _c l ⁻¹										SAR
			ECe	K ⁺	Ca ²⁺	Mg ²⁺	Na ⁺	Cl ⁻	HC O ₃ ⁻	CO ₃ ²⁻	SO ₄ ²⁻	RSC	
W1	7.84	1.78	0.40	7.00	3.10	7.29	4.30	3.60	0.00	9.89	-6.50	9.25	2.29
W2	7.34	2.11	0.61	8.00	4.10	8.43	3.95	3.80	0.00	13.39	-8.30	10.64	2.42
W3	7.21	2.02	0.45	8.35	2.45	8.99	3.65	3.60	0.00	12.99	-7.20	10.14	2.73
W4	7.31	2.11	0.50	8.00	3.40	9.19	3.90	3.45	0.00	13.74	-7.95	10.77	2.72
W5	7.34	2.75	0.41	11.20	4.55	11.35	4.65	3.55	0.00	19.31	-12.20	14.30	2.86
W6	7.77	3.52	0.52	13.75	4.25	16.65	6.25	3.40	0.00	25.52	-14.60	19.01	3.93
W7	7.44	4.45	0.46	20.95	4.25	18.83	5.40	3.40	0.00	35.69	-21.80	23.24	3.75
W8	7.47	6.05	0.64	27.95	7.35	24.53	8.55	3.55	0.00	48.37	-31.75	32.73	4.13
W9	7.76	3.89	0.59	15.90	5.35	17.06	5.90	3.35	0.00	29.65	-17.90	20.72	3.70
W10	7.64	6.82	0.69	26.30	8.45	32.80	15.45	4.05	0.00	48.74	-30.70	39.82	5.56
W11	7.71	6.68	0.65	29.65	6.30	30.38	15.20	3.80	0.00	47.98	-32.15	39.19	5.07
W12	7.72	6.91	0.68	28.60	8.55	31.29	10.25	3.90	0.00	54.97	-33.25	37.74	5.13
W13	7.62	7.45	0.82	27.70	13.75	32.19	11.70	4.00	0.00	58.76	-37.45	41.08	5.00
W14	7.45	9.68	0.85	23.53	22.80	49.67	13.30	4.55	0.00	79.00	-41.78	52.80	7.30
W15	7.57	8.31	0.67	29.85	22.85	29.77	8.78	5.25	0.00	69.12	-47.45	43.33	4.10
Tukey's HDS Values	N.S	1.36	0.51	5.74	4.05	9.32	4.58	1.13		11.75			

This result agree with those recorded by Esmail(1986 and 1992) ,Salih(2008) and Baba(2010). The significant positive correlation coefficient (r=0.95^{**}) was recorded between IWQI and EC_e as shown in figure(2).

Cations and anions:

Table (4) explained that the water class depending on water quality index affected significantly on concentration of Ca²⁺, Mg²⁺ and Na⁺, the highest value of it were (29.85, 22.80 and 49.67 mmol_c l⁻¹) recorded at (W15, and W14) respectively, while the lowest value of them (7.00, 2.45 and 7.29 mmol_c l⁻¹) were obtained from (W1, and W3) respectively, but IWQI was not affected significantly on K⁺ concentration in soil extract .In general the increase in concentration of cations in irrigation water caused increase in their concentration in soil extract.

Figures (3,4,5 and 6)indicated that significant positive correlation coefficient was recorded between concentration of Ca²⁺,Mg²⁺, Na⁺ and

K⁺ in soil extract and the values of IWQI depending on Maia and Rodrigues (2012) with the correlation coefficient values (r =0.88^{**}, 0.97^{**}, 0.91^{**} and 0.83^{**}) respectively .

The IWQI affected significantly (p 0.01) on concentration of Cl⁻, HCO₃⁻ and SO₄²⁻ of soil extract ,the highest value of them (15.45, 5.25 and 79.00 mmol_c l⁻¹) were recorded from(W10,W15 and W14), while the lowest values of it were (3.65, 3.35 and 9.89 mmol_c l⁻¹) obtained from (W3, W9 and W1) respectively (table, 4).

As shown from figures (7 and 8) depending on Maia and Rodrigues (2012) the positive significant correlation coefficient values were obtained between IWQI and each of Cl⁻ and SO₄²⁻ concentrations in soil extract with the correlation coefficient values of (r= 0.82^{**}, and 0.95^{**})respectively.

Figure (2): Relationship between IWQI and EC of soil extract depending on Maia and Rodrigues(2012).

Figure (3) Relationship between IWQI and Ca^{2+} in soil extract depending on Maia and Rodrigues(2012) .

Figure (4): Relationship between IWQI and Mg^{2+} in soil extract depending on Maia and Rodrigues(2012).

Figure (5): Relationship between IWQI and Na^+ in soil extract depending on Maia and Rodrigues (2012) .

Figure (6): Relationship between IWQI and k^+ in soil extract depending on Maia and Rodrigues(2012) .

Figure (7): Relationship between IWQI and Cl^- in soil extract depending on Maia and Rodrigues(2012).

Figure (8): Relationship between IWQI and SO_4^{2-} in soil extract depending on Maia and Rodrigues(2012) .

Effect of irrigation water quality on some chemical parameters of soil extract:

Sodium Adsorption Ratio (SAR):

Depending on Maia and Rodrigues (2012) as shown from figure(9) the significant positive correlation between IWQI and SARe with the correlation coefficient value of ($r=0.89^{**}$) .

Residual Sodium Carbonate (RSC):

Depending on Maia and Rodrigues (2012) the positive significant correlation coefficient was recorded between IWQI and RSCe with the values of ($r=0.96^{**}$) as shown from figure (10).

Salinity Potential (SP):

According to Maia and Rodrigues (2012) figure (11) indicates to the positive significant correlation was recorded between IWQI and SPE with r value of (0.94^{**}) .

Figure (9): Relationship between IWQI and SARe depending on Maia and Rodrigues(2012).

Figure (10): Relationship between IWQI and RSCe depending on Maia and Rodrigues(2012).

Figure (11): Relationship between IWQI and SPE depending Maia and Rodrigues (2012) .

Effect of irrigation water quality on wheat plant:

The results of statistical analysis show the significant effect ($p < 0.01$) of water quality on straw weight, spike weight, grain weight and weight of 1000grains as shown from table (5).

Effect of irrigation water quality on protein content of wheat:

The irrigation water quality affected significantly at ($p < 0.01$) on protein content of wheat grain (figure, 12) the highest value was (11.30%) recorded at W10 which have excellent class depending on Maia and Rodrigues (2012)

for IWQI. While the lowest value was (7.18%) obtained for W14 which have the good class of IWQI. This may due to the different in chemical compositions of irrigation water especially NO_3^- concentration, since the highest NO_3^- concentration ($0.57 \text{ mmol}_c \text{ l}^{-1}$) was founded in W10 and the lower value ($0.43 \text{ mmol}_c \text{ l}^{-1}$) was obtained from W14, in additional to the highest ($11.01 \text{ mmol}_c \text{ l}^{-1}$) concentration of Cl^- in W14 which has antagonistic relation with NO_3^- (table, 2) . Similar results were recorded by Esmail (1986 and 1992) and Salih(2008) .

Figure (12): Effect of irrigation water quality on protein% in wheat grains.

Effect of irrigation water quality on concentration of some nutrients and chlorophyll in plant:

Table (6) shows significant effect ($p < 0.01$) of IWQI on concentration of K^+ , Ca^{2+} , Mg^{2+} , and Na^+ in dry matter of wheat plant. The highest values were (1.23, 5.46, 4.13 and 11.51) mg g^{-1} recorded at W2, W5, W6 and W14 respectively.

The IWQI of the mentioned water qualities were located under excellent class for all of them except W14 which has good class (table,5) depending on Maia and Rodrigues (2012), while the lowest values of it were (0.66, 2.83, 2.18 and 2.55) mg g^{-1} recorded for W14, W2, W13 and W1

respectively. This may be due to Mg^{2+}/Ca^{2+} ratio in irrigation water and individual

Table (5): Effect of irrigation water quality on weight of (Hay, Spikes, Grains) pot^{-1} , 1000 grains, and chlorophyll content of wheat

Water quality	weight				Chlorophyll (SPAD)	IWQI Maia and Rodrigues (2012)	Water Class
	Hay	Spik e g pot^{-1}	Grain	1000 grains(g)			
W1	71.55	50.40	38.00	41.95	50.52	0.19	excellent
W2	76.28	61.76	52.83	45.08	53.54	0.67	excellent
W3	65.26	54.14	37.12	42.10	52.17	0.36	excellent
W4	55.72	53.33	36.93	41.95	52.21	0.40	excellent
W5	66.86	54.26	37.46	43.55	52.19	0.58	excellent
W6	57.85	60.43	49.73	43.60	52.44	0.75	excellent
W7	65.30	54.10	44.22	42.93	52.70	0.75	excellent
W8	66.90	59.07	47.92	43.15	53.64	0.83	excellent
W9	58.09	56.59	44.31	43.43	52.54	0.90	excellent
W10	74.76	57.82	44.44	44.15	53.99	1.30	excellent
W11	65.71	49.76	36.00	41.45	53.55	1.29	excellent
W12	55.63	53.85	40.56	41.98	54.27	1.28	excellent
W13	54.40	51.03	36.47	41.78	53.64	1.36	excellent
W14	60.32	51.56	42.91	41.48	53.74	2.14	good
W15	71.99	52.92	36.92	41.55	53.64	2.19	good
Tukey's HSD Value	7.75	8.21	6.55	1.05	2.17		

