Improving the Productivity and Nutritional Status of Washington Navel Orange Tress by Using Some Nano Compounds and Natural Extracts under Different Irrigation System

1- Vegetative growth and nutritional status

Atawia, A. R*.;Abd El-Latif, F. M.* ; El-Badawy, H. E.* ;Farag,A. A. and EL Atrouny, R. A.***
* Hort. Dep., Fac. of Agric., Benha Univ. ** Agric. Eng. Dep., Fac. of Agric., Benha Univ.
Corresponding Author: abousrie.ahmad@fagr.bu.edu.eg

Abstract

The present investigation was undertaken throughout the two successive seasons of 2016 and 2017 at fruit orchard, Faculty of Agriculture at Moshtohor, Benha University, Toukh region, Qalyubeia Governorate, Egypt.

The main goal from study evaluate the effect of some stimulating substances i.e., (yeast extract and nano fertilizer) at different concentrations and irrigation levels on some vegetative growth measurements and leaf nutritional status of Washington navel orange trees budded on sour orange rootstock. Results indicated that, all investigated stimulating substances treatments under study as foliar spray at various concentrations and irrigation with high level resulted in a positive and significant increase in most vegetative growth measurements and improving leaf nutrient contents of Washington navel orange trees in comparison with the control during both seasons of study. The best results were obtained from sprayed trees with yeast extract at 150 ml/liter+lithovit at4.0g/liter and irrigation with 3894.1 m^3 water / feddan / year compared to the water spray and irrigation with 3127.8 m^3 water /feddan/year during both seasons of study.

Keywords: Citrus, yeast extract, lithovit, irrigation, vegetative growth and nutritional status.

Introduction

Citrus is considered one of the most important fruit crops grown in many tropical and subtropical countries. In Egypt, citrus has a great attention and widely cultivated due to importance for local consumption (high nutritive value) and economic importance however, represent a main source for foreign currencies by exportation to many countries of world especially both European and Asian countries. Moreover, it ranks the first in Egyptian fruit production and the second after the grapes in the world as fruit production. The Egyptian Agriculture statistics in 2017 indicate that, citrus total planted area reached 477510 feddans and total citrus production of this area equal 4451644 tons of fruits, this represents 28.78 % and 37.08% of total fruits orchards area and fruits production, respectively. Total orange cultivated area represents 326484 feddans with total fruits production of 3147545 tons. **Ministry of Agriculture, Economic Affairs Sector, 2017**.

Yeast is one of the richest natural source of high quality protein, namely the essential amino acids as lysine, tryptophan etc., contains the essential elements and trace nutrients as Ca, Fe and Co etc. and the best sources of vitamins (B_1, B_2, B_6 and B_{12}), also the yeast extract is a valuable source of bio-constituents especially cytokinins**(Amer, 2004).** Furthermore, many researchers reported that spraying some fruit trees including citrus trees with different stimulating substances such as active dry yeast extract at the different concentrations can promote plant growth may be due to activate root cells at the same time stimulating biosynthesis of endogenous cytokinins from roots **,** enhancing leaf water status, shoot growth and root pull strength **(Demir*et al*., 2004),** stimulation the uptake of N, P, K, Mg, Ca, Fe, Zn and Cu by the plants **(Nelson** and **Van–Staden, 1984)** and stimulation the biosynthesis of chlorophylls, carotenoidsand ascorbic acid which protect photosynthesis apparatus of horticulture plants (**Crouch** and **Van–Staden, 1993**) as well as stimulation stem elongation and regulation cell membrane components under drought stress **(Smirnoff, 1995** and **Fletcher *et al*., 1988)**.

Nanotechnology is a promising field of interdisciplinary research. It opens up a wide array of opportunities in various fields like agriculture. The potential uses and benefits of nanotechnology are enormous. Nanoparticles generate both positive and negative biological effects in living cell **(Nel*et al*., 2006)** .There is increasing amount of research on the biological effects of nanoparticles on higher plants. Similarly, mixture of nanoscales hastened germination in soya bean **(Lu *et al*., 2002).**

Nano-fertilizers are used recently as an alternative to conventional fertilizers for slow release and efficient use by plants. Lithovit is recommended by European Community for organic farming according to EWG 2092/91 **(Bilal, 2010).** It is a natural CO_2 foliar fertilizer made from limestone deposits by tribodynamic activation and micronization to levels of 10-20 microns. Most of Lithovit particles remain as thin layer on the surface of leaves and penetrate frequently when they get wet by dew at night. Lithovit could be used for enhancing yield, quality and storage properties of crop especially when plants are subjected to stress, where it acts as a long term reservoir supplying plants with CO_2 (**Bilal,2010 and Kumar, 2011**).

