Effect of Iron, KNO3, GA3 and Humic acid on Growth and Leaf Nutrients of Almond *(Prunus amygdalus L.)* Transplants 1-Vegetative Growth

Azad **A**hmed **M**ayi
Department of Horticulture, College of Agriculture, University of Duhok, Kurdistan Region, Iraq.
(Accepted for publication: October 10, 2016)

Abstract

This investigation was conducted during the growing season of 2011-2012, in the nursery of the Malta station/ Duhok. Kurdistan region, Iraq. On two year old Almond transplants, grown in polyethylene bags. The transplants were foliar sprayed two times; 20th April , 10th May 2011, with three levels of Iron (0, 40, 80 mg.l^{-1}), three levels of GA3 (0, 250 and 500 mg.l^{-1}), four levels of KNO3 (0, 50,100, and 200 mg.l^{-1}) and three levels of Humic acid (0, 25 and 50 mg.l^{-1}). The transplants were left under nursery conditions till 1 October, 2011. The experimental was arranged as Factorial including Randomized Complete Block Design (R.C.B.D) with five replicates with five transplants per unit. Foliar spray of Humic acid at 50mg.l^{-1} increased significantly stem diameter (0.57 cm, lateral shoot length (25.33 cm), lateral shoot number (20.67), leaves number (62.67), leaves fresh (6.30%) and dry weight (3.33%). GA3 at 250 mg.l^{-1}significantly increased leaves area (12.56 cm2), shoot fresh weight (25.4%), and dry weight (15.22%) and root length (38cm). However, 40mgFe.l^{-1} increases significantly chlorophyll content (66.63%). While, KNO3 significantly affected on root fresh weight (13.16 %), and dry weight (7.62%).

Keywords: *Fe, GA3, KNO3, Humic, leaf nutrients, Almond transplants.*

Introduction:

The almond (*Prunus dulcis,* syn. *Prunus amygdalus, Amygdalus L. communis, Amygdalus dulcis)* (Bahyiv) in Kurdistan or badam in Indian English, from Persian: بادام) is a species of tree native to the Middle East and South Asia. "Almond" is also the name of the edible and widely cultivated seed of this tree. Within the genus *Prunus*, it is classified with the peach in the subgenus *Amygdalus*, distinguished from the other subgenera by the corrugated shell (endocarp) surrounding the seed (Amira,2013) *Prunus amygdalus* is a member of the family Rosaceae. The sweet cultivated almond originated from bitter-seeded species that evolved in the deserts and foothills of central and southwest Asia (Kester, and Ross 1996). Although the exact origin of almonds has been difficult to determine, it has been suggested that almonds are native to the temperate, desert areas of western Asia, from which they gradually spread to other regions of the world. Domesticated almonds have been documented from Bronze Age sites in Greece and Cyprus and were common in Palestine by 1700 BC. In addition to the cultivated almond, *Prunus dulcis*, more than 30 wild or minor cultivated almond species are known to exist (Denisov, 1988) Wild populations of almond species, representing a wide range of morphological and geographical forms, have evolved throughout southwest and central Asia from Turkey and Syria (Kurdistan of Iraq, Turkey and Syria) into the Caucasus Mountains, through Iran, and into the deserts of the Tian-Shan and Hindu Kush Mountains of Tajikistan, Uzbekistan, and Afghanistan (Amira, 2013, and Denisov, 1988). Wild almond species commonly grow in areas between 28^{0}N and 38$^-$N and between 41$^-$E and 54$^-$E, and at altitudes from 1100 m to 2700 m (Ghahreman, 1999). Iran is optimally situated for growing almonds. Nearly 20 of the wild species have been reported from Iran, indicating that the country is within the center of origin for almonds (Gorttapeh *et al*.,2006). Therefore, it is necessary to investigate the possibilities of improving growth of Almond applying several cultural practices such as fertilization or spraying by some growth regulators. Soil is regard as the main source of iron nutrient as most of Kurdistan soils contains large quantities of this element, yet the available quantities for absorption by the plant may be low and do not meet the plant demands (Azad,2007). Since most of these soils are calcareous and their pH is very high (Al-Zubaidi, 1989), and this tends to decrease iron availability in the soils, besides the continuous trees removal of iron from the soil. Subsequently, the application of iron to improve growth of plants is required, since iron plays an important role in the synthesis of chlorophyll and in forming of many hymes protein such as different cytochromes which participate in the respiration process and also in the formation of the peroxidase and catalase enzymes that dominate some different functions in the plant metabolism (Marschner, 1986 and Tsipouridis, *et al*.,2006) .