Table (6): The mean concentration of some nutrients in wheat dry matter.

water quality	concentration in $mg\ g^{-1}$					
	N	P	K^{+}	Ca^{2+}	Mg^{2+}	Na^{+}
W1	19.00	1.37	0.67	5.26	2.61	2.55
W2	22.75	0.72	1.23	2.83	3.06	2.74
W3	18.00	1.33	1.05	4.96	3.35	2.95
W4	26.50	0.97	0.86	4.56	3.14	2.69
W5	25.25	1.14	0.90	5.46	2.96	2.83
W6	16.75	1.41	1.04	4.47	4.13	3.58
W7	16.25	2.69	0.90	3.99	2.47	4.36
W8	25.00	1.59	0.97	4.22	2.53	5.71
W9	16.25	1.03	0.77	4.52	2.71	3.99
W10	22.75	1.34	0.85	4.56	2.55	7.62
W11	29.50	1.39	0.98	5.17	3.22	7.90
W12	21.50	2.86	0.81	4.75	2.73	6.46
W13	17.00	2.87	0.85	4.39	2.18	6.31
W14	21.00	2.96	0.66	4.30	2.36	11.51
W15	20.75	2.38	0.90	5.17	2.23	6.27
Tukey's HSD Value	13.67	1.51	0.94	2.21	0.99	2.84

concentration of nutrients, while the concentration of N was not affected significantly by IWQI. The positive correlation was recorded between Na⁺ content in plant and IWQI depending on Maia and Rodrigues (2012), with the correlation coefficient value of ($r= 0.86^{**}$) as shown in figure(13).

Figure (13): Relationship between Na⁺ in plant and IWQI depending on Maia and Rodrigues (2012).

The irrigation water quality affected significantly ($p < 0.01$) on concentration of P in wheat plant. The highest concentration (2.96 mg g^{-1}) was recorded in W14 while the lowest value was (0.72 mg g^{-1}) recorded for W2. This may be due to the difference in ionic composition of irrigation water and soil solution, and the highest concentration of Cl⁻ in W14 (table, 1) which has antagonistic with phosphorus. The significant correlation coefficient was recorded between P in plant and IWQI depending on Maia and Rodrigues(2012) ($r= 64^{**}$) respectively as shown in figure (14). These results agree with those recorded by Esmail(1986), Al-azawi(1986), Esmail *et al.*(2000), Salih(2008) and Baba (2010).

Figures (15) explains the significant correlation coefficient between IWQI and chlorophyll content with correlation coefficient value of $r=0.90^{**}$ (Maia and Rodrigues, 2012).

Figure (14): Relationship between P in plant and IWQI depending on Maia and Rodrigues (2012).

Figure (15): Relationship between chlorophyll and IWQI depending on Maia and Rodrigues(2012).

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COMPARISON BETWEEN SOME SOIL CHEMICAL PROPERTIES AND SOME NUTRIENTS IN TREES AT ZAWITA AND HIJRAN FOREST

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ABSTRACT

This investigation was conducted to study the effect of two forest sites (pine forest at Zawita and oak forest at Hijran), and two seasons of soil and plant sampling during (1st to 18th of May, 2013) and (17th–29th of September, 2013) on some chemical properties of the forest soils, such as concentration of some cations, anions and micronutrients in soil and forest trees. The main results were summarized as follow: The concentrations of available micronutrients in surface soil samples under pine and oak trees were in the decreased sequence of Mn^{2+} Fe^{2+} Zn^{2+} Cu^{2+} , while the sequence of them in pine and oak trees were decreased Fe^{2+} Mn^{2+} Zn^{2+} Cu^{2+} . In general the concentration of most of the studied macro and micronutrients in oak leaves were higher than their concentration in pine leaves.

KEY WORDS: Forest soil, Oak, Pine.

INTRODUCTION

Pine trees (*Pinus brutia* Ten.) which belong to pinaceae family distributed as a natural trees in Kurdistan region at Zawita /Duhok governorate. They are a medium to large sized evergreen coniferous trees. It grows on most of soils except compact clayey soil (Goor and Barney, 1976). The differing climatic condition affects on nutrient absorption by forest trees, also the genus play a role in nutrient absorption (Sdiq, 1988).

(*Quercus aegilops* l.) is a medium-sized, deciduous tree, and it grows from sea level 500 to more than 1000 m. It is found in all kinds of soils texture, but best grows on loamy soil in dry climate with as little as 400 mm rain per year (Goor and Barney, 1976). It play an

important role in increasing of organic matter in the soil, which causes increase in availability of essential nutrients and adding elements to the soil in different seasons of the year and this improve the growth of these trees (young, 1990).

Sheikh Abdullah (2012) studied the effect of sites of six forest soils (Xalakan pine forest, Dukan oak forest, Baxy-baxteyre-pine, Goizha-Cypress, Goizha-Olive and Penjween oak) on soil chemical properties, the results indicated to significant difference between chemical properties of the studied forest soils, the chemical properties of the soils ranged between:-

Ec_c (0.08-2.02 dS.m⁻¹), pH (6.62-8.36), total

$CaCO_3$ (5.0 – 49.5 %), CEC (15.43-30.05 Cmolc.kg⁻¹). Barwari (2013) explained the type of forest trees or locations affected on above chemical properties of the soil, in general the highest values of them recorded from oak forest at Swaratoka location, while lowest values of them obtained from pine forest at Zawita location. The mean values of Ec_c , pH, O.M, and CEC in composite forest sample were [0.46 dS.m⁻¹, 7.49, 5.83 %, and 29.08 Cmolc.kg⁻¹ soil] respectively.

The deciduous oak litter had a higher initial nutrient content and released its nutrients faster and in a higher proportion than the perennial oak litter, significantly increasing soil fertility beneath its canopy (Aponte *et al.*, 2012). Since the previous studies not included the effect of sites, types of forest trees and seasons on nutrient availability in forest soils, and forest trees for this reason, this study was selected to study:

Effect of site of forest, type of forest trees and season on some soil properties and concentration of some macro and micronutrients of surface soil and concentration of some macro and micro nutrients in pine and oak leaves.

MATERIALS AND METHODS:

Description of the studied area

Zawita pine forest located in Duhok governorate in Iraqi Kurdistan region. While the Hijran located at right side of the main road of Salahaddin – Shaqalawa/ Erbil city (Fig. A).

Soil Sampling:

The samples were taken during (1st to 18th of May, 2013) and (17th –29th of September, 2013) which included tree and soil at two sites (Zawita forest and Hijran forest) during spring and autumn as follow:

At Zawita forest 3 composite surface soil samples at depth (0-35 cm) were taken, but at Hijran forest 8 composite surface soil samples were taken. The soil samples were air dried and sieved by 2mm sieves, then saved in plastic containers and stored in laboratory (College of Agriculture/ laboratory 2 and laboratory of research center) in order to conducting chemical analyses.

Electrical conductivity (Ec_E), pH ,organic matter, calcium carbonate ($CaCO_3$), cation exchange capacity (CEC), bulk density, particle

size distribution ,total nitrogen, available phosphorus, sodium(Na^+), potassium (K^+), calcium(Ca^{2+}), magnesium (Mg^{2+}), available micronutrients (Fe^{2+} , Mn^{2+} , Zn^{2+} , Cu^{2+}) according to Ryan *et al.* (2001).

Tree sampling and digestion:

Samples of tree leaves were taken at spring and autumn from forest trees (*Pinus brutia Ten.*) and (*Quercus aegilops l.*) in Zawita and Hijran forests respectively, then oven dried at 65 °C for 72 hrs, after that ground by mill and digested using 1:1 volume ratio of H_2SO_4 and H_2O_2 for nutrient determination.

