Response of Washington Navel Orange Trees to Foliar Spray with Some Bio and Mineral Compounds

Bakry, Kh. A.[1]; Khamis, M. A.[1]; Sharaf, M. M.[1]; Ebrahim, H. K.[2] and Yassin, H. I[2].

[1] Hort. Dep., Fac. of Agric., Benha Univ., Egypt [2] Hort. Res. Inst., Agric. Res. Cen., Egypt

ABSTRACT

The present study was conducted on fruitful Washington navel orange trees grown at a private orchard during 2009 & 2010 seasons to evaluate the influence of some bio and mineral compounds i.e., Nofaterin and Biomagic foliar spray in different combinations with N, P, K and fertilizers on growth, productivity, fruit quality and nutritional status of Washington navel orange trees. Each of the tested nine treatments improved all the evaluated parameters dealing with: 1- growth parameters (No. of shoots / one meter limb, shoot length and thickness, No. of leaves per shoot and leaf surface area) 2- fruiting measurements (fruit set and fruit retention percentage and yield/tree), 3- Fruit physical properties (fruit weight , dimensions , shape index , juice volume and peel thickness) or chemical properties (juice TSS %, acidity %, TSS /acid ratio , total sugars and Vitamin C content), as well as leaf nutritional status (N, P, K, Ca, Mg, Fe, Mn and Zn). However, the beneficial effect varied greatly from one treatment to another. Anyhow, Biomagic + $(NH_4)_2SO_4$ + K_2SO_4 at 1% + P_2O_5 at 100 ppm treatment was statistically the superior, followed descending by Nofaterin + $(NH_4)_2SO_4$ at 1% + K_2SO_4 at 1% + P_2O_5 at 100 ppm treatment. However, the control (water spray) treatment had the least values for all tested vegetative and fruiting parameters.

Keywords: Bio & Mineral Compounds, citrus, Foliar spray.

1. INTRODUCTION:

Citrus are one of the most important fruit crops grown in many tropical and subtropical countries. At the moment, there is about 1.5 million hectares cultivated of citrus for commercial scale in the world yielding nearly 40 million metric tons of oranges, lemons, limes, etc (Anonymous, 2008).

In Egypt, citrus has great attention due to its importance for local consumption or as a main source for foreign currencies by exportation to the European countries. The area of citrus cultivated in Egypt rapidly increased, especially in the newly reclamated desert lands and reached about 453.722 feddan, out of them 369.022 feddan are fruit full producing about 3:5 millions tons with average of 9.55 ton/fed. (Anonymous, 2008).

Bio-fertilization is biological preparations containing primarily patent strains of micro - organisms in sufficient numbers. This micro - organisms have definite beneficial roles in the fertility of soil rhizosphere and plants growth. The multi- strain bio - fertilizers might contain different strains of symbiotic associative diazatrophes, phosphate- solubilizing micro- organisms, silicate dissolving micro-organisms, blue green algae and VAM (Saber, 1993).

Bio-fertilizers proved to eliminate the use of pesticides sometimes and rebalance the ratio between plant nutrients in soils. They are easy and safe to handle with field applications that, improved their efficiency in increasing crop yields and decreasing the costs of some agricultural practices. It is worthy to state that, bio-fertilizers do not replace mineral fertilizers, but significantly reduce their rate of application (Ishac, 1989).

Bio-fertilizers are very safe for human, animal and environment. Since, they reduce at the lower extent the great pollution happened in environment.

Applications of biofertilizers are now commercially available. Specific strains are used as biological fertilizers, for nitrogen, phosphorus and silicate dissolving such as N-fixing bacteria and yeasts. The use of these materials encourage growth and flowering as well as reflected positively on tree productivity.

The requirement of amino acids in essential quantities is well known as a means to increase yield and overall quality of crops. The application of amino acids for foliar use is based on its requirement by plants in general and at critical stages of growth in particular. Plants absorb amino acids through stomata and are proportionate to environment temperature.

Amino acids are fundamental ingredients in the process of protein synthesis. About 20 important amino acids are involved in the process of each function. Studies have proved that amino acids can directly or indirectly be absorbed by leaves or roots and consequently influence the physiological activities of the plant.

Thus, this study aimed to investigate the effect of application of some bio and mineral nutritive compounds on vegetative growth, nutritional status and productivity of mature Washington navel orange trees.

