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Response of some Mineral Content Characteristics of Young Olive Tree Leaves (Cv. Arbequina) to Spraying with Potassium and Chelated Iron

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ABSTRACT

The study was conducted in olive orchard belonging to the College of Agriculture / University of Kirkuk, Iraq, located in the Sayyada area during the 2024 growing season to study the effect of spraying potassium at three concentrations (0, 1000 and 1500) mg L⁻¹ and chelated iron at four concentrations (0, 100, 200 and 300) mg L⁻¹ on some mineral content traits of the leaves of 4-year-old Arbequina olive trees. Spraying was carried out on three dates during the growing season, starting from 15/3 to 15/5, with a one-month interval between each spray. The results obtained can be summarized as follows: spraying with a concentration of 1500 mg L⁻¹ of potassium significantly influenced the levels of macronutrients NPK, carbohydrates, and protein in the leaves, which reached (3.63, 0.72, 5.43, 6.10, 22.66)% respectively. Meanwhile, concentrations of 1000 and 1500 mg L⁻¹ of potassium had a significant effect on the iron content of the leaves, which reached (131.44 and 132.86) mg kg⁻¹ respectively. Spraying with chelated iron at concentrations of 200 and 300 mg L⁻¹ led to a significant increase in the nitrogen and protein in the leaves, which reached (3.57, 3.73 and 22.34, 22.33)% respectively. As for the spraying with a concentration of 300 mg L⁻¹ of chelated iron, it significantly affected the increase in the percentages of phosphorus, potassium, iron, and carbohydrates in the leaves, reaching (0.69%, 5.29%, 135.03 mg kg⁻¹, 6.60%) respectively. The interaction between the concentrations of the studied factors had a significant effect on improving the studied traits.

Keywords: K₂SO₄, Fe-EDDHA, Olive, *Olea europaea* L, Arbequina.

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INTRODUCTION

Olive (*Olea europaea* L.) is a perennial evergreen plant belonging to the Oleaceae family, which grows between latitudes of (30-45)^o in both hemispheres. There is much evidence indicating that the cultivation of olive trees dates back over 6000 years. Throughout the successive centuries, olive trees have been viewed as part of the social and cultural traditions of every country and region where they are grown [1]. The original habitat of the olive tree is located in a vast area of Asia Minor, bounded by the Caucasus Mountains, extending through Iran and the coasts of Syria and Palestine. However, some historians believe that the original home of the olive is Afghanistan due to the presence of several species that belong to the Oleaceae family, which may relate to the cultivated olive variety [2]. From the eastern coast of the Mediterranean Sea, olive cultivation spread around the Mediterranean basin. During this time, the selected agricultural varieties were hybridized with many wild species to achieve the best adaptation to environmental conditions and to increase the diversity among cultivated species. After about 3500 years of this spread, olives reached America through Spanish colonizers and missionaries, and immigrants from the Mediterranean basin also introduced these trees to South Africa and Australia [1].

Potassium is one of the positively charged ions (monovalent) that plants require in large quantities, even though it does not enter into any organic compound. It is a highly mobile element that moves to where it is needed within plant tissues; thus, symptoms of deficiency first appear on the lower or older leaves rather than on the younger leaves [3]. Potassium affects vital processes within the plant, especially respiration and photosynthesis. One of the most important roles potassium plays in the plant is its involvement in the process of transpiration and the opening and closing of stomata. Potassium is also a key activator of enzymes as well as playing a role in protein metabolism; it influences the formation of chlorophyll and the water content of the leaves [4,5]. In this field, [6] noted that spraying 58-year-old Bāshiqi olive trees with potassium sulfate at three concentrations (0, 500 and 1000 mg L⁻¹) resulted in a significant increase in the nitrogen and potassium content of the leaves, which reached (1.239 and 1.293, 1.233 and 1.303)% respectively, compared to the non-sprayed treatment which was 1.189%. However, no significant differences were found among the potassium concentrations used in the study regarding the phosphorus content of the leaves.

