Effect of spraying with nano-iron and adding organic fertilizer to improve some chemical traits for Jujube leaves of Al-Tafahi cultivar (*Ziziphus mauritiana Lam*.)

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Abstract

The experiment was conducted in a private orchard in Al-Hartha district , Basra province during the autumn season 2019-2020.In order to know the effect of spraying with iron nano-chelated fertilizer and adding Potgrond organic fertilizer to improve some chemical properties of the leaves of Jujube trees, *Ziziphus mauritiana Lam*. The experiment was designed as a factorial experiment according to a randomized complete block design (R.C.B.D) with three replicates. Three concentrations of chelated iron (0, 1, 2) $g.L^{-1}$ and two concentrations of Potgrond organic fertilizer (0, 4) $kg.tree^{-1}$ were used. The results were analyzed statistically using the LSD test at a 5% probability level and using the Genstat statistical program. The results showed that spraying with nano chelated iron at a concentration of $2g.L^{-1}$ led to an improvement of traits including chlorophyll, carbohydrates, nitrogen, phosphorous, potassium and iron in leaves and it reached (3.56 mg. 100 g^{-1}, 67.36 mg.100 $g.L^{-1}$, 2.00%, 0.50%, 1.80% , 6.03%), respectively, The addition of organic fertilizer Potgrond 4 $kg.tree^{-1}$ caused a significant increase in chlorophyll, carbohydrates, nitrogen, phosphorous, potassium and iron, and it reached (3.31 mg. 100 g^{-1}, 69.70 mg. 100 g^{-1}, 1.90%, 0.46%, 1.67%, 5.13%), respectively. , And the interaction between the two study factors showed a significant effect on the studied traits.

Key words: *Ziziphus mauritiana*, nano iron, organic fertilizer, Jujube leaves.

* **Part of M.Sc. Thesis of the first author**

تأثير الرش بالحديد النانوي واضافة السماد العضوي في تحسين بعض الصفات الكيميائية لأوراق السدر صنف التفاحي *Ziziphus mauritiana* Lam.

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المستخلص:

نفذت التجربة في أحد البساتين الاهلية في قضاء الهارثة - محافظة البصرة أثناء الموسم الخريفي 2019-2020م بهدف معرفة تأثير الرش بسماد نانو الحديد المخلبي وأضافة السماد العضوي POTGROND في تحسين بعض الصفات الكيميائية لأوراق اشجار السدر صنف التفاحي *Ziziphus mauritiana* Lam. وصممت التجربة كتجربة عاملية وفق تصميم القطاعات العشوائية الكاملة (R.C.B.D) وبثلاث مكررات . واستعملت ثلاثة تراكيز من نانو الحديد المخلبي (0 ، 1 ، 2) غم لتر$^{-1}$ وتركيزين من السماد العضوي Potgrond (0 ، 4) كغم شجرة$^{-1}$. وحللت النتائج احصائياً باستعمال اختبار اقل فرق معنوي LSD وعلى مستوى احتمال 5% وباستخدام البرنامج الأحصائي Genstat اوضحت النتائج ان الرش بنانو الحديد المخلبي بتركيز 2 غم لتر$^{-1}$ أدى الى تحسين الصفات ومنها الكلوروفيل والكربوهيدرات والنتروجين والفسفور والبوتاسيوم والحديد في الأوراق وبلغ (3.56 ملغم.100غم$^{-1}$ ، 67.36 ملغم.100غم$^{-1}$ ، 2.00% ، 0.50 % ، 1.80% ، 6.03 %) بالتتابع ، كما ان اضافة السماد العضوي Potgrond 4 كغم شجرة$^{-1}$ احدثت زيادة معنوية في الكلوروفيل والكربوهيدرات والنتروجين والفسفور والبوتاسيوم والحديد وبلغ (3.31 ملغم.100غم$^{-1}$ ، 69.70 ملغم.100غم$^{-1}$ ، 1.90 % ، 0.46 % ، 1.67% ، 5.13 %) بالتتابع ، واظهر التداخل بين عاملي الدراسة تأثيراً معنوياً في الصفات المدروسة.