2. MATERIALS AND METHODS:

This study was conducted on fruitful Washington navel orange trees "*Citrus sinensis L.*" Osbeck budded on sour orange rootstock and grown in clay loamy soil at a private orchard at Tesfa village belongs to Kafr Shockr district, Kaliobia Governorate, Egypt during 2009 and 2010 experimental seasons. It aimed to investigate the effect of foliar spray treatments with some bio and mineral compounds. In this experiment, foliar spray with different combinations between some macro (N,P, and K) and micro (Fe, Mn, Zn, B) nutrient element were compared with the N, P and K fertilization program adopted in the farm according to Ministry of Agriculture recommendations. Herein urea, ammonium sulphate, orthophsphoric acid, potassium sulphate, Biomagic* "biostimulant" and Nofaterin** were the macro and micro nutrient sources for the different investigated spray solutions. Since, all investigated spray solutions used with 2^{nd} to 9^{th} treatments were applied as additional nutritive sources plus one fourth the doses of soil applied to control (ammonium sulphate, superphosphate and potassium

---

* Biomagic produced by soil microbiology unit, desert research has PH 5.5 and consists of 12 amino acids (2.45%), 8 vitamins (0.05%), macro elements (N 14%, P_2O_5 7.5%, K_2O 11% and Mg 4.5%) and micro elements (Fe 160 ppm, Zn 124 ppm, Mn 100 ppm, B 14 ppm, Cu 45 ppm and Mo 12 ppm).

** Nofaterin consists of N, P_2O_5, K_2O, Fe, Zn, Mn, B and Mo at 5, 5, 5, 0.15, 0.115, 0.10, 0.05 and 0.02 %, respectively.

Thus, the different fertilization spray treatments investigated in this experiment were as follows:

T_1- Control (water spray of trees subjected to only the N, P, K fertilizers programs adopted in the farm).

T_2- Foliar spray with urea at 0.5% + orthophosphoric acid at 100 ppm P_2O_5 + K_2SO_4 at 1%.

T_3- Foliar spray of $(NH_4)^2SO_4$ at 1% + orthophosphoric acid at 100 ppm P_2O_5 + K_2SO_4 at 1%.

T_4- Foliar spray of Nofaterin at 2 l / 300 l water.

T_5- Foliar spray of Biostimulant (Biomagic) at 7.5g/tree.

T_6- Foliar spray of Nofaterin at 2 l / 300 l water + T_2.

T_7- Foliar spray of Nofaterin at 2 l / 300 l water + T_3.

T_8- Foliar spray of Biomagic at 7.5g/tree + T_2.

T_9- Foliar spray of Biomagic at 7.5g/tree + T_3.

sulphate fertilizers). It was hoped to find out an easier and fast method of application to supply trees with their nutrition requirements from one hand and for a financial aims from the other.
The super film as a surfactant agent at (0.16) was used with all investigated spray treatments including the control one.
Foliar application of Nofaterin (2 l / 300 l water), Biomagic (7.5 g / tree), P_2O_5 at 100 ppm / L, urea at 0.5% and $(NH_4)_2SO_4$ at 1% were sprayed twice: 1st on mid April (after 75% petal fall), while 2nd on mid May (one month later). Spray treatments were applied covering the whole foliage of each tree using canopy, 10 liters / tree.

Experiment layout:
The complete randomized block design with three replications was applied. The response of Washington navel orange trees to the different investigated nutritive amendment treatments was evaluated through determining the changes exhibited in the following characteristics:

A- Vegetative growth measurements:
In this regard, number of developed shoots per one meter of every tagged limb, average shoot length & thickness, number of leaves/shoot and average leaf areas were investigated.

B- Some fruiting measurements:
Fruit set %, fruits retention %, yield (estimated as weight in kg and number of harvested fruits per tree) and fruit quality (physical & chemical properties) in response to the investigated treatments were determined. Hence, average fruit weight, dimensions (polar & equatorial diameters), shape index, juice volume and peel thickness as well as fruit juice TSS, total acidity, TSS / acid ratio, total sugars % and ascorbic acid (VC. content) were the investigated fruit physical and chemical properties, respectively.

C- Nutritional status:
In this regard, leaf nutrient elements content (N, P, K, Ca, Mg, Fe, Mn and Zn) in response to the various bio and mineral nutritive substances were investigated as an indicator of nutritional status for Washington navel orange trees.
Representative samples of fourth and fifth leaves from the base of spring shoots were collected from each replicate in October during both seasons. The samples were thoroughly washed with tap water, rinsed

twice with distilled water and oven dried at 70°C till a constant weight and finely ground for determination of:
Total leaf (N) content was determined by the modified micro Keldahl after (Pregl, 1945). Total leaf (P) content was determined by wet digestion of plant materials after the methods described by (Piper, 1958). Total leaf (K) content was determined photometrically according to (Brown and Lilliand, 1946). Calcium, Magnesium, Iron, Manganese and Zinc were determined using the atomic absorption spectrophotometer "Perkin Elmer -3300" after Chapman and Pratt (1961).
Leaf nutrient element contents were expressed as a ratio of the leaf dry weight i. e., percentage for the macro - elements (N, P, K, Ca and Mg) and part per million (ppm) with micronutrient elements (Fe, Mn and Zn).
The obtained data during each season were subjected to analysis of variance according to (Snedecor and Cochran, 1977). Differences among means were differentiated according to the Duncan, multiple test range (Duncan, 1955).