GA_3 is the most familiar commercial growth promoter. It facilitates plant elongation, by increase cells division and expansion (Hartman *et al.*,2002) GA_3 delays leaves senescence, by delaying chlorophyll, protein and RNA destruction, in addition to synthesis of these components (Wasphy,1995).

Humic Substances is no one single chemical known as humic acid, since the chemical structure has never been completely defined. These materials are composed of complicated organic mixtures which are linked together in a random manner, resulting in extraordinarily complex materials. It has been suggested that no two molecules of humus are exactly the same. The special properties of humic materials result from this extreme heterogeneity and their high chemical reactivity Humic materials have an abundance of carboxyl groups and weakly acidic phenolic groups, which contribute to their complexation and ion-exchange properties. They exhibit both hydrophobic and hydrophilic characteristics and can bind to soil mineral surfaces (Mikkelsen, 2005).

Potassium takes part in many important processes, regulating the opening and closing of stomata, the transport of organic and inorganic ions within the plant. Sufficiency level of (K%) in olive leaves were (0.8-1.3), which sampled from the mid-length of current year's young shoots that do not bear fruit. (Wassel, 2007).

Thus the aims of this study is to find out the most suitable concentrations of Fe, GA_3,KNO3 and Humic acid used as a foliar spray for best growth and leaf nutrients of almond transplants.

Materials and Methods

This investigation was conducted during the growing season of 2011-2012, in the nursery of the Malta station/ Duhok, Kurdistan region. Iraq. Almond transplants, two year old, grown in polyethylene bags containing 3Kg of soil. The transplants were foliar sprayed two times; 20^{th}April, 10^{th} May 2011, with three levels of Iron (0, 40, 80 $mg.l^{-1}$), three levels of GA3 (0, 250 and 500 $mg.l^{-1}$), four levels of KNO3 (0, 50,100, and 200 $mg.l^{-1}$) and three levels of Humic acid (0, 25 and 50 $mg.l^{-1}$). The transplants were left under nursery conditions till 1 October, 2011. The experimental was arranged as Factorial including Randomized Complete Block Design (R.C.B.D) with five variables (Fe, GA3, KNO3 and Humic acid) and five replicates with five transplants per unit. The results were analyzed statistically and the comparison was made using Duncan's multiple range tests at 5% probability (Al-Rawi and Khalaf-Alla 1980). All the data were tabulated and statistically Analyzed with computer using (SAS,2000).

Measurements:

1-Mean Stem Diameter (cm).

2-Mean primary branches length (cm) per transplants.

3-Mean of Primary Branches Number per transplants.

4-Mean Leaves Number per transplants;

5-Mean Leaf Area (cm^2).

6-Total Chlorophyll Content (%): It was determined by using SPAD- 502.

7- Leaves, Shoots and Roots fresh and dry Weight (g).

8- Mean Primary Roots Length (cm) per transplants.

Results:

Stem diameter (cm):

Table (1) declears that foliar spray with Humic acid at $50mg.l^{-1}$ significantly increased stem diameter that gave the highest stem diameter value (0.57 cm) as compared with other treatments.

Lateral branches length (cm):

Reveals that the almond transplants when treated with Humic acid at $50mg.l^{-1}$ gave the highest value of lateral branches length (25.33 cm), which was significantly superior on the rest of treatment.

Branches number:

Results in Table (1) showed that the transplants when treated with Humic acid at $25mg.l^{-1}$ gave the highest value of lateral branch number (20.67).

Leaves number:

In Table (1) noticed that almond seedlings when treated with Humic acid at $50mg.l^{-1}$ produced the highest number of leaves reached to 62.67).

Leaf area (cm2):

In Table (1) it is found that the foliar spray of GA3 had a significant stimulatory effect on leaf area parameter of almond were transplant when the almond transplants treated with 250 $mg.l^{-1}$ GA3 gave the highest value of leaf area (12.56 cm^2).

Chlorophyll %:

Data presented in Table (1) declared that the leaves content of chlorophyll significantly increased with applying the Iron, where the highest value of chlorophyll percentage (66.63%) was recorded when the almond transplants were treated with 40 mg.l^{-1} iron.