Introduction

Jujube plant (*Ziziphus mauritiana*) belongs to the family Rhamnaceae and to the genus Ziziphus (13, 23). Jujube trees are a multi-purpose plant, where their fruits are eaten fresh because they contain a high content of vitamin C, sugars, proteins, organic and amino acids, fats and mineral salts. Each 100 g pulp contains 20.9 calories. Jujube trees are used as fuel or windbreaks, in addition to the medicinal benefits of its leaves and bark (5, 7, 15, 4). The Al-Tufahi cultivar is considered an excellent and commercially desirable cultivar . The type follows Mauritiana, as its fruits are spherical, semi-spherical, or elliptical, and are yellow-green in color at maturity (3). Nanomaterials exhibit properties of materials that differ from them when they are with their conventional dimensions of more than 100 nm (9). Among the nano fertilizers is chelated iron nano fertilizer, which is a source rich in divalent iron due to its high stability and gradual release of iron in a wide range of pH (11-3), This type of chelated iron nano fertilizer is characterized by an increase in the ratio of ferrous iron to ferric iron in the chelated surface, which leads to an increase in the synthesis of chlorophyll in the plant (18). In addition to being fast absorption due to the small size of its minutes and its stability under different conditions, which leads to an increase in the ability to be stored for long periods and this leads to its use at the required times and one hectare needs small quantities of it compared to traditional fertilizers, which helps reduce the costs of using high-priced chemical fertilizers as well. on increasing environmentally-friendly agricultural production (11). The importance of organic fertilizers, including Potgrond fertilizer, is that it is added to orchards to achieve several purposes, including improving soil properties by disassembling soil particles, especially heavy particles and improving ventilation so that water and air penetrate them and raise the soil content of various nutrients, where the proportion of nitrogen, potassium, phosphorous and some The micro-elements when the decomposition of the organic matter is complete. Humus is a rich source of nitrogen and phosphorous and contains humic and fulvic acids (22, 12). Although the Jujube trees of the Al-Tuffah cultivars were among the widespread trees in Basra Governorate, they have deteriorated due to poor environmental conditions and the leveling of agricultural lands in addition to the high salinity of irrigation water. In view of the fact that this cultivar is one of the commercial cultivars desired by the consumer, which significantly decreases the productivity of his orchards, and as an attempt to improve some of the chemical properties of his tree leaves, which is positively reflected on its yield, as well as to test the efficiency of Potgrond organic fertilizer and nano iron, the current research was conducted.

Materials and Methods

The experiment was conducted during the autumn season 2019-2020 in one of the private gardens in Al-Hartha district, Al-Basrah province to study the effect of spraying of three concentrations of nano-iron chelate fertilizer (0, 1, 2) $g.L^{-1}$ and two concentrations of organic fertilizer (0, 4) $kg.tree^{-1}$ in some chemical traits of the leaves of the Jujube trees of the Al-Tufahi cultivar. (18) trees were selected similar in the strength of vegetative growth and free from disease and insect infection, and at the age of 15 years for one tree (grafted on seed roots by the method of shield grafting) and cultivated in clay silt soil, Table (1) with dimensions of 5 x 5 m. All service operations were conducted from regular irrigation, pruning, pest control, manual and mechanical weeding and in an integrated manner until The end of the experiment. Random samples were taken from Orchard soil at a depth of (0-90) cm and analyzed in the laboratories of the Marine Sciences Center / University of Basra, Table (1) and analyzed samples of irrigation water on three different periods: 1/10/2019, 1/12/2019 and 1/2/2020 Table (2).

Fertilizer treatments

A- Organic fertilizer (Potgrond): the fertilizer was added in three batches, the first before flowering 9/21/2019, the second three weeks after the first treatment 10/12/2019 and the third three weeks after the second treatment 11/2/2019 Table (3) shows The components of this fertilizer produced by the Dutch Klasmann company, and the treatment was done with the addition of organic fertilizer as follows

1. control treatment (0 kg.tree $^{-1}$): The three trees designated for this treatment did not have organic fertilizer added to them.

2. Treatment (4 kg.tree^{-1}): 4 kg of organic fertilizer were added to each of the three trees designated for this treatment, in the form of a circular ring around the tree.