Nutrient analysis:

Some macro and micro-nutrients (N, P, K^+ , Ca^{2+} , Mg^{2+} , Na^+ , Mn^{2+} , Zn^{2+} , Fe^{2+} , Cu^{2+}) were

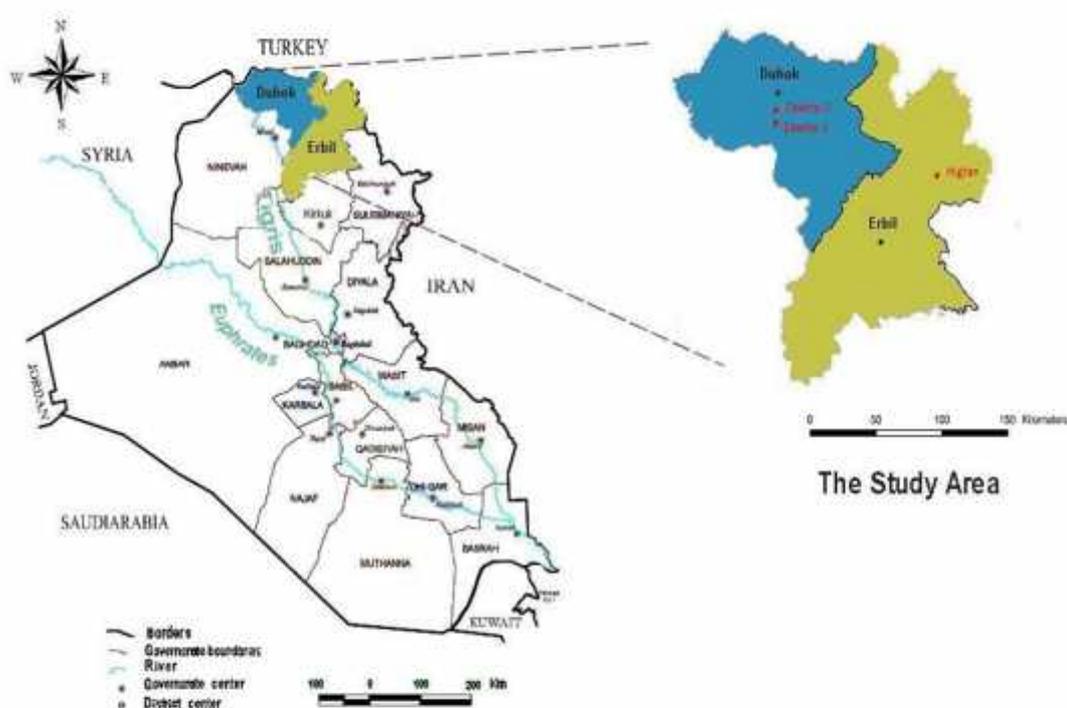


Fig. (A):-Map of Iraq showing study areas in Duhok and Erbil province (Zawita, and Hijran forest).

determined with using the standard methods as mentioned in soil analysis (Ryan *et al.*, 2001).

Statistical Analysis:

The Statistical analysis was conducted depending on paired and non-paired t-test using SPSS program version (20).

RESULTS AND DISCUSSION

Effect of site and season of sampling on some chemical properties of surface soil:

The season of sampling not affected significantly on E_c mean value of surface soil under pine trees (Zawita forest), which were (0.15 and 0.33) $dS.m^{-1}$ in spring and autumn respectively. At Hijran forest the season affected significantly on E_c for surface soil under oak trees. The highest E_c value for surface soil under oak trees in autumn may be due to the greater effect of environmental factors (temperature and rainfall) on surface soil. The mentioned results indicated to higher E_c value of surface soil under oak vegetation at Hijran in comparing with its value under pine vegetation at Zawita in both seasons. Similar results were obtained by Barwari (2013), he indicated that salt content or low soluble salt content in the studied sites (Zawita, Swarutuka and Koradere) attributed to desalinization process as affected by relatively high amount of rainfall and increasing of leaching rate through studied forest soil. Similar results were obtained by Yehia (1982) he found that the range of E_c was between (0.18-0.47) $dS.m^{-1}$ for Zawita site, or may be to the difference in soil chemical properties and environmental condition of the studied sites (Zawita and Hijran forest).

Table (1) manifested that at Zawita forest the season affected significantly at level of significance 0.01 on pH of surface soil samples under oak trees at Hijran. The mean of pH value for surface soil samples under pine trees were 7.70 and 7.63 in spring and autumn respectively and the season of sampling also affected significantly on pH value of surface soil sample under oak trees, the highest value (7.85) was recorded in autumn, while the lowest value (7.31) was obtained in spring season. It is appeared that the higher value of pH of the soil surface under oak trees at Hijran forest. The mentioned results indicated to higher pH value for surface soil under oak vegetation at Hijran comparing with its value under pine vegetation at Zawita in both seasons. Similar results were recorded by (Yehia, 1982). Sheikh Abdulla (2012) showed the relative high

pH value of the surface layers under oak forest is due to the decomposition of leaves and the addition of bases then increase in percentage of base saturation due to dry and hot climate during the summer months.

Table (1) referred to non significant difference between organic matter of surface soil sample in both studied seasons of soil sampling at Zawita forest. At Hijran oak forest the significance difference at level of significance 0.01 was recorded only between organic matter content of surface soil samples in the studied season, the highest mean value (65.6) $g.kg^{-1}$ was recorded in autumn season, while the lowest mean value (39.5) $g.kg^{-1}$ was obtained in spring season. The highest organic matter of surface soil samples under oak trees in autumn season may be attributed to high decomposition rate of oak leaves in soil than the soil receiving coniferous needles which caused more increase in organic matter of surface soil samples in autumn, similar results were obtained by (Singh and Bhatnagar, 1997) (Sheikh Abdullah, 2012) and (Barwari, 2013).

The soil $CaCO_3$ in both sites were not affected significantly by season of sampling (Table, 1).

Table (1) explains that there is no significant differences in CEC values for surface soil samples at both sites Zawita pine forest and Hijran oak forest.

Effect of type of forest trees and season of sampling on concentration of some soil macronutrients:

At Zawita forest the season of sampling affected significantly at level of significant 0.05 on available K^+ of surface soil samples under pine trees. The higher value of available K^+ in spring may be due to release of fixed K^+ between expanding clay minerals after rainfall. The mentioned results indicated to the higher concentration of available K^+ under oak vegetation at Hijran than its concentration under pine vegetation (Zawita forest) in both seasons (Table, 2). This may be due to the difference in type of trees and the rate of their decomposition. Similar results were recorded by (Sheikh Abdullah, 2012 and Barwari, 2013).

On the other hand at Hijran forest soil as shown in table (2) the season was not affected significantly on nitrogen and phosphorus but affected significantly on soluble potassium in surface soil samples under oak trees, at level of significance 0.05.

The highest values of available phosphorus and soluble potassium (3.46 and 120.33 $\mu\text{g}\cdot\text{g}^{-1}$ soil) were obtained in autumn season at Hijran forest, while the lowest values of them (3.49 and 98.64 $\mu\text{g}\cdot\text{g}^{-1}$ soil) were recorded in spring season. This may be due to leaching and erosion in spring which caused decrease in their concentration in spring, similar results were obtained by (Barwari, 2013).

At Zawita and Hijran forest the results in table (2) referred to non significant effect of season on (Na^+ , Ca^{2+} , and Mg^{2+}) except Na^+ concentration in surface soil under pine trees at Zawita site which was affected significantly at level of significant 0.05 by season of sampling.

The highest value of Na^+ ($0.42 \text{ Cmol}_c\cdot\text{L}^{-1}$) was recorded in spring season at Zawita forest, while the lowest value ($0.17 \text{ Cmol}_c\cdot\text{L}^{-1}$) was obtained in autumn season, but there is no significant effect of season at Hijran. This may be due to the high dissolving of sodium salt in water in comparing to other salts in soil (Al-Zubaidi, 1992), similar results were recorded by (Al-doski, 2012).

At Zawita forest the season of soil sampling affected significantly at level of significant 0.05 on available K^+ concentration under pine trees. While at Hijran oak forest only the soluble potassium concentration of surface soil affected significantly at level of significant 0.01 by season of sampling.

The highest value of available potassium was (582.11) recorded in autumn season at Hijran, however the highest value for Zawita (464.29 $\mu\text{g}\cdot\text{g}^{-1}$ soil) was found in spring. Similar results were recorded by (Sheikh Abdullah, 2012) for surface soil samples of pine forest, due to weathering of mica then release of potassium.

Effect of type of forest trees and season on concentration of some micronutrients in forest soils:

In general the concentration and distribution of the studied micronutrients (Zn^{2+} , Cu^{2+} , Mn^{2+} , and Fe^{2+}) were affected by numerous factors like soil depth, type of forest trees and time of sampling.

Table (3) referred to non-significant effect of season of soil sampling on Zn^{2+} concentration of the surface soil sample under pine trees at Zawita forest. The mean concentration of soil available Zn^{2+} under pine forest or trees was $0.46 \mu\text{g}\cdot\text{g}^{-1}$ soil in spring, and its value in autumn season was $1.05 \mu\text{g}\cdot\text{g}^{-1}$ soil.

It is appeared from the mentioned results that the highest concentration of available Zn^{2+} at

Zawita was recorded in soil samples taken under pine trees in autumn season; this may be due to effects of rainfall which caused dilution of Zn^{2+} in spring season, or decomposition of leaves in autumn then increase in its concentration or due to higher organic matter content of surface soil samples. At Hijran forest the mean of Zn^{2+} concentration under oak trees in both spring and autumn were 0.46 and $1.07 \mu\text{g}\cdot\text{g}^{-1}$ soil respectively, it means that Zn^{2+} concentration in autumn season at Hijran is higher than its concentration in spring, this may be due to the reason as mentioned previously. It means that the time of sampling affected significantly on available Zn^{2+} of the soil under oak trees, the higher concentration was recorded in autumn season compared with spring season, this may be due to the high rainfall and leaching during winter, in additional to litter fall and decomposition in autumn.