Table (1): Effect of different organic and chemical fertilization on growth and leaf nutrients of almond transplants.

parameters / treatment	Stem diameter (cm)	lateral shoot length (cm)	lateral shoot number	Leaves number	Leaf area $(cm)^2$	chlorophyll (%)
Control	0.47b	18.33bc	6.00e	32.67fg	10.45ab	48.30f
Fe (40 mg.l^{-1})	0.43b	16.67c	9.00cd	46.33cd	12.26a	65.63a
Fe (80 mg.l^{-1})	0.43b	18.00bc	10.67c	48.67bc	7.32b	54.90c
GA3 (250 mg.l^{-1})	0.43b	17.00c	3.67f	32.00fg	12.56a	53.10d
GA3 (500 mg.l^{-1})	0.47b	19.00bc	2.00f	29.00g	10.55ab	57.77b
K2O (50 mg.l^{-1})	0.40b	14.00c	10.00c	42.00de	10.17ab	57.97b
K2O(100 mg.l^{-1})	0.43b	23.00ab	13.33b	49.00bc	11.47b	50.23e
K2O(200 mg.l^{-1})	0.43b	18.00bc	7.67de	37.00ef	7.66b	52.77d
HA (25 mg.l^{-1})	0.50ab	17.67c	19.67a	53.33b	7.66b	48.77e
HA (50 mg.l^{-1})	0.57a	25.33a	20.67a	62.67a	10.45ab	53.23d

Means within a column, following with the same latter are not significantly different according to Duncan multiple range test at the probability of 5% levels

Leaves fresh weight %:

Table (2) showed that spraying Humic acid at level 50mg.l^{-1} significantly increased leaves fresh weight (6.33%) compared with other treatments.

Leaves dry weight %:

Table (2) showed that spraying Humic acid at level 50mg.l^{-1} significantly increased leaves dry weight and gave the highest value (3.33%) when compared with control treatment.

Shoot fresh weight %:

Data presented in Table (2) showed that when the almond transplant treated with GA3 at level 250mg.l^{-1} significantly effected on shoot fresh weight gave the highest value (25.4%) compared with the untreated treatment.

Shoot dry weight %:

In Table (2) showed that almond transplants when treated with GA3 at 250mg.l^{-1} significantly gave the highest value (15.22%).

Table (2): Effect of different organic and chemical fertilization on growth and leaf nutrients of almond transplants.

parameters / treatment	Shot fresh weight (g)	Shot dry weight (g)	Leaf fresh weight (g)	Leaf dry weight (g)
Control	7.57g	4.54f	1.25cd	0.76d
Fe (40 $mg.l^{-1}$)	9.47e	5.44e	2.10bc	1.20c
Fe (80 $mg.l^{-1}$)	14.43c	8.44c	0.95cd	0.63d
GA3 (250 $mg.l^{-1}$)	25.40a	15.22a	3.43b	2.43b
GA3 (500 $mg.l^{-1}$)	8.70f	4.44f	0.73cd	0.27e
K2O (50 $mg.l^{-1}$)	12.70d	7.13d	2.13bc	1.33c
K2O(100 $mg.l^{-1}$)	16.53b	9.28b	1.92bc	1.16c
K2O(200 $mg.l^{-1}$)	8.67f	5.38e	1.53cd	0.80d
HA (25 $mg.l^{-1}$)	6.80h	4.35f	0.93cd	0.63d
HA (50 $mg.l^{-1}$)	12.47d	7.47d	6.30a	3.33a

Means within a column, following with the same latter are not significantly different according to Duncan multiple range test at the probability of 5% levels.

Table (3): Effect of different organic and chemical fertilization on growth and leaf nutrients of almond transplants.

parameters / treatment	Root length (cm)	fresh weight (g)	dry weight (g)
Control	28.00f	7.03e	4.57f
Control	35.00bc	11.86ab	6.75bc
Fe (40 $mg.l^{-1}$)	36.67ab	8.29e	5.39d
Fe (80 $mg.l^{-1}$)	38.00a	11.86ab	6.73bc
GA3 (250 $mg.l^{-1}$)	32.00d	8.33e	3.86g
GA3 (500 $mg.l^{-1}$)	33.00cd	12.08a	7.44ab
K2O (50 $mg.l^{-1}$)	31.00de	13.16a	7.62a
K2O(100 $mg.l^{-1}$)	29.33ef	7.86ef	5.03de
K2O(200 $mg.l^{-1}$)	33.00cd	7.94ef	4.54f
HA (25 $mg.l^{-1}$)	35.00bc	9.90c	6.22

Means within a column, following with the same latter are not significantly different according to Duncan multiple range test at the probability of 5% levels.

Primary root length (cm):
In the table (3) noticed that the transplants when treated with GA3 at level 250mg.l^{-1} gave the highest value of root length (38cm).