Lithovit compound containing calcium carbonate (80%) Magnesium carbonate (4.6%) and Fe (0.75%) particles. The beneficial effect of this compound is being contains calcium carbonate ($CaCo_3$) decomposes to calcium oxide (Cao) and carbon dioxide (Co_2) in leaves stomata, and this Co_2 increases photosynthesis intensity, leading to increased carbon uptake and assimilation , thereby increasing plant growth **(Carmen *et al.*, 2014).** Magnesium which is the control elements in chlorophyll molecule and it also as enzyme activator and constituent of many enzymes. Also, Iron is very important for chlorophyll formation and photosynthesis and activities many enzyme system and respiration of plants **(Marschner, 1995 and Nadi*et al.*, 2013).**

The positive effect of lithovit compound on plant growth and biochemical constituents was reported by **(Abo-Sedera*et al.*, 2015)** found that, foliar application of lithovit at 3 g/l and seaweed extracts increased vegetative growth , total green pods yield and it compounds as well as pod quality of snap bean plants, Also, (**Abd El Ghafar*et al.*, 2016)** showed that, foliar application with lithovit 0.5 g/l significant increased number of umbel , height of number scape , diameter of umbel, chlorophyll and carotenoids, seed yield /plot and seed germination % of onion plants.

Water is fast becoming an economical score resource in many areas of the world especially in arid and semiarid regions. In Egypt, water is considered as a limited resource because of increasing population. Moreover, water is one of the most important components in biological systems (**Salisbury and Ross, 1985**). Maximizing the use of irrigation water is essential for increasing of irrigation water demands (**Brown, 1999**).

Wright and Stark (1990) revealed that, plant growth and development retarded when water supply as restricted. But, **Ismail *et al.*, (2007)** on pear and**Kandil and EI-Feky (2006)** on apricot used 40, 60, 70 or 80 % field capacity (F.C.) and obtained the best growth parameters and yield components with 80 % F.C. Moreover, **Cathoun (1975)** found that, the increase in tension from zero to 0.33 bar released more than 75 % of water in light textured soil but less than 50 % in heavy ones. **Levin *et al.*, (1980)**, stated that, root distribution depended upon the volume of wetted soil, which was related to soil hydraulic conductivity, the rate and duration of water application. Therefore, using water soil potential at 100-200 mbar (12.94m^3/tree/year) was recommended as the best level for "Canino" apricot trees in sandy soil (**Kandil and EI-Feky, 2006**).

This present investigation aimed to study the effect of different some stimulating substances i.e. active dry yeast extract and lithovit at different concentrations as foliar spray on some vegetative growth measurements and leaf nutritional status of bearing Washington navel orange trees under different irrigation levels.

Materials and Methods

The present dissertation was conducted on fruitful trees of sweet orange "*Citrus sinenses* L." Belonging to Washington navel orange cultivar during two successive experimental seasons (2016 and 2017).

In this experiment fifty eight-year old Washington navel orange trees budded on sour orange "*Citrus aurantium*" rootstock and grown in clayloamy soil at Experimental Station of Faculty of Agriculture,Benha University at Moshtohor ,Toukh region, Kaliobia Governorate were the plant material used in this regard to investigate the influence of two irrigation levels and different some stimulating substances i.e. active dry yeast extract and lithovit at different concentrations as foliar spray on some vegetative growth measurements and nutritional status of bearing Washington navel orange trees. Each nutrient compound was investigated solelyor combined to other and foliar spray on vegetative growth.

The experiment was arranged in a factorial designed experiment contained 2 irrigation levels (3894.1 m^3 water / feddan / year or 3127.8 m^3 water /feddan/year) X 8 stimulating substances = 16 treatments. Each treatment had three replicates and one tree for each, (randomize complete block design). The sixteen treatments represented the different possible combinations between the following two investigated factors. Trees irrigated with level 1 (3894.1 m^3 water / feddan / year) treated with:

1-Control (water spray of trees subjected to only the N, P, K fertilizers programs adopted in the farm).
2-Foliar spray with yeast extract at 150 ml/liter.
3-Foliar spray with yeast extract at 200 ml/liter.
4-Foliar spray with lithovit at 2.0g/liter.
5-Foliar spray with lithovit at 4.0g/liter.
6-Foliar spray with yeast extract at 150 ml/liter + lithovit at 2.0g/liter.
7-Foliarspraywithyeast extract at 150 ml/liter + lithovit at 4.0g/liter.
8-Foliarspraywithyeast extract at 200 ml/liter + lithovit at 4.0g/liter.

Trees irrigated with level 2 (3127.8 m^3 water /feddan/year) treated with same treatments.

- Yeast extract andlithovit treatments were applied three times in last week of March (full bloom), last week of April and last week of June.
- Level of irrigation water was determined with Cutthroat Flume after **Fareg (2007)**.

