Plant Archives Vol. 20, Supplement 2, 2020 pp. 574-577 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

EFFECT OF SPRAYING WITH POTASSIUM HUMATE AND AZOREN MIX ON GROWTH TRAITS AND NUTRIENTS CONTENT OF LOCAL LEMON *CITRUS LIMON* SAPLINGS

Ali A.A.A. Al-Kraawi*[1], Ghaleb B.A. Al-Abbasi[1] and Furqan S.S. Alabbasi [2]
[1]Department of Horticulture and Landscaping, College of Agriculture, University of Kufa, Najaf, Iraq
[2] Department of Biology, Faculty of Education for Girls, University of Kufa, Najaf, Iraq
Corresponding E-mail: ghalib.alabbasi@uokufa.edu.iq

Abstract

This study was conducted in the certified citrus nursery in Al-Hindiya district, Karbala Governorate, for the 2019 season, on seedlings of local sour lemon grafted on the origin of bitter orange at the age of 3 months. Where the seedlings were sprayed with compost organic potassium humate with four concentrations (0, 360, 240, 120) mg. L^{-1} and the nutrient solution Azoren Mix with four concentrations (0, 0.5, 1, 1.5) g. L^{-1} separately or jointly (3/15/2019). The results showed that spraying the seedlings with any of the composts or both resulted in a significant increase in the average height of the seedlings, stem diameter, dry weight of the vegetative group and the leaf content of the nutrients (N, K, Fe, Zn). The interference treatment of potassium humate 360 mg. L^{-1} and Azoren Mix 1.5 g. L^{-1} resulted in the highest rates for the above-studied traits compared to the control treatment.

***Keywords*:** Potassium Humate, foliar application, Azoren Mix, *Citrus limon*, nutrients

Introduction

Citrus belongs to the Rutaceae family, which is characterized by the presence of oil glands in most parts of the plant that give it a distinct aromatic smell. This family includes many races, the most important of which is the gender (Citrus) of economic importance, and the regions of Southeast Asia are the original habitat of citrus fruits (Khafji and his group , 1990).

The local lemon (*Citrus limon* [L.] Burm) is one of the species of the Citrus genus grown in Iraq because of the favorable conditions for cultivation. It is estimated that there are 291,537 sour lemon trees in Iraq, and fruit production is estimated at 5,178 tons. The fruit of the lemon is distinguished by being rich in vitamins and minerals, which are necessary for building the human body (Al-Jumaili and Al-Dujaili, 1990). Lemon fruits are used in the manufacture of juices and fresh consumption as well as use as mixtures for many foods, in the treatment of pneumonia and cancer, it increases the abundance so it is used to treat kidney disease, soothe the nerves and is used to treat arteriosclerosis and high blood pressure (Forte), (2011).

In recent times, the use of organic fertilizers such as humic acids, which are commercial organic products, are usually made from crushed Leonardite rocks that consist of 60% humic and volcanic acids (Stevenson (1994).

These organic acids have been used in many research areas to improve the growth and production of vegetable crops and some fruit trees as their addition to the soil or plant causes an increase in the growth strength and nutrient absorption (Çimrin *et al*., 2010). Al-Hayani mentioned (2016) that the paper feeding of lemon saplings at the age of one year with humic acid with a concentration (1%) resulted in an increase in the original diameter, length and diameter of the bait, the number of leaves and the leaf area.

In a study by Ethbeab *et al*. (2019) treatment of humic acid at a concentration of (2.5, 5) ml. L^{-1} of the origin of *Citrus fulgamaryana* resulted in significant growth in vegetative growth, with an increase in the number of leaves, leaf area and main stem diameter. Fertilization with nutrient solutions containing micronutrients improves the vegetative growth of the plant and this is confirmed by the results of Zoremtluangi *et al*. (2019).

And Eith (2017) showed that spraying with a nutrient solution, prosole, at a concentration of (2) g.L^{-1} on local grafted seedlings, resulted in a significant increase in the length of the vegetative branch, the number of leaves, the number of side branches, the taste diameter and the origin diameter. Hassan (2017) notes that leaf spraying with a green growth solution in concentrations (0, 3, 6, 9) mg. L^{-1} for seed seedlings at one year old resulted in a significant increase in the leaf content level of chlorophyll, nitrogen, phosphorus and potassium.