Iron is a micronutrient that all living organisms need, and it is essential for the growth and development of all plants and

cannot be replaced by another element. In the 19th century, iron was first identified as a nutrient for plants; it is a vital component of many plant enzymes and is required for a large number of biological functions in the plant. It has two fundamental roles in the vital activities within the plant: the first is the activation of oxidation-reduction enzymes through its ability to lose and gain electrons, and the second is that it helps in the construction of the chlorophyll molecule, even though it is not part of its structure. Additionally, plants need iron in physiological processes such as cell division, respiration, and the process of photophosphorylation. Iron is also involved in forming the important cytochrome transport chain in both photosynthesis and respiration, with 70% of the iron found within chloroplasts, highlighting its importance in the photosynthesis process within the plant [9,10]. [11] in their study on the response of two-year-old Manzanillo olive seedlings found that spraying with a concentration of (45 ml L⁻¹) of nanoferric chelate resulted in a significant increase in the carbohydrate content of the leaves, which reached 40.96%. Concentrations of (30 and 45) ml L⁻¹ recorded the highest levels of iron content in the leaves at 102.98 and 106.96 ppm respectively. The three concentrations used in the study (15, 30, and 45 ml L⁻¹) of Nano ferric chelate had a significant effect on increasing nitrogen concentration and protein percentage in the leaves. The values reached (1.86, 1.91, 1.89 and 11.64, 11.95, 11.85)% respectively compared to the control treatment which reached (1.63 and 10.20)% respectively, while the concentrations used did not show any significant effect on the significant increase of phosphorus and potassium percentages in the leaves compared to the control treatment. In the study by [12], when spraying olive seedlings of the Sorani variety with iron at a concentration of 1000 mg L⁻¹, a significant increase was observed in the total carbohydrate percentage and the concentrations of the macronutrients NPK in the leaves, reaching (48.56, 3.09, 1.07, 0.40 and 1.29)% respectively compared to a concentration of 500 mg L⁻¹ and the control treatment. [13] found that spraying young Kishmishi grapevines aged 7 years with chelated iron at a concentration of 1 g L⁻¹ resulted in a significant superiority in the leaf content of macronutrients NPK and iron compared to a concentration of 0.5 g L⁻¹ and the control treatment. The aim of this study is to encourage an increase in the mineral content of the leaves of young Arbequina olive trees, which will reflect in the future on accelerating the entry of the trees into the fruiting stage by increasing their carbohydrate content through spraying with potassium and iron, and to determine the best concentration among the concentrations of the factors used in the study either individually or interactively.

Materials and Methods

The experiment was conducted in olive orchard located at the Agricultural Research Station affiliated with the College of Agriculture / University of Kirkuk, Iraq, situated in the Sayada area on latitude 35.38 North and longitude 44.34 East, from 15/3/2024 to 1/10/2024, on young Arbequina olive trees aged 4 years, planted at a distance of 4×4 meters. Homogeneous-sized trees were selected, and pruning was performed at the beginning of the growing season along with all service operations such as weeding, irrigation, and fertilization during the study period. The foliage of the trees was sprayed with three concentrations of potassium in the form of potassium sulfate K₂SO₄ (0, 1000 and 1500) mg L⁻¹ and chelated iron Fe-EDDHA at four concentrations (0, 100, 200 and 300) mg L⁻¹, using a 5-liter handheld sprayer until fully wet. The spraying operation was conducted shortly before sunrise.

The spraying was done on three dates: the first spray on March 15, the second spray on April 15, and the third spray on May 15 during the growing season for both factors. The substance used was the brightener at a concentration of 0.1% with the spray solution to reduce the surface tension of the leaves. The experiment was designed according to a completely randomized block design with three replications, two factors, and two trees per experimental unit, resulting in a total of 24 trees per replication and a total of 72 trees in the experiment. The treatments were randomly distributed within each block. The data from the experiment was statistically analyzed using an ANOVA TABLE with the computer following the [14] system for agricultural experiments, and the means were compared using Duncan's Multiple Range Test at a significance level of 0.05 as mentioned by [15].