B- Nano fertilizer (nano iron chelate):

Jujube trees of the Al-Tufahi cultivar were sprayed with three concentrations of chelated iron nano fertilizer (0, 1, 2) g.L^{-1} and on three sprayers, the first before flowering 9/21/2019 and the second sprayer ten days after the first sprayers1/10/2019 and the third sprayer Ten days after the second sprayer of 11/10/2019, at 5 L.tree $^{-1}$. The concentrations of spraying treatments with chelated iron nano (produced by the Iranian company Khazra Nano Chelated Fertilizer) are as follows:

1. control treatment (0 g.L^{-1} nano iron chelate): Each of the three trees designated for this treatment was sprayed with 5 liters of distilled water only.

2. Treatment (1 g.L^{-1}): The spraying solution was prepared by dissolving 5 g of chelated iron nano fertilizer in 5 liters of distilled water.

3. Treatment (2 g.L^{-1}): The spraying solution was prepared by dissolving 10 gm of chelated iron nano fertilizer in 5 liters of distilled water.

Studies traits:

1. Total chlorophyll pigment (mg 100 g^{-1}):

The total amount of chlorophyll (mg.L^{-1}) was estimated through the following equation according to (10):

Total Chlorophyll (mg.L^{-1}) = 20.2 D (645) + 8.02 D (663)

Then convert the amount of chlorophyll from mg.L^{-1} to mg 100g^{-1} fresh weight according to the following equation:

Amount of Chlorophyll mg 100g $^{-1}$ = (Chlorophyll mg.L $^{-1}$ / 1000x sample weight) x 100

2. The leaves content of total dissolved carbohydrates (mg 100g $^{-1}$ dry weight):

The concentration of total dissolved carbohydrates in the leaves was determined according to the method of phenol with sulfuric acid described before (8).

3. Estimate the percentage of nutrients in the leaves (%):

a. Determination of the percentage of nitrogen in the leaves (%): The concentration of nitrogen element in the leaves was estimated using the Micro kjeldhal device according to the Stemdisstilation method described before (16).

B. Determination the percentage of phosphorous in leaves (%): Phosphorus was estimated by (14) method.

C. Determination the percentage of potassium in leaves (%): The potassium element was estimated as mentioned (16).

D.Determination of the iron element in the leaves (mg / liter-1): the iron element was estimated by the Atomic Absorption Spectrophotometer, according to (19).

 ISSN 2072-3875

Table (1) Some chemical and physical traits of the soil at the study location at a depth of (0 - 90) cm from the soil surface during the growing season 2019-2020 .

Soil Texture	Soil separators ($g.kg^{-1}$ soil)			Elements ($g.kg^{-1}$ soil)			PH	Soil organic matter (%)	Electrical conductivity (E. C.)
	sand %	%Clay	Silt %	N	P	K			
Silty Clay	2	25	73	2.95	0.45	1.05	7.67	0.40	4.06 $Ds.m^{-1}$

Table (2): Some physical and chemical traits of the water used to irrigate the trial trees during the 2019-2020 growing season.

date of the analysis			Type of analysis	No.
2020/2/1	2019/12/1	2019/10/1		
7.25	9.14	7.58	(E. C.) Electrical conductivity	1
8.05	6.53	7.24	pH	2
5824.4	3250.6	5410.1	Chloride ions ($mg.L^{-1}$)	3
3001.8	4536.4	3378.8	Sodium ions ($mg. L^{-1}$)	4
1247.3	1536.7	1333.5	Sulfate ($mg.L^{-1}$)	5

Table (3) components of Potgrond organic fertilizer

% 90	Organic matter
% 75 – 60	Humidity
% 6.3 – 5.5	PH with aqueous extract
10.5 $g.kg^{-1}$	Composite fertilizer N. P. K. neutralizer

Results and discussion

1-The effect of spraying with chelated iron nano fertilizer and adding Potgrond organic fertilizer, and the interaction between them in the concentration of total chlorophyll pigment in the leaves of Jujube trees, the Al-Tufahi cultivar. Table (4) shows that spraying with chelated iron nano fertilizer at a concentration of 2 $g.L^{-1}$.It significantly excelled on the other concentrations by giving the highest concentration of total chlorophyll pigment, at 3.69 mg 100 g^{-1}, while the concentration of 1 $g.L^{-1}$ was excelled on the control treatment that gave the lowest concentration of total chlorophyll pigment 2.83 mg 100 g^{-1}. The reason for the increased content of the leaves of total chlorophyll may be due to the fact that iron is directly involved in the formation of the enzyme caproporphyrinogen oxidase, which is an enzyme involved in the sixth step of Porphyrins metabolism and is necessary for the manufacture of α-amino levulinic acid, which is the precursor to the formation of chlorophyll