3. RESULTS AND DISCUSSION:

A- Vegetative growth measurements:

It is quite evident from Table (1) that all investigated bio and mineral treatments significantly increased the tested five growth parameters as compared with the control. However, the response varied obviously from one treatment to another in spite of all growth parameters followed in most cases the same trend during both the experimental seasons. Anyhow, Biomagic at 7.5 g/tree + $(NH_4)2SO_4$ at 1% + K_2SO_4 at 1% + P_2O_5 at 100 ppm. ($7^{\underline{th}}$ treatment) was the most effective treatment and ranked statistically the superior, since it gained the greatest number of shoots per one meter limb, average shoot length and thickness, number of leaves per shoot and average leaf area during both seasons.
This result goes in line with those found by Sharaf *et al.* (2011) who reported that Washington navel orange trees. Moreaver, the obtained result regarding the positive response of vegetative growth to mineral nutrition goes in line with those previously mentioned by El-Otmani *et al.* (2004) on Clementine mandarin.

B- Fruiting measurements:

As shown in table (2), all investigated increased treatments significantly fruit set and fruits retention percentage as well as yield of Washington navel orange trees (estimated either as number or weight of harvested fruits / tree) as compared to the control during both 2009 & 2010 seasons. However, the rate of response exhibited by the different bio and mineral compounds substances in the aforesaid three fruiting measurements varied greatly from one treatment to another despite all fruiting parameters followed approximately the same trend during both seasons. Hence, Biomagic at 7.5 g/tree + $(NH_4)2SO_4$ at 1% + K_2SO_4 at 1% + P_2O_5 at 100ppm. ($7^{\underline{th}}$ treatment) was statistically the superior which recorded the highest increase than control and overall other investigated treatments for all fruiting measurements during both seasons.

The obtained results go partially in line with those of Paschoal *et al*, (1999) on sweet orange and Sharaf *et al.* (2011) on Washington navel orange.

C- Fruit physical properties:

It was so clear from Table (3) that all investigated fruit physical properties except peel thickness and fruit shape index were increased by the different tested bio and mineral nutritive treatments as compared to the control. The rate of response varied from one treatment to another, whereas the heaviest fruit, the tallest polar diameter, widest equatorial diameter and greatest juice volume was significantly coupled with those fruits of Washington navel orange trees subjected to Biomagic at 7.5 g/tree + $(NH_4)2SO_4$ at 1% + K_2SO_4 at 1% + P_2O_5 at 100ppm. ($7^{\underline{th}}$ treatment).

The obtained results regarding the positive effect of bio fertilizers application on some fruit physical characteristics go generally in line with those reported by several investigators, Paschoal *et al.* (1999) on fruit juice volume and peel of orange fruit, Abd El-Migeed *et al.* (2007) and Sharaf *et al.* (2011) on Washington navel orange fruits.

In addition, earlier findings of several investigators gave support to the present results regarding the beneficial effect of some mineral fertilizers on some physical properties (Mohamed,1996) on fruit juice volume of Balady mandarin and Ahmed *et al.* (2002) on average fruit weight, size, dimensions, juice volume and peel thickness of Valencia orange.

D- Fruit juice chemical characteristics:

It is quite clear from Table (4) that, all investigated bio and mineral nutritive treatments increased obviously the five fruit juice chemical properties under study. Such trend was true during both 2009 and 2010 seasons and differences were statistically significant among treatments except for the TSS / acid ratio. Anyhow, it could be safely concluded that the highest values of fruit juice TSS %, TSS / acid ratio, total sugars % and ascorbic acid (VC) content were significantly in concomitant to fruits of Washington navel orange trees subjected to Biomagic + $(NH_4)2SO_4$ at 1% + K_2SO_4 at 1% + P_2O_5 at 100 ppm. (7^{th} treatment).

Findings of several investigators, Darwish *et al.* (1992) on Balady orange, Wassel *et al.* (2000) on Balady mandarin and Maji and Ghosh (2007) on Pummelo, demonstrated that various mineral fertilizers application increased fruit chemical properties.

E- Leaf mineral content:

As shown in Tables (5 and 6), all leaf elements content were significantly increased by any of the investigated bio and mineral nutritive treatments as compared to control. Such trend was true during both seasons. Biomagic + $(NH_4)2SO_4$ at 1% + K_2SO_4 at 1% + P_2O_5 at 100 ppm which showed the 1st rank compared with other treatments. Anyhow, the Nofaterin + $(NH_4)2SO_4$ at 1% + K_2SO_4 at 1% + P_2O_5 at 100ppm (6^{th} treatment) came second and exhibited statistically the highest leaf nutrient elements content.