Studied characteristics: collected fully grown leaves from different areas and from all trees for the experimental units at the end of the experiment, washed them several times with distilled water to remove the adhering dust, and placed them inside perforated paper bags in an electric oven at a temperature of 70 °C for 48 hours until a constant weight was achieved. Then, finely ground the leaves and took 0.2 g of the dry samples, which were digested using concentrated sulfuric acid (H₂SO₄) and concentrated perchloric acid (HClO₄) in a ratio of 1:4 mL for each, respectively, according to what was mentioned by [16]. The following traits were studied:

- 1- Nitrogen (%):** The nitrogen was determined using a Micro-Kjeldahl device according to the method mentioned by [17].
- 2- Phosphorus (%):** Phosphorus was estimated using the colorimetric method and measuring light absorption at a wavelength of 410 nanometers using the spectrophotometer (EMC V LAB-1 100) according to the method of [18].
- 3- Potassium (%):** Potassium was estimated using the Flame photometer model (Elicocl-378) according to the method of [18].
- 4- Carbohydrates (%):** Carbohydrates were estimated using the Spectrophotometer model (EMC V LAB-1 100) at a wavelength of 490 nanometers according to [19].
- 5- Protein content in the leaves (%):** It was calculated using the following equation: Protein percentage = Nitrogen percentage × 6.25. Iron content in the leaves (mg kg⁻¹): It was estimated using the Atomic Absorption device according to the method of [20].

6- Iron content of leaves (mg kg⁻¹): It was estimated using the atomic absorption device according to the method of [20].

Results and Discussion

1- Nitrogen percentage in leaves (%): The results shown in Table (1) indicated that the nitrogen percentage in the leaves of young olive trees significantly increased when sprayed with potassium and iron. The spray with a concentration of 1500 mg L⁻¹ of potassium in the form of potassium sulfate resulted in a significant increase in this percentage, recording the highest value of 3.63% compared to other concentrations, while the control treatment recorded the lowest percentage at 2.84%. Spraying with concentrations of (200 and 300) mg L⁻¹ of iron in the form of chelated iron also led to a significant increase in the same trait, reaching (3.57 and 3.73)%, respectively, compared to the concentrations (0, 100) mg Fe L⁻¹, which recorded (2.72 and 2.99)% respectively. As for the interaction between potassium and iron concentrations, it had a significant effect on increasing the nitrogen percentage in the leaves. The treatment with a spray concentration of 1500 mg L⁻¹ of potassium combined with a spray concentration of 300 mg Fe L⁻¹ of chelated iron recorded the highest percentage at 4.1%, significantly exceeding the other treatments, while the control treatment recorded the lowest percentage at 2.15%.

Table (1) Effect of spraying potassium and chelated iron on the nitrogen content (%) in the leaves of young olive trees *Olea europaea* L. cv. Arbequina.

Fe-EDDHA Mg L ⁻¹	K ₂ SO ₄ (Mg L ⁻¹)			Average Fe-EDDHA
	0	1000	1500	
0	2.15 g	3.07 d	2.92 ef	2.72 c
100	2.57 fg	2.86 ef	3.54 bc	2.99 b
200	3.15 cde	3.65 b	3.92 ab	3.57 a
300	3.48 bcd	3.59 bc	4.12a	3.73 a
Average K ₂ SO ₄	2.84 c	3.29 b	3.63 a	

The values with similar letters for each factor or their interactions, considered separately, do not differ significantly according to the Duncan's multiple range test at a significance level of 0.05%.

2-Phosphorus percentage in leaves (%): The results of the statistical analysis in Table (2) showed that spraying young olive trees of the Arbequina variety with a concentration of 1500 mg L⁻¹ of potassium in the form of potassium sulfate led to a significant increase in the percentage of phosphorus in the leaves, which reached 0.72% compared to the lowest percentage of 0.63% in the control treatment. Spraying with a concentration of 300 mg Fe L⁻¹ of chelated iron also resulted in a significant increase in the same trait, recording the highest percentage of 0.69%, with a significant difference from the control treatment of 6.15%. The interaction results between the concentrations of potassium and iron showed a significant effect on the percentage of phosphorus in the leaves of the trees, as the spraying with a concentration of 1500 mg K L⁻¹ of potassium sulfate combined with the spraying of 300 mg Fe L⁻¹ of chelated iron recorded the highest percentage of 0.75%, significantly surpassing the other interactions, while the control treatment recorded the lowest percentage of 0.62%.