 ISSN 2072-3875

(6). Also, the treatment of 4 kg.tree^{-1} organic fertilizer had a significant effect in increasing the concentration of total chlorophyll pigment in the leaves and it reached 3.31 mg 100 g^{-1}. While the control treatment recorded the lowest concentration of chlorophyll and reached 3.11 mg 100 g^{-1}, and the reason may be due to the organic fertilizer containing the nitrogen component, which has a significant effect on increasing the total chlorophyll pigment in the leaves, where nitrogen enters the construction of the porphyrins ring that is essential in the synthesis of chlorophylls. The same table also indicated that the interaction between spraying with chelated iron nano fertilizer and adding organic fertilizer was also significant. The bi-interaction treatment (2 nano iron g.L^{-1} and 0 kg.tree $^{-1}$ organic fertilizer) excelled by giving the highest percentage of total chlorophyll in leaves, which reached 3.87 mg 100 g^{-1}, while the control treatment gave the lowest concentration of total chlorophyll, which reached 2.50 mg 100 g^{-1}.

Table (4) The effect of spraying with nano iron-chelated fertilizer and adding Potgrond organic fertilizer and its interaction in the total chlorophyll pigment concentration (mg 100 g^{-1}) for Jujube leaves of trees of The Al-Tufahi cultivar .

Average effect of organic fertilizer Potgrond	Nano iron chelate g.L $^{-1}$			organic fertilizer Potgrond Tree.kg $^{-1}$
	2	1	0	
3.11	3.87	2.98	2.50	0
3.31	3.50	3.25	3.17	4
	3.69	3.12	2.83	Average effect of nano chelated iron fertilizer
L.S.D. value. At the level of 0.05				
interaction between nano chelated iron fertilizer and organic fertilizer	Nano iron chelate			organic fertilizer
0.335	0.237			0.193

2-The effect of spraying with nano chelated iron fertilizer, adding Potgrond organic fertilizer, and the interaction between them in the concentration of total dissolved carbohydrates in Jujube leaves of the Al-Tufahi cultivar .

The results in Table (5) show that the concentration of 2 gL^{-1} nano chelate iron fertilizer significantly excelled on the other concentrations by giving it the highest concentration of dissolved carbohydrates in the leaf which was 67.36 mg.100g^{-1}, while the treatment of 0 g.L^{-1} nano chelated iron gave the lowest concentration of dissolved carbohydrates in the leaf. and 57.40 mg 100 g^{-1}. Perhaps the reason for the increase in carbohydrates in the leaves is that nano fertilizers improve the growth of plants, increase the efficiency of the use of nutrients, and give more space for various metabolic reactions in the plant, which increases the average of photosynthesis and increases the production of carbohydrates (17). The same table also shows that adding organic fertilizer at

 ISSN 2072-3875

a concentration of 4 kg.tree^{-1} organic fertilizer had a significant effect on increasing the total dissolved carbohydrates in the leaves, where it reached 69.70 mg 100 g^{-1}, while the carbohydrate concentration in the control treatment reached 57.11 mg100 g^{-1},The reason for the increase in carbohydrates in the leaves may be due to the increase in the chlorophyll content of the leaves due to the action of organic fertilizer, and this means a higher carbon representation. As the chlorophylls are the direct center of light energy harvesting, thus increasing photosynthesis and carbohydrate accumulation in the leaves (2). As for the interaction, the interaction treatment (2 g.L^{-1} nano iron chelate fertilizer and 4 kg.tree^{-1} organic fertilizer) significantly excelled on the other treatments by giving it the highest concentration of dissolved carbohydrates in the leaf, reaching 76.25 mg 100 g^{-1}.Whereas, the control treatment recorded the lowest concentration of dissolved carbohydrates in the leaf, which was 50.11 mg 100 g^{-1}.

Table (5) The effect of spraying with nano iron-chelated fertilizer and adding Potgrond organic fertilizer, and the interaction between them in the concentration of total dissolved carbohydrates (mg 100 g^{-1}) for Jujube leaves of trees of The Al-Tufahi cultivar .

Average effect of organic fertilizer Potgrond	Nano iron chelate g.L $^{-1}$			organic fertilizer Potgrond Tree.kg $^{-1}$
	2	1	0	
57.11	58.48	62.74	50.11	0
69.70	76.25	68.16	64.69	4
	67.36	65.45	57.40	Average effect of nano chelated iron fertilizer
L.S.D. value. At the level of 0.05				
interaction between nano chelated iron fertilizer and organic fertilizer	Nano iron chelate			organic fertilizer
5.230	3.698			3.020

3- The effect of spraying with nano chelated iron fertilizer, adding Potgrond organic fertilizer, and the interaction between them in the concentration of nitrogen, phosphorus, potassium and iron elements in the leaves of Jujube leaves of the Al-Tufahi cultivar .

The results in Table (6) indicate that the nano chelated iron fertilizer led to an increase in the concentration of the nitrogen component, where the concentration of 2 g.L^{-1} nano chelated iron had a significant effect by giving it the highest increase in the concentration of the nitrogen element in the leaf as it reached 2.00%, while the control treatment gave the lowest concentration of the nitrogen in leaves, it reached 1.64%. The same table also indicates that the addition of 4 kg.tree $^{-1}$ organic fertilizer led to a significant increase in the concentration of nitrogen component in the leaf, reaching 1.90%, while the control treatment recorded the lowest concentration of nitrogen, which reached 1.75%. The interaction between the two factors had a significant effect in increasing the

 ISSN 2072-3875

nitrogen concentration in the leaf, where the interaction treatment (2 g.L^{-1} nano chelated iron and 4 kg.$tree^{-1}$ organic fertilizer) achieved the highest concentration of nitrogen in the leaf, which reached 2.11%, while the lowest concentration was the nitrogen in the control treatment, which amounted to 1.62%. The results in Table (6) also indicate that spraying with nano chelated iron fertilizer had a significant effect in increasing the percentage of phosphorous in the leaves, where the treatment of 2 g.L^{-1} nano chelate iron recorded the highest percentage of phosphorus and reached 0.50%, while the control treatment recorded the lowest percentage of phosphorus, which reached 0.34. %,It is also noted from the same table that the addition of organic fertilizer had a significant effect in increasing the percentage of phosphorous in the leaves, where the treatment of 4 kg.$tree^{-1}$ recorded the highest percentage of phosphorus in the leaves, which reached 0.46%, while the control treatment recorded the lowest percentage, at 0.37%. As for the interaction, the interaction treatment (2 g.L^{-1} nano chelate iron fertilizer and 4 kg.$tree^{-1}$ organic fertilizer) significantly excelled on all treatments by giving it the highest percentage of phosphorus, which reached 0.52%, while the control treatment recorded the lowest percentage of phosphorus in the leaves, at 0.28%. The results in Table (6)showed that spraying nano iron chelated fertilizer has a significant effect on increasing the concentration of the potassium element in the leaves of the Jujube leaves of the Al-Tufahi cultivar ,where the treatment of 2 g.L^{-1} was excelled by giving it the highest concentration of the potassium element in the leaves, which reached 1.80%, while the control treatment was recorded the lowest concentration of potassium in leaves, which was 1.31%.

Table (6)showed that the addition of organic fertilizer at a concentration of 4 kg.$tree^{-1}$ had a significant effect in increasing the concentration of potassium in leaves, which reached 1.67%, while the control treatment gave the lowest concentration of potassium, which amounted to 1.46%. As for the bi-interaction treatments, the treatment (2 g L^{-1} nano chelated iron fertilizer and 4 kg.$tree^{-1}$ organic fertilizer) significantly excelled on the other treatments by giving the highest concentration of potassium in leaves, which amounted to 1.96%.Whereas, the interaction treatment (0 gL^{-1} nano iron chelate fertilizer and 0 kg.$tree^{-1}$ organic fertilizer) recorded the lowest concentration of potassium in leaves, reaching 1.21%.The results in Table (6) also indicated that spraying of chelated iron with a concentration of 2 g.L^{-1} had a significant effect by giving it the highest concentration of iron in leaves, which was 6.03%, while the control treatment gave the lowest concentration of iron in leaves, reaching 3.25%. The addition of organic fertilizer at a concentration of 4 kg.$tree^{-1}$ had a significant effect in increasing the concentration of iron in leaves, amounting to 5.13%, while the control treatment recorded the lowest concentration of iron in leaves, reaching 4.14%. As for the interaction treatment, the treatment (2 g.$L^{-1}$of chelated iron nano fertilizer and 4 kg of organic fertilizer tree) significantly excelled on the other treatments by giving it the highest concentration of iron in leaves and it was 6.60%, while the comparison treatment recorded the lowest concentration of iron in leaves, which was 2.63%. The increase in the concentrations of nitrogen, potassium and iron elements in the leaves may be due to the effect of nano chelated iron fertilizer in the formation of a strong root system with high efficiency in absorbing nutrients from the soil, and the high absorption of nano iron and increasing its surface area requires the absorption of the elements necessary for the photosynthesis process (20) These are consistent with the findings of (21,18) when studying Moringa plants, *M. peregring* and lettuce, and *Lactuca sativa* L, respectively, as they showed that increasing the iron concentration increases the concentrations of other nutrients. As for the increase in these elements in the leaves of Jujube trees, to which the organic fertilizer is added, it may be due to the fact that this fertilizer is a rich source of the macro and micro

 ISSN 2072-3875

elements necessary for the growth and development of the trees, and the decomposition of the organic fertilizer may lead to the formation of some organic acids such as humic acid, fulvic acid and natural chelates that facilitate the process absorb these elements (1).We conclude from the current study the efficiency of nano iron chelate fertilizer, especially at a concentration of 2 $g.L^{-1}$ in improving most of the chemical properties of the Jujube leaves of the Al-Tufahi cultivar , as well as the addition of organic fertilizer Potgrond at a concentration of 4 $kg.tree^{-1}$ had a significant effect in improving most of the chemical properties in the leaves of Jujube trees.

Table (6) The effect of spraying with nano iron chelated fertilizer and adding Potgrond organic fertilizer and the interaction between them on the percentage of nitrogen, phosphorous, potassium and iron elements (%) in Jujube leaves of trees of The Al-Tufahi cultivar .

iron ($mg.L^{-1}$)	potassium (%)	phosphorous (%)	Nitrogen (%)	organic fertilizer Potgrond $Tree.kg^{-1}$	
4.14	1.46	0.37	1.75	0	
5.13	1.67	0.46	1.90	4	
0.387	0.126	0.050	0.097	L.S.D. 0.05	
				Nano iron chelate $g.L^{-1}$	
3.25	1.31	0.34	1.64	0	
4.61	1.60	0.41	1.85	1	
6.03	1.80	0.50	2.00	2	
0.474	0.155	0.062	0.119	L.S.D. 0.05	
The interaction between organic fertilizer and nano-iron					
2.63	1.21	0.28	1.62	0	0
4.31	1.55	0.36	1.76	1	
5.46	1.63	0.49	1.88	2	
3.88	1.40	0.41	1.65	0	4
4.92	1.64	0.45	1.95	1	
6.60	1.96	0.52	2.11	2	
0.670	0.219	0.088	0.169	L.S.D. 0.05	

References:

1. Salman, Adnan Hamid. (2000). The effect of the interaction between irrigation with saline water and organic wastes on some soil characteristics and onion yield. Master Thesis - Department of Soil and Water Sciences - College of Agriculture - University of Baghdad - Iraq.

2. Al-Sahaf, Fadel Hussein, Iman Jaber Abdel Rasoul and Iqbal Muhammad Gharib Al-Barzanji. (2003). Relationship between leaf chlorophyll content and fruit carbohydrate content in twelve tomato genotypes. Iraqi Journal of Agricultural Sciences. 34 (6): 69--74.

3. Taain, Diaa Ahmed (2006). The effect of post-harvesting of calcium chloride treatment on the storage behavior of Ziziphus mauritiana Lam. Cv. Tufani. Basra Research Journal (Al-Alamyat). The 32nd Issue, Part Three, 57-64.

 ISSN 2072-3875

4. Muhammad, Khawla Hamza. 2011. Effect of spraying with urea and potassium chloride on some physiological and anatomical aspects of Jujube leaves and fruits of Ziziphus mauritiana Lam. cv. Tufahi. PhD thesis. Department of Horticulture and Garden Engineering. faculty of Agriculture. Albasrah university. Iraq.