This result goes in line with Abd El-Migeed *et al.* (2007) and Sharaf *et al.* (2011) on Washington navel orange trees.

Table 1: Response of some vegetative growth measurements of fruitful Washington navel orange trees to some bio and mineral fertilizers (foliar spray) during 2009&2010 seasons

Treatments	No. of shoots/ one meter limb		Shoot length (cm)		Shoot thickness (mm)		No. of leaves/shoot		Leaf area (cm^2)	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	**2010**
1-Control (water spray).	13.85 F	15.82 F	22.20 G	23.85 G	2.01 F	2.11 F	23.11 G	24.91 G	20.00 F	**20.00 F**
2- $(NH_4)_2SO_4$ at 1% + K_2SO_4 at 1 % + P_2O_5 at 100ppm (foliar spray).	16.10 D	17.07 D	23.69 F	25.31 F	2.57 D	2.65 D	26.81 F	28.25 F	25.00 D	**25.00 D**
3- Urea at 0.5% + K_2SO_4 at 1% + P_2O_5 at 100ppm (foliar spray).	15.30 E	16.97 E	23.52 F	25.14 F	2.37 E	2.44 E	26.22 F	26.81 F	23.83 E	**23.69 E**
4- Nofaterin (foliar spray) at 2L/300 L water.	17.35 D	18.24 D	24.99 E	26.95 E	2.57 D	2.70 D	28.08 E	31.31 E	25.42 D	**27.45 D**
5- Biomagic (foliar spray) at 7.5 g/L water.	17.52 C	18.49 C	26.25 D	27.85 D	277 C	2.89 C	31.99 D	34.04 D	25.55 D	**27.50 D**
6-Nofaterin + $(NH_4)_2SO_4$ at 1% + K_2SO_4 at 1% + P_2O_5 at 100ppm	18.90 B	19.90 B	29.07 B	30.44 B	3.01 B	3.01 B	35.84 B	38.91 B	29.00 A	**30.90 A**
7-Biomagic + $(NH_4)_2SO_4$ at 1% + K_2SO_4 at 1% + P_2O_5 at 100ppm.	19.97 A	20.89 A	30.35 A	31.71 A	3.10 A	3.11 A	37.01 A	40.15 A	29.05 A	**31.00 A**
8-Nofaterin + Urea at 0.5% + K_2SO_4 at 1% + P_2O_5at 100ppm	17.53 C	18.67 C	27.79 C	29.14 C	2.97 B	3.00 B	33.74 C	36.21 C	27.05 C	**28.69 C**
9-Biomagic + urea at 0.5% + K_2SO_4 at 1% + P_2O_5 at 100ppm.	**17.61 C**	**18.65 C**	**27.50 C**	**28.68 C**	**2.77 C**	**2.90 C**	**32.41 D**	**34.62 D**	**28.45**	**29.89g**

- Values within each column followed by the same letter (s) are not significantly different at 5% level .

Table 2: Response of fruit set (%), change in fruit retention (%) and yield tree of fruitful Washington navel orange trees to some bio and mineral fertilizers (foliar spray) during 2009&2010 seasons

Treatments	Fruit set (%)		Remained fruits% (June 20th)		Remained fruits% (December 15th)		Number of fruits / Tree		Yield (kg)/ Tree	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	**2010**
1-Control (water spray).	19.91G	22.10G	15.70G	15.86 G	9.38 H	11.04 H	203.32 I	213.62 I	40.65 I	**42.92 I**
2- $(NH_4)_2SO_4$ at 1% + K_2SO_4 at 1 % + P_2O_5 at 100ppm (foliar spray).	24.97 E	26.17E	20.21 E	20.32 H	12.79F	14.21 F	290.32 G	300.49 H	67.89 G	**75.39 H**
3- Urea at 0.5% + K_2SO_4 at 1% + P_2O_5 at 100ppm (foliar spray).	23.94 E	25.20F	18.00 F	18.09 F	11.08G	12.62 G	265.15 H	379.05 D	58.66 H	**90.02 F**
4- Nofaterin (foliar spray) at 2L/300 L water.	25.51 E	26.36E	20.23 E	21.00 E	14.50E	1 5.68E	315.66 F	332.49 F	78.87 F	**86.69 G**
5- Biomagic (foliar spray) at 7.5 g/L water.	27.21 D	28.07D	20.53 E	21.10 E	14.64E	15.97 E	338.66 E	356.49 F	89.26 E	**95. 94 E**
6-Nofaterin + $(NH_4)_2SO_4$ at 1% + K_2SO_4 at 1% + P_2O_5 at 100ppm	30.97 B	31.57B	25.84 B	27.77 B	19.78B	20.91 B	395.21 B	405.15 B	119.40 B	**126.94 B**
7-Biomagic + $(NH_4)_2SO_4$ at 1%+ K_2SO_4 at 1% + P_2O_5 at 100ppm.	32.47 A	33.17A	27.56 A	29.96 A	21.47A	22.44 A	407.66 A	415.82 A	126.98 A	**133.74 A**
8-Nofaterin + Urea at 0.5% + K_2SO_4 at 1% + P_2O_5 at 100ppm	27.77 D	28.17D	22.29 D	23.34 D	16.35D	17.54 D	350.59 D	376.49 E	96.74 D	**104.78 D**
9-Biomagic + urea at 0.5% + K_2SO_4 at 1% + P_2O_5 at 100ppm.	**29.37 C**	**29.87C**	**24.04 C**	**25.25 C**	**18.05C**	**19.11 C**	**366.66 C**	**381.49 C**	**106.15 C**	**114.50 C**

