Plant Archives Vol. 20 Supplement 1, 2020 pp. 1001-1007 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

EFFECT OF THE FOLIAR APPLICATION OF CHELATED IRON AND SALICYLIC ACID ON SPECIFIC CHARACTERISTICS OF FIG SAPLINGS

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Abstract

A field experiment was carried out at University of Baghdad/College of Agricultural Engineering Sciences during 2019 season in order to evaluate the effect of foliar application of chelated Iron and Salicylic acid on vegetative characteristics of Fig saplings cv. Wazery. A randomized complete block design was conducted in a factorial scheme on the total of 96 trees, with 16 treatments and 3 replicates, each experimental unit contained 2 saplings. The experiment included 4 concentrations of both chelated iron (0, 100, 200, 300 mg L^{-1}) and Salicylic acid (0, 50, 100, 150 mg L^{-1}). Results revealed that the F_3 treatment of chelated iron and S_3 treatment of Salicylic acid gave the highest values in plant height, root diameter, branches length, leaf area, leaf content of chlorophyll, leaf content of N, P, K, Fe, and protein in comparison with S_0. The interaction treatment Fe_3S_3 gave the highest values in most studied parameters except for leaf content of K which has significantly increased by the Fe_3S_2 treatment.

Key words: Fig, Chelated iron, Salicylic acid, Leaf area

Introduction

Ficus Carica L. are deciduous trees that belong to Moraceae family, Limited numbers of these trees are edible and most of them are classified as ornamental plants (Harrison, 2005 and Herre *et al.,* 2008). Fig trees were originated in the Arabian Peninsula, then spreaded to North Africa, Spain, Portugal, southern France, Italy, and Greece, also the fig trees were known in Iraq since ancient times, as their name were found in the Babylonian civilization (Mars *et al.,* 2003, Mango, 2006). The Fig tree is classified as a semi-tropical tree that often has more than one stem, and its branches are not intertwined compared to the rest of the trees, also the fig trees are distinguished by their milky liquid with a distinct smell (cook and Rasplus, 2003 and Ronsted *et al.,* 2005). Fig fruits are used as fresh, dried fruit, or juices, as well as Latex is used in the manufacture of cheese. Fig is one of the medicinal plants known since ancient times for its multiple medicinal and therapeutic benefits; it contains many vitamins such as Vitamin B_1, B_2 and B_5, Vitamin D_2 and D_3, Vitamin E, Citric acid and Ascorbic acid, it also contains mineral elements such as phosphorus, iron, sodium and potassium, in addition to small amounts of proteins, fats and carbohydrates (Doymaz, 2008 and Mehmet *et al.,* 2009). The exposure of some mineral elements in most of the Iraqi soil to many factors that determine their movement and readiness as a result of the high pH and salinity, which often causes a weak root system in the absorption of these elements from the soil due to its lack of solubility in the soil solution (Maria *et al.,* 1996 and Fageria *et al.,* 2009). In order to secure the plant requirements of nutrients during the critical and sensitive stages of growth, it is better to apply the nutrients directly by the foliar application, as this method can provide the plant with 85% of its need of the nutrients (Tariq *et al.,* 2007 , Marschner and Marschner, 2012). Foliar nutrition plays an important role in improving the vegetative growth characteristics of the plant through the nutrients contribution in producing the main and secondary compounds that have an interrelated role in the plant formation that is able to grow in a balanced manner and