Table (2) Effect of potassium and chelated iron spraying on the phosphorus percentage in the leaves (%) of young olive trees *Olea europaea* L. cv. Arbequina.

Fe-EDDHA Mg L ⁻¹	K ₂ SO ₄ (Mg L ⁻¹)			Average Fe-EDDHA
	0	1000	1500	
0	0.62 e	0.65 d	0.69 c	0.65 c
100	0.64 d	0.62 de	0.72 b	0.66 bc
200	0.63 de	0.67 c	0.72 b	0.67 b
300	0.64 d	0.67 c	0.75 a	0.69 a
Average K ₂ SO ₄	0.63 c	0.65 b	0.72 a	

The values with similar letters for each factor or their interactions, considered separately, do not differ significantly according to the Duncan's multiple range test at a significance level of 0.05%.

3-Potassium percentage in leaves (%): The results shown in Table (3) indicated that spraying young olive trees of the Arbequina variety with a concentration of 1500 mg L⁻¹ of potassium led to a significant increase in the percentage of potassium in the leaves, recording the highest percentage of 5.43% compared to the lowest percentage recorded in the control treatment, which was 4.83%. Meanwhile, spraying with a concentration of 300 mg Fe L⁻¹ of chelated iron resulted in a significant increase in the same trait, recording the highest percentage of 5.29% compared to the other concentrations, with an increase rate of 8.17% over the control treatment. As for the interaction between the potassium and iron concentrations, it had a significant effect in increasing the percentage of potassium in the leaves of the trees, as the interaction treatment spraying with a concentration of 1500 mg L⁻¹ of potassium combined with the spraying at a concentration of 300 mg L⁻¹ of iron recorded the highest percentage of 5.84%, significantly exceeding the other interactions, while the control treatment recorded the lowest percentage of 4.72%.

Table (3) Effect of potassium and chelated iron spraying on the potassium percentage in the leaves (%) of young olive trees *Olea europaea* L. cv. Arbequina.

Fe-EDDHA Mg L ⁻¹	K ₂ SO ₄ (Mg L ⁻¹)			Average Fe-EDDHA
	0	1000	1500	
0	4.72 e	4.87 de	5.09 cd	4.89 c
100	4.87de	4.92 de	5.23 c	5.00 bc
200	4.82de	4.50 cde	5.54 b	5.12 b
300	4.91 de	5.13 cd	5.84 a	5.29 a
Average K ₂ SO ₄	4.83 c	4.98 b	5.43 a	

The values with similar letters for each factor or their interactions, considered separately, do not differ significantly according to the Duncan's multiple range test at a significance level of 0.05%.

4-Total carbohydrates percentage in leaves (%): The results of Table (6) showed that spraying young olive trees of the Arbequina variety with a concentration of 1500 mg L⁻¹ of potassium recorded the highest percentage of total carbohydrates in the leaves, reaching 6.10%, which did not significantly differ from the concentration of 1000 mg K L⁻¹, as it reached 6.05%. Both surpassed the control treatment, which recorded the lowest percentage of 5.65%. Meanwhile, spraying with a concentration of 300 mg L⁻¹ of iron resulted in a significant increase in the same trait, recording the highest percentage of 6.60% compared to other concentrations, while the control treatment recorded the lowest percentage of 5.39%. As for the results of the interaction between potassium and iron concentrations, they had a significant effect on percentage of total carbohydrates in the leaves, as the interaction treatment at a concentration of 1500 mg L⁻¹ of potassium combined with a concentration of 300 mg L⁻¹ of iron recorded the highest percentage of 7.15%, significantly surpassing the other interaction treatments, while the control treatment recorded the lowest percentage of 5.20%.