- Values within each column followed by the same letter (s) are not significantly different at 5% level .

Sinai J. of Applied Sc. (ISSN:2314-6079), Is.: 2, Vol.:1 2013, pp.: 47 -62

Table 3: Response of fruit weight, fruit dimensions, fruit shape index, peel thickness and Juice volume of fruitful Washington navel orange trees to some bio and mineral fertilizers (foliar spray) during 2009 & 2010 seasons

Treatments	Fruit weight (g)		Fruit dimensions (cm.)				Fruit shape index		Peel thickness (mm)		Juice volume (cm^3)	
			Polar diameter		Equatorial diameter							
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	**2010**
1-Control (water spray).	199.95I	200.98I	6.77H	7.21H	6.68H	7.20H	1.013C	1.0001C	3.00C	3.91C	69.93I	**71.19I**
2- $(NH_4)_2SO_4$ at 1% + K_2SO_4 at 1 % + P_2O_5 at 100ppm (foliar spray).	233.84G	250.90G	7.09F	7.71F	6.95F	7.60F	1.020B	1.014B	4.11BC	4.57BC	89.41G	**98.26G**
3- Urea at 0.5% + K_2SO_4 at 1% + P_2O_5 at 100ppm (foliar spray).	221.23H	237.50H	6.91G	7.46G	6.82G	7.45G	1.013C	1.001C	3.20C	4.24C	81.24H	**89.49H**
4- Nofaterin (foliar spray) at 2L/300 L water.	249.86F	260.73F	7.25E	7.90E	7.08E	7.80E	1.024B	1.012B	4.15BC	4.57BC	98.81F	**106.03F**
5- Biomagic (foliar spray) at 7.5 g/L water.	263.56E	269.12E	7.42D	8.16D	7.20D	7.96D	1.030A	1.025A	4.80AB	5.24AB	106.66E	**110.33E**
6-Nofaterin + $(NH_4)_2SO_4$ at 1% + K_2SO_4 at 1% + P_2O_5 at 100ppm	302.13B	313.32B	7.79B	8.59B	7.60B	8.43B	1.025B	1.018B	490A	524A	134.96B	**140.56B**
7-Biomagic + $(NH_4)_2SO_4$ at 1% + K_2SO_4 at 1% + P_2O_5 at 100ppm.	311.48A	321.65A	7.95A	8.74A	7.70A	8.54A	1.032A	1.026A	5.00A	5.91A	142.09A	**148.36A**
8-Nofaterin + Urea at 0.5% + K_2SO_4 at 1% + P_2O_5 at 100ppm	275.93D	278.32D	7.45D	8.24D	7.22D	8.03D	1.031A	1.026A	4.85AB	5.24AB	114.36D	**119.26D**
9-Biomagic + urea at 0.5% + K_2SO_4 at 1% + P_2O_5 at 100ppm.	**289.50C**	**300.15C**	**7.61C**	**8.42C**	**7.40C**	**8.28C**	**1.021B**	**1.016B**	**4.80AB**	**5.24AB**	**123.09C**	**128.43C**

- Values within each column followed by the same letter (s) are not significantly different at 5% level.

Table 4: Response of some fruit juice chemical characteristics (TSS, Total acidity, TSS/ acid ratio, total sugar and VC) of fruitful Washington navel orange trees to some bio and mineral fertilizers (foliar spray) during 2009 & 2010 seasons