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obtain a better vegetative and root growth (Derrick, 2009). Providing plants with nutrient reflects positively in increasing their growth, One of these fertilizers is the use of chelated iron, which has an essential and necessary role in many important functions, it plays an important role in the protein formation, preserving the green matter inside the plant, nucleic acids and chloroplasts which reflected on Chlorophyll content, also it is involved in building cytochromes which play an Important role in photosynthesis and respiration (Yasin, 2001, Tiaz and Zeiger, 2006). Hasson (2012) mentioned that the application of chelated iron (Fe-EDDHA) has significantly increased plant's height, branched number, branched length, leaf area, and leaf content of chlorophyll. El-Shazly and Dris (2004) revealed that the foliar application of apple trees cv. Anna with chelated iron (Fe-EDDHA) in concentration 500 mlg L^{-1} has significantly increased the vegetative growth, branches length, and leaf area. Dawood *et al.,* (2012) recorded that the foliar application of chelated iron in the concentration of 60 mlg L^{-1} gave the highest values in plant's height and stem diameter of pistachio saplings. salicylic acid has important effects on the physiological processes related to the growth and development of plants, it controls the absorption and transmission of ions and the permeability of cell membranes, closing stomata, enhance the chlorophyll and carotene pigments formation, as well as the photosynthesis and increasing the activity of many important enzymes (Hayat *et al.,* 2007 and Aimer *et al.,* 2011). It also has an important role in stimulating cell elongation, division and differentiation (Jaddo, 2015). In addition, salicylic increases the plant's ability to resist thermal stress and protection from ultraviolet radiation by inhibiting defensive genes against stress (Senaratna *et al.,* 2000 , Afzal *et al.,* 2006 , Martin-Mex *et al.,* 2010 and Khan *et al.,* 2010). Therefore, the research aimed to study the effect of spraying with different levels of chelated iron and salicylic acid on improving the vegetative growth characteristics of Fig saplings and determining the most appropriate level of fertilizer to obtain the best vegetative growth.

Meterials and Methods

A field experiment was conducted during the fall season of 2018-2019 in College of Agricultural Engineering Sciences / University of Baghdad in order to evaluate the effect of different levels of chelated Iron and Salicylic acid on vegetative growth characteristics of Fig saplings cv. Wazery. A randomized complete block design (RCBD) was applied on 96 saplings, with 16 treatments, 3 replicates, and each experimental unit was occupied with 2 saplings (Al-sahuki and Whaib,1990) including the foliar application of two factors; the first was chelated iron (0, 100, 200 and 300 mg L^{-1}) and the second was Salicylic acid (0, 50, 100 and 150 mg L^{-1}) as shown below:

1. chelated iron 0 + Salicylic acid 0 (F_0S_0)
2. chelated iron 0 + Salicylic acid 50 mg L^{-1} (F_0S_1)
3. chelated iron 0 + Salicylic acid 100 mg L^{-1} (F_0S_2)
4. chelated iron 0 + Salicylic acid 150 mg L^{-1} (F_0S_3)
5. chelated iron 100 mg L^{-1} + Salicylic acid 0 mg L^{-1} (F_1S_0)
6. chelated iron 100 mg L^{-1} + Salicylic acid 50 mg L^{-1} (F_1S_1)
7. chelated iron 100 mg L^{-1} + Salicylic acid 100 mg L^{-1} (F_1S_2)
8. chelated iron 100 mg L^{-1} + Salicylic acid 150 mg L^{-1} (F_1S_3)
9. chelated iron 200 mg L^{-1} + Salicylic acid 0 mg L^{-1} (F_2S_0)
10. chelated iron 200 mg L^{-1} + Salicylic acid 50 mg L^{-1} (F_2S_1)
11. chelated iron 200 mg L^{-1} + Salicylic acid 100 mg L^{-1} (F_2S_2)
12. chelated iron 200 mg L^{-1} + Salicylic acid 150 mg L^{-1} (F_2S_3)
13. chelated iron 300 mg L^{-1} + Salicylic acid 0 mg L^{-1} (F_3S_0)
14. chelated iron 300 mg L^{-1} + Salicylic acid 50 mg L^{-1} (F_3S_1)
15. chelated iron 300 mg L^{-1} + Salicylic acid 100 mg L^{-1} (F_3S_2)
16. chelated iron 300 mg L^{-1} + Salicylic acid 150 mg L^{-1} (F_3S_3)

