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EFFECT OF ORGANIC FERTILIZERS AND THE FOLIAR APPLICATION OF NUTRIENTS ON THE VEGETATIVE GROWTH OF NAVEL ORANGE

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Abstract

This experiment was carried out in a lath house at University of Baghdad / College of Agricultural engineering sciences / Dept. of Horticulture and landscape design during the season of 2019 on the grafted saplings of Navel orange in order to evaluate the effect of organic fertilizer (Growel) in the concentrations of (0, 2.5, 5, and 7.5 gm) and the foliar application of Foliartal and Microponic in the concentrations of (0, 0.5, 1, and 2 ml.L^{-1}) on vegetative growth of navel orange. The experiment was conducted according to RCBD design. Results revealed that the application of organic fertilizer has a significant effect on the vegetative parameters; the concentration of 7.5 gm gave the highest values of stem diameter, plants height, average of secondary shoots, and leaves content of chlorophyll, leaves content of N, P, K, Zn, Fe, Mn. B, and Cu which were 1.84 mm, 20.05 cm, 12.85 shoot, 226.88 mlg.100 gm^{-1} wet weight, 2.47%, 0.215%, 1.803%, 57.47 ppm, 107.76 ppm, 12.40 ppm, 33.18 ppm, and 11.75 ppm respectively, in comparison with the control treatment which gave the lowest values for the studied parameters. While the foliar application of nutrients (Foliartal) and (Micropontic) under the concentration of 2 ml.L^{-1} gave the highest values of Stem diameter, plant height, secondary shoots average, leaves area, leaves content of chlorophyll, K, Zn, Fe, Mn, and B, and carbohydrates percent in vegetative growth, and C/N ratio which were 1.81 mm, 20.45 cm, 11.84 shoot.sapling^{-1}, 47.77 dcm^2, 217.70 ml /g 100 gm^{-1} wet weight, 1.809%, 59.97 ppm, 108.75 ppm, 12.79 ppm, 33.34 ppm, 26.92%, and 14.13 respectively, in comparison with the control treatment.

Key words : Novel orange, Organic fertilizer, foliar application of nutrients.

Introduction

Orange trees are considered as one of the most important trees; their fruits are rich in vitamins and mineral nutrients; the fruits peel, flowers and leaves are considered as an important source of extracting aromatic oils (Liu *et al.,* 2010). The soil application of organic fertilizer is an important way to stimulate the growth of saplings; it has an important role in improving the physical and chemical properties of the soil and contains all the nutrients required for the growth and development of the plant, including micronutrients (Al-Aareji *et al.,* 2014). The foliar fertilization has a main role in improving the growth of saplings; it provides an absolute and fast path of absorption without obstacles (Al-Mawsali, 2018).

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Abd-alwahab and Al-Mashari (2017) indicated during their study on the application of two concentrations of humic acid (3 and 6 ml. L^{-1}) on navel orange saplings and local lemon grafted on bitter orange; that the concentration of 6 ml.L^{-1} gave a significant increment in the shoots number, leaves area of navel orange and the highest values of leaf content of chlorophyll of lemon, also the same concentration of humic acid gave the highest percent of carbohydrates in vegetative growth in both of the lemon and navel orange, while the concentration of 3 ml. L^{-1} gave the highest leaves content of chlorophyll in navel orange compared to the lowest comparison value in all parameters. (Takhaial and Blaket, 2019) mentioned that the application of foliar nutrients (DECSON) which contains some mineral nutrients (Fe 0.4%, Mn 0.4%, B 0.45%, Cu 0.08%, Zn 0.3%), at a concentrations of (0,

10, 20 ml. L^{-1}) On the 7 months old local lemon saplings grafted on the two seedling rootstocks, bitter orange and sweet lemon gave a significant increment in the leaf content of chlorophyll, especially under the foliar application of the concentration of 20 ml. L^{-1} and also gave the highest values of leaves content of N, P and K, Fe and Zn, while the control treatment gave the lowest values in all studied parameters. After all given above; this study was aimed to stimulate and build a strong structure of the vegetative growth of Navel orange saplings by the application of organic fertilizers and the foliar application of nutrients, it also aimed to evaluate the effect of the foliar application of nutrients.