Treatments	TSS (%)		Total acidity (%)		T.S.S. / acid ratio		Total sugar (%)		VC (mg/100 ml)	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	**2010**
1-Control (water spray).	10.12E	10.22E	1.34A	1.33A	7.55G	7.68G	6.37 H	6.99 H	49.58 H	**51.11 H**
2- $(NH_4)_2SO_4$ at 1% + K_2SO_4 at 1 % + P_2O_5 at 100ppm (foliar spray).	11.30C	11.32C	1.18C	1.16C	9.58E	9.76E	9.12 F	9.15 F	55.79 F	**58.34 F**
3- Urea at 0.5% + K_2SO_4 at 1% + P_2O_5 at 100ppm (foliar spray).	10.70D	10.72D	1.27B	1.25B	8.42F	8.58F	7.32 G	7.52 G	52.69 G	**56.11 G**
4- Nofaterin (foliar spray) at 2L/300 L water.	11.52C	11.89C	1.14CD	1.12CD	10.11D	10.35D	9.60 E	9.61 E	57.79 E	**60.77 E**
5- Biomagic (foliar spray) at 7.5 g/L water.	11.60C	11.62C	1.01CD	1.10CD	10.36D	103.56D	10.05D	10.06 D	60.13 D	**62.44 D**
6-Nofaterin + $(NH_4)_2SO_4$ at 1% + K_2SO_4 at 1% + P_2O_5 at 100ppm	12.33B	12.39B	0.990E	0.970E	12.45B	12.77B	11.16B	11.25 B	67.71 B	**69.34 B**
7-Biomagic + $(NH_4)_2SO_4$ at 1% + K_2SO_4 at 1% + P_2O_5 at 100ppm.	12.87A	12.90A	0.979E	0.965E	13.15A	13.42A	11.60 A	11.69 A	70.79 A	**71.33 A**
8-Nofaterin + Urea at 0.5% + K_2SO_4 at 1% + P_2O_5 at 100ppm	12.19B	12.22B	1.09D	1.07D	11.18C	11.42C	10.52 C	10.52 C	64.13 C	**65.87 C**
9-Biomagic + urea at 0.5% + K_2SO_4 at 1% + P_2O_5 at 100ppm.	**12.30B**	**12.39B**	**1.08D**	**1.06D**	**11.39C**	**11.69C**	**10.71C**	**10.79 C**	**65.64 C**	**66.87 C**

- Values within each column followed by the same letter (s) are not significantly different at 5% level.

Table 5: Response of leaf N, P, K, Ca and Mg of fruitful Washington navel orange trees to some bio and mineral fertilizers (foliar spray) during 2009 & 2010 seasons

Treatments	N (%)		P (%)		K (%)		Ca (%)		Mg (%)	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	**2010**
1-Control (water spray).	2.05 F	2.25 F	0.150 B	0.162 B	1.15 E	1.22 E	2.91 G	2.94 G	0.288 F	**0.299 F**
2- $(NH_4)_2SO_4$ at 1% + K_2SO_4 at 1 % + P_2O_5 at 100ppm (foliar spray).	2.60 D	2.62 D	0.152 B	0.171 B	1.22 D	1.31 D	3.72 D	3.74 D	0.341 E	**0.370 E**
3- Urea at 0.5% + K_2SO_4 at 1% + P_2O_5 at 100ppm (foliar spray).	2.41 E	2.42 E	0.152 B	0.166 B	1.20 D	1.28 D	3.30 F	3.34 F	0.341 E	**0.360 E**
4- Nofaterin (foliar spray) at 2L/300 L water.	2.64 D	2.40 D	0.154 B	0.175 B	1.30 C	1.39 C	3.72 E	3.74 E	0.393 D	**0.433 D**
5- Biomagic (foliar spray) at 7.5 g/L water.	2.66 D	2.40 D	0.164 B	0.178 B	1.32 C	1.42 C	4.08 D	4.14 D	0.446 C	**0.500 C**
6-Nofaterin + $(NH_4)_2SO_4$ at 1% + K_2SO_4 at 1% + P_2O_5 at 100ppm	3.00 B	3.06 B	0.211 A	0.212 A	1.42 B	1.52 B	4.50 B	4.54 B	0.504 B	**0.575 B**
7-Biomagic + $(NH_4)_2SO_4$ at 1%+ K_2SO_4 at 1% + P_2O_5 at 100ppm.	3.19 A	3.25 A	0.211 A	0.215 A	1.50 A	1.59 A	4.72 A	4.84 A	0.556 A	**0.635 A**
8-Nofaterin + Urea at 0.5% + K_2SO_4 at 1% + P_2O_5 at 100ppm	2.84 C	2.82 C	0.205 A	0.210 A	1.40 B	1.52 B	4.17 D	4.20 D	0.448 C	**0.503 C**
9-Biomagic + urea at 0.5% + K_2SO_4 at 1% + P_2O_5 at 100ppm.	**2.86 C**	**2.85 C**	**0.202 A**	**0.210 A**	**1.42 B**	**1.52 B**	**4.15 C**	**4.23 C**	**0.451 C**	**0.505 C**

- Values within each column followed by the same letter (s) are not significantly different at 5% level.

Table 6: Response of leaf Fe, Mn and Zn contents (ppm) of fruitful Washington navel orange trees to some bio and mineral fertilizers (foliar spray) during 2009 & 2010 seasons

Treatments	Fe (ppm)		Mn (ppm)		Zn (ppm)	
	2009	2010	2009	2010	2009	**2010**
1- Control (water spray).	88.89 G	94.86 G	42.13 G	44.65 G	30.04 H	**22.68 H**
2- $(NH_4)_2SO_4$ at 1% + K_2SO_4 at 1 % + P_2O_5 at 100ppm (foliar spray).	104.18 E	107.95 E	48.00 EG	48.68 E	34.98 G	**35.65 G**
3- Urea at 0.5% + K_2SO_4 at 1% + P_2O_5 at 100ppm (foliar spray).	97.71 F	99.99 F	46.53 F	46.85 F	34.50 G	**35.65 G**
4- Nofaterin (foliar spray) at 2L/300 L water.	112.35 D	115.89 D	49.47 E	49.82 E	36.64 F	**38.27 F**
5- Biomagic (foliar spray) at 7.5 g/L water.	118.91 CD	122.76 CD	51.93 D	52.72 D	39.18 E	**40.29 E**
6- Nofaterin + $(NH_4)_2SO_4$ at 1% + K_2SO_4 at 1% + P_2O_5 at 100ppm	127.21 AB	130.33 AB	54.97 B	56.83 B	44.89 B	**46.99 B**
7- Biomagic + $(NH_4)_2SO_4$ at 1%+ K_2SO_4 at 1% + P_2O_5 at 100ppm.	129.84 A	134.76 A	56.98 A	58.22 A	46.53 A	**48.49 A**
8- Nofaterin + Urea at 0.5% + K_2SO_4 at 1% + P_2O_5at 100ppm	122.58 C	125.79 C	52.04 D	53.18 D	42.92 C	**44.75 C**
9- Biomagic + urea at 0.5% + K_2SO_4 at 1% + P_2O_5 at 100ppm.	**124.57 BC**	**127.89 BC**	**53.26 C**	**54.58 C**	**40.92 D**	**42.40 D**

- Values within each column followed by the same letter (s) are not significantly different at 5% level.

REFERENCES:

Abd El-Migeed, M. M.; M. M. Saleh and E. A. Mostafa (2007). The beneficial effect of minimizing mineral nitrogen fertilization on Washington navel orange trees by using organic and biofertilizers. World J. Agric. Sci. IDOSI Publications, Faisalabad, Pakistan, 3:1, 80-85, 22 refs.

Ahmed, F. F.; A. M. Akl; E. O. Abo El-Komsan; M. Y. Hegab and E. Youness-Randa (2002). Effect of different sources, levels and methods of nitrogen applications on growth, leaf mineral content, fruit setting, yield and fruit quality of Valencia orange trees. 2- The effect on yield and fruit quality. J. Agric. Res. & Develop. 22 (4): 501-518.

Anonymous (2008). Year book of statistics of Ministry of Agriculture. (Agricultural Economical and Statistical Department, Arab Republic of Egypt: Cairo) [In Arabic].

Brown, J. D. and Lilliand, O. (1946). Rapid determination of potassium and sodium in plant material and soil extract by flam-photometer. Proc. Amer. Soc. Hort. Sci., 48: 341-346.

Chapman, H. D. and P. F. Pratt (1961). Methods of Analysis for soil, plant and waters. Univ. Calif. Division of Agric. Sc.: 6th Ed. P: 56-64.

Darwish, O. H.; F.F. Ahmed; M.A. El-Sayed and M.A. Mohamed (1992). Foliar and soil applications of urea and their effects on growth, yield and quality of Balady orange trees. Minia J. Agric. Res. & Dev. 14 (1): 50-70.

Duncan, D. B. (1955). Multiple range and multiple F. tests. Biometrics, 11: 1-42.

El-Otmani, M.; F.Z.Taibi; B. Lmoufid ; A.Ait-Oubahou and C.J. Lovatt (2004). Improved use of foliar urea on Clementine mandarin to manipulate cropping in a sustainable production system. Acta Horticulturae. International Society for Horticultural Science (ISHS), Leuven, Belgium: 632, 167-175. Price: 81 EURO.

Ishac, Y. Z. (1989). Inoculation with associative N2-fixers Egypt. nitrogen fixation with non-legumes. Kluwer Academic Publishers. Pp. 241-246.

Maji, M. and G. Ghosh (2007). Effect of nitrogen levels on physio-chemical characteristics of fruits of pummelo Citrus grandis (L.). Environment and Ecology. MKK Publication, Calcutta, India, 25S: Special 4, 1214-1215.

Mohamed, M. A. (1996). Studies on Balady mandarin fertilization using soil and foliar application of some macro and micronutrients. 4th Arabic Conf. for Hort. Crops, 25-28 March, El-Minia, Egypt, pp. 797-813.