The treatments were randomly distributed to the saplings, and the foliar application of chelated iron and salicylic acid was carried out individually every two weeks for two months starting from 15/3/2019 by using a hand spray (10 liters) until the degree of complete wetness with the addition of a diffuser (Tween 20 0.1 Ml L^{-1}) to reduce the surface tension of water molecules. The measurements were taken for the following parameters; plant's height (cm): measured from the drafting point by the metric measurement tape in the beginning (mid-March) and the (the end of October) end of growing season. Stem diameter (mm): measured at the beginning and the end of growing season by Vernier Then the difference was calculated, which represented the increase

in the stem diameter. Branches length (cm): measured using the metric measurement tape at the beginning of the growing season and at the end of it then the difference was calculated. Leaf area (Dsm^2): 10 known area tablets were taken from three leaves and dried in an electric oven at a temperature of 65°C until the weight stabilized, then the leaf area was calculated according to the following equation: $$leaf\ area \quad \frac{Tablets\ area \quad leaves\ dry\ weight}{Tablets\ dry\ weight}$$

Leaf content of chlorophyll (Spad unit): using Chlorophyll meter by measuring 10 leaves per experimental unit, then the average was calculated (Minnotti et al, 1994) and measured by Spad units according to (Jemison and Williams, 2006).

Leaf content of nutrients: the fully-grown leaves were taken from different areas of the saplings and for each experimental unit, then the leaves were washed to remove the dust and dried in an electric oven at a temperature of 70º until the weight stabilized (Al-Sahaf, 1989) Then the samples were grinded and 0.2 g of the sample were taken and digested by adding 4 ml of sulfuric acid and 2 ml of perchloric acid according to Jones and Steyn (1973), Nitrogen content was measured by Micro Kjeldahl according to Bhargava and Raghupathi (1999). And the Phosphorus (P%) by Using ammonium molybdate and ascorbic acid in a Spectrophotometer along a wavelength of 662 nm according to Bhargava and Raghupathi (1999), and Potassium (K%) by Flame Photometer according to Bhargava and Raghupathi (1999), and the Iron (Fe) by using Atomic absorption Spectrophotometer according to (Jackson, 1958). Protein content (%): calculated according to the dry weight as shown in the following equation

Protein content (%) = N(%) × 6.25 (A.O.A.C, 1970).

Results and Discussion

Plant's height (cm): Results in Table 1 revealed that the foliar application of chelated Iron has significantly increased the plant's height; the concentration F_3 gave the highest value peaked at 33.75 cm compared to the control treatment which gave the lowest value reached 17.92 cm. The application of Salicylic acid at S_3 gave the most significant value peaked at 27.00 cm in comparison with S_0 which gave the lowest value reached 21.08 cm. The interaction between chelated Iron and Salicylic acid has significantly increased the studied parameter; the treatment F_3S_3 gave the highest value reached 39.33 cm while the treatment F_0S_0 gave the lowest value (15.33 cm).

Table 1: Effect of foliar application of Chelated Iron and Salicylic acid on Plant's height.

Plant's Height (cm)					
Treatments	**S_0**	**S_1**	**S_2**	**S_3**	**Average**
F_0	15.33	17.83	18.67	19.83	17.92
F_1	18.00	18.33	20.33	20.67	19.33
F_2	22.50	24.33	26.33	28.17	25.33
F_3	28.50	31.83	35.33	39.33	33.75
Average	21.08	23.08	25.17	27.00	
L.S.D 0.05	F		0.862		
	S		0.862		
	Interaction		1.725		

Stem diameter (mm): Results in Table 2 revealed that the foliar application of chelated Iron has a significant effect on stem diameter; the concentration F_3 gave the highest value peaked at 2.89 mm, in comparison with the control treatment which gave the lowest value reached 1.38 mm. Also, the foliar application of Salicylic acid has significantly increased the studied parameter; the concentration S_3 gave the highest value peaked at 2.46 mm, while the concentration S_0 gave the lowest value reached 2.01 mm. The interaction between chelated Iron and Salicylic acid at the treatment F_3S_3 gave the highest values peaked at 3.25 mm, while the treatment F_0S_0 gave the lowest value reached 1.15 mm.

Table 2: Effect of foliar application of Chelated Iron and Salicylic acid on stem diameter.

Stem Diameter (mm)					
Treatments	**S_0**	**S_1**	**S_2**	**S_3**	**Average**
F_0	1.15	1.34	1.47	1.54	1.38
F_1	1.83	1.94	2.16	2.25	2.05
F_2	2.35	2.59	2.70	2.81	2.61
F_3	2.68	2.75	2.86	3.25	2.89
Average	2.01	2.15	2.29	2.46	
L.S.D 0.05	F		0.055		
	S		0.055		
	Interaction		0.110		

Table 3: Effect of foliar application of Chelated Iron and Salicylic acid on branches length.