Root fresh, dry weight %:
Results showed that the significant effect, when compared with untreated, while the highest value(13.16, 7.62 %) respectively of root fresh and dry weight percentage was recorded with KNO3 at 100mg.l^{-1}

Discussions:

Foliar spray of **Humic acid** at 50mg.l^{-1} increased significantly increased stem diameter, lateral shoot length, lateral shoot number, leaves number, leaves fresh and dry weight most of the parameters may be return to the special properties of humic materials result from this extreme heterogeneity and their high chemical reactivity Humic materials have an abundance of carboxyl groups and weakly acidic phenolic groups, which contribute to their complexation and ion-exchange properties. They exhibit both hydrophobic and hydrophilic characteristics and can bind to soil mineral surfaces (Mikkelsen (2005).

GibbeA3 at 250 mg.l^{-1}significantly increased leaves area, shoot fresh and dry weight and root length. Because, it facilitates plant elongation, by increase cells division and expansion (Hartman *et. al.* 2002). GA_3 delays leaves senescence, by delaying chlorophyll, protein and RNA destruction, in addition to synthesis of these components (Wasphy, 1995).

Iron at 40mgFe.l^{-1} increases significantly chlorophyll content. Subsequently, the application of iron to improve growth of plants is required, since iron plays an important role in the synthesis of chlorophyll and in forming of many hymes protein such as different cytochromes which participate in the respiration process and also in the formation of the peroxidase and catalase enzymes that dominate some different functions in the plant metabolism (Marschner, 1986).

Potassium nitrate, significantly affected on root fresh and dry weight, Potassium takes part in many important processes, regulating the opening and closing of stomata, the transport of organic and inorganic ions within the plant.

References

Al-Rawi K.M. and A. Khalaf-Alla, (1980). Analysis of Experimental Agriculture Disgen, Dar Al-Kutub for Printing and Publishing, Mosul Univ. (In Arabic)

Al-Zubaidi, A.H. Soil Salinity(1989). Theatrical and Practical Principles. Beat Al-Hekma. Baghdad Univ

Amira Salih Abdulrahman (2013). Effect of Foliar Spray of Ascorbic Acid, Zinc, Seaweed Extracts and biofertilizer (EM1) on Growth of Almonds (Prunus amygdalus) Seedling. Int. J. Pure Appl. Sci. Technol., 17(2), pp. 62-71.

Azad A. Mayi (2007). Effect of foliar spray with iron and GA_3 on the Vegetative growth, Nutrient contents, Yield and some storage characteristics of Apple fruits cvs. 'Barwari' and 'Starking'.Ph.D.Thesis.Colle. of Agric. Duhok Univ

Denisov V.P. (1988). Almond genetic resources in the USSR and their use in production and breeding. Acta Hortic 224: 299-306.

Drovnic C.E., G.S. (1965). Howell and A.J. Elore. Influence of crop load on photosynthesis and dry mater partitioning at several grapevines II: Seasonal change in single leaf and whole vine photosynthesis, Amer. J. End. Vitic., 46(40), 469-477.

Ghahreman A., (1999). Attar F. Biodiversity of Plant Species in Iran.Tehran University Publishing. Tehran.

Gobara A.A. (1998). Response of Lecont Pear trees of foliar application of some nutrients, Egypt, J.Hort., 25, 55-70.

Gorttapeh A.H., Hassani M.H, Ranji H. (2006) Recognition and ecological investigation of almond species (Amygdalus spp.) in West Azarbaijan province. Acta Hortic 726: 253-256.

Hartman, H. T.; D. E. Kester; F. T. Davies and J. R. L .Geneve (2002). Plant Propagation: Principle and Practices. 7th Ed. Prentice Hall, Upper Saddle River, New Jersey 07458.

Kester, D.E. and N.W. Ross. (1996). History. In: Almond Production Manual, W.C. Micke (ed) Univ. of Calif., Div. Ag. and Natural Res., Pub. No. 3364, pp. 1-2.

Marschner, H. (1986).Mineral Nutrition in Higher Plants. Acad. Press. Inc. London, LTD.

Mikkelsen R.L. (2005). Humic Materials for Agriculture,Better Crops (Vol. 89, No. 3

Reisinauer H.M., (1978).Soil and Plant-Tissue Testing in California, Division of Agricultural Sciences, University of California, Bulletin 1879.

SAS(2000). Institute, Inc. Statistical Analysis System, SAS institute Inc., Cary, NC, USA.

Sathe S.K, Wolf W.J, Roux K.H. (2002).Biochemical characterization of amandin, the major storage protein in almond (Prunus dulcis L.). J Agric Food Chem 50: 4333-4341.