Paschoal, A. D.; Y. D. A. Senanayake and U. R. Sangakkara (1999). Improved soil chemical and physical conditions and their relations to yield and fruit quality of orange in a field under Kyusei Nature Farming and EM. Technology in Barzil. Fifth International Conference on Kyusei Nature Farming, Bangkok, Thailand, 23-26 October , 175-181.

Piper, C. S. (1958). Soil and Plant Analysis. Inter. Sci. Publishers. New York, 213-217.

Pregl, E. (1945). Quantitative Organic Micro Analysis. 4th Ed. Chundril, London.

Saber, S. M. (1993). The use of multi-strain bio-fertilizers in agriculture. Theory and pratice. Proc. Sixth International Symposium on Nitrogen Fixation with Non-legumes, Ismailia, Egypt, p.61.

Sharaf, M. M. ; Kh. A. Bakry, and Sh. F. EL- Gioushy (2011). The influence of some bio and organic nutritive addenda on growth, productivity, fruit quality and nutritional status of Washington navel orange trees. Egypt. J. Appl. Sci., 26 (9): 253-268.

Snedecor, G.W. and W.G. Cochran (1977). Statistical Methods, Eight Edition, Iowa State University Press.

Wassel, A. H.; F. F. Ahmed and T. A. Ebrahiem (2000). Nitrogen better management for high yield and quality of Balady mandarin trees grown in sandy soil. The 2nd Scientific Conference of Agric. Sci., Assuit, Oct. 293-300.

استجابة أشجار البرتقال أبو سرة (واشنطن) للرش الورقى ببعض المركبات الحيوية والمعدنية

خالد علي بكري[1] محمد عبد الوهاب خميس[1] محمد محمد شرف[1]

حسين قابيل إبراهيم[2] هالة إبراهيم ياسين[2]

[1] قسم البساتين –كلية الزراعة –جامعة بنها –مصر [2] معهد بحوث البساتين –مركز البحوث الزراعية –مصر

أجريت هذه الدراسة على أشجار مثمرة لصنف البرتقال بسره (واشنطن) نامية بمزرعة خاصة خلال موسمي ٢٠٠٩ و ٢٠١٠ بهدف تحسين نمو وإنتاجية وجودة الثمار

والحالة الغذائية للأشجار باستعمال مركبات حيوية ومعدنية هي النوفاترين والبيوماجيك واليوريا وسلفات الامونيوم والسوبرفوسفات وسلفات البوتاسيوم سواء استخدم كل مركب بمفرده أو مع غيره رشا على الأوراق وقد تم تقييم المعاملات من حيث تأثيرها على النمو الخضري (عدد الأفرخ النامية علي المتر الطولي للفرع الرئيسي، طول وسمك الفرخ وعدد الأوراق/ فرخ ومساحة الورقة والإنتاجية (نسبة العقد ونسبة بقاء الثمار ومحصول الشجرة وجودة الثمار فيما يتعلق بالصفات الطبيعية (وزن الثمرة– أبعادها – شكل الثمرة– حجم العصير – سمك القشرة) والصفات الكيمائية (نسبة المواد الصلبة الذائبة الكلية – الحموضة الكلية والنسبة بينهما والسكريات الكلية وفيتامين ج) بالإضافة الى محتوي الأوراق من العناصر الكبرى(النيتروجين– الفوسفور – البوتاسيوم– الكالسيوم– الماغنسيوم) والصغرى (الحديد – المنجنيز – الزنك).

أظهرت جميع المعاملات للمركبات الحيوية والمعدنية تأثيرها الإيجابي علي جميع القياسات الخضرية وإنتاجية الأشجار وجودة الثمار ومحتوي الأوراق من العناصر الكبرى والصغرى، وان تباينت الإستجابة من معاملة إلي أخري. وعموماً فان المعاملة السابعة (بيوماجيك + سلفات الأمونيوم وسلفات البوتاسيوم بمعدل ١٪ + خامس اكسيد الفوسفور ١٠٠ جزء فى المليون) كانت هي الأكثر تأثيراً في هذا الصدد يليها المعاملة السادسة (نوفاترين + سلفات الأمونيوم وسلفات البوتاسيوم بمعدل ١٪ + خامس اكسيد الفوسفور بتركيز ١٠٠ جزء فى المليون). أما اقل المعاملات فعالية فكانت الكنترول. وعليه يمكن أن نوصي باستخدام بيوماجيك + سلفات الأمونيوم وسلفات البوتاسيوم بمعدل ١٪ + خامس أكسيد الفوسفور بتركيز ١٠٠ جزء فى المليون رشا على أشجار البرتقال بسره تحت الظروف المماثلة للتجربة.

الكلمات المفتاحية: المركبات الحيوية والمعدنية، الموالح، الرش الورقي.