Branches Length (cm)					
Treatments	**S_0**	**S_1**	**S_2**	**S_3**	**Average**
F_0	10.44	12.02	13.61	14.15	12.55
F_1	13.42	13.13	14.88	15.84	14.31
F_2	17.08	18.81	21.39	23.67	20.24
F_3	24.95	26.00	27.18	27.23	26.34
Average	16.47	17.49	19.26	20.22	
L.S.D 0.05	F		1.174		
	S		1.174		
	Interaction		2.348		

Branches length (Cm): Results in Table 3 presented that the foliar application of chelated Iron has significantly increased the branches length; the concentration F_3 gave the highest value peaked at 26.34 cm compared to the control treatment which gave the lowest value reached 12.55 cm. The application of Salicylic acid at S_3 gave the most significant value peaked at 20.22 cm in comparison with S_0 which gave the lowest value reached 16.47 cm. The interaction between chelated Iron and Salicylic acid has significantly increased the studied parameter; the treatment F_3S_3 gave the highest value reached 27.23 cm while the treatment F_0S_0 gave the lowest value reached 10.44 cm.

Leaves area (dm^2): Results in Table 4 revealed that the foliar application of chelated Iron has a significant effect on the total leaves area in the plant; the concentration F_3 gave the highest value peaked at 164.09 dm^2, in comparison with the control treatment which gave the lowest value reached 93.48 dm^2. Also, the foliar application of Salicylic acid has significantly increased the studied parameter; the concentration S_3 gave the highest value peaked at 133.39 dm^2, while the concentration S_0 gave the lowest value reached 117.36 dm^2. The interaction between chelated Iron and Salicylic acid at the treatment F_3S_3 gave the highest values peaked at 175.77 dm^2, while the treatment F_0S_0 gave the lowest value reached 87.23 dm^2.

Table 4: Effect of foliar application of Chelated Iron and Salicylic acid on leaves area.

Leaves Area (dm^2)					
Treatments	**S_0**	**S_1**	**S_2**	**S_3**	**Average**
F_0	87.23	92.73	96.77	97.20	93.48
F_1	102.43	107.20	114.90	120.40	111.23
F_2	127.13	129.30	136.33	140.20	133.24
F_3	152.63	160.20	167.77	175.77	164.09
Average	117.36	122.36	128.94	133.39	
L.S.D 0.05	F		2.907		
	S		2.907		
	Interaction		5.815		

Leave content of chlorophyll (Spad unit): Results in Table 5 revealed that the foliar application of chelated Iron has a significant effect on chlorophyll content; the concentration F_3 gave the highest value peaked at 41.17 spad unit, in comparison with F_0 which gave the lowest value reached 36.19 spad unit. Also, the foliar application of Salicylic acid has significantly increased the studied parameter; the concentration S_3 gave the highest value peaked at 40.34 spad units, while the concentration S_0 gave the lowest value reached 36.97 spad units. The interaction between chelated Iron and Salicylic acid at the treatment F_3S_3 gave the highest values peaked at 42.66 spad unit, while the treatment F_0S_0 gave the lowest value reached 35.00 spad units.

Table 5: Effect of foliar application of Chelated Iron and Salicylic acid on leaf content of chlorophyll.

Leaf Content of Chlorophyll (spad units)					
Treatments	**S_0**	**S_1**	**S_2**	**S_3**	**Average**
F_0	35.00	36.49	36.01	37.27	36.19
F_1	36.64	38.21	39.38	39.85	38.52
F_2	37.59	39.47	40.41	41.57	39.76
F_3	38.65	41.28	42.10	42.66	41.17
Average	36.97	38.86	39.47	40.34	
L.S.D 0.05	F		0.792		
	S		0.792		
	Interaction		1.584		

Nitrogen leaf content (%): Results in Table 6 showed that the foliar application of chelated Iron has a significant effect on nitrogen leaf content; the concentration F_3 gave the highest value peaked at 1.401%, in comparison with F_0 which gave the lowest value reached 0.881%. Also, the foliar application of Salicylic acid has significantly increased the studied parameter; the concentration S_3 gave the highest value peaked at 1.289%, while the concentration S_0 gave the lowest value reached 1.073%. The interaction between chelated Iron and Salicylic acid at the treatment F_3S_3 gave the highest values peaked at 1.485%, while the treatment F_0S_0 gave the lowest value reached 0.811%.