Table (4) Effect of potassium and chelated iron spraying on the total carbohydrate ratio in the leaves (%) of young olive trees *Olea europaea* L. cv. Arbequina.

Fe-EDDHA Mg L ⁻¹	K ₂ SO ₄ (Mg L ⁻¹)			Average Fe-EDDHA
	0	1000	1500	
0	5.20 d	5.45 cd	5.53 cd	5.39 c
100	5.72 cd	5.93 cd	5.43 cd	5.69 bc
200	5.85 cd	5.98 cd	6.28 cb	6.04 b
300	5.82 cd	6.83 ab	7.15 a	6.60 a
Average K ₂ SO ₄	5.65 b	6.05 a	6.10 a	

The values with similar letters for each factor or their interactions, considered separately, do not differ significantly according to the Duncan's multiple range test at a significance level of 0.05%.

5- Iron content in leaves (mg kg⁻¹): The results clearly shown in Table (5) indicated that spraying Arbequina olive trees with potassium at concentrations of (1000 and 1500) mg L⁻¹ as K₂SO₄ led to a significant increase in the leaf iron content reaching (131.44 and 132.86) mg kg⁻¹, respectively, compared to the control treatment which reached 129.00 mg kg⁻¹. Meanwhile, spraying with a concentration of 300 mg L⁻¹ of iron in the form of Fe-EDTA resulted in a significant increase in the same property, recording the highest percentage of 135.03 mg kg⁻¹ compared to the other concentrations, while the control treatment recorded the lowest percentage of 128.42 mg kg⁻¹. The results of the interaction between potassium and iron concentrations showed a significant effect on the iron content in the leaves of olive trees, where the interaction treatment at a potassium concentration of 1500 mg L⁻¹ combined with a 300 mg L⁻¹ iron concentration recorded the highest percentage of 137.86 mg kg⁻¹, significantly outperforming the other interaction treatments, whereas the control treatment recorded the lowest percentage of 123.69 mg kg⁻¹.

Table (5) Effect of spraying potassium and chelated iron on the iron content in the leaves (mg kg⁻¹) of young olive trees *Olea europaea* L. cv. Arbequina.

Fe-EDDHA Mg L ⁻¹	K ₂ SO ₄ (Mg L ⁻¹)			Average Fe-EDDHA
	0	1000	1500	
0	123.69 f	129.71 cd	131.88 bcd	128.42 c
100	130.75 cd	133.56 abc	129.24 de	131.18 b
200	125.70 ef	130.48 cd	133.10 bcd	129.76 bc
300	135.88 ab	132.00 bcd	137.22 a	135.03 a
Average K ₂ SO ₄	129.00 b	131.44 a	132.86 a	

The values with similar letters for each factor or their interactions, considered separately, do not differ significantly according to the Duncan's multiple range test at a significance level of 0.05%.

6- Protein percentage in leaves (%): The results shown in Table (4) revealed that spraying trees with a concentration of 1500 mg L⁻¹ of potassium in the form of potassium sulfate led to a significant increase in the protein percentage in the leaves, reaching 22.66% compared to other concentrations, with an increase of 5.63% over the control treatment. Spraying with concentrations of (200 and 300) mg L⁻¹ of iron also resulted in a significant increase in the same trait, reaching (22.34 and 23.33)% respectively compared to other concentrations, while the control treatment recorded the lowest percentage at 16.97%.

The interaction between potassium and iron concentrations was significant in increasing the protein percentage in the leaves, as the interaction treatment with a concentration of 1500 mg L⁻¹ of potassium sulfate combined with spraying at a concentration of 300 mg L⁻¹ of chelated iron recorded the highest percentage of 25.75%, which was not significantly different from the treatment of spraying with a concentration of 1500 mg L⁻¹ of potassium combined with spraying at a concentration of 200 mg L⁻¹ of iron, which reached 24.50%, both of which significantly surpassed the other interaction treatments, while the control treatment recorded the lowest percentage for this trait 13.46%.