5. Arndt, S. K; Lifford, S.C; Wanek , W.; JONE , H. Gandpopp, m(2001) . Physiologicaland morphological adaptation of fruit tree Ziziphus rountundi folia inresponse to progressive dronght stress tree physiology , 21:705-712. (c)2001 Heron publishing victoria Canada.

6. Barker, A.V. and Stratton, M.L. (2015). Iron. Chapter 11. In: Barker, A.V.and Pilbeam, D.J. (eds): Handbook of Plant Nutrition. Second Edition. CRC Press Taylor and Francis Group. London. New York, pp: 399-426.

7. Bowe, C. (2006). Composition. In: Ber and Other Jujubes. Chapter 2, pp: 18-28, (Williams, J.T., Smith, R.W., Haq, N., and Dunsiger, Z. eds). Southampton Centre for Underutilised Crops.UK.

8. Dobiose, M. K. ; Grilles, K.A.; Hamiltor , J.K.; Rebers , D.A. and Smith, F. (1956) . Calorimetric method for determination of sugars and substances. Anal. Chem., 28 : 350 – 356.

9. Ghorbani, H.; Safekordi, A.; Attar, H. and Sorkhabadi,S.(2011). Biological and nonbiological methods for silver nanoparticles synthesis. Chem. Biochem. Eng., 25 (3) :317–326 .

10. Goodwin, T. W. (1976). Chemistry & Biochemistray of plant pigment. 2nd Academic. Press. London. NewYork. San Francasce. pp.373 .

11. Guru, T. Veronica, N. R. Thatikunta, N. Reddy and S. Narender. 2015. Crop nutrition management with Nano fertilizers. International Journal of Environmental science and Technology: 1(1) P:4-6.

12. Hassanpanah, D. and A. Jafar. (2012). Evaluation of 'Out Salt' anti-stress material effects on mini-tuber production of potato cultivars under in vivo condition . Journal of Food, Agriculture and Environment Vol.10 (1) : 256 - 259 .

13. Lyrene , P . M. (1979) . The Jujube tree (Ziziphus jujuba Mill .) . Fruit var. J . , 33 : 4 – 100.

14. Murphy ,T. and Riley, J.R. (1962). A modified single solution method for the determination of phosphate in natural waters.Analytica Chimica Acta. 27:31-36.

15. Nasri , M. B. and Nabil M. A. (2006). Floral Biology study of Zizipnus Lotus L. Acta Horticultur 840: International jujube symposium.

16. Page ,A.L. ;Miller, P.H. and Keeney, D.R. (1982). Methods of soil analysis. part(2) 2nd .ed.Madison. scn. Wisconson.USA.

17. Qureshi, A., D.K. Singh and S. Dwivedi .2018. Nano-fertilizers: A Novel Way for Enhancing Nutrient Use Efficiency and Crop Productivity., 7(2): 3325-3335.

18. Roosta, H.R.; Jalali, M. and Vakili Shahrbabaki, S.M.V. (2015). Effect of nano Fe-chelate, Fe-EDDHA and FeSo4 on vegetative growth, physiological parameters and some nutrient elements concentrations of four varieties of Lettuce (Lactuca sativa L.) in NFT System. Journal of Plant Nutrition, 38(14): 1-20.

19. Sandell, E. B. (1950) Colorimetric determination of traces of metals. Znded. Interscience

Publishers, New York. 673p.

20. Sekhon, B.S. (2014). Nanotechnology in agri-food production: an overview.Nanotechnology, Science and Applications, 7: 31-53.

21. Soliman, A.S.; El-feky, S.A. and Darwish, E. (2015). Alleviation of salt stress on Moringa peregrina using foliar application of

nanofertilizers. Journal of Horticulture and Forestry, 7(2): 36-47.

22. Verkaik, E . (2006). Short term and long term effects of tannins on nitrogen mineralization and litter decomposition in kauri C.F. (Agathis australis .D.Don Lindl) forest . Plant and Soil , 87 : 337-343.

23. Williams, J. T. (2006). Introduction,Taxonamy and History. In :Williams, J.T., Smith, R. W., Haq, N., and Dunsiger, Z. (Editors),Ber and Other Jujubes. Southampton Centre for Underutilised Crops., Chap. 9, pp. 1-17.

 ISSN 2072-3875