Table 6: Effect of foliar application of Chelated Iron and Salicylic acid on Nitrogen leaf content.

Nitrogen Leaf Content (%)					
Treatments	**S_0**	**S_1**	**S_2**	**S_3**	**Average**
F_0	0.811	0.867	0.914	0.932	0.881
F_1	1.072	1.243	1.300	1.356	1.243
F_2	1.153	1.296	1.347	1.384	1.295
F_3	1.256	1.400	1.462	1.485	1.401
Average	1.073	1.202	1.256	1.289	
L.S.D 0.05	F		0.046		
	S		0.046		
	Interaction		0.093		

Phosphorus leaf content (%): Results in Table 7 presented that the foliar application of chelated Iron has a significant effect on Phosphorus leaf content; the concentration F_3 gave the highest value peaked at 0.232%, in comparison with F_0 which gave the lowest value reached 0.144%. Also, the foliar application of Salicylic acid has significantly increased the studied parameter; the concentration S_3 gave the highest value peaked at 0.198%, while the concentration S_0 gave the lowest value reached 0.175%. The interaction between chelated Iron

Table 7: Effect of foliar application of Chelated Iron and Salicylic acid on Phosphorus leaf content.

Phosphorus Leaf Content (%)					
Treatments	**S_0**	**S_1**	**S_2**	**S_3**	**Average**
F_0	0.130	0.145	0.149	0.154	0.144
F_1	0.162	0.169	0.176	0.181	0.172
F_2	0.189	0.193	0.203	0.215	0.199
F_3	0.221	0.225	0.238	0.244	0.232
Average	0.175	0.183	0.192	0.198	
L.S.D 0.05	F		0.005		
	S		0.005		
	Interaction		0.011		

and Salicylic acid at the treatment F_3S_3 gave the highest values peaked at 0.244%, while the treatment F_0S_0 gave the lowest value reached 0.130%.

Potassium leaf content (%): Results in Table 8 presented that the foliar application of chelated Iron has a significant effect on Potassium leaf content; the concentration F_3 gave the highest value peaked at 1.105%, in comparison with F_0 which gave the lowest value reached 1.009%. Also, the foliar application of Salicylic acid has significantly increased the studied parameter; the concentration S_3 gave the highest value peaked at 1.077%, while the concentration S_0 gave the lowest value reached 1.046%. The interaction between chelated Iron and Salicylic acid at the treatment F_3S_2 gave the highest

Table 8: Effect of foliar application of Chelated Iron and Salicylic acid on Potassium leaf content.

Potassium Leaf Content (%)					
Treatments	**S_0**	**S_1**	**S_2**	**S_3**	**Average**
F_0	0.973	0.989	1.033	1.040	1.009
F_1	1.049	1.053	1.060	1.066	1.057
F_2	1.069	1.075	1.082	1.086	1.078
F_3	1.093	1.099	1.109	1.006	1.105
Average	1.046	1.054	1.071	1.077	
L.S.D 0.05	F		0.006		
	S		0.006		
	Interaction		0.013		

values peaked at 1.109%, while the treatment F_0S_0 gave the lowest value reached 0.973%.

Iron (Fe) leaf content (mg kj^{-1}): Results in Table 9 revealed that the foliar application of chelated Iron has a significant effect on leaf Iron content; the concentration F_3 gave the highest value peaked at 82.62 mg kj^{-1}, in comparison with the control treatment which gave the lowest value reached 51.82 mg kj^{-1}. Also, the foliar application of Salicylic acid has significantly increased the studied parameter; the concentration S_3 gave the highest value peaked at 70.06 mg kj^{-1}, while the

Table 9: Effect of foliar application of Chelated Iron and Salicylic acid on Iron leaf content.