Materials and Methods

This research was carried out during the 2019 season in the Al-Jadiriya / Baghdad on 128 saplings of 1 year's old navel orange. The treatments were randomly distributed among four replicates by two saplings per experimental unit. A factorial experiment was carried out with two factors (4×4) according to randomized complete block design (RCBD). The first factor was the soil application of organic fertilizer (Growel), which consisted of some macro nutrients and organic matter at four concentrations which were (0, 2.5, 5, 7.5 gm.sapling^{-1}) and symbolized as (G_0, G_1, G_2, and G_3) respectively. The second factor was the foliar application of Foliartal and Microponic, which were consisted of some macro and micro nutrients at four concentrations which were (0, 0.5, 1, and 2 ml. L^{-1}) and symbolized as (M_0, M_1, M_2, and M_3) respectively. A 5 liter manual sprayer was used for the foliar application until the full wetness of saplings.

Table 1: The effect of organic fertilizers and nutrients and their interaction on (stem diameter, average of secondary shoots, leaves area, leaves content of chlorophyll and Nitrogen) of the Navel orange for the 2019 season.

Treatment	Stem diameter (mm)	average of secondary shoots (shoots.sapling^{-1})	Leaves area (Dcm^2)	Leaves content of chlorophyll (mlg 100gm^{-1} wet weight)	N(%)
G_0	1.44	9.47	35.45	183.95	2.14
G_1	1.69	10.78	43.74	202.63	2.35
G_2	1.66	10.84	46.04	199.75	2.43
G_3	1.84	12.85	52.85	226.88	2.47
LSD (G)	0.02	0.17	1.10	1.06	0.02
M_0	1.42	9.65	39.04	189.33	2.26
M_1	1.70	10.97	44.15	196.55	2.37
M_2	1.70	11.47	47.11	209.63	2.38
M_3	1.81	11.84	47.77	217.70	2.37
LSD (M)	0.02	0.17	1.10	1.06	0.02
G_0M_0	1.12	8.60	29.81	161.9	2.05
G_0M_1	1.43	9.63	31.69	202.9	2.04
G_0M_2	1.84	9.88	38.40	183.5	2.36
G_0M_3	1.37	9.75	41.88	187.5	2.10
G_1M_0	1.28	9.75	34.97	200.5	2.23
G_1M_1	2.28	10.13	50.12	203.4	2.37
G_1M_2	1.45	11.50	47.43	214.1	2.36
G_1M_3	1.73	11.75	42.43	192.5	2.44
G_2M_0	1.68	10.00	39.02	202.3	2.45
G_2M_1	1.33	11.75	39.05	171.1	2.54
G_2M_2	1.79	10.73	51.01	203.5	2.41
G_2M_3	1.85	10.88	55.07	222.1	2.32
G_3M_0	1.60	10.25	52.34	192.6	2.32
G_3M_1	1.76	12.38	55.74	208.8	2.54
G_3M_2	1.71	13.75	51.59	237.4	2.38
G_3M_3	2.27	15.00	51.71	268.7	2.62
LSD (G×M)	0.04	0.33	2.20	2.12	0.03

Organic fertilizer was applied four times, two of which were during spring season and two during the fall season. While the spraying of nutrients were six times; three of which were during the spring season and three were during the fall season. The results of the treatments were compared with a test of the least significant difference (L.S.D) at a probability level of 0.05 (Alrawi and Hamad, 2000). The following parameters were measured: stem diameter (mm), average of secondary shoots (shoot.sapling^{-1}), leaves area (dm2), leaf content of chlorophyll (mg. 100 g-1 wet weight), Leaves content of C (%), leaves content of Nitrogen (%), leaves content of Phosphorus (%), leaves content of Potassium (%), leaves content of Boron (ppm), carbohydrates percent in vegetative growth (leaves + shoots) %.

Results and Discussion

Results in table 1 revealed that the concentration of G3 gave the highest values of stem diameter, average of secondary shoots, leaves area, and leaves content of chlorophyll and Nitrogen reached (1.84 mm, 12.85 shoot.sapling^{-1}, 52.85 dcm^2, 226.88 mg, 2.47%) respectively, in comparison with the control treatment which gave the lowest values. On the other hand, the application of the second factor at the concentration of M3 gave the highest values of the parameters that were mentioned above reached (1.81 mm, 11.84 shoots.sapling^{-1}, 47.77 dcm^2, 217.70 mg) respectively, except for the leaves content of Nitrogen which reached the highest rate under the concentration of M_2 (2.38%) which did not significantly differ from M_3 treatment in comparison with the control treatment that gave the lowest values for all measured parameters. The interaction treatment between the two factors at the treatment G_3M_3 gave the highest values of stem diameter, shoots number, leaves content of chlorophyll, and Nitrogen reached 2.27 mm, 15.00 shoots.sapling^{-1}, 268.7 mg, 2.62% respectively, while the interaction treatment of G3M1 gave highest value of leaves area reached (55.74 dcm^2) compared to the control treatment which gave the lowest values for all parameters.