Table (6) Effect of potassium and chelated iron spraying on the protein percentage in the leaves (%) of young olive trees *Olea europaea* L. cv. Arbequina.

Fe-EDDHA Mg L ⁻¹	K ₂ SO ₄ (Mg L ⁻¹)			Average Fe-EDDHA
	0	1000	1500	
0	13.46 g	19.21 de	18.25 ef	16.97 c
100	16.08 fg	17.89 ef	22.15 bc	18.70 b
200	19.71 cde	22.81 b	24.50 ab	22.34 a
300	21.77 bcd	22.48 bc	25.75 a	23.33 a
Average K ₂ SO ₄	17.76 c	20.59 b	22.66 a	

The values with similar letters for each factor or their interactions, considered separately, do not differ significantly according to the Duncan's multiple range test at a significance level of 0.05%.

The reason for the improvement observed in the content of the papers from mineral elements may be attributed to the increased metabolic activities of the plants and the role of potassium in increasing the plant's content of sugar and starch, which enhances the effectiveness of the enzymatic systems, as it is responsible for activating approximately 60-80 clear enzymes from the growth enzymes responsible for photosynthesis and energy compounds and chlorophyll production, leading to an increase in most traits [21]. Additionally, potassium plays a role in the metabolism of amino acids and proteins, as it affects the availability of nutrients like nitrogen, having a role in the movement of this element within the plant. Potassium acts as a co-ion with the negatively charged nitrate ion during its transfer from the root system to the shoot system, where nitrate is reduced to ammonia to contribute to the formation of amino acids and proteins [22]. Potassium deficiency also negatively affects the distribution of processed carbohydrates in the leaves and their transport to other parts of the plant [23]. [24] indicated that potassium deficiency in the plant adversely affects the efficiency of energy transfer in chloroplasts and mitochondria, impacting the synthesis of sugars, starches, fats, ascorbic acid, and the formation of the cuticle in the leaves. This is consistent with the results of [6, 7, 8].

The increase in the content of the leaves from mineral elements when spraying with iron may be attributed to the role of iron in many vital processes within the plant, including the formation of nucleic acids, proteins, and enzymes that promote increased cell division and cell elongation, leading to an increase in plant tissue growth. Additionally, it enhances the absorption of water and nutrients by the roots, which in turn drives the plant towards vegetative growth, as well as increases the number and length of roots where cytokinins are produced, which are then transported to the leaves, thus stimulating cell division and differentiation of plant cells that lead to increased vegetative growth, leaf area, and greater carbohydrate accumulation [9]. Furthermore, increased vegetative growth leads to enhanced absorption of elements by the plant, as noted by [25]. These results are consistent with findings by [11, 12, 13, 26, 27].

Conclusion

We conclude from the results of the tables above that spraying young olive trees of the Arbequina variety with a concentration of 1500 mg L⁻¹ of potassium in the form of potassium sulfate and a concentration of 300 mg L⁻¹ of iron in the form of chelated iron has improved the content of the tree leaves in macro-nutrients, iron, and carbohydrates significantly, both individually and in combination.

References

- [1]. Olias, J.M. and Garcia, J.M. (1997). Olive In Postharvest physiology and sub-tropical fruits (Mitra,S,ed). AB International, Oxford, England, pp: 229-243.
- [2]. Vavilov, N.I. (1951). Phytogeographic basis of plant breeding the origin, variation, immunity and breeding of cultivated plants. *chronica botanica*, 13:1-366.
- [3]. Ali, N.El-D.Sh. (2012). The Guide to Plant Nutrition. Translated, Part One, Dar Al-Kutub Al-Ilmiyah for Printing, Publishing, and Distribution, University of Baghdad, Ministry of Higher Education and Scientific Research.
- [4]. Devlin, R. M. and F. H. Witham (2011). Plant Physiology. Translated by: Sharaki, Mohamed Mahmoud, Abdul Hadi Khadr, Ali Saad al-Din Salama, and Nadia Kamel. Arab House for Publishing and Distribution, third edition, Cairo, Egypt.
- [5]. Abdel Aal, K.A.D., S.A.F. Hassan, Y.M. Hafiz and M.M. Salem (2013). Fundamentals of Plant Physiology. Faculty of Agriculture, Kafr El Sheikh University, Egypt.
- [6]. Al-Zubaidi, A. A. (2003). The effect of spraying and aerial application of urea and potassium on the vegetative and fruit characteristics and the compounds Methoxalin and Saponin in olives. Master's thesis, College of Agriculture,

University of Baghdad, Iraq.

- [7]. Sarrwy, S.M.A., E.A. Mohamed and H.S.A. Hassan (2010). Effect of foliar sprays with Potassium nitrate and Mono-Potassium Phosphate on leaf mineral contents, fruit set, yield and fruit quality of Picual Olive Trees grown under sandy soil conditions. *American-Eurasian J. Agric. and Environ*, 8(4): 420-430.
- [8]. Gowda, A.M., H.A.M. Ali and T.Kh. El-Bolok (2022). Effect of Foliar Spraying with Different Sources of Potassium on Growth, Leaf Mineral Composition, Yield and Fruit Quality of Picual Olive Trees. *Egyptian Journal of Horticulture*, 49 (1): 103-114.
- [9]. Al-Sahaf, F. H. (1989). *Applied Plant Nutrition*. Ministry of Higher Education and Scientific Research, University of Baghdad, House of Wisdom, Mosul Press, Iraq.
- [10]. Al-Naimi, S. N. A. (2000). *Principles of Plant Nutrition (Translator)*. National Library institution for printing and publishing. University of Mosul. 2nd edition. Iraq. pp: 772.
- [11]. Alalam, A.T. S. and A.H.E. Alalaf (2020). Response of the olive seedlings of manzanillo variety to foliar spray with some growth stimuli. *Plant Cell Biotechnology and Molecular Biology*, 21(41&42):27-34.
- [12]. Hussein, S.A., M.A. Lateef and R.A. Al-Qady (2021). The effect of foliar application of Iron, Chelated Zink, And Gibberellin on Some of the Vegetative Growth Parameters of Olive Seedlings Cultivar (Sorani). *International Journal of Agricultural and Statistical Sciences*, 17(1): 1497-1502.
- [13]. Hussein, S.A. (2024). Response of Young grapevines (Kishmishi cultivar) to Spraying by Iron Chelated and the growth regulator benzyl adenine. *Tikrit Journal for Agricultural Sciences*, 24(3): 13-23.
- [14]. SAS (2001). *Statistical Analysis System*. SAS Institute Inc. Cary, Nc. USA.
- [15]. Roger, M.R.N.C. and A.M. Hasted (2003). *Statistical Methods in Agriculture and Experimental Biology* Champan. Hall, CRC, A CRC Press Co., Washington, D. C.
- [16]. Johnson, C. M. and A. Ullrich (1959). *Analytical Method for Use in Plant Analysis Bulletin 766*. University of California Agriculture Experiment station, Berkeley CA.
- [17]. A.O.A.C. (1980). *Official methods of analysis 13th of association of ficial analytical chemists – Washington,dc*.
- [18]. Estefan, G., R. Sommer and J. Ryan (2013). *Methods of soil, plants, and water analysis, ICARDA* , International for Agriculture Research in the Dry Areas, third edition ICARDA @ cigar.org www.icarda.org.
- [19]. Dubois, M., K.A. Gilles, L.K. Hamilton, P.A. Rebers and F. Smith (1956). Colorimetric method for determination of sugars and related substannccs. *Anal. Chem.*, 28(3): 350-6.
- [20]. Haynes, R.J. (1980). A Comparison of two modified kjeldhal digestion techniques for Multi- element plant analysis with conventional wet and dry ashing methods . *Comm. Soil .Sci. Plant Analysis* .11(5): 459-467.
- [21]. Havlin, J.L., J.D. Beaton, S.L. Tisdale and W.L. Nelson (2005). *Soil fertility and fertilizers* , in an introduction to nutrient management , 6th ed. Prentic Hall, New Jersey: 199-218.
- [22]. Najem, A.W.Y., A.H.A. Hadi and M.S. Khadr (1997). *Facts about Potassium*. Agricultural Research Center, Ministry of Agriculture and Land Reclamation, Arab Republic of Egypt.
- [23]. Yang, X.E., X. Liu, W.M. Wang, Z.Q. Ye and A.C. Luo (2004). Potassium Internal use efficiency relative to growth vigor. Potassium distribution, and carbohydrate allocation in rice genotypes. *Journal of Plant Nutrition*, 27(5).
- [24]. Allen, V.B. and J.P. David (2006). *Handbook plant nutrition*. Taylor and Francis Group.
- [25]. Ismail, A.A. and A.S.K. Ghazai (2012). Response of olive seedlings to the addition of seaweed extract to the soil and foliar feeding with magnesium and fenugreek seed extract for foliar spray. *Iraqi Journal of Agricultural Sciences*. 43 (2): 119-131.
- [26]. Hussein, S.A. (2023). Role of Decomposed animal manure and humic acid in improving the vegetative growth and mineral content of young Olive trees Cv. Sourany. *Al-Azhar Journal of Agricultural Research*, 48 (3): 51-57.
- [27]. Azeez, D.R., R.A. Medan and S.A. Hussein (2017). Effect of foliar application of chelated calcium and boron on growth and yield of strawberry (*Fragaria ananassa* Duch.) CV. Festival. *Kirkuk University Journal for Agricultural Sciences, Supplement to Volume 8: 77-86*.

