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EFFECT OF ROOTSTOCK TYPE, ORGANIC FERTILIZER AND IRRIGATION INTERVALS ON GROWTH OF "MAHALI" LEMON TRANSPLANTS

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ABSTRACT

This experiment was carried out in lath house at University of Baghdad / college of Agricultural Engineering Sciences /Department of Horticulture and Landscape design during the two season 2019 and 2020 .The experience was conducted according to Split-split plots Within Design (RCBD) By three factors, the first factor was two -irrigation Intervals (every 3, 6 days), the second factor was three of rootstock (Volcamariana, Swingle Citrumelo and sour orange) and the third factor organic fertilizer, was three concentrations, which is (0, 2.5 and 5 ml. L^{-1}/plant). results showed that irrigation periods had a significant effect, as it gave (every 3 days) increased in the leaf area and concentration of chlorophyll, N, P and P in the leaves, As for the rootstock they had a significant effect ,the rootstock of the Citrumelo exceed in the content of the leaves of (N, P, K). While the organic fertilizer, it had a significant effect in all the mentioned characteristics, compared to the comparison treatment.

***Keywords*:** Irrigation Intervals, organic fertilizer, citrus rootstock

Introduction

Citrus lemon trees belong to the genus Citrus, and the north-eastern regions of India and southwestern China are the original home of this type, and lemons are the third most important citrus species (Al-Khafaji *et al*., 1990). Scientific studies have indicated that the rootstock used in vaccination in citrus has a role in influencing many characteristics for the cultivar variety including the set, size and nature of tree and fruit growth, other growth indicators, nutritional status, and tolerance to environmental factors such as soil and climate, and to spread diseases (Agustí, 2003), As mentioned by Al-Alaaf (2018), citrus trees are grown on determined rootstock in order to take advantages of characteristics of these rootstock and types, as some of these rootstocks have good qualities that may not be available in other types. Organic fertilizers have a vital role in the practice of organic agriculture as it is the only fertilizer that provides plant nutrients and improves soil quality, as the use of liquid organic fertilizers increased the absorption of macro and micro nutrients and compared to mineral fertilized plants, moreover, the effect of organic fertilization positively on the carbohydrate content (Fructose, lactose, and sucrose) mainly in citrus leaves (Martínez-Alcántara *et al*., 2016).

Maybe one of the most important methods of good management in the optimal use of water is to control the number of irrigation in each season or to give on to much number of irrigation by determining the period between irrigations, that is, scheduling irrigation in order to reach the highest yield, the method of irrigation intervals are the most common method of efficiency use Water determining irrigation. irrigation intervals that improve efficiency use water and proved cost is very important.the time period for irrigation is the use of rotating irrigation during the planting season, and It is considered the most important way to provide irrigation water without reducing growth and productivity (Smith *et al*., 2002). Hameed *et al*. (2018) obtained when adding 10% liquid humic acid with irrigation water to increase the leaf content of chlorophyll, N, P and K for lemon trees. Soliman *et al*. (2016) also found in a study of the effect of irrigation treatments on growth and yield in peach trees of the Florida Prince, using four levels of irrigation, which are (9.11, 11.5, 13.41 and 15.42), it was found that the irrigation treatment at the level of 15.42 gave a significant increase in the leaf content N, P, K and the chlorophyll.

As a result of water scarcity that occurs in Iraq due to the politicking of neighboring countries, allocations for the water of the two rivers have decreased. Therefore, means must be sought to help plants for conserving water or reduce water consumption and withstand stress, therefore, the objectives of this study to know the effect of organic fertilizer and irrigation periods on the rootstock used in growth and nutritional status for local lemon seedlings grafted on it them.