From the mentioned results it is clear that in the surface soil samples under oak vegetation (Hijran forest) the concentration of Zinc is higher than it is concentration under pine vegetation in Zawita in both seasons. Similar results were record by (Barwari, 2013) and (Ahmad, 2015), this may due to the difference in soil texture, parent material and type of trees of the studied sites (Brady and weil, 2002). Table (3) explained at Zawita forest the season affected significantly on Cu^{2+} at level of significance 0.05 for surface soil sample under pine trees. The mean concentration of Cu^{2+} under pine forest or trees was $0.82 \mu\text{g}\cdot\text{g}^{-1}$ soil in spring season, and its mean value in autumn season was $0.50 \mu\text{g}\cdot\text{g}^{-1}$ soil. It means the highest mean value was recorded in spring season and the lowest mean value was obtained in autumn season under pine trees at Zawita forest. It means the concentration of available Cu^{2+} for the forest soil in spring is higher than its concentration in autumn season under pine trees, or it is clear that the behavior of Cu^{2+} at Zawita soil forest is differing from behavior of Zn^{2+} , or its solubility is more than the solubility of Zn^{2+} as indicated it by (Lindsay, 1979).

At Hijran forest the season affected significantly at level of significance 0.05 on Cu^{2+} concentration in surface soil samples under oak trees. Table (3) showed the mean concentration of Cu^{2+} for the soil under oak trees in spring and autumn were 0.82 and $0.41 \mu\text{g}\cdot\text{g}^{-1}$ soil respectively, it means that Cu^{2+} concentration in spring season at Hijran

Table(1):- Effect of site and season of sampling on some chemical properties of forest soil.

Characteristics	Zawita (pine forest)^		Hijran (oak forest)		
	Surface soil		Surface soil		
	Spring	Autumn	Spring	Autumn	
Mean g.kg ⁻¹	Ec _e 1:1 dS.m ⁻¹	0.15	0.33	0.14	0.43
		Cal.t = 1.56 n.s		Cal.t = 5.74**	
	pH 1:1	7.70	7.63	7.31	7.85
		Cal.t = 0.23 n.s		Cal.t = 9.77**	
	O.M	38.1	35.7	39.5	65.6
		Cal.t = 0.49 n.s		Cal.t = 4.22**	
	CaCO ₃	116.7	133.3	111.9	123.8
		Cal.t = 0.26 n.s		Cal.t = 0.33 n.s	
CEC Cmolc.kg ⁻¹	18.90	22.30	17.13	20.54	
	Cal.t = 0.90 n.s		Cal.t = 1.39 n.s		

^ The comparison between soil chemical properties in spring and autumn was conducted for surface soil of each site separately.

* =significant at 5% level of significance. ** = significant at 1% level of significance. n.s = non-significant

is higher than its concentration in autumn, this may be due to the reasons as mentioned previously at Zawita site. The mentioned results indicated to the concentration of Copper under pine vegetation at Zawita surface soil is higher than its concentration under oak vegetation at Hijran forest in autumn season only, this may be due to differing in type of tree at the studied sites. Similar results were obtained by (Sheikh Abdullah, 2012).

The mean concentration of available Mn^{2+} of surface soil samples under pine trees forest at Zawita was $14.93 \mu g.g^{-1}$ soil in spring season, and the mean concentration of Mn^{2+} in autumn season was $11.25 \mu g.g^{-1}$ soil, the statistical analysis indicated to non significant difference between them. At Hijran forest the season of sampling affected significantly on Mn^{2+} concentration under oak trees. The concentration of available Mn^{2+} in spring is higher than its concentration in autumn season under pine trees. At Hijran forest the mean concentration of Mn^{2+} for the surface soil under oak trees during spring and autumn were 19.54 and $15.97 \mu g.g^{-1}$ soil respectively, it means that Mn^{2+} concentration in spring season at Hijran is higher than its concentration in autumn for surface soil, this may be due to competition between each of Fe^{2+} , Cu^{2+} , and Zn^{2+} with Mn^{2+} on adsorption sites. From the mentioned results, it is appeared that the concentration of Manganese of surface soil under oak vegetation at Hijran is higher than its concentration under pine vegetation at Zawita in both seasons. These results agree with those recorded by (Barwari, 2013) and (Sheikh Abdullah, 2012). Table (3) referred to significant effect of season on Fe^{2+} concentration at both Zawita pine forest and Hijran oak forest. The mean concentration of soil available Fe^{2+} under pine trees forest was $15.18 \mu g.g^{-1}$ soil in spring, and the mean concentration of Fe^{2+} in autumn season was $7.96 \mu g.g^{-1}$ soil. It means the concentration of available Fe^{2+} of the forest soil in spring is higher significantly than its concentration in autumn under pine trees. This may be due to the role of rain water in dissolving of precipitated iron in form of carbonate and hydroxyl (Lindsay, 1979). Similar results were obtained by (Barwari, 2013). At Hijran forest the mean concentration of Fe^{2+} under oak trees in spring and autumn were 12.90 and $7.58 \mu g.g^{-1}$ soil respectively, it means that Fe^{2+} concentration in spring season at Hijran is higher than its concentration in autumn. This may be due to the reasons as mentioned previously. The

difference between iron concentration in the studied sites and seasons is high; this may be due to the interaction effect between slope, soil depth and season of sampling. Similar results were obtained by (Sheikh Abdullah, 2012) and (Barwari, 2013).

Mean value of available micronutrient for surface soil samples of both sites (Zawita and Hijran forest) were in the following sequence $Mn^{2+} > Fe^{2+} > Zn^{2+} > Cu^{2+}$. These results disagree with the sequence of micronutrient ($Fe^{2+} > Mn^{2+} > Zn^{2+}$) at Zawita and Swaratoka forest soil recorded by (Barwari, 2013). This may be due to differences in the number of soil samples and slopes studied by him.

Effect of season of sampling and type of forest trees on concentration of some macronutrients in forest trees:

Table (4) showed that the season affected significantly at level of significance 0.05 on concentration of nitrogen and potassium of oak leaves at Hijran forest only. While the season of sampling was not affected significantly on the concentration of the studied macronutrients of pine trees of Zawita forest.

The highest concentration of nitrogen and potassium (1.90 and 1.78%) were recorded in oak trees at Hijran forest in spring season respectively, while the lowest values of them (1.49 and 1.08%) were recorded in autumn season.

In general the concentrations of the studied macronutrients in oak leaves at Hijran forest were higher than their concentration in pine leaves at Zawita forest in spring and non uniformity in autumn season (Table, 4). This may be due to difference in genetic characters of oak and pine trees in addition to differing in soil and environmental properties of the studied sites. Similar results were recorded by (Sheikh Abdullah, 2012).

The concentration of the nitrogen, potassium and phosphorus in pine trees of Zawita forest were adequate, since optimum concentration of them for pine trees were more than (1.40%, 0.14% and 0.70%) respectively. On the other hand the optimum concentrations of them in oak leaves are (2.3%, 0.22 % and 0.90%) respectively (Taylor, 1991). It is appeared from the above information the nitrogen content is adequate for pine trees but not adequate for oak trees since the mean value of nitrogen content in pine and oak trees were (1.44 and 1.72 %) respectively.

Effect of site, season and type of forest trees on concentration of some micronutrients in forest trees:

Table (4) showed the season was did not affect significantly on concentration of available Zn^{2+} and Mn^{2+} in pine and oak trees at Zawita and Hijran forest trees respectively. While it was affected significantly on concentration of both Cu^{2+} and Fe^{2+} in pine trees of Zawita forest and oak trees of Hijran forest respectively.

The highest values were (4.60 and $4.65 \mu g.g^{-1} plant$) of Cu^{2+} in pine leaves of Zawita and oak leaves of Hijran forest were recorded in spring season, while the lowest values of them (2.36 and $2.69 \mu g.g^{-1} plant$) were obtained in autumn season respectively.

It is clear from leaves of tree analysis, that the behavior of Fe^{2+} is differing from Cu^{2+} , since the highest concentration of Fe^{2+} (73.31

and $87.02 \mu g.g^{-1} plant$) were recorded from pine and oak leaves at Zawita and Hijran forest in autumn season respectively. This may be due to antagonistic relation between Cu^{2+} and Fe^{2+} (Tisdale *et al.*, 1997) and because of low availability of phosphorus in autumn season due to higher temperature compared with spring season since the increase in temperature causes increase in phosphorus fixation (Al-Sulaivany, 1993).

Table(2): -Effect of site and season on concentration of ions in forest soil.

	Ions	Zawita (pine forest) [^]		Hijran (oak forest)	
		Surface soil(pine)		Surface soil(oak)	
		Spring	Autumn	Spring	Autumn
Mean	Total N %	0.18	0.12	0.36	0.32
		Cal.t = 0.70 n.s		Cal.t = 0.72 n.s	
	Available P	3.98	3.52	3.49	3.46
		Cal.t = 0.70 n.s		Cal.t = 0.10 n.s	
	available K	464.29	82.09	404.02	582.11
		Cal.t = 6.21*		Cal.t = 9.23**	
	Soluble K	108.70	82.10	98.64	120.33
		Cal.t = 0.91 n.s		Cal.t = 3.12*	
	Ca ²⁺	1.37	1.47	1.24	1.14
		Cal.t = 0.19 n.s		Cal.t = 0.85 n.s	
	Mg ²⁺	1.50	1.50	1.53	1.80
		Cal.t = 0.02 n.s		Cal.t = 0.53 n.s	
	Na ⁺	0.42	0.17	0.46	0.24
		Cal.t = 8.66*		Cal.t = 1.92 n.s	

[^] The comparison between concentration of macronutrients in spring and autumn was conducted for surface soil of each site separately.

*=significant at 5% level of significance

**= significant at 1% level of significance

n.s = non-significant

Table(3): -Effect of site, season and type of forest trees on concentration of some micronutrients in forest soils.