Therefore, the experiment aimed to study the effect of spraying potassium humate and the nutrient solution Azoren Mix and overlapping between them and determining the best concentrations in the growth of local sour lemon seedlings and increasing their nutrient content to improve vegetative growth and reduce the time required for the production and marketing of seedlings.

Materials and Methods

This experiment was conducted in a certified citrus nursery in Karbala Governorate, Al-Hindiya district, on local sour lemon grafted on the origin of bitter orange, using 192 uniform 3 months old saplings planted in 10 kg plastic pots. The saplings were sprayed six times (15/3, 15/4, 15/5, 15/8, 15/9, and 15/10/2019) during the experimental period. Treatments were potassium humate (KH) at four concentrations (0, 120, 240, 360) mg. L^{-1} (manufactured by the German company D-40549, contains KH 85%, K 12%, N 0.8%, Fe 1%. And the nutrient solution Azoren Mix (AM) at four concentrations (0, 0.5, 1, 1.5) g.L^{-1} (Produced Van Iperen International, Poland, consists of B, Cu, Fe, Mn, Mo, Zn and MgO. As diffuser, liquid soap at rate of 0.01 ml.L^{-1} was added to reduce surface tension. The experiment was RCBD included 16 treatments with three replicates and 4 saplings per experimental unit.

Data were recorded at the end of the experiment including the average increase in plant height (measured from the plant crown area up to the highest developing apical), stem diameter (mm) taking at 5 cm above the crafting zone, shoot dry weight (gm), leaf contents of the nutrients including Nitrogen% estimated using the Black Kildal micro apparatus, 1965. Potassium K% using the Flame Photometer according to Black, (1965) and iron Fe and zinc Zn were estimated by the Atomic Absorption at wavelength of 248 nm for iron and 214 nm for zinc (Walsh, 1970).

Data analysis

All the collected data were analyzed and analysis of variance ANOVA was performed using GenStat 2012 computing program. Mean were compared (P≤0.05) based on Duncan's multiple range tests whenever appropriate (Al-Rawi and Khalaf-Alah, 2000).

Results and Discussion

Regarding the effect of different treatment on vegetative growth parameters of lemon saplings, it is noted from the results (Table1) that spraying with potassium humate at concentration of 360 mg.L^{-1} led to the highest values of the tested growth indicators (plant height increase, stem diameter and shoot dry weight) compared to other concentrations of the same fertilizer including the control. Likewise for the Azoren mix treatments, the highest values for these indicators were associated with spraying with the highest concentration (1.5g.L^{-1}). Generally, the highest values for the average increase in plant height (66.35 cm), stem diameter (4.94 mm) and shoot dry weight (57.53 g) were recorded in the interaction treatment of 360 mg. L^{-1} potassium humate and 1.5g.L^{-1} Azoren Mix compared to 27.97 cm, 2.37 mm and 24.31 g in the untreated control saplings, respectively.

As for the effect of potassium humate and Azoren Mix on leaf content of nutrients N, K, Fe, and Zn, it is similarly noticed (Table 2) that the treatment of 360 mg.L^{-1} potassium humate resulted in the highest values in the leaf content of N, K, Fe, and Zn compared to other concentrations, as well as Azoren Mix at concentration at 1.5 g.L^{-1} compared to its other concentrations. The interaction treatment of 360 mg. L^{-1} potassium humate and 1.5 g. L^{-1} Azoren Mix also resulted in the highest leaf content of N, K, Fe, and Zn that of 1.57%, 2.44%, 138.60 mg. Kg^{-1} and 40.92 mg. Kg^{-1} compared to the control treatment which resulted in values of 1.41%, 2.32%, 121.00 mg. Kg^{-1} and 33.33 mg. Kg^{-1}, respectively.

Table 1 : Effect of spraying with Potassium humate and Azoren Mix in growth characteristics and nutrient content of local lemon saplings.