Materials and Method

This experiment was carried out in lath house of the research station B of University of Baghdad/college of Agricultural Engineering Sciences /Department of Horticulture and Landscape design during the two season 2019 and 2020, to study the effect of the rootstocks, organic fertilizer and Irrigation Intervals on the growth of seedlings of the local lemon variety. The first factor involved exposing the plants to two Irrigation Intervals which is irrigation each 3 days and is symbolized by (A1) and irrigation every 6 days

and is symbolized by (A2), which was calculated by adding irrigation water to the total weight of the pots with their contents at the field capacity depending on the weight method of the pots from each treatment, completing the water deficiency and estimating the decrease in moisture content, the equation:

Total weight of the pot at the field capacity = the weight of the dry soil in the oven + the typical weight of the water to reach the field capacity + the weight of the empty pot + the weight of the filter + the weight of the fertilizer + the weight of the seedling according to the stages of growth, the total weight at the field capacity = 13.404 kg + 2480 ml 0.700 + Gm + 0.400 gm + 5 gm + 9800 kg) = 25690 kg, and this weight is maintained at each irrigation Intervals for every 3 or 6 days and completed to this number and compensated for the moisture deficiency occurring in each period. the weight of the plant during the growth stages must also be taken into consideration and compensate for the calculations.

As for the second factor, It use three citrus rootstock, which are of Volkameriana and is symbolized by C1, Swingle Citrumelo, is symbolized by C2 and Sour orange which is symbolized by C3. As for the third factor , it used Organic fertilizer (Fulvigrow) (Table 2) adding a ground six times between one addition and another for 15 days, which are (1/3, 15/3, 1/4, 15/4, 1/5 and 15/5) in three concentrations, which are comparison treatment (adding water Only) and its symbolized by F0 , 2.5 ml. L^{-1}/plant its symbolized by F1 and 5 ml. L^{-1}/plant its symbolized by F2. Seedlings were brought at the age of 3 years and then transferred from plastic pots of 10 kg capacity to plastic containers perforated from the bottom of 25 kg capacity. The experiment was carried out using split-split plots within the design of the RCBD with three factors, as the first factor included irrigation with two Intervals (main plots), the second factor included rootstock three types (secondary plots) and the third factor included organic fertilizer in three concentrations (the sub-secondary plots), which includes 18 treatments and three repetitions, with two seedlings for each experimental unit, and the number of seedlings is 108 seedlings. The results will be analyzed using the Genstat program and the averages will be compared using the least significant difference at a 5% probability level.

Table 2 : Components of the organic fertilizer (Fulviegrow):

Adjective	the ratio
Total nitrogen (N)	3.10 %
Potassium oxide (K_2O)	3.04 %
Free amino acids	3.07 %
Fulvic acids	25.00 %
pH	5.5 %
Density	1.22 g.ml

1- The rate increase in the height of the main stem (cm)

2-Leaf content of chlorophyll (mg. 100 gm^{-1} fresh weight): The chlorophyll content of leaves was estimated according to (Goodwin, 1976).

3- leaves content of Nitrogen(%) :Nitrogen was estimated according to the method presented in (Chapman and Pratt, 1961).

4-Leaf content of phosphorous (%): Phosphorus was estimated according to the method mentioned in (Page, 1982).

5-Leaf content of potassium (%): Potassium is estimated according to the method proposed from (Haynes ,1980).

Results and discussion

1. The rate increase in the length of the main stem (cm)

Results of table (2) showed that the irrigation Intervals had a significant effect on the average increase in the length of the main stem, as the irrigation Intervals exceeded every 3 days, compared to the irrigation Intervals every 6 days for the two seasons in respectively. Also, the type of rootstock; had a significant effect, as the rootstock of the Sour orange exceeded for the two seasons in respectively. Organic fertilizer also had a significant effect for this characteristic, as the concentration of 5gm. L^{-1} exceeded to treatment without adding fertilizer for the two seasons in respectively.