Experiment layout:

Onlate March 2016 and 2017 fourmain branches (limbs/scaffolds) well distributed around each tree

peripherywerecarefullyselectedandtaggedd uring 1st and 2nd seasons, respectively. Moreover, 20 newlyspringdevelopedshoots werealsolabeled.

1. Vegetative growth measurements:

Onmid October 2017and 2018 years the following vegetative growth parameters were determined.

In this regard, average number of newly developed shoot speronemeter of every tagged limb,average (length&thickness)and numberofleaves,pereach labeledshootwereestimated.

2.**Leaf mineralcomposition**:

Representativesamplesoffourthandfifthl eavesfromthebase of spring shoots were collectedfrom each replicate in October during both seasons. Thesampleswerethoroughlywashedwithtap water,rinsedtwicewithdistilledwaterandove ndriedat80°Ctillaconstantweightandfinelyg roundfor determinationof:

a.Total Nitrogen: Total leaf (N) was determined by the modified micro Keldahlmethodmentioned by **(Pregl, 1945)**.

b.Total phosphorus: Totalleaf(P) wasdeterminedbywet digestionofplant materialsafterthemethodsdescribedby usingsulphoricandperichloricacidwhichhasbeenstron glyrecommended by**(Piper,1958)**.

c. Total potassium: Total leaf (K)was determined photometrically inthedigestedmaterialaccordingtothemethod de

d.CalciumandMgpercentageaswellasIron, ManganeseandZincweredeterminedusingtheAtomicab sorption spectrophotometer"PerkinElmer-3300"after**Chapmanand Pratt(1975)**.

Statisticalanalysis:

Alldataobtainedduringbothseasonsweresubjected to analysis ofvarianceaccordingto**Snedecor and Cochran, 1977**. Inaddition, significant differences among means weredifferentiated according to the Duncan, multipletestrange**(Duncan,1955)**.

Results and Dissections

1. Vegetative growth:

The response of fruitful Washington navel orange trees to some bio and nano fertilizers (foliar spray) and two irrigation levels was studied through the determination of some vegetative growth parameters (No. of shoots, shoot length, shoot diameter, number of leaves/shoot, leaves fresh weight and leaves dry weight).

A. Specific effect:

Regarding the specific effect of the fertilizers substances(yeast extract and lithovit) on no. of shoots, shoot length, shoot diameter, number of leaves/shoot, leaves fresh weight and leaves dry weight of Washington navel orange trees data in **Tables (1-6)** revealed that, the highest significant values of all measurements were obtained when the trees where sprayed with yeast extract at 150 ml/liter + lithovit at 4.0g/liter.Meanwhile the latest values were obtained when the trees where sprayed with water (control).

Concerning the specific effect of irrigation levels, it was clear that, the highlevel (3894.1 m^3 water / feddan / year)was better than the low level (3127.8 m^3water/feddan/years) in enhancing all vegetative growth measurements during two experimental seasons.

B. Interaction effect:

With referring to the interaction between fertilizers substances and irrigation levels on no. of shoots, shoot length, shoot diameter, number of leaves/shoot, leaves fresh weight and leaves dry weight).

Data in **Tables (1-6)** indicated that, the maximum values were detected with the combination between foliarspraywithyeast extract at 150 ml/liter+lithovit at4.0g/liter and irrigation with 3894.1 m^3 water / feddan / yearduring two seasons.

On the other hand, the least values of no. of shoots, shoot length, shoot diameter, number of leaves/shoot, leaves fresh weight and leaves dry weight were observed when the Washington navel orange trees treated with water and irrigated with 3127.8 m^3 water /feddan/year during two experimental seasons.

Our results regarding the impact of yeast extract are in general agreed with the findings of **El-Shazly and Moustafa (2013)** and **Ayed (2016)** onWashington navel orange, they reported that yeast extract increased growth measurements.

The obtained results concerning the impact of lithovit are confirmed by the findings of **Abd El-Aal and Rania – Eid (2018)** on soybean plants reported that, foliar application with lithovit caused significant increases in all vegetative growth characteristics as compared with the control treatment. Lithovit compound consists of calcium carbonate (80%) Magnesium carbonate (4.6%) and Fe (0.75%) particles. The beneficial effect of this compound leading to increasing carbon uptake and assimilation, thereby increasing plant growth **(Carmen *et al.*, 2014).**

These results concerning to irrigation levels are in general agreed with the findings of **Sanchez *et al.*, (1989)** on Verna lemons; **Zekri (1991)** on citrus rootstocks and **Saeed *et al.*, (2005)** on jojoba seedlings obvious that, stem length, no. of branches, number of leaves per plant and root length were significantly increased as available water increased.

2. Leaf mineral content:

A- