The Effect of Foliar Feeding with Chelated Iron and a Suspension of Dry Yeast on The Vegetative and Fruitful Growth Characteristics of Olive Trees, Cultivar Ashrsi

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Abstract

This experiment was carried out during the planting season of 2021-2022 in one of the private fields for olive cultivation in the city of Rawa located in the village of (Abu Koi) of the Western Desert of Anbar, to study the effect of foliar nutrition with chelated iron (CHI_0, CHI_1 and CHI_2) at three levels of concentrations 0, 100, 200 mg L^{-1} in the tree, and dry yeast suspension (DYE_0, DYE_1, and DYE_2) at three levels of concentration 0, 10, 20 g L^{-1} and the interaction between them its effect on vegetative growth and fruit characters of olive trees (var. Ashrassi). The trees were sprayed three times in a row, the first spray was in April, and the following sprays were 30 days apart. The results showed that the effect of foliar application with chelated iron for CHI_2 treatment at a concentration of 200 mg L^{-1} showed that there were significant differences the increase in branch length amounted to 90.97 cm, the increase in the length of the fruit is 21.33 mm, the weight of the flesh of the fruit is 5.38 g, the weight of the kernel is 0.77 g. While for factor the suspension of dry yeast, the treatment DYE_2 at a concentration of 20 g L^{-1} was significantly superior in increasing the length of the branch 84.25 cm, increase in the length of the fruit 21.02 mm, the weight of the flesh of the fruit 5.63 g, the weight of the kernel 0.78 g, dry matter in leaves 51.21%.

Keywords: Foliar feeding, chelated iron, dry yeast, olive trees.

تأثير التغذية الورقية بالحديد المخلبي ومعلق الخميرة الجافة على خصائص النمو الخضري والثمار لأشجار الزيتون صنف أشرسي

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المستخلص

نُفذت هذه التجربة خلال موسم الزراعة 2021–2022 في أحد الحقول الأهلية الخاصة بزراعة الزيتون في مدينة راوه في قرية) أبو كوى (التابعة لصحراء الغربية لمحافظة الأنبار لدراسة تأثير التغذية الورقية بالحديد المخلبي يرمز لها DYE_0 و DYE_1 , DYE_2 بثلاث مستويات تراكيز 0, 100, 200 ملغم لتر $^{-1}$ ومعلق الخميرة الجافة CHI_2, CHI_1, CHI_0 بثلاث مستويات تركيز 0, 10, 20 غم لتر $^{-1}$ والتداخل بينهم وتأثيرها في صفات النمو الخضري والثمري لأشجار الزيتون صنف أشرسي. تم رش الأشجار بثلاث مواعيد على التوالي كانت الرشة الأولى في شهر نيسان بين رشة واخرى 30 يوم. بينت النتائج ما يلي أنَ تأثير التغذية بالحديد المخلبي للمعاملة CHI_2 بتركيز 200 ملغم لتر $^{-1}$ أنَ هناك فروق معنوية في الزيادة في طول الفرع بلغت 90.97 سم، الزيادة في طول الثمرة 21.33 ملم، وزن لحم الثمرة 5.38 غم، وزن النواة 0.77 غم، الزيادة في وزن الرطب للثمار 53.78 غم، معدل حجم الثمرة 5.70 سم^3 , حجم لب الثمرة 5.10سم^3 , نسبة الزيت في الثمار 17.41%. أما العامل معلق الخميرة الجافة DYE_2 بتركيز 20 غم لتر $^{-1}$ تفوق معنوي

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في زيادة طول الفرع بلغت 84.25 سم والزيادة في طول الثمرة 21.02 ملم ووزن لحم الثمرة 5.63 غم ووزن النواة 0.78 غم ووزن الرطب للثمار 56.32 غم ومعدل حجم الثمرة 5.93سم^3 وحجم لب الثمرة 325.سم^3 والحاصل الكلي 14.03 كغم الشجرة $^{-1}$ ونسبة المادة الجافة في الأوراق والتي بلغت 51.21.

الكلمات المفتاحية: التغذية الورقية، الحديد المخلبي, الخميرة الجافة، شجرة الزيتون.

Introduction

Olive is an evergreen tree whose scientific name is *Olea europaea* L. It belongs to the olive family Oleaceae of the trees of the subtropics (Mahdi, 2011). Most studies indicate that the olive tree Fertile originated in the Crescent region of the Arab world, specifically the imaginary line passing from the northwest of Iraq, southern Turkey, Syria, Lebanon and Palestine. What supports this is the presence of wild natural orchards growing in the mountainous areas of northwestern Iraq (Darwish, 2015). Some olive trees grow well outside these areas but do not bear fruit (Al-Jabi, 2007). Despite the availability of all the appropriate environmental conditions for the cultivation of olive trees in Iraq, the cultivated areas are still below the required level, where olive cultivation suffers from several problems locally and globally that sometimes limit its spread and lead to the deterioration of its cultivation, and the deterioration of olive orchards in terms of soil fertility as a result of neglecting the necessary service operations (Al-Allaf, 2020). It is sufficient for a person to obtain 30-50 gm to provide the body with its daily needs of mineral salts necessary to maintain the body's integrity, as olive fruits contain astringent substances that help reduce saliva secretion and prevent stomach cramps in addition to its benefits for patients with diabetes, muscle spasms, gingivitis, tonsillitis and stomach and intestines ulcers (Fernandez-Escobar et al., 1999).

Its oil also helps digestion, as it is a good laxative, as is a bile-dispersal of gravel and an anti-toxin that is drunk to prevent it from leaking out of the stomach, and that drinking a spoonful of olive oil on an empty stomach is a successful treatment for liver ailments and makes it easier for food to slip unobstructed. Anbar Governorate ranked first in production for 2020, as it estimated 12,050 tons of Iraq's total production, followed by Nineveh Governorate, while Baghdad Governorate occupied third place. The best date for picking the fruits is October and November for pickling and not for extracting oil. Many olive orchards in Iraq suffer from weak growth and low yield because most of their cultivation areas are in calcareous soils with high pH. In addition, olive trees are evergreen and thus deplete large amounts of nutrients annually, as the best growth and yield require the availability of micro and macronutrients in perfect availability. Because most of the soils of the central and southern regions of Iraq tend to be alkaline, the micro-nutrients precipitate in the form of insoluble complex compounds in the soil solution and thus become unavailable for plants. The importance of applications sometimes comes when the activity of the roots decreases during critical growth stages, such as flowers and nodes, as competition is intense for the nutrients absorbed from the soil, which makes some elements unavailable to the plant (Al-Sahaf and Al-Dujaili, 1994).

It was mentioned (Qassem et al., 1978) the possibility of saving in the quantities of fertilizers added to the soil from 2-100 times when using foliar fertilization and obtaining the same response. It has certainly become common use and is recommended to increase the productivity of trees, improve the quality of fruits, and meet the trees' need for microelements by spraying the vegetative mass with fertilizer solution to avoid the problem of fixing them in the soil (Mahdi, 2011). Most of the nutrients needed for plants (86%) can be met through the leaves, with those absorbed through the roots that meet the plants' basic need for elements up to 15% (Abdul, 1988). Many studies by researchers in the world have demonstrated the importance and role of chelated iron in improving the growth and characteristics of crops by adding it to plants and that it does not cause damage to the plant in addition to being easy to absorb, transfer and decompose within the plant chloroplasts and the formation of plant proteins (Al-Mawsili, 2011). Yeast is also a natural and essential source of some hormones, such as cytokinin, auxin and gibberellin, as they encourage cells to elongate and divide, increase carbohydrates, synthesize protein and nucleic acids, and form chlorophyll. Its nitrogen content causes an increase in vegetative growth in terms of the height and leaf area of the plant (Al-Ani and Al-Obaidi, 2017).

This study aims to study the effect of foliar applications with chelated iron, one of the necessary microelements and a suspension of dry yeast. The interaction between them on olive trees (var. Ashrassi) planted under the conditions of the desert areas of Anbar Governorate, which were spread in different parts of Iraq to improve vegetative and fruit characteristics of olive trees and improve the quantitative and qualitative characteristics of the fruits.

Materials and Methods

The experiment was carried out in one of the private fields for olive cultivation / Rawa district in the village of (Abu Koi) belonging to the Western Desert, which is 193.1 km from the center of Anbar Governorate, which is located at 41.919° longitude and 34.482° latitude on 15/4/2021 until 15/ 12/2021, to study the effect of foliar application with chelated iron and a suspension of dry yeast on the vegetative growth and yield characteristics of olive trees (var. Ashrassi). A factorial (3*3) experiment was conducted according to the R.C.B.D design with 3 replications. The investigation included 27 experimental units. The trees were of homogeneous vegetative growth at the age of 12 years. The planting distance for trees was 4 m and between lines was 5 m.

The study included two factors of foliar nutrition:

Foliar Nutrition Factor of Chelated Iron (CHI): A spray solution was prepared from CHI and dissolved in water and prepared at concentrations (0,1 00, and 200) mgL^{-1}have symbols of (CHI_0, CHI_1, and CHI_2).

Foliar Nutrition Factor of Dry Yeast Extract (DYE): It was prepared by dissolving dry baking yeast powder in water according to the studied concentrations of 0, 10, and 20 g L^{-1} have symbols of DYE_0, DYE_1, and DYE_2. Add sugar at a 1:1 ratio and then keep the mixture for a full 24 hours to activate and multiply the yeast p (El-Tohamy et al., 2009).

Studied traits

1. Branch length increase (cm): The marked branch lengths were measured before the start of the experiment and were marked with a thread to know the increase in branch length compared to measuring the same branch again at the end of the investigation. The difference represents the increase in branch length.
2. Fruit length (mm): 20 fruits were selected, and their length was measured using the vernier.
3. Weight of the flesh of the fruit (g): Based on the following equation:
$$weight\ of\ the\ flesh\ of\ fruit = weight\ of\ whole\ fruit - weight\ of\ the\ kernel$$
4. Kernel weight (g): The kernel was weighed after removing it from the previously selected fruits with a sensitive electric..
5. Leaves dry matter percentage (%): Measurement of dry matter content according to (A.O.A.C., 1980).
6. The percentage of oil in the fruits (%): the extraction process was carried out according to what was stated in A.O.A.C. (1980) and using a fat extraction device (Soxhlet).

Results and Discussion

The increase in branch length

The results shown in Table 1 indicate that there are significant differences for the treatment CHI_2 concentrations 200 mgL^{-1} respectively in the increase in branch length, which reached the highest value of 90.97 cm, which morally differentiated from the treatment CHI_1 by evaluating its value 88.15 cm respectively compared to the control treatment CHI_0, which reached the lowest value of 57.89 cm. Whereas the suspension of dry yeast, the treatment DYE_2 concentrations 20g L^{-1}, which had the highest value of 84.25 cm, outperformed treatment DYE_1, which did not differ from the control treatment DYE_0, which had the lowest value of 75.87 cm. While the interaction treatment for the study factors had significant differences in the treatment $CHI_2 \times DYE_{00}$ respectively, which reached the highest value of 95.22 cm respectively, compared to the control treatment $CHI_0 \times DYE_{00}$, which reached the lowest value of 42.00 cm.

Table 1. Foliar feeding with chelated iron (CHI) and dry yeast (DYE) of olive trees cultivar Ashrassi on increasing the branch length.

dry yeast	chelated iron			Mean
	CHI_0	CHI_1	CHI_2	
DYE_0	42.00	93.46	95.22	76.89
DYE_1	56.51	80.65	90.44	75.87
DYE_2	75.15	90.33	87.26	84.25
LSD 0.05		2.38		1.38
Mean	57.89	88.15	90.97	
LSD 0.05		1.38		

Fruit length (mm)

The results showed a significant superiority in the increase in the length of the fruit for the chelated iron treatment of the CHI_1 treatment 21.75 mm, which differs significantly from treatment CHI_2 (21.33 mm), compare compared to treatment CHI_0, which amounted to 21.04 mm (Table 2). In contrast, the dry yeast suspension treatment showed significant superiority in increasing the fruit length for the treatment DYE1, which amounted to 22.51 mm and differed significantly from treatment DYE2 which amounted to 21.02 mm, compared to treatment DYE_0, which amounted to 20.59 mm. In contrast, the interaction treatment between chelated iron and dry yeast recorded a significant superiority in treatment $CHI_2 \times DYE_1$, which reached the highest rate of 22.87 mm, which didn't which differ significantly from treatment $CHI_0 \times DYE_1$ (22.85 mm) compare compared to treatment $CHI_0 \times DYE_0$ which reached the lowest rate of 19.81 mm.

Table 2. Foliar feeding with chelated iron (CHI) and dry yeast (DYE) of olive trees cultivar Ashrassi on increasing the length of the fruit

dry yeast	chelated iron			Mean
	CHI_0	CHI_1	CHI_2	
DYE_0	19.81	21.31	20.67	20.59
DYE_1	22.85	21.81	22.87	22.51
DYE_2	20.47	22.14	20.44	21.02
LSD 0.05		0.05		0.03
Mean	21.04	21.75	21.33	
LSD 0.05		0.03		

Weight of the flesh of the fruit

The results indicate a significant difference in the treatment of chelated iron. The treatment CHI_2, which amounted to 5.38, didn't differ from treatment CHI_1, which amounted to 5.17, compared to treatment CHI_0, which amounted to 4.74 g (Table 3). Also, treatment DYE_2 for yeast suspension, 5.63 g, was superior and significantly different from treatment DYE_1, which amounted to 5.32 g, compared to the lowest value of the measurement treatment, which was 4.33 gm. Also, treatment DYE_2 of the yeast suspension (5.63 g) , was superior and significantly different from treatment DYE_1 (5.32 g) , compared to the lowest value of the compared treatment (4.33 g). Whereas for the interaction treatments between the two factors of the study, treatment $CHI_1 \times DYE_2$ achieved the highest significant difference, which amounted to 6.06 g, which didn't different significant treatment $CHI_2 \times DYE_1$ (6.02 g), compared to the lowest value of the compare treatment $CHI_0 \times DYE_0$ (4.07 g).

Table 3. Foliar feeding with chelated iron (CHI) and dry yeast (DYE) of olive trees cultivar Ashrassi on the weight of the flesh of the fruit

dry yeast	chelated iron			Mean
	CHI_0	CHI_1	CHI_2	
DYE_0	4.07	4.44	4.49	4.33
DYE_1	4.95	5.00	6.02	5.32
DYE_2	5.22	6.06	5.62	5.63
LSD 0.05		0.42		0.24
Mean	4.74	5.17	5.38	
LSD 0.05		0.24		

Kernel weight

The results indicate that there were significant differences in the average kernel weight for the chelated iron CHI_2 treatment (Table 4), which gave the highest value of 0.77 g, which didn't mean it differed significantly from treatment CHI_1 which amounted to (0.76 g) compared to the lowest value of the compare treatment CHI_0 which amounted to (0.65g). The study factor of dry yeast significantly affected treatments DYE1 and DYE2 compared to treatment DYE_0, with an average kernel weight of 0.77, 0.76, and 0.65, respectively. Whereas for the interaction between the two factors of the study, the treatment $CHI_1 \times DYE_2$, which didn't mean which differ significantly from treatment $CHI_2 \times DYE_{01}$, significantly outperformed with an average kernel weight of 0.89 g and 0.84g compared to the lowest value of $CHI_0 \times DYE_0$ for the compared treatment, which reached the lowest value of 0.57 g.

Table 4. Foliar feeding with chelated iron (CHI) and dry yeast (DYE) of olive trees cultivar Ashrassi on the Kernel weight (gm).

dry yeast	chelated iron			Mean
	CHI_0	CHI_1	CHI_2	
DYE_0	0.57	0.69	0.69	0.65
DYE_1	0.81	0.69	0.84	0.78
DYE_2	0.58	0.89	0.79	0.75
LSD 0.05		0.08		0.04
Mean	0.65	0.76	0.77	
LSD 0.05		0.04		

Leaves dry matter percentage

The results indicate that the effect of chelated iron showed no significant differences in the leaves' dry matter percentage (Table 5). In contrast, the two treatments of dry yeast, DYE_1 and DYE_2, recorded significant differences respectively, gave the highest rate of 51.21%, followed by 50.54%, respectively, compared to the control treatment, DYE_0, which reached the lowest percentage of 42.73%. Whereas for the interaction between the two factors of the

study, the two treatments, $CHI_2 \times DYE_2$ and $CHI_2 \times DYE_1$, gave significant differences, respectively. The highest percentages reached 55.89, and 55.56%, significantly outperforming $CHI_2 \times DYE_0$, which recorded the lowest value of 33.18%.

Table 5. Foliar feeding with chelated iron (CHI) and dry yeast (DYE) of olive trees cultivar Ashrassi on the leaves dry matter percentage (%).

dry yeast	chelated iron			Mean
	CHI_0	CHI_1	CHI_2	
DYE_0	50.36	44.64	33.18	42.73
DYE_1	44.94	53.12	55.56	51.21
DYE_2	48.61	47.13	55.89	50.54
LSD 0.05		3.03		1.75
Mean	47.97	48.29	48.21	
LSD 0.05		1.75		

The percentage of oil in the fruits:

The results indicate the superiority of treatment CHI_2, with the highest percentage of oil in the fruits (17.41%). In contrast, the control treatment CHI_0 recorded the lowest rate of oil, reaching 14.81%, which didn't differ significantly from treatment CHI_1. As for the yeast factor, treatment DYE_1 significantly outperformed with oil percent of 16.34%, which is significant with treatment DYE_2 at 15.72, while the compared treatment DYE_0 recorded the lowest oil percentage of 14.96%. Whereas for the interaction between the two factors of the study, treatment $CHI_2 \times DYE_0$ was significantly superior by giving the highest rate of oil, which reached 18.32%, which didn't mean it differed significantly from treatment $CHI_2 \times DYE_0$ 18.14%. At the same time, compared to treatment $CHI_0 \times DYE_0$, the lowest percentage was 12.73%.

Table 6. Foliar feeding with chelated iron (CHI) and dry yeast (DYE) of olive trees cultivar Ashrassi on the percentage of oil in the fruits (%)

dry yeast	chelated iron			Mean
	CHI_0	CHI_1	CHI_2	
DYE_0	12.73	14.01	18.14	14.96
DYE_1	17.37	15.88	15.78	16.34
DYE_2	14.32	14.53	18.32	15.72
LSD 0.05		0.67		0.38
Mean	14.81	14.80	17.41	
LSD 0.05		0.38		

The results showed significant superiority in vegetative and fruitful traits: branch length, fruit length, fruit flesh weight, kernel weight, and the percentage of oil in treatment CHI_2 at a concentration of 200 mg L^{-1}. The reason is due to the important role of micro-nutrients

in plant growth and development, due to their essential relationship in conducting various vital activities, whose direct and indirect effects are due to their activation of different enzymes, The effects of which extend to the various stimulating activities that occur inside the plant, and thus affect the yield of the plant, especially its components of proteins and carbohydrates, whose effects are reflected on the plant in general (Taiz and Zeiger, 2010). These results agree with (Omar et al., 2020), (Sharif, 2020), (Abdel Wahed and Jewar, 2020), (Al-Araji, 2001).(Abdul Karim et al., 2021), Iron also has a role in maintaining the green matter inside plants and has a key role in the representation of nucleic acids and chloroplasts (Barbandi, 2007). The reason may be attributed to the role of iron in activating redox enzymes that participate in the electron chain in the respiration process, so it participates in chlorophyll synthesis and increases the accumulation of phytoferritin in the chloroplast, it is reflected in vegetative growth (Al-Sahhaf, 1989). Iron is one of the essential elements in synthesising the chlorophyll molecule. Although it is not included in its composition, it acts as co-enzymatic for several enzymes responsible for the anabolism of chlorophyll and the necessary enzymes in the respiration process. The increase of nutrients leads to an increase in carbon metabolism and some produced metabolic compounds such as saccharides towards the fruits, which is positively reflected in some quantitative properties of the fruits and the weight, size, length, and diameter of the fruit (Al-Jubouri, 2006).

As for the second study factor, the significant superiority in growth and yield indicators for foliar application with DYE suspension may be attributed to the fact that it is a natural source for some plant growth regulators such as cytokines, auxin, and gibberellin that stimulate elongation and division of cells, increasing carbohydrates, synthesis of nucleotide acids, chlorophyll structuring, increasing vegetal and physiological properties (Al-Ani and Al-Obaidi, 2017). Treatment DYE_2 at a concentration of 20g L^{-1} achieved significant superiority in branch length, fruit length, kernel weight, fresh weight of fruits, dry matter percentage of leaves and oil in fruits. The reason is that spraying the plant with a suspension of dry yeast improves the plant's vegetative and flowering growth indicators because it contains many nutrients and compounds important for plant growth (Al-Khafaji, 1990). These results agree with Al-Karawi et al. (2018), Dababo et al. (2018), Jassem (2009) Shereen et al. (2010). the reason may be attributed to dry yeast content of growth stimulators compounds like thiamin and riboflavin B2 that has a main role in carbohydrate assimilation and amino acids synthesis (Nagodawithana, 1991) because they transport amine clusters from amino acids to new active spots.

Conclusions

It was concluded that the effect of foliar feeding with chelated iron for treatment CHI_2 at a concentration of 200 mg L^{-1} differed significantly in all indicators of vegetable and fruity growth. Thus, it was recommit ended that other field studies must be carried out using micro-elements, especially chelated iron, by foliar spraying on other fruit trees, especially in desert areas, which suffer from basal soils and insufficient absorption of iron

necessary to improve vegetable growth, which is reflected positively on the tree. The second factor was to conclude the effect of the suspension of dry yeast DYE_2 with a concentration of 20 g L^{-1} was Significantly superior in all fruiting characters. Thus, it was recommended that other field studies be conducted with paper spraying on fruit trees to improve the qualitative and quantitative characteristics of fruits and the early maturity of fruits compared to other transactions.

References

A.O.A.C. (1980). Official Methods of Analysis. 13th Ed. Association of Official Analytical Chemists. Washington, D.C

Abdul Karim, A. A., Hussein, N. H., & Khalil S. A. (2021). The effect of spraying with chelated iron and gibberellic acid on the growth of seedlings of *Citrus aurantium* L. *Iraqi Journal of Soil Sciences*, 21(1).

Abdul, K. (1988). Physiology of nutrients in plants. Salahaddin University.

Abdel Wahed, M. Sh. & Jewar, A. S. (2020). Effect of spray by chelated iron in physical and chemical characteristics of iraqi banana *Musa paradisica* L . var sapientum (L .) oktze cultivation south Iraq. *Dhi Qar University Journal of Agricultural Research*, 9(2), 91-103.

Al-Ani, M. H. I. & Al-Obaidi, N. M. D. (2017). Response of maize cultivars to bio-fertilization with bread yeast *Saccharomyces cerevisiae* L. *Anbar Journal of Agricultural Sciences*, 15(2), 471-483.

Al-Allaf, A H. (2020). Development of olive orchards in ninawa governorate. College of Agriculture and Forestry. Iraq.

Al-Araji, J. M. A. (2001). The effect of spraying with iron and zinc on the vegetative and fruitful growth and content meanings of pear trees, Ottoman variety. *Iraqi Journal of Agricultural Sciences*, 32(6), 77-82.

Al-Jabi, F. (2007). Olive tree-first edition-zain design advertising and printing services, Nablus, Palestine.