Table 2 : Effect of rootstock type and Organic fertilizer and irrigation Intervals on the rate increase in main stem length (cm) for lemon seedlings for the growing seasons 2019 and 2020

irrigation intervals	rootstocks	season 2019 organic fertilizer (ml.L^{-1}) F0	F1	F2	A x C	season2020 organic fertilizer (ml.L^{-1}) F0	F1	F2	A x C
	C1	25.00	36.00	38.00	33.00	18.50	22.00	25.00	21.83
A1	C2	31.00	41.00	41.00	37.67	21.50	31.50	29.00	27.33
	C3	33.00	43.00	48.00	41.33	23.00	28.00	33.00	28.00
	C1	22.00	23.00	29.00	24.67	15.00	18.00	19.50	17.50
A2	C2	23.00	28.00	29.00	26.67	16.00	20.00	22.00	19.33
	C3	25.00	30.00	29.00	28.00	17.00	22.00	24.50	21.17
LSD			6.52		4.49		2.00		1.70
F		26.50	33.50	35.67	A	18.50	23.58	25.50	A
LSD			2.58				0.61		
A x F	A1	29.67	40.00	42.33	37.33	21.00	27.17	29.00	25.72
	A2	23.33	27.00	29.00	26.44	16.00	20.00	22.00	19.33
LSD			3.19		2.39		1.00		1.24
					C				C
C X F	C1	23.50	29.50	33.50	28.83	16.75	20.00	22.25	19.67
	C2	27.00	34.50	35.00	32.17	18.75	25.75	25.50	23.33
	C3	29.00	36.50	38.50	34.67	20.00	25.00	28.75	24.58
LSD			4.98		3.82		1.57		1.40

2-Leaf content of chlorophyll (mg. 100 gm^{-1} fresh weight)

Results of table (3) showed that the irrigation Intervals had a significant effect on on the chlorophyll content of leaves, as the irrigation Intervals exceeded every 3 days for the two seasons in respectively. Also, the type of rootstock; had a significant effect, as the rootstock of the Sour orange exceeded for the two seasons in respectively, Organic fertilizer also had a significant effect for this characteristic, as the concentration of 5gm. L^{-1} exceeded to treatment without adding fertilizer for the two seasons in respectively.

Table 3 : Effect of rootstock type and Organic fertilizer and irrigation Intervals on the chlorophyll content of leaves (mg. 100 g^{-1} fresh weight) for lemon seedlings for the growing seasons 2019 and 2020

		Season2019				season 2020			
rootstocks	irrigation intervals	organic fertilizer (ml.L^{-1})			A x C	organic fertilizer (ml.L^{-1})			A x C
		F0	F1	F2		F0	F1	F2	
A1	C1	145.63	212.34	230.28	196.08	235.00	273.15	291.42	266.52
	C2	168.91	246.38	223.14	212.81	275.66	267.07	291.35	278.02
	C3	194.38	276.87	266.03	245.74	237.84	373.42	366.65	325.97
A2	C1	133.27	185.3	194.45	171.00	231.88	247.8	252.81	244.16
	C2	164.54	216.39	205.34	195.42	241.67	266.27	254.66	254.2
	C3	174.76	187.18	214.33	191.46	236.52	244.59	258.01	246.37
LSD			5.79		3.93		3.44		2.24
F		163.58	220.74	222.26	A	243.09	278.72	285.82	A
LSD			2.324				1.41		
A x F	A1	169.64	245.2	239.81	218.21	249.5	304.55	316.47	290.17
	A2	157.52	196.29	204.7	186.17	236.69	252.89	255.16	248.24
LSD			3.65		4.45		2.15		2.56
					C				C
C x F	C1	138.45	198.82	212.36	183.21	233.44	260.48	272.12	255.34
	C2	166.45	231.38	214.24	204.02	258.66	266.67	273	266.11
	C3	184.57	232.02	240.18	218.92	237.18	309	312.33	286.17
LSD			4.07		2.76		2.41		1.56

3- Percentage of nitrogen in the leaves (%)

The results in Table (4) show that there is a significant effect on the percentage of nitrogen in the leaves, as the irrigation Intervals exceeded every 3 days, compared to the irrigation Intervals every 6 days for the two seasons in respectively. The assets have a evident effect on this characteristic, as the rootstock of the stromelo exceeded for the two seasons in respectively, and the organic fertilizer had a significant effect for this characteristic, as the concentration of 5 g. L^{-1} was exceeded on treatment without adding fertilizer for the two seasons in respectively.

Table 4 : Effect of rootstock type and Organic fertilizer and irrigation Intervals on Percentage of nitrogen in the leaves(%) for lemon seedlings for the growing seasons 2019 and 2020

		season 2019				Season2020			
irrigation intervals	rootstocks	organic fertilizer (ml.L^{-1})			A x C	organic fertilizer (ml.L^{-1})			A x C
		F0	F1	F2		F0	F1	F2	
A1		1.87	2.67	2.52	2.35	2.15	2.21	2.55	2.30
	C2	1.97	2.81	2.54	2.44	2.46	2.54	2.83	2.61
	C3	2.12	1.62	1.52	1.75	2.42	2.43	2.53	2.46
A2	C1	1.32	1.43	2.23	1.66	2.17	2.26	2.23	2.22
	C2	1.81	1.81	2.12	1.91	2.15	2.35	2.37	2.29
	C3	1.61	1.52	2.16	1.76	2.14	2.23	2.25	2.20
LSD			0.19		0.12		0.19		0.11
F		1.78	1.97	2.18	A	2.24	2.33	2.46	A
LSD			0.08				0.08		
A x F	A1	1.98	2.36	2.19	2.18	2.34	2.39	2.63	2.45
	A2	1.58	1.58	2.17	1.77	2.17	2.28	2.26	2.23
LSD			0.11		0.13		0.11		0.12
					C				C
	C1	1.59	2.05	2.37	2.00	2.16	2.23	2.39	2.26
c x F	C2	1.89	2.31	2.33	2.17	2.3	2.44	2.60	2.45
	C3	1.86	1.57	1.84	1.75	2.28	2.33	2.39	2.33
LSD			0.13		0.08		0.13		0.08

4- Percentage of phosphorous in leaves (%)

The results in Table (5) confirm significant differences in the increase in the percentage of phosphorus in the leaves, as the irrigation Intervals exceeded every 3 days, compared to the irrigation Intervals every 6 days for the two seasons in respectively. While the rootstock gave a significant effect, the rootstock of the stromelo exceeded for the two seasons in respectively, the organic fertilizer also had a significant effect for this characteristic, as the concentration of 5 g. L^{-1} was exceeded on treatment without adding fertilizer for the two seasons in respectively.

Table 5 : Effect of rootstock type and Organic fertilizer and irrigation Intervals on Percentage of phosphorous in the leaves(%) for lemon seedlings for the growing seasons 2019 and 2020

irrigation intervals	rootstocks	season2019				season 2020			
		organic fertilizer (ml.L^{-1})			A x C	organic fertilizer (ml.L^{-1})			A x C
		F0	F1	F2		F0	F1	F2	
A1	C1	0.208	0.222	0.268	0.233	0.221	0.238	0.314	0.257
	C2	0.214	0.303	0.191	0.236	0.225	0.316	0.193	0.245
	C3	0.146	0.178	0.213	0.179	0.156	0.195	0.226	0.192
A2	C1	0.14	0.182	0.269	0.197	0.144	0.193	0.298	0.212
	C2	0.205	0.218	0.221	0.215	0.224	0.240	0.230	0.231
	C3	0.152	0.168	0.190	0.170	0.146	0.165	0.175	0.162
LSD		0.044			0.035	0.020			0.013
F		0.177	0.212	0.224	A	0.186	0.224	0.239	A
LSD		0.014				0.008			
A x F	A1	0.189	0.234	0.216	0.213	0.200	0.249	0.244	0.231
	A2	0.165	0.189	0.226	0.193	0.171	0.199	0.234	0.201
LSD					0.030	0.012			0.014
					C				C
C x F	C1	0.174	0.202	0.268	0.214	0.183	0.215	0.306	0.234
	C2	0.209	0.261	0.206	0.225	0.224	0.278	0.212	0.238
	C3	0.149	0.173	0.201	0.174	0.151	0.180	0.200	0.177
LSD		0.033			0.028	0.014			0.009