Iron Leaf Content (%)					
Treatments	**S_0**	**S_1**	**S_2**	**S_3**	**Average**
F_0	50.38	51.47	52.26	53.19	51.82
F_1	58.52	60.54	63.56	66.35	62.24
F_2	71.63	72.52	75.21	76.86	74.06
F_3	81.06	82.26	83.32	83.84	82.62
Average	65.40	66.70	68.59	70.06	
L.S.D 0.05	F		0.647		
	S		0.647		
	Interaction		1.295		

concentration S_0 gave the lowest value reached 65.40 mg kj^{-1}. The interaction between chelated Iron and Salicylic acid at the treatment F_3S_3 gave the highest values peaked at 83.84 mg kj^{-1}, while the treatment F_0S_0 gave the lowest value reached 50.38 mg kj^{-1}.

Protein leaf content (%): Results in Table 10 presented that the foliar application of chelated Iron has a significant effect on protein leaf content; the concentration F_3 gave the highest value peaked at 8.754%, in comparison with F_0 which gave the lowest value reached 5.507%. Also, the foliar application of Salicylic acid has significantly increased the studied parameter; the concentration S_3 gave the highest value peaked at 8.059%, while the concentration S_0 gave the lowest value reached 6.706%. The interaction between chelated Iron

Table 10: Effect of foliar application of Chelated Iron and Salicylic acid on protein leaf content.

Protein Leaf Content (%)					
Treatments	**S_0**	**S_1**	**S_2**	**S_3**	**Average**
F_0	5.069	5.421	5.712	5.827	5.507
F_1	6.702	7.771	8.127	8.477	7.769
F_2	7.206	8.100	8.421	8.648	8.094
F_3	7.848	8.750	9.135	9.283	8.754
Average	6.706	7.510	7.849	8.059	
L.S.D 0.05	F		0.291		
	S		0.291		
	Interaction		0.582		

and Salicylic acid at the treatment F_3S_3 gave the highest values peaked at 9.283%, while the treatment F_0S_0 gave the lowest value reached 5.069%.

Based on all given above; there is a significant effect of the foliar application with chelated Iron on vegetative characteristics of Fig saplings and increasing the leaf content of chlorophyll; This may be due to the role of Iron on the plant activities as a cofactor in the formation of chlorophyll, and Cytochromes which have an important role in the respiration and photosynthesis processes (Focus, 2003). Iron also plays an essential and necessary

role in many important enzymes in the respiration process, including Catalase, Peroxidase and Cytochrome oxidase. The participation of Iron in these compounds represents a special importance in oxidation reactions; Iron's importance lies in the transfer of electrons through the oxidation and reduction reactions which is one of the important roles in the processes of Cells metabolism (Focus, 2003, Yasin, 2001). Additionally; it has an important role in forming amino acids, proteins and enzymes that induce the increment of cells division and elongation, and tissues growth, which leads to increase the cambium activity, then increases the plant height, stem diameter, and branches length, or it may be due to the increment of chlorophyll content and leaf area which lead to increase the dry plant nutrient and then increase the vegetative growth (Taiz and Zeiger, 2006, Kabota, 2005). The increment of leaf chlorophyll content can be due to the role of Iron in increasing the number and sizes of chloroplasts, which leads to increase the leaves chlorophyll content (Prism *et al.,* 2011). The increment of mineral nutrients content in fig saplings may also be attributed to the important role of iron in the photosynthesis process through its formation role of different cytochromes as well as its role in the cell division process, which leads to an increment in photosynthesis productions and increase in the root's absorption which reflected on plant nutrients, and increase the leaf content of nitrogen, phosphorous and potassium (Tylor, 1995). These results are in agreement with Kabota (2005) and Hasson (2012) in their studies on, Mango and Ziziphus; they mentioned that the application of chelated Iron has enhanced the vegetative growth. The increment of vegetative growth may be due to the foliar application of Salicylic acid for its role in increasing cells division in the apical tissues which leads to increase the plant's height, stem diameter, branches number and leaf area, It also work as anti-oxidations of internal hormones through its direct effect in stimulating Auxins which were important in cells division, and positively reflected on the rates of vegetative growth (Khan *et al.,* 2010 and Aimer *et al.,* 2011).