Treatments	Plant height increase (cm)	Stem diameter mm	Shoot dry weight (g)	% Leaf content of			
				N %	K %	Fe mg. Kg^{-1}	Zn mg. Kg^{-1}
Control (0% Potassium humate, 0% Azoren Mix)	27.97 o	2.37 l	24.3 k	1.41 m	2.32 k	121.00 l	33.33 l
Azoren Mix 0.5g/L	32.74 mn	2.85 j	26.73 j	1.43 k	2.34 i	125.40 i	35.20 j
Azoren Mix 0.1 g/L	34.12 m	3.29 g	28.82 i	1.47 g	2.35 h	127.60 g	36.74 g
Azoren Mix 1.5 g/L	36.38 l	3.60 ef	31.90h	1.53 d	2.40 d	129.03 f	37.73 e
Potassium humate 120 g/L	31.89 n	2.64 k	26.51 j	1.42 l	2.33 j	123.20 k	34.54 k
Potassium humate 120 g/L+ Azoren Mix 0.5g/L	38.68 k	2.96 i	29.70 i	1.45 i	2.35 h	126.50 h	35.64 i
Potassium humate 120 g/L+ Azoren Mix 0.1 g/L	44.32 i	3.29 g	34.76 g	1.49 f	2.38 f	128.70 f	37.29 f
Potassium humate 120 g/L+ Azoren Mix 1.5 g/L	47.42 h	3.64 e	37.62 f	1.54 c	2.41 c	132.00 d	38.50 c
Potassium humate 240 g/L	42.24 j	2.96 i	31.57 h	1.43 k	2.34 i	124.30 j	34.43 k
Potassium humate 240 g/L+ Azoren Mix 0.5g/L	49.43 g	3.19 h	34.32 g	1.46 h	2.37 g	128.37 f	36.19 h
Potassium humate 240 g/L+ Azoren Mix 0.1 g/L	53.18 f	3.52 f	42.46 e	1.50 e	2.41 c	130.13 e	38.06 d
Potassium humate 240 g/L+ Azoren Mix 1.5 g/L	56.36 e	3.92 c	51.37 b	1.55 b	2.42 b	136.07 b	38.94 b
Potassium humate 360 g/L	58.66 d	3.29 g	38.17 f	1.44 j	2.37 g	125.40 i	35.31 j
Potassium humate 360 g/L+ Azoren Mix 0.5g/L	61.80 c	3.74 d	44.11 d	1.49 f	2.39 e	130.02 e	36.96 g
Potassium humate 360 g/L+ Azoren Mix 0.1 g/L	63.72 b	4.03 b	49.72 c	1.53 d	2.42 b	133.11 c	38.39 c
Potassium humate 360 g/L+ Azoren Mix 1.5 g/L	66.35 a	4.94 a	57.53 a	1.57 a	2.44 a	138.60 a	40.92 a
Potassium humate Average	32.80 d	3.03 d	27.94 d	1.46 d	2.35 d	125.76 d	35.75 d
	40.58 c	3.13 c	32.15 c	1.47 c	2.37 c	127.60 c	36.49 c
	50.31 b	3.40 b	39.93 b	1.49 b	2.39 b	129.72 b	36.91 b
	62.63 a	3.89 a	47.38 a	1.51 a	2.40 a	131.78 a	37.90 a
Azoren Mix Average	40.19d	2.81d	30.14d	1.43 d	2.34 d	123.48 d	34.40 d
	45.66c	3.18c	33.72c	1.46 c	2.36 c	127.57 c	36.00 c
	48.84b	3.53b	38.94b	1.50 b	2.39 b	129.89 b	37.62 b
	51.63a	3.91a	44.61a	1.55 a	2.42 a	133.93 a	39.02 a

Values are means of 3 replicates (4 plants). Means followed by the same letter are not significantly different according Duncan's multiple range test ($P \leq 0.05$)

The increase in the characteristics of vegetative growth as a result of spraying with potassium humate is often due to being a source of humic acid that contributes to stimulating growth in addition to containing organic compounds and mineral elements such as N, Fe and potassium that are of great importance in increasing plant metabolic activities. These substances are essential in stimulating the amino acid and protein manufacturing enzymes, the manufacture of chlorophyll, and the synthesis of sugars, proteins and ATP energy compounds that affect the growth and size of the plant (Martin, 2012). These results are consistent with the findings of (Wesaman Square, 2018) and