5- Potassium percentage in leaves (%)

The results of table (6) show that the irrigation periods had a significant effect on the potassium content of leaves, as the irrigation Intervals exceeded every 3 days, compared to the irrigation Intervals every 6 days for the two seasons in respectively. Also, the type of rootstock has an impact, as the rootstock of the stromelo was exceeded in the first season, as for the second season, the rootstock of the sour orange was exceeded. The organic fertilizer has a significant effect in this characteristic, as the concentration of 5 gm. L^{-1} exceeds the treatment without adding fertilizer for the two seasons in respectively.

Table 6 : Effect of rootstock type and Organic fertilizer and irrigation Intervals on Percentage of phosphorous in the leaves(%) for lemon seedlings for the growing seasons 2019 and 2020

irrigation intervals	rootstocks	Season2019				season 2020			
		organic fertilizer (ml.L^{-1})			A x C	organic fertilizer (ml.L^{-1})			A x C
		F0	F1	F2		F0	F1	F2	
A1	C1	1.47	1.57	1.51	1.52	1.94	2.11	2.37	2.14
	C2	1.42	1.75	2.29	1.82	1.65	2.46	2.55	2.22
	C3	1.51	1.70	1.70	1.63	1.93	2.14	1.91	1.99
A2	C1	1.43	1.53	1.41	1.46	1.56	1.66	2.13	1.78
	C2	1.54	1.67	1.63	1.61	1.60	1.18	1.60	1.46
	C3	1.33	1.51	1.65	1.49	1.71	2.14	2.19	2.01
LSD		0.19			0.12	0.20			0.12
F		1.45	1.62	1.70	A	1.73	1.95	2.12	A
LSD		0.08				0.08			
A x F	A1	1.46	1.67	1.83	1.66	1.84	2.24	2.28	2.12
	A2	1.43	1.57	1.56	1.52	1.62	1.66	1.97	1.75
LSD		0.11			0.13	0.12			0.13
					c				c
C X F	C1	1.45	1.55	1.46	1.49	1.75	1.88	2.25	1.96
	C2	1.48	1.71	1.96	1.71	1.63	1.82	2.08	1.84
	C3	1.42	1.61	1.67	1.56	1.82	2.14	2.05	2.00
LSD		0.14			0.09	0.14			0.08

The results showed in the above mentioned characteristics that the effect of increasing irrigation interval (water stress) may be due to the shortage of irrigation water, which leads to a decrease in water in the leaves and affects the function of stomata in the gas exchange, reduced photosynthesis, a decrease in the absorption of nutrients, and causing an imbalance in the hormonal balance, Or it may be due to that water stress leads to rupture of the membranes of the chloroplast by the action of shrinkage and enzymatic catabolism of the membranes, thus influencing different biological and physiological processes such as photosynthesis, respiration, absorption of ions, chlorophylls and carbohydrates (Jaleel *et al*., 2009 ; Melgar *et al*., 2010), the decrease in stomatal area may be due to a reduction in the leaf content of chlorophyll and this is due to the shortage of absorption of Co2 and the closing of the stomata due to the accumulation of absicic acid (ABA) in the chloroplasts, and as a result the decrease in the rate of photosynthesis occurs (Gupta, 2010).

As for the contrast of the increase between the rootstock of citrus in these characteristic, it may be due to the contrast of the physiological changes, which include chlorophyll formation, carbohydrate accumulation, mineral absorption, nutrient transition, and growth-stimulating materials production, and the reason may be due to the presence of genetic differences between the rootstock of local lemon (Forner *et al*., 2014).