Concentration of available micronutrients $\mu\text{g.g}^{-1}$ soil	Zawita (pine forest) [^]		Hijran(oak forest)	
	Surface soil(pine)		Surface soil(oak)	
	Spring	Autumn	Spring	Autumn
Zn ²⁺	0.46	1.05	0.46	1.07
	Cal.t= 1.67 n.s		Cal.t = 9.36**	
Cu ²⁺	0.82	0.50	0.82	0.41
	Cal.t= 5.82*		Cal.t= 3.25*	
Mn ²⁺	14.93	11.25	19.54	15.97
	Cal.t= 0.54 n.s		Cal.t=1.14*	
Fe ²⁺	15.18	7.96	12.90	7.58
	Cal.t= 7.49**		Cal.t= 7.73**	

[^] The comparison between concentration micronutrients for surface soil in spring and autumn was conducted for each site separately.

*=significant at 5% level of significance **= significant at 1% level of significance

n.s=non-significant

Table (4):- Effect of site and season on concentration of some macro and micro nutrients in pine and oak leaves.

	Ions	Zawita (pine forest) [^]				Hijran (oak forest) [^]	
		Pine trees		Oak trees		Spring	Autumn
		Spring	Autumn	Spring	Autumn		
Mean	N	1.28	1.69	1.90	1.49	Cal.t = 3.77*	
	P	0.26	0.26	0.34	0.35	Cal.t = 0.13 n.s	
	K ⁺	1.35	1.36	1.78	1.08	Cal.t = 0.05 n.s	
	Na ⁺	0.35	0.18	0.24	0.23	Cal.t = 3.36*	
	Ca ²⁺	2.10	2.02	2.07	2.14	7.84	n.s
	Mg ²⁺	1.93	3	2.83	3.00	0.46	n.s
	Zn ²⁺	5.29	15.44	4.92	11.43	0.71	n.s
	Cu ²⁺	4.60	2.36	4.65	2.69	4.36	n.s
	Mn ²⁺	28.88	30.92	24.88	20.46	13.85**	
	Fe ²⁺	42.88	73.31	27.16	87.02	0.55	n.s
		Cal.t = 6.87**		Cal.t = 7.03**			

[^] The comparison between concentration of macro and

**= significant at 1% level of significance n.s = non-significant

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PHOSPHOROUS BEHAVIOR FROM DIFFERENT FERTILIZER RESOURCES IN SOME CALCAREOUS SOILS- KURDISTAN REGION-IRAQ

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ABSTRACT

A laboratory experimental was conducted at the laboratories of soil sciences and water / College of Agriculture/ University of Duhok, to study the behavior of phosphorous from three different sources of phosphate fertilizers (MAP, DAP, and TSP) in three different soil textures (Clay loam, silty clay loam and loamy) of calcareous soils under three different incubation time (48, 168 and 336) h. The studied soils were characterized by high soil pH, high level of calcium carbonate and low organic matter content. Three levels of phosphorous (0, 50 and 100) mg. P Kg soil⁻¹, from different phosphate fertilizers were added to the studied soils. The soils were kept at fixed temperature (298°K) and at soil moisture (75) % of the field capacity during studied incubation periods, till reaching equilibrium with the soils. The results showed that with increasing the amount of applied P levels and incubation time, the added P under go to react with soil components and transform to form more stable phosphate compounds as OCP, -TCP and HA. As well as the soil properties of studied soils influenced on the period of phosphorous transformation in soil, as the clay content, CaCO₃%, OM%, and soil pH value of the soil increased, the transformation period of added P fertilizers to form more stable phosphate compounds in studied soils decreased. Generally OCP and -TCP are governing solubility of P in studied soils.

KEY WORDS: phosphorous behavior, phosphorous fertilizers, calcareous soil, Soil texture, incubation time.

INTRODUCTION

The phosphorus consider as an essential macronutrient for plant growth (Mengel and Kirkby, 2001). Two thirds of the soils over the entire world suffer from low availability of phosphorous to plants, (Lynch, 2011). Usually the reason of low availability of soil phosphorous to plant and its immobility in soil is the low solubility of phosphate minerals in soil, (Stevenson & Pierzyski, 2004). The chemistry of phosphorus in soils is every complex system, (Condron and Teissen, 2005).

For many years researchers overall the world gave more attention to phosphate fertilizers reactions in the soil, especially to super phosphate due to common use by the farmers comparing with other phosphate fertilizers. In general the coarse soil texture such as sandy and sandy loam have lower capability in phosphate fixation comparing with fine textural soils like, clay and clay loam, which have higher capacity in phosphorous fixation, because the fine textural soils have larger surface area and sites of phosphate adsorption, rather than iron and aluminum oxides which fix phosphate in soils,

(Tisdale et al., 1997, Sparks, 2007, Waqas, 2008 and Shen *et al.*, 2011). After adding phosphate fertilizers to calcareous soil, most of it changed to non available forms for plants, only small portion of added fertilizer will be readily available for plants. Havlin et al., (2007) and Obreza, et al., (1993) mentioned that about (70-90) % of applied phosphorous fertilizer to soils high in soil pH value, high in calcium carbonate content, such as calcareous

soils, will retain in soil or change to fixed forms, because phosphate subjected to fixation (adsorption and precipitation) by calcium carbonate (Amedy, 2000, Havlin et al., 2007 and Rahman, 2013). Tisdale et al., (1997), they mentioned that in the first year only about 20% of the added phosphorous from superphosphate fertilizer will be available for plant, while the remaining amount exposed to different reactions in soil with time and changed to less available form for plants.

Also in their studies they have been differentiated the behavior of phosphate fertilizer upon the solubility diagram approach, while these studies doesn't gave clear idea to the kinetic reactions in the soil.

The importance of kinetic solubility attributed to ability of predicting phosphate availability to plants. These made the researchers to introduce the time as transformation factor. Barrow and Shaw (1975), Barrow (1979 and 1983), Amedy, (2000) and Rahman, (2013) have been pointed out that the time of phosphorous reaction with soil components decreases the efficiency of applied phosphorous with time.

Also phosphorous may immobilize by exchanging with exchangeable Ca on the active sites of CaCO₃ (Tisdale et al., 1997, Sposito, 1994, 2008 and Hussein, 2009). As well as the added P may reacts with dominant Ca²⁺ in soil solution and precipitate, forming new phosphate compounds like monocalcium phosphate (MCP), and Dicalcium phosphate (DCP), which are available forms to plants. Thus with time gradually change to tricalcium phosphate (TCP), octocalcium phosphate (OCP), and hydroxyl apatite (HA), fluorapatite, chloroapatite, oxiapatite, carbonate apatite, which are more stable forms of phosphorous and less available to plants in alkaline soils, (Al-Sulaivani 1993, Amedy, 2000 and Shen, et al., 2011, Rahman, 2013). Reddy et al., (1999), found that extent of phosphorous adsorption relatively is higher at the beginning and with time gradually decreased with increasing fertilization rate of P. Mam Rasoul and Saeed, (2014), found that the governing key of phosphorous availability in calcareous soils is the adsorption process. Al-Jubouri, (1999), has been ranked the solubility of phosphate compounds according to its solubility as follows (MCP > DCP > TCP > OCP > HA > FA).

Due to the soils of Kurdistan region- Iraq, classified as Calciorthid soils, which characterized by high soil pH value, high in calcium carbonate content and low organic matter content and cultivated intensively, thus lead to suffer from phosphate deficiency. In the last decades several studies were conducted about Phosphorous status in these soils, but no one have been studied the

effect of the types of different phosphorous fertilizer types on phosphorous status in different soil texture of calcareous soils. Therefore, this study was devoted to compare the solubility behavior of several P fertilizers [monoammonium phosphate (MAP), diammonium phosphate (DAP) and triple super phosphate (TSP)], in calcareous soils of Duhok and Erbil governorates- Kurdistan region/ Iraq.

MATERIALS & METHODS

Three surface soil samples were collected from the active zone depth for plant root (0-30) cm of cultivated fields (Girsheen village/ Summel district and Feeshkhabour village / Zakho district in Duhok Governorate and College of Engineering / University of Salahaldeen/ Erbil - Kurdistan region- Iraq).

Soil samples were prepared, then physical and chemical analysis were done on the 2mm sieving samples table (1), particle size distribution determined using hydrometer method, (Ryan *et al.*, 2003). While the chemical analysis included: (soil pH, electrical conductivity (EC), which measured by portable pH- and EC- meter model HANA and soluble Ca²⁺ determined in soil extract (1:5), titrimetrically with ethylene diamine tetra acetic acid disodium salt (EDTA-2Na), as mentioned by (Ryan *et al.*, 2003). Available phosphorus have been extracted using Olsen's method (Na-bicarbonate 0.5M) adjusted at pH (8.5), and P determined spectrometrically according to (Ryan *et al.*, 2003), using spectrophotometer shimadzo at wave length 882nm at wave length 660nm. The ionic strengths of soil extract calculated according to (Griffen and Jurinak, 1974). Where the activity coefficients of ion species (Ca²⁺ and H₂PO₄⁻) were calculated using Davies modified equation and ion activity species (Ca²⁺ and H₂PO₄⁻) were calculate by Law s low as mentioned by, (Lindsay, 1979)

Table (1) :-Some physical and chemical properties of studied soils.