(Ghafoori and Al-Dulaimi, 2018) on local orange seedlings. As for the increase in the growth indicators when treating with the nutrient solution Azoren Mix, it may be attributed to its containment of micronutrients ready for absorption that share the composition of amino and nucleic acids and important enzymes in increasing vegetative growth and the formation of a chlorophyll molecule that is the basis for photosynthesis, thus increasing the proportion of the material manufactured in the leaves Which was positively reflected in the increase in the vegetative and root system (Maschner, 2002) and these results are consistent with the findings of Abdel-Kazim and Hamza (2018) when spraying iron on sour lemon saplings. And the results of Zoremtluangi *et al*. (2019) on mandarin trees treated with Zn, Mn, Cu and B.

Spraying with potassium humate also increased the leaf content of the nutrients due to an abundance of ready-to-absorb nutrient elements on the leaves and to the role of organic acids in potassium humate in increasing the permeability of cellular membranes and facilitating the process of nutrient transport, especially N, P, K, which led to Increasing plant efficiency to absorb and accumulate these elements in the leaves (Hashem, 2014) (Abu Dahi, 1989). These results are consistent with the findings of Ennab (2016) on Egyptian lemon trees and Hameed *et al*. (2018) on mandarin trees.

As for the effect of Azoren Mix in increasing the ratio of nitrogen, it is attributed to the important iron role in the food-making process and its role in the synthesis of the necessary cytochromes in this process in addition to the role of zinc in cell division. This leads to a positive increase in photosynthesis products in the process of absorbing nitrogen and increasing its representation within the plant and thus increasing Percentage of nitrogen in the leaves (Shiyal *et al*., 2010) (Al-Falahi and Al-Janabi, 2016).

While the increase in the content of potassium leaves is also due to the role of zinc in the photosynthesis process as an aid in the manufacture of the chlorophyll molecule and thus the increase in the production of carbohydrates and proteins, which results in an increase in the absorption of potassium from the roots (Mengel and Kirkby, 2001), (Sheila *et al*., 2010). These results are consistent with Abdel Amir and others (2011) where spraying with a nutrient solution on bitter seedlings resulted in a significant increase in the percentage of nutrients (N, P, K) in the leaves and similar results in the study of Abdel-Kazim and Hamza (2018) on bitter seedlings.

References

Abd al-Kadhim, S.J. and Hassan, H.H. (2018). The effect of scion type and spraying with iron on the growth of lemon and mandarin seedlings grafted on bitter orange. Journal of the University of Karbala Scientific, 16(1): 312-318.

Abdul, A.H.K.; Qais, J.A.M. and Etedal, S.H. (2011). The effect of spraying with leaf fertilizer Bruceol and garlic water on the growth of *Citrus aurantium* L. seedlings. Al Furat Journal of Agricultural Sciences, 3(4): 54-65.

Abu-Dahi, Y.M. (1989). Practical plant nutrition. Bait Al-Hikmah press. Baghdad University, Ministry of Higher Education and Scientific Research, Iraq

Al-Falahi, T.H.R. and Al-Janabi, A.M.I. (2016). The effect of parasinolide treatment and Agroleaf leaf spray on some growth characteristics of local orange scion. Diyala Journal of Agricultural Sciences, 8(2): 28-40.

Al-Hayani, A.M.A. (2016). The effect of origin and spraying with humic acid on tolerance of sour lemon saplings to salinity in irrigation water and characteristics of vegetative growth. Basra Journal of Agricultural Sciences, 29(2): 485-501.

Al-Jumaili, A.A.R. and Al-Dujaili, J.A.H. (1990). Fruit production. Baghdad University, Ministry of Higher Education and Scientific Research, Iraq.

Al-Khafaji, M.A.; Suhail, A.; His perfume and Alaa, A.R.M. (1990). Evergreen fruit. University of Baghdad, Ministry of Higher Education and Scientific Research, Iraq.

Black, C.A. (1965). Methods of soil Analysis part. 2 Chemical and Microbiological properties. Amer. Soc. Agron. Inc. Publisher Madison. Wisconsin, USA .16.