Tsipouridis C., D. Almaliotis, T. Thomidis, A. Isaakidis. (2006). Effects of different sources of iron, hormones and Agrobacterium tumefaciens on the chlorophyll and iron concentration in the leaves of peach trees. Hort. Sci. (Prague), 33, (4): (1).40–147

Wasphy, I. A. (1995). Growth and Flowering Regulator, and its Use in Agriculture. Acad. Library. Egypt

Wassel A.H., M.A. Hameed, A. Gobara and M. Attia, (2007). Effect of some micronutrients, gibberellic acid and ascorbic acid on growth, yield and quality of white Banaty seedless grapevines, African Crop Sci. Conference Proceeding, 8, 547-553.

كارتێكرنا زبلێ ئاسن و پوتاسیومی و ترشێ و جبریلین هیومیكی لسەر شینكاتی و ئاستێ خارنێ د ناڤ بەلگێن نەمامكێت باهیڤێ 1 – كەسكاتیێ (*Prunus amygdalus L.*)

كورتیا لێكولینێ:

ئەڤ ڤەكولینە هاتە كرن لسالا2011 ل نەمامگەها مالتا یابسەر وەزارەتا چاندنێ ڤە ل پارێزگەها دهوك/هەرێما كوردستانا ئیراقێ نەماكێت باهیڤا بزیێ دوو سالی یێت چاندی دناڤ كیسكێت بایلونی دا هاتنە رەشاندن دوو جارا 20 نیسانێ و10 گولانا 2011. ترشێ جبریلیك وئاسن و زبلێ ترشا هیومیكی بسێ خەستیا (0و250و500 ملگم /لتر و 0و40و80 ملگم /لتر و0 و25و50) لدیف ئێك و KNO3 بچار خەستیا (0و50و100و200)ملگم/لیتر. و نەخشێ RCBD بكارئینا بو ڤەكولینێ 5ریپلیكێت ئو 5 نەمامك بكار ئینان بو هەر ریپلیكێتەكێ. ئەنجامێت ڤەكولینێ بڤی رەنگی بون زبلێ هیومیك بخەستیا 50 ملگم/لیتر بو ئەگەرا زێدەكرنا تیرێ قرمی و زمارەو درێزیا تاكا وزمارەو سەنگیا بەلگا یا تەرو هشك هروەسا ترشێ جبریلیك بخەستیا 250 ملگم/لیتر روبەرێ بەلگی و سەنگیا تەرو هشك یا تاكاو درێزیا رهیا بەلێ ئاسنی بخەستیا 40ملگم/لیتر بویا كلوروفیلی ئو زبلێ KNO3 بخەستا 100 ملگم /لیتر سەنگیا تەرو هشك یا رهیا زێدەكرن بشوپەوەری بجوداهی دگەل هەمی پارامیتەرا.

تاثیر الحدید ونترات البوتاسیوم وحامض الجبریلین وحامض الهیومیك فی النمو الخضري و الحالة الغذائیة لأوراق شتلات اللوز (*Prunus amygdalus L.*) 1– النمو الخضری

الخلاصة:

اجری البحث فی مشتل مالطا محافظة دهوك اقلیم كردستان العراق ، التابعة لوزارة الزراعة فی عام **2011**. كانت شتلات اللوز بعمر سنتین و مزروع فی اكیاس النایلون . تم الرش الورقی فی موعدین **20** نیسان و**10** مایس عام **2011**و بثلاثة تراكیز لكل من الحدید و حامض الهیومیك و الجبریلین (**0**و**40**و**80**)، (**0**و**25**و**50**)،(**0**و**250**و**500**)ملغم/لترعلی التوالی اربعة تراكیز من البوتاسیوم **50**و**100**و**200**)ملغم/لیتر.و تم استخدام التجربة العاملیة بتصمیم القطاعات العشوائیة الكاملة ب(**5**) مكررات و (**5**)شتلة لكل مكرر.اوضحة النتائج سماد حامض الهیومیك ب**50** ملغم/لتر ادی الی زیادة قطر الساق،عدد و طول الافرع الجانبیة و عدد الاوراق و وزن الاوراق الطریة والجافة مقارنة بالمعاملات الاخری. و حامض الجبریلیك ب**250** ملغم/لتر ادی الی زیادة المساحة الورقیة و وزن الطري والجاف للافرع الجانبیة وطول الجزور بینما ب**40** ملغم/لتر من الحدید ادی الی زیادة صبغة الكلوروفیل لكن سماد البوتاسیوم بتركیز **100** ملغم/لتر زادة معنویا وزن الطري والجاف للجزور مقارنة بالمعاملات الاخری.