Soil Properties	Location		
	Girsheen	Feeshkhabo	Erbil
Soil texture	Clay loam	Silty clay loam	loamy
EC (dS.m ⁻¹) in soil extract (1:10) at 25°C	0.45	0.67	0.37
pH in soil extract (1:10) at 25°C	7.79	8.00	7.95
CaCO ₃ (g.kg ⁻¹)	192.50	300.00	115.00
Active CaCO ₃ ⁼ (g.kg ⁻¹)	155.00	87.50	66.00
Soluble cations (mol _c .m ⁻³)			
Ca ²⁺	2.25	2.06	1.6
Mg ²⁺	1.00	0.79	0.55
Na ⁺	0.07	0.27	0.32
K ⁺	0.16	0.15	0.07
Soluble anions (mol _c .m ⁻³)			
HCO ₃ ⁼	2.64	4.50	2.10
CO ₃ ⁼	trace	trace	trace
Cl ⁼	0.45	0.77	0.85
SO ₄ ⁼	0.30	0.16	0.50
O. M (g.kg ⁻¹)	17.80	19.80	12.00
Cation exchange capacity (CEC) (Cmol _c .Kg ⁻¹)	31.32	21.49	27.20

This study was conducted to study the solubility of three levels of phosphate from monammonium phosphate (MAP), (28:28:0) %, diammonium phosphate (DAP), (18:46:0) % and triple super phosphate (TSP), (46% P₂O₅) fertilizers, in three different soil textures of studied calcareous soils (Clay loam from Girsheen village, silty clay loam from Feeshkhabour and loamy soil from College of Engineering village, using double function solubility diagram. Rather than identifying the phosphate minerals which control phosphate solubility in studied soils at different incubation time (48, 168 and 336) h. For this purpose (100g) of each soil sample with three replicates have been treated with different levels (0, 50 and 100 mg. P Kg soil⁻¹) from each phosphate fertilizers. The studied soils were kept under fixed temperature (298°K), and at (75%) soil moisture of field capacity for incubation periods (48, 168 and 336) h., after reaching equilibrium the phosphorous concentration in studied soils also were measured, according to Olsen's method describes by (Ryan *et al.*, 2003). The phosphate potential has been plotted against lime potential using double function solubility diagram (Aslying, 1954 and Al-Sulaivany, 1993).

RESULTS AND DISCUSSION

Calcium carbonate potential and phosphate potential parameters used in determination of phosphorous solubility by drawing solubility diagrams of dicalcium phosphate dihydrate (DCDP), octacalcium phosphate (OCP), beta-tricalcium phosphate (-TCP) and hydroxyl apatite (HA), according to the dissociation constant values ($\log K^*$) of the above phosphate minerals which are equal to (0.63, 11.76, 10.18, and 14.46) respectively, (Lindsay, 1979). Figures (1, 2 and 3) and appendix (1) show some physiochemical parameter of loamy soil texture (of college of engineering location from Erbil), which fertilized by different levels phosphate fertilizers (zero, 50 and 100) mg. P Kg soil⁻¹, from MAP, DAP and TCP phosphate fertilizers, after incubation for different periods (24, 168, and 338) h. By plotting the obtained results on double function solubility diagram, it found that the main unit in all phosphate fertilizer types (monocalcium phosphate, MCP) and at various added levels, were transformed in loamy soil after incubation period (24 and 168) h, to be locate between to (OCP and -TCP) curves, and located under saturated status with OCP because located under OCP curve. This may refer to the possibility that

OCP may control and govern the phosphorous concentration in soil solution of this soil. But when located over saturated status with -TCP, this describes that the present phosphate compound has similar solubility of that -TCP, and is responsible of providing the soil solution with phosphate. Thus may be used as an indicator of non stability of the OCP to form a transformation phase state "Metastable" (Brown and Sartain, 2000). Both OCP and -TCP are low soluble compounds of phosphorous and less available to plants. As well as with increasing the added P levels the solubility of phosphorous increased in comparison with control. This may refer to the soil properties, [high soil pH, clay content, active CaCO₃ content %, Ca²⁺ and cation exchange capacity of the soil (CEC)] which increases buffering capacity of the soil, then increases reaction of added P with time to form more stable P compounds of low solubility. Similar results found by, (Al-Sulaivani 1993, Brown and Sartain, 2000, Esmail, 2012, and Rahman, 2013). While under the effect of the same treatments, but for incubation time (338h), the phosphate solubility shifted toward under saturation state of -TCP of more solubility comparing with control, and located over saturation state with HA of lesser solubility Figure (3). This means that -TCP is responsible for P concentration in soil solution, and may be attributed to that the added P with time reacted more with soil components especially with Ca²⁺ and CaCO₃ and changed to more stable state of low solubility.

Figure (4) and appendix (2) appear the effect of physiochemical parameter of clay loam texture soil (of Girsheen location), and different levels (zero, 50 and 100) mg. P Kg soil⁻¹, of MAP, DAP and TCP, after incubation for different periods (24, 168, and 338)h, after plotting it found that an application level of (Zero and 50 mg. P Kg soil⁻¹) of MAP and DAP, for incubation period, is located between (OCP and -TCP) curves, under saturated status with OCP, this demonstrate that OCP is responsible for P concentration in soil solution. When at P levels (50) mg. P Kg soil⁻¹ for incubation period (24 h) and at level (100) mg. P Kg soil⁻¹ of all applied P fertilizers for incubation time (168h) the solubility of P shift to be under saturated status with -TCP and over saturation with HA. Figures (5 and 6) showed that all applied P levels at the studied incubation periods were located between -TCP and HA which indicated

that it located under saturated with -TCP, which was responsible of supplying soil solution with P, exception of added P fertilizer MAP at level of (50 mg. P Kg soil⁻¹) which located on the OCP curve for incubation time (24h), that mean it was at equilibrium state with P concentration in soil solution.

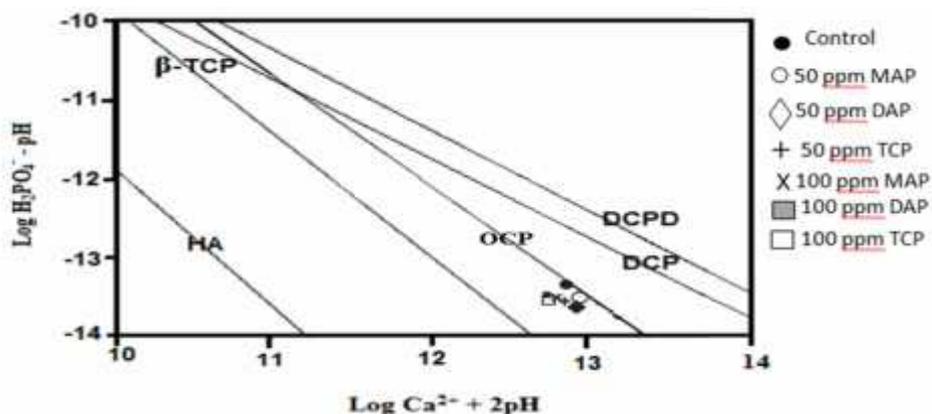


Fig.(1):- Effect of different levels of MAP, DAP and TCP in solubility equilibrium of phosphate in loamy soil of College of Engineering -Erbil, after 48 hours

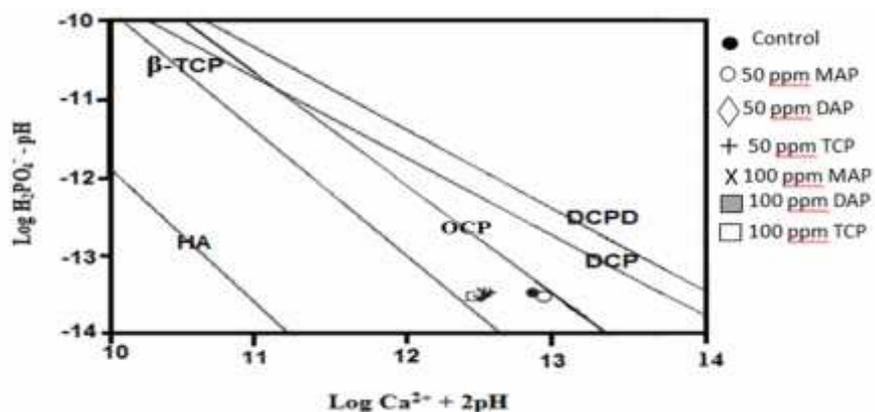


Fig. (2):- Effect of different levels of MAP, DAP and TCP in solubility equilibrium of phosphate in loamy soil of College of Engineering -Erbil, after 168 hours

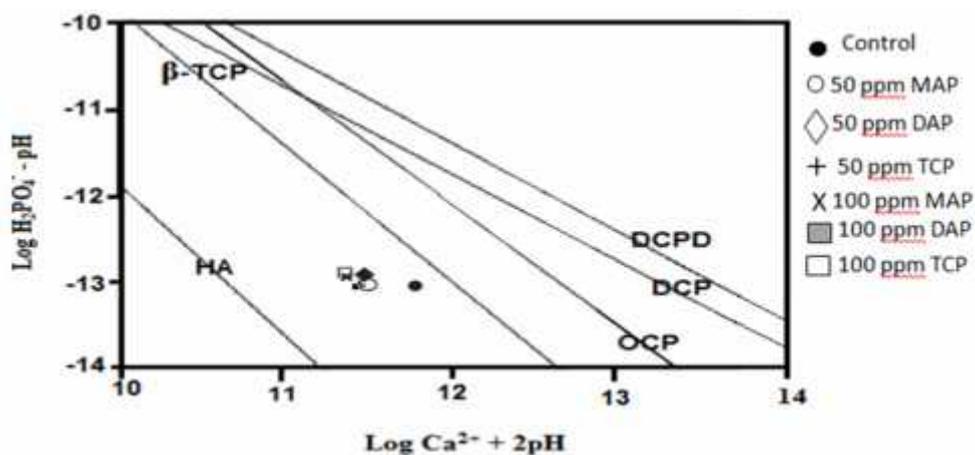


Fig. (3):- Effect of different levels of MAP, DAP and TCP in solubility equilibrium of phosphate in loamy soil of College of Engineering -Erbil, after 336 hours

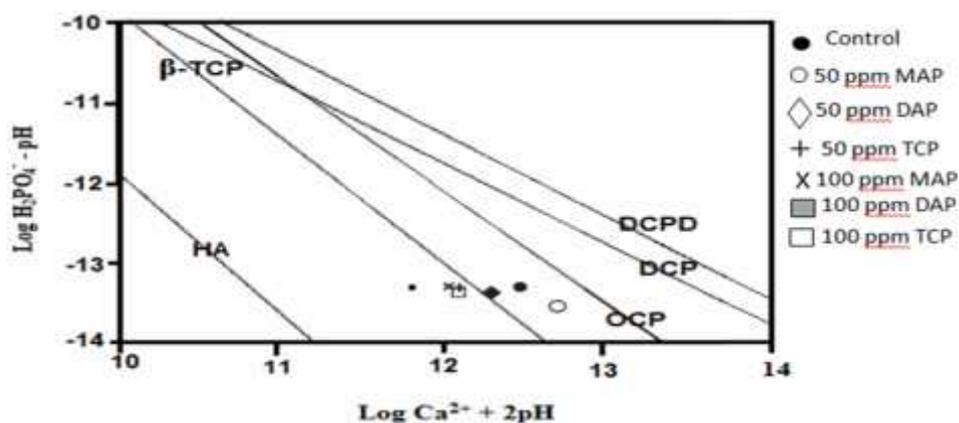


Fig. (4):- Effect of different levels of MAP, DAP and TCP in solubility equilibrium of phosphate in Clay loam soil of Girsheen-Duhok after 48 hours

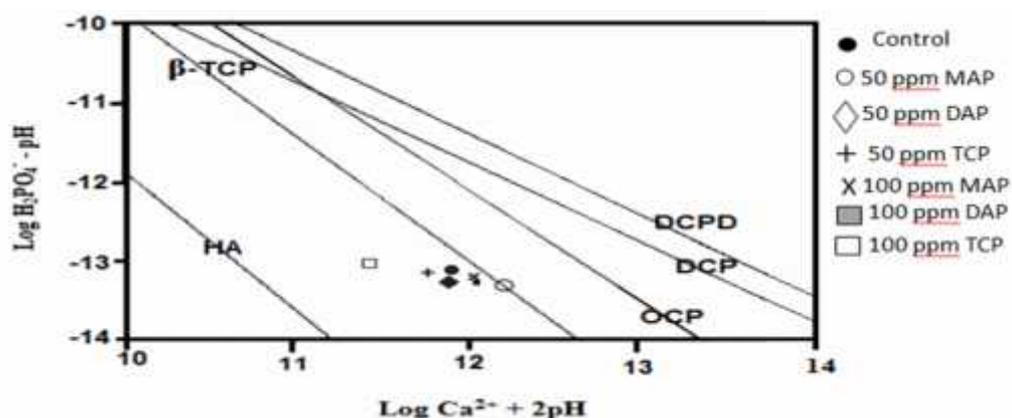


Fig. (5):- Effect of different levels of MAP, DAP and TCP in solubility equilibrium of phosphate in Clay loam soil of Girsheen-Duhok after 168 hours

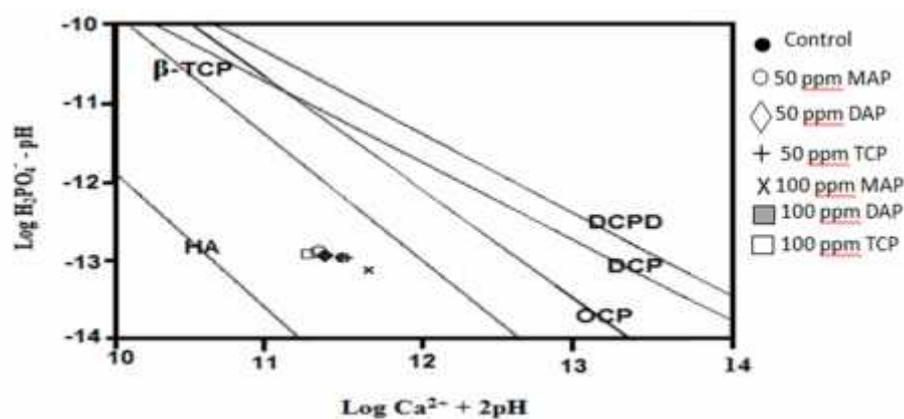


Fig. (6):- Effect of different levels of MAP, DAP and TCP in solubility equilibrium of phosphate in Clay loam soil of Girsheen-Duhok after 336 hours

This may be due to the physiochemical properties of the soil as mentioned before, as well as the concentration of added phosphorous, and differences in fertilizers properties that influences the soil pH when added to the soil. Thus the applied P reacted with soil component, to form more

stable phosphorous compounds with increasing incubation time, and the existence of OCP which is higher in solubility than HA. Therefore, OCP is responsible and governing the phosphate concentration in soil solution and may use as indicator of non stability of OCP and with time may be transform to lower soluble phosphate compound -TCP and HA. These results are agreed with those state out by (Al-Sulaivani 1993, Brown and Sartain, 2000, Esmail, 2012, and Rahman, 2013).

Figures (7,8 and 9) show that all added P levels and for (24, 168, and 338)h, in clay soil texture (Feeshkhabour location), changed to form more

stable compound of OCP which located at under saturated state of OCP and with increasing incubation time transformed to less soluble P compounds -TCP at incubation period (338h) because after plotting the obtained data it located at over saturated curve of -TCP, that showed precipitated in soil and transform to non soluble P mineral. This may be attributed to the same reasons which mentioned before, with indication that in the studied soils the added P fertilizers transformed and shift more rapidly to more stable P compounds of OCP and -TCP. This may be related to the clay, CaCO₃ % content, high pH value of the soil and organic matter content (OM) % of this soil (table1) which is greater in comparing with other studied soils. This may refer to increases in the surfaces of reaction area with added P fertilizers. These results were in agreement with those found by (Al-Sulaivani 1993, Brown and Sartain, 2000, Esmail, 2012, and Rahman, 2013).

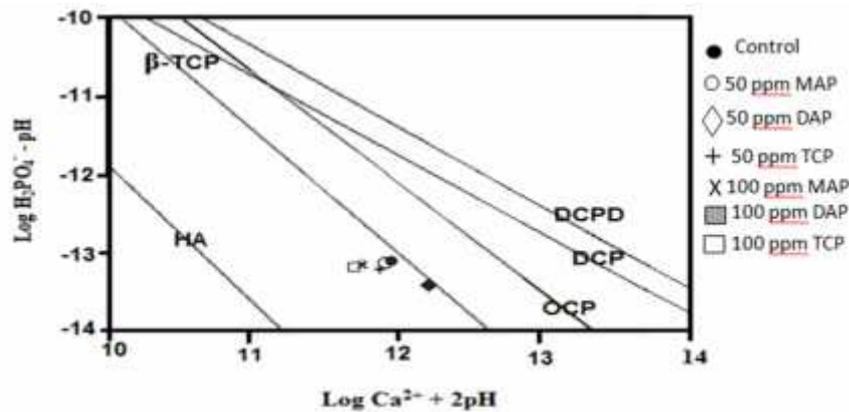


Fig. (7):- Effect of different levels of MAP, DAP and TCP in solubility equilibrium of phosphate In Silty Clay loam soil of Feeshkhabour-Duhok after 48 hours

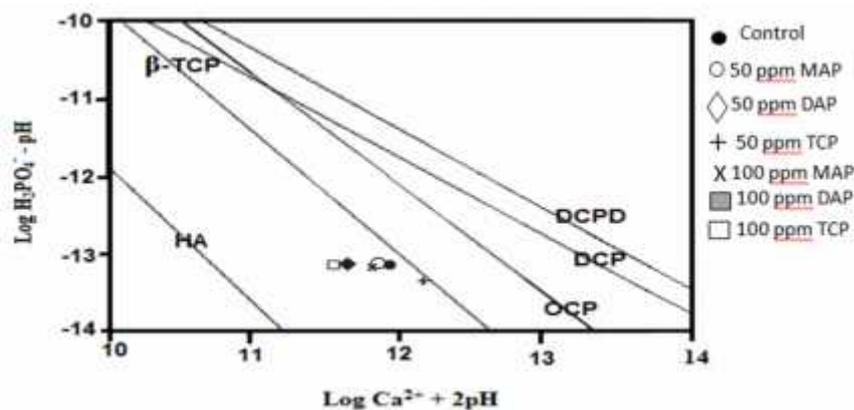


Fig. (8):- Effect of different levels of MAP, DAP and TCP in solubility equilibrium of phosphate In Silty Clay loam soil of Feeshkhabour-Duhok after 168 hours