References

A.O.A.C. (1970). Official Method of Anaylsis. 11th . Ed. Washington D.C. Association of the Official Analytical Chemish. P. 1015.

Afzal, I., S.M.A. Basra, M. Farooq and A. Nawaz (2006). Alleviation of Salinity Stress in Spring Wheat by Hormonal Priming with ABA, Salicylic Acid and Ascorbic Acid. *International Journal of agriculture and biology,* **1560–8530:** 23–28.

Aimar, D., M. Calafat, A.M. Andrade, L. Carassay, G.I. Abdala and M.L. Molas (2011). Drought Tolerance and Stress Hormones: From Model Organisms to Forage Crops, Plants and Environment, Dr. Hemanth Vasanthaiah (Ed.), ISBN: 978-953-307-779-6.

Al-Sahaf, F.H. (1989). Applied Plant Nutrition. University of Baghdad - Ministry of Higher Education and Scientific Research. p.260.

Al-sahuki, M.M. and K.M. Whaib (1990). Design and Analysis of experiments. Univ. Of Bagh. Dar al hekma, 488.

Bhargava, B.S. and H.B. Raghupathi (1999). Analysis of plant Materials for Macro and Micronutrient. P: 49-82. In Tandon, H.L.S. (ed). Methods of Analysis of Soil, Plant, Water and Fertilizers. Binng Printers L-14, Lajpat New Delhi, 110024.

Cook, J.M.C. and Y.J. Rasplus (2003). Mutualists with attituale : Coevolving Fig Wasps and Figs. *Trends in Ecology and Evolution,* **18:** 241–248.

Dawood, Z.A., A.H. Alalaf and A.T. Shayal Alalam (2012). Effect of Foliar Spray of Iron Cheleate and Acta Acro Fertilizers on Growth of *Pistachio Vera* L. Seedling. *Raf. J. Sci.,* **23(2):** pp. 71-81.

Derrick, O. (2009). Foliar Fertlization : Mechanisms and Magnitude of Nutrient Uptake . Paper For the Fluid Fertilizer Foundation Meeting in Scottsdale, Arizona. U.S.A.

Doymaz, I. (2008). Sun drying of Figs : An experimental study. *J. Food Eng.,* **71:** 403–407.

El-Shazly, S.M. and R. Dris (2004). Response of 'Anna' apple trees to foliar sprays of cheated iron, manganese and zinc, *J. of Food, Agriculture and Environment,* **2(3 and 4):** 126-130.

Fageria, N.K., M.P. Barbosa Filho, A. Moreira and C.M. Guimaraes (2009). Foliar Fertilization of Crop Plants. *Journal of Plant Nutrition,* **32(6):** 1044-1064.

Focus (2003). The importance of micro- nutrients in the region and benefits of including them in fertilizers. *Agro-chemicals report,* **111(1):** 15 - 22.

Harrison, R.D. (2005). Figs and the university of Tropical rain forests. *Bio scince,* **55:** 1053–1064.

Hasson, R.H. (2012). Effect of Fertiliyzation by Chelated Iron (Fe-Edta)And Date of Applicahion on Growth of Mango Seedling C.V. Mahally. *Euphrates Journal of Agriculture Science,* **4(4):** 25-34.

Hayat, S., B. Ali and A. Ahmad (2007). Salicylic acid: Biosynthesis, Metabolism and Physiological Role in Plants. In: S. Hayat and A. Ahmad : Salicylic acid: A plant hormone, Springer, Nether land; pp. 1-14.

Herre, E.A., Kc. Jan eler and C.A. Machado (2008). Evolutionary Ecology of Fig leaves extra ; Recent pro grass and out staneling Puzzles. *Ann. Per. Ecol. Evol. Syst.,* **37:** 438–56.

Jackson, M.L. (1958). Soil Chemical Analysis. Prentice Hall Inc. N.J. Englewood Cliff, Z.A.H. Jaddo (2015). Effect of salicylic acid and Organic Fertilizer (Humic Acid) on Growth and some Medical Alkaloids in *Catharanthus roseus* L. MSc

Thesis. College of agriculture. University of Baghdad. Iraq.