Results in table 2 revealed that application of Gowel fertilizer at the concentration of G_3 gave the highest values of leaves content of phosphorus, potassium, and boron and carbohydrates percent in vegetative growth reached 0.215%, 1.803%, 33.18 ppm, 25.52%, respectively, while the concentration of G_2 gave the highest values of leaves content of carbon reached 83.56%, which did not significantly differ from treatment G_3, in comparison with the control treatment that gave the lowest value in all the parameters that mentioned above. On the other hand, the application of the second factor at the concentration of M_3 gave the highest values of leaves content of potassium, carbon, boron and carbohydrates percent in vegetative growth reached 1.809%, 82.23%, 33.34 ppm, 26.92%, respectively, while the concentration of M_2 gave the highest values of leaves content of phosphorus (0.218%) which did not significantly differ from the M_3 treatment compared to the control treatment which gave the lowest values in all the studied parameters. The interaction treatment between two factors at G_3M_3 gave the highest values of leaves content of potassium, and boron and carbohydrates percent in vegetative growth reached 1.965%, 44.78 ppm, 31.28%, respectively, while the interaction treatment at G_3M_2 gave the highest value of leaves content of phosphorus reached 0.245%, and the interaction of G_3M_1 gave the highest value of the leaves content of carbon, reached (85.10%) in

Table 2: The effect of organic fertilizers and nutrients and their interaction on (leaves content of phosphorus, potassium, carbon and boron and carbohydrates percent in vegetative growth).

Treatment	% P	%K	% C	% B	%CHO
G_0	0.193	1.582	79.59	24.88	20.79
G_1	0.203	1.696	81.18	27.80	23.32
G_2	0.205	1.757	83.57	29.38	24.95
G_3	0.215	1.803	83.56	33.18	25.52
LSD (G)	0.008	0.009	0.58	0.72	0.11
M_0	0.188	1.550	80.90	25.25	19.94
M_1	0.196	1.707	82.16	27.90	21.82
M_2	0.218	1.773	82.16	28.76	25.90
M_3	0.214	1.809	82.23	33.34	26.92
LSD (M)	0.008	0.009	0.58	0.72	0.11
G_0M_0	0.183	1.428	78.63	22.60	16.18
G_0M_1	0.185	1.613	79.93	28.38	18.98
G_0M_2	0.215	1.760	81.15	24.15	23.83
G_0M_3	0.190	1.528	78.63	24.40	24.18
G_1M_0	0.183	1.710	80.13	27.48	22.40
G_1M_1	0.205	1.600	79.78	28.90	21.63
G_1M_2	0.200	1.645	81.15	22.70	24.55
G_1M_3	0.225	1.828	83.65	32.12	24.70
G_2M_0	0.195	1.533	82.35	24.18	20.73
G_2M_1	0.200	1.803	83.83	29.80	20.73
G_2M_2	0.213	1.778	84.83	31.50	30.83
G_2M_3	0.213	1.915	83.28	32.05	27.50
G_3M_0	0.190	1.530	82.48	26.75	20.45
G_3M_1	0.195	1.810	85.10	24.50	25.93
G_3M_2	0.245	1.908	83.30	36.70	24.40
G_3M_3	0.228	1.965	83.35	44.78	31.28
LSD (G×M)	0.016	0.017	1.16	1.43	0.22

comparison with the control treatment which gave the lowest values in all studied parameters.

The role of organic fertilizer can be due to its composition of some macro nutrients that provide the need for the vegetative growth, which leads to an increase in cell division and enlargement, thus increasing the efficiency of photosynthesis, chlorophyll content and sugars formation (Singh, 2003), which leads to an increase in stem diameter, shoots number, leaves area, chlorophyll and the accumulation of Carbohydrates in shoots (Havlin *et al.,* 2005). Also the increment of carbon content can be due to the application of organic fertilizer to the soil which increases the nutrients concentration in the soil which leads to increase their readiness so the absorption quantities through the roots will increase and thus their concentration in the leaves (Taiz and Ziger, 2010). Also the foliar application of the nutrients, N, P and K work to increase vegetative growth by increasing cell division and enlargement and also increases the amount of nutrients absorbed through their role in photosynthesis and the formation of ATP compounds and as a stimulant for many enzymes and mechanical regulation of stomata opening and closing, which leads to increase the vegetative growth and increase stem diameter, shoots number, leaves area, the chlorophyll content, as well as the carbohydrate formation and transmission (Hopkins and Huner, 2004). The role of boron is mainly in stimulation of proteins production, carbohydrates and nucleic acids, which contributes to increase the growth and improving the production by increasing the sugars percent in fruits (Saenz, 2001).

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