As for organic fertilizer, it had a significant effect in increasing the above-mentioned characteristics, Perhaps the reason for increasing the content of chlorophyll leaves when adding organic fertilizers is the role of organic compounds, amino acids and elements contained in organic fertilizer, including potassium, Table (1) because of its effective role in increasing the leaf content of chlorophyll in that it represents the highest concentration of dissolved positive ions in the plant cell sap and is an important factor in the process of photosynthesis and the transmission of its products, as well as regulating the work of stomata as the accumulation of potassium in the guard cells is the driving force for the process of stomatal opening and closing (Tisdale, 2005).

References

Agustí, M. (2003). Citricultura , Ed. Mundi-Prensa. Madrid, España.

Al-Alaaf, A.H.I. (2018). Why do we grow citrus trees on specific rootstock. Horticulture and landscape Gardening Department. college of Agriculture and Forestry / University of Mosul / Iraq

Al-Khafaji, M.A.; Atara, S.A. and Muhammad, A.A. (1990). Evergreen perennial fruit. University of Baghdad - Ministry of Higher Education and Scientific Research, Republic of Iraq.

Chapman, H.D. and Pratt, P.F. (1961). Method of analysis for soils plant and water . University of California, Division of Agricultural Science.

Forner-Giner, M.A.; Rodriguez-Gamir, J.; Martínez-Alcántara, B.; Quinones, A.; Iglesias, D. J.; Primo-Millo, E. and Forner, J. (2014). Performance of Navel orange trees grafted onto two new dwarfing rootstocks (Forner-Alcaide 517 and Forner-Alcaide 418). Scientia Horticulturae, 179: 376-387.

Goodwin, T.W. (1976). Chemistry & Biochemistray of plant pigment. 2nd Academic. Press. London. New York. San Francisco: 373.

Gupta, S.D. (2010). Reactive oxygen species and antioxidants in higher plants. CRC Press.

Hameed, A.; Fatma, S.; Wattoo, J. I.; Yaseen, M. and Ahmad, S. (2018). Accumulative effects of humic acid and multinutrient foliar fertilizers on the vegetative and reproductive attributes of citrus (*Citrus reticulata* cv. kinnow mandarin). Journal of plant nutrition, 41(19): 2495-2506.

Haynes, R.J. (1980). Acomparison of two modified Kjedhal digestion techniques for multi elements plant analysis with convertional wet and dry ashing Methods. communein. soil Sci. plant Analysis. 11(5): 459 ‑467.

Jaleel, C.A.; Manivannan, P.A.R.A.M.A.S.I.V.A.M.; Wahid, A.; Farooq, M.; Al-Juburi, H.J.; Somasundaram, R.A.M.A.M.U.R.T.H.Y. and Panneerselvam, R. (2009). Drought stress in plants: a review on morphological characteristics and pigments composition. Int. J. Agric. Biol, 11(1): 100-105.

Martínez-Alcántara, B.; Martínez-Cuenca, M. R.; Bermejo, A.; Legaz, F. and Quinones, A. (2016). Liquid organic fertilizers for sustainable agriculture: Nutrient uptake of organic versus mineral fertilizers in citrus trees. *PloS one*, 11(10): e0161619.

Melgar, J.C.; Schumann, A.W. and Syvertsen, J.P. (2010). Fertigation frequency affects growth and water and nitrogen use efficiencies of swingle citrumelo citrus rootstock seedlings. HortScience, 45(8): 1255-1259.

Page, A.I. (1982). Methods of soil analysis. part 2. Chemical and Micro biological properties. Amer. Soc. Agron. Midison. Wisconsin. USA.

Smith, M.; Kivumbi, D. and Heng, L.K. (2002). Use of the FAO CROPWAT model in deficit irrigation studies. In Deficit irrigation practices.

Soliman **.(2016) .E.A ,and Zaghloul .E.A ,Ennab ;.M.A.M , Effect of irrigation regimes and nitrogen rates on yield and fruit quality of Florida Prince ,growth .138-129 :(2)61 ,Sci .Agric .J .Alex .peach trees**

Tisdale, S.L.; Havlin, J.L.; Nelson, W.L. and Beaton, J.D. (2005). Soil Frtility and Fertilizers. 5th Editions. USA.