Jemison, J. and M. Williams (2006). Potato–Grain Study Project Report. Water Quality Office. University of Maine, Cooperation Extension. http://www.umext.main.edu.

Jones, J.B. and W.J.A. Steyn (1973). Sampling ,Handling and Analyzing plant tissue samples. P.248-268. In: Soil Testing and plant Analysis. ed. by L.M. walsh and J.D. Beaton. Soil Science Society of America, Inc, 677 South Segee Rd, Madison, Wiscon sin, USA.

Kabota, D.E.S. (2005). Effect of foliar sprays with Fe, Zn, N on the vegetative growth of Ber *zizyphus mauritiana* L. *cv.* Tufahi. MSc Thesis. College of agriculture. University of Baghdad. Iraq.

Khan, N.A., S. Shabian, A. Masood, A. Nazar and N. Iqbal (2010). Application of salicylic acid increases contents of nutrients and antioxidative metabolism in mungbean and alleviates adverse effects of salinity stress. *Int. J. Plant Biol.,* **1:** 1-8.

Mango, N. (2006). Fig mltorticlture in Japan. The Japanese society for Horticultural science (cds) . Shonkadoh publication, Dept. of Publishing of Nakanishi Printing CO. Ltel., P. 106–110.

Maria, D., E. Raigon, A. Maquieira and Rosa Puchades (1996). The use of slow – release fertilizers in citrus. *Journal of Horticulture Science,* **71(3):** 349 – 359.

Mars, M., K. Chatti, O. Saadoud, Chi. Salhi Hanna, A. Trifi and M.M. Marrachi (2003). Fig Cultivation and genetic resources in Tunisia. *An overview Actuator,* **798:** 27–32.

Marschner, H., P. Marschner (2012). Marschner's Mineral nutrition of higher plants. Third edition, Elsevier/Academic Press, Amsterdam, 651 p.

Martín-Mex, R., S. Vergara-Yoisura, A. Nexticapán-Garcés and A. Larqué-Saavedra (2010). Application of low concentration of salicylic acid increases the number of flowers in Petunia hibrida. *Agrociencia,* **1(15):** 773-778.

Mehmet, G., M. Tuzu and O. Yilmaz (2009). Analysis of fatty acid and some lipophilic vitamins founds in the fruits of the Ficus carica variety picked from the Adiyaman District. *Journal of Biological science,* **413:** pp: 320-323.

Minnotti, P.L., D.E. Halseth and J.B. Sieczka (1994). Chlorophyll measurement to assess the nitrogen status of potato varieties. *Hortscience,* **29(12):** 1497-1500.

Prism, A.H., A.A. Saleh and J.F. Adnan (2011). Effect of agraft treatment of growth regulator and spraying with nutrient solution in the growth of orange seed lings. *Euphrates Journal of Agriculture Science,* **3(1):**.

Ronsted, N., M.G.D. Weiblen, J.N. Cook, C. Salamin, A. Machade and V. Savolainen (2005). 60 Million years of Codivergence in the Fig – wasp Symbiosis. *Proceedings of the Royal Society of London B.,* **272:** 2593–2599.

Senaratna, T., D. Touchell, E. Bunn and K. Dixon (2000). Acetyl salicylic acid (Aspirin) and salicylic acid induce multiple stress tolerance in bean and tomato plants. *Plant Growth Regulation,* **30(2):** 157-161.

Taiz, L. and E. Zeiger (2006). Plant Physiology. 4th. ed. Sinauer Associates, Inc. publisher Sunderland, Massachus-AHS. U.S.A.

Tariq, M., M. Sharif, Z. Shah and R. Khan (2007). Effect of foliar application of micronutrients on the yield and quality of sweet orange (*Citrus sinensis* L.). *Pak. J. Biol. Sci.,* **10(11):** 1823-1828.

Tylor, K.C. (1995). "Good grower response to nutrition survery, Fertilization". *Articales. Amer,* **2:** Issue. 3.

Yasin, B.T. (2001). The Basics of Plant Physiology. Arabization Committee. Qatar University. Doha. 634.