استجابة بعض صفات المحتوى المعدني لأوراق أشجار الزيتون الفتية صنف *Arbequina* للرش بالبولتاسيوم والحديد المخلبي

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¹تقسم البستنة وهندسة الحدائق، كلية الزراعة، جامعة كركوك، العراق.

الخلاصة

اجريت الدراسة في حقل زيتون التابع لكلية الزراعة/ جامعة كركوك، العراق الواقعة في منطقة صيادة خلال موسم النمو 2024 لدراسة تأثير الرش بالبولتاسيوم بثلاث تراكيز (0، 1000، 1500) ملغم لتر-1 والحديد المخلبي بأربع تراكيز (0، 100، 200، 300) ملغم لتر-1 في بعض صفات المحتوى المعدني لأوراق أشجار الزيتون الفتية صنف *Arbequina* بعمر 4 سنوات، إذ تم الرش بثلاث مواعيد خلال موسم النمو بدأ من 3/15 ولغاية 5/15 وبفارق شهر واحد بين الرش والثنائية. ولخصت النتائج التي تم الحصول عليها بما يلي: أدى الرش بتركيز 1500 ملغم لتر-1 من البولتاسيوم إلى تفوق معنوي في نسبة المغذيات الكبرى *NPK* والكربوهيدرات والبروتين في الأوراق حيث بلغ (3.63، 0.72، 5.43، 22.66، 6.10)% على التوالي، في حين أثر تركيزي 1000 و1500 ملغم لتر-1 من البولتاسيوم إلى زيادة معنوية في محتوى الأوراق من الحديد والذي بلغا (131.44 و132.86) ملغم كغم-1 على التوالي. وأدى الرش بالحديد المخلبي بتركيزين 200 و300 ملغم لتر-1 إلى زيادة معنوية في نسبة النتروجين والبروتين في الأوراق اللذان بلغا (3.57، 3.73 و22.34، 22.33)% على التوالي، أما الرش بتركيز 300 ملغم لتر-1 من الحديد المخلبي أثر وبشكل معنوي في زيادة نسبة الفسفور والبولتاسيوم والحديد والكربوهيدرات الكلية في الأوراق وبلغ (0.69، 5.29، 135.03 ملغم كغم-1، 6.60)% على التوالي، وكان للتداخل الثنائي بين تراكيز العوامل الداخلة في الدراسة أثر معنوي في تحسين الصفات المدروسة.

الكلمات المفتاحية: كبريتات البولتاسيوم، الحديد المخلبي، زيتون، *Olea europaea L*.