Çimrin, K.M.; Onder, T.; Metin, T. and Burcu, T. (2010). Phosphorus and humic acid application alleviate salinity stress of pepper seedling . African Journal of Biotechnology, 9(36): 5845-5851.

Ennab, H.A. (2016). Effect of Humic Acid on Growth and Productivity of Egyptian Lime Trees (*Citrus aurantifolia* Swingle) under salt stress conditions J. Agric. Res. Kafr El-Sheikh Univ. A. Plant production 42(4).

Ethbeab, I.; Laila, J.; Falah, T.F. and AL-Miahy, H.R. (2019). Effect of organic fertilizer master humic-Fulvic acid and salt clean on some chemical characteristics of soil and some vegetative characteristics of stock Volkameriana. Muthanna journal of Agriculture Science 7(1).

Forte, C.A. (2011). Health Beneficial citrus compounds. Senior Thesis. Bachelor of Arts Bard college at simon's Rock Great Barrington, Massachusetts, 71 P.

Ghafoori, A.T. and Al-Dulaimi, A.F. (2018). The effect of spraying with GANA.G and Bio-health nutrients on some growth characteristics of local orange seedlings *Citrus sinensis* L. Iraqi Journal for Studying Desert. Volume (8) Issue (1).

Hameed, A.; Shabih, F.; Javed, I.W.; Muhammad, Y. and Saeed, A. (2018). Accumulative Effects of Humic acid and Multi Nutrient Foliar Fertilizers on the Vegetative and Reproductive Attributes of Citrus (*Citrus reticulata*) cv. Kinnow mandarin) Journal of Plant Nutrition ISSN: 0190- 4167 (Print) 1532- 4087.

Hashem, H.A. (2014). The effect of spraying with organic liquid fertilizer (LiQ Humus) and licorice extract on the growth of local orange seedlings. The Technical Journal. Volume 27 (3).

Hassan, S.R. (2017). The effect of spraying with the growth green solution and salicylic acid on the growth of *Citrus aurantium* L. Karbala Journal of Agricultural Sciences, 4(2): 60-66.

Maidan, R.A. and Maree, R.S. (2018). The effect of adding NPK and humic acid on growth and chlorophyll content of seed orange *Citrus sinensis* L. trees. Journal of Kirkuk University of Agricultural Sciences. Special issue for the Third International Agricultural Conference. 352-257.

Marschner, H. (2002). Mineral Nutrition of higher Plants, 2nd Ed. London, UK: Academic Press.

Martin, J. (2012). Impact of marine extracts applications on cv. Syrah grape (*Vitis vinifera* L.) yield components,

harvest juice quality parameters, and nutrient uptake. A Thesis, the Faculty of California Polytechnic State University, San Luis Obispo

Mengel, K.; Kirkby, E.A.; Kosegarten, H. and Appel, Th. (2001). Principles of Plant Nutrition. 5 th Edition. Kluwer Academic Publishers London.

Patton, L. (1984). Photosynthesis and growth of willow used for short rotation. Ph.D. Thesis submitted to the univ. of Dublin(Trinity College).1990.Studies of variation in primary productivity growth and morphology in relation to the selective improvement of broad –leaved trees species .Ph. D. Thesis submitted to the National Univ. Irland.

Sheal, M.N.; Saleh, A.S.; Abdul, W. and Ibrahim, M.R. (2010). The effect of autumn grafting and foliar spray with iron and zinc on growth of citrus saplings grafted on bitter orange. Technical Magazine, 23(2): 144-156.

Stevenson, F.J. (1994). Humus chemistry, Genesis, Composition, Reaction, John wily and Sons, New York.

Walsh, L.M. (1970). Instrumental methods for Analysis of Soils and plant tissue, Soil Science Society of America , Inc. Madison, Wisconsin, U.S.A. PP. 222.

Zoremtluangi, J.; Elizabeth, S. and Debashis, M. (2019). Influence of Foliar Micronutrients on Growth, Yield and Quality of Khasi Mandarin (*Citrus Reticulata* Blanco) In Mizoram Res. on Crops 20(2): 322-327 Printed in India.