Al-Jubouri, N. (2006). Effect of spraying iron, copper, zinc and boron on the mineral content, growth characteristics and yield of local orange trees *Citrus sinensis* Osbeck. Ms,c, Thesis, College of Agriculture, Tikrit University.

Al-Karawi, H., Salman, F.& Al-Mousawi, I. (2018). The effect of spraying with dry yeast and boron on the growth and production of the licorice plant grown under protected cultivation conditions. *Al-Furat Journal of Agricultural Sciences*, 10(3), 60-68.

Al-Khafaji, Z. M. (1990). Biotechnology, University of Baghdad.

Al-Mawsili, M. A. (2011). Soil fertility and nutrition of horticultural plants. University of Mosul.

Al-Sahaf, F. H. & Al-Dujaili, J. A. (1994). Effect of the number of times spraying with Al-Nahrain nutrient solution on the quantity and quality of yield in the white Shadda grape variety. *Iraqi Journal of Agricultural Sciences*, 25(2), 134-139.

Al-Sahhaf, F. (1989). Applied plant nutrition.University of Baghdad.

Barbandi, A. (2007). Palm cultivation and the nutritional and medicinal benefits of dates. Raslan Foundation for Publishing and Distribution, Damascus - Syria.

Darwish, M. A. (2015). The olive tree techniques of its cultivation and processing of its fruits, Department of Horticulture and Forests, Ministry of Agriculture, Baghdad, Iraq,

Dababo, M. B., Baghdadi, M. & Maarouf, A. (2018). The effect of foliar fertilization and biofertilizer EM1 on the quality and productivity of persimmons *Diospyros kaki* L. variety Hachiya.. *Hama University Journal*, 1(6).

EL-Tohamy, W. A., EL-Abady, H. M. & EL-Greadly N. H. M. (2009). Studies on the effect of *Putrescine*, yeast and vitamin C on growth, yield and physiological responses of Eggplant under sandy soil conditions. *Australian Journal of Basic and Applied Sciences*, 2(2), 296- 300.

Fernandez-Escobar, R, Moreno, R. & Garcıa-Creus, M. (1999). Seasonal changes of mineral nutrients in olive leaves during the alternate-bearing cycle. *Scientia Horticulturae*, 82(1-2), 25-45

Jassem, S. N. (2009). Effect of spraying with bread yeast suspension on vegetative and flowering growth and flowering age of freesia. *Iraqi Journal of Agricultural Sciences*, 40 (1), 110-119.

Mahdi, F T. (2011). Olive tree and specifications of varieties cultivated in iraq. The General Authority for Extension and Agricultural Cooperation - Ministry of Agriculture, Republic of Iraq.

Nagodawithana, W. (1991). Yeast technology Universal Foods Corporation Milwaukee, Wisconsin, Published by Van Nostrand Reinhold, New York.

Omar, A., Khurshid, M. & Taha, M. S. (2020). The effect of humic acid and chelated iron on the yield and quality of two strawberry cultivars *Fragaria* × *ananassa* Duch Al Furat *Journal for Agricultural Sciences*, 12(2), 405-422.

Qassem, S. M., Afridri, M. M. & Samiullah, R. K. (1978). Effect of leaf applied phosphorus on the yield characteristics of ten barley varieties. Indian Journal of Agricultural Sciences, 48(4), 215-217.

Sharif, R. S. (2020). The role of Fe-EDTA chelated iron and nitrogen in improving the quality of soybean seeds at two levels of soil pH. *Samarra Journal of Pure and Applied Sciences*, 2(3), 95-104.

Shereen, A. S., El Taweel, A. A. & Amar, M. N. (2010). Effect of inoculation by some plant growth promoting Rhizobacteria (PGPR) on production of olive trees (*Manzanillo* cultivar). Journal of Plant Production. 1 (12), 1577-1592.

Taiz, L. & Zeiger, E. (2010). Plant Physiology. 5th[ed]. Publishers Sunderland, Massachusetts USA.