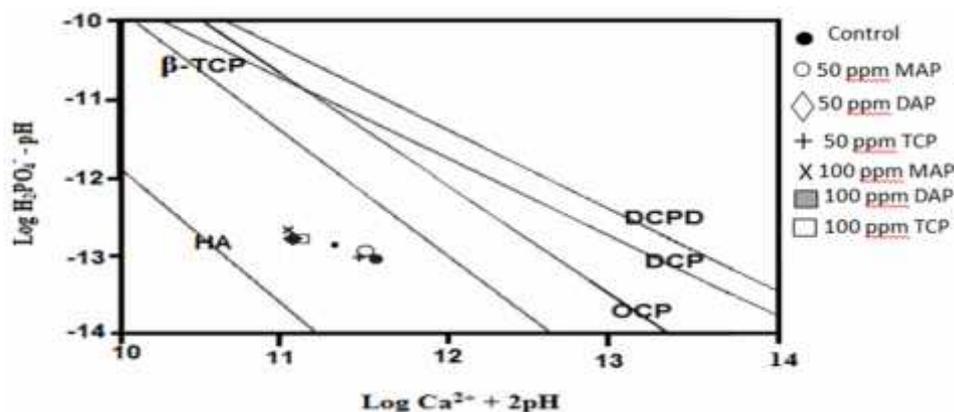


Fig. (9):- Effect of different levels of MAP, DAP and TCP in solubility equilibrium of phosphate In Silty Clay loam soil of Feeshkhabour-Duhok after 336 hours.

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(Appendix 1) Some physiochemical parameters of loamy soil of Erbil after fertilization and incubation for (48,168, and 336) hours which use for identifying phosphate minerals.

Location	Soil texture	Incubation time (h.)	Fertilizer resource (ppm)	Ion activity coefficient (f_i)		Ion Activity		pH	Phosphate potential ($H_2PO_4^-$ - pH)	Calcium- potential (Ca^{2+} + 2pH)
				$H_2PO_4^-$	Ca^{2+}	$H_2PO_4^- \times 10^{-6}$	$Ca^{2+} \times 10^{-5}$			
college of Engineering - Erbil	Loamy	48	Control	0.914	0.701	12.00	14.00	8.40	-13.329	12.947
			(50) NP	0.905	0.671	6.00	11.00	8.47	-13.699	12.984
			(100) NP	0.904	0.668	6.00	7.00	8.56	-13.776	12.972
			(50) DAP	0.901	0.659	6.00	9.00	8.48	-13.718	12.925
			(100)DAP	0.905	0.671	6.00	9.00	8.42	-13.649	12.808
			(50) TSP	0.902	0.661	6.00	8.00	8.42	-13.650	12.739
			(100) TSP	0.907	0.677	6.00	7.00	8.44	-13.667	12.745
			Control	0.904	0.667	10.00	13.00	8.34	-13.570	12.801
		168	(50) NP	0.896	0.646	10.00	10.00	8.49	-13.727	12.983
			(100) NP	0.896	0.646	10.00	7.00	8.36	-13.590	12.564
			(50)DAP	0.895	0.642	10.00	9.00	8.34	-13.547	12.611
			(100)DAP	0.895	0.641	10.00	8.00	8.32	-13.562	12.567
			(50) TSP	0.896	0.644	10.00	8.00	8.32	-13.537	12.509
			(100) TSP	0.891	0.631	10.00	7.00	8.33	-13.577	12.481
			Control	0.894	0.671	6.00	13.00	7.86	-13.093	11.830
			(50) NP	0.885	0.597	6.00	9.00	7.85	-13.089	11.650
		336	(100)NP	0.898	0.635	6.00	13.00	7.75	-12.982	11.601
			(50) DAP	0.893	0.628	6.00	8.00	7.79	-13.029	11.492
			(100) DAP	0.894	0.619	6.00	8.00	7.72	-12.962	11.335
			(50) TSP	0.890	0.621	6.00	7.00	7.83	-13.065	11.480
			(100) TSP	0.886	0.593	6.00	8.00	7.71	-12.953	11.323

(Appendix 2) Some physiochemical parameters of Clay Loam soil of Girsheen (Duhok) after fertilization and incubation for (48,168, and 336) hours which use for identifying phosphate minerals

Location	Soil texture	Incubation time (h.)	Fertilizer resource (ppm)	Ion activity coefficient (f _i)		Ion Activity		pH	Phosphate potential (H ₂ PO ₄ ⁻ - pH)	Calcium- potential (Ca ²⁺ + 2pH)
				H ₂ PO ₄ ⁻	Ca ²⁺	H ₂ PO ₄ ⁻ × 10 ⁻⁶	Ca ²⁺ × 10 ⁻⁵			
Girsheen	Clay Loam	48	Control	0.913	0.695	6.00	12.00	8.17	-13.399	12.410
			(50) NP	0.913	0.694	6.00	8.00	8.42	-13.649	12.742
			(100) NP	0.898	0.651	6.00	7.00	8.23	-13.472	12.308
			(50) DAP	0.911	0.687	6.00	8.00	8.12	-13.350	12.131
			(100)DAP	0.899	0.654	6.00	7.00	8.09	-13.325	12.056
			(50) TSP	0.900	0.655	6.00	7.00	8.07	-13.302	11.977
			(100) TSP	0.896	0.645	6.00	7.00	8.12	-13.351	12.084
			Control	0.892	0.634	10.00	10.00	7.95	-13.183	11.904
		168	(50) NP	0.884	0.610	10.00	11.00	8.11	-13.353	12.237
			(100) NP	0.882	0.607	10.00	8.00	8.04	-13.283	11.977
			(50)DAP	0.880	0.600	10.00	8.00	7.93	-13.175	11.780
			(100)DAP	0.891	0.629	10.00	10.00	8.01	-13.256	12.011
			(50) TSP	0.890	0.627	10.00	7.00	8.10	-13.336	12.045
			(100) TSP	0.887	0.621	10.00	8.00	7.77	-13.015	11.441
			Control	0.904	0.670	6.00	13.00	7.67	-12.900	11.470
			(50) NP	0.893	0.624	6.00	11.00	7.65	-12.891	11.353
		336	(100)NP	0.597	0.643	6.00	10.00	7.72	-12.951	11.413
			(50) DAP	0.892	0.620	6.00	10.00	7.89	-13.135	11.758
			(100) DAP	0.897	0.635	6.00	10.00	7.74	-12.979	11.502
			(50) TSP	0.900	0.659	6.00	11.00	7.76	-12.988	11.553
			(100) TSP	0.896	0.645	6.00	8.00	7.70	-12.939	11.300

(Appendix 3) Some physiochemical parameters of Silty Clay Loam soil of Feeshkhabour (Dohuk) after fertilization and incubation for (48, 168, and 336) hours which use for identifying phosphate minerals

Location	Soil texture	Incubation time (h.)	Fertilizer resource (ppm)	Ion activity coefficient (f_i)		Ion Activity		pH	Phosphate potential ($H_2PO_4^- - pH$)	Calcium- potential ($Ca^{2+} + 2pH$)
				$H_2PO_4^-$	Ca^{2+}	$H_2PO_4^- \times 10^{-6}$	$Ca^{2+} \times 10^{-5}$			
Feeshkhabour	Silty Clay Loam	48	Control	0.909	0.682	6.00	11.00	7.95	-13.175	11.949
			(50) NP	0.906	0.676	6.00	10.00	7.94	-13.168	11.881
			(100) NP	0.904	0.667	6.00	8.00	8.18	-13.408	12.244
			(50) DAP	0.902	0.663	6.00	8.00	7.97	-13.201	11.859
			(100)DAP	0.901	0.661	6.00	8.00	7.94	-13.181	11.798
			(50) TSP	0.906	0.673	6.00	8.00	7.95	-13.175	11.794
			(100) TSP	0.898	0.651	6.00	7.00	7.96	-13.194	11.741
		168	Control	0.889	0.625	10.00	12.00	7.94	-13.174	11.967
			(50) NP	0.884	0.611	10.00	11.00	7.90	-13.142	11.856
			(100) NP	0.870	0.572	10.00	9.00	7.90	-13.143	11.726
			(50)DAP	0.871	0.576	10.00	9.00	8.12	-13.365	12.181
			(100)DAP	0.882	0.605	10.00	10.00	7.92	-13.157	11.824
			(50) TSP	0.871	.575	10.00	9.00	7.94	-13.189	11.841
			(100) TSP	0.873	0.581	10.00	8.00	7.89	-13.125	11.689

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دووهمین کونفرانسی زانستی یی چاندنی ل ژیر دروشمی
بهرف چاندنه کا باشرت

المؤتمر العلمي الزراعي الثاني تحت شعار
نحو زراعة افضل

٢٦-٢٧ نيسان ٢٠١٦

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ژماره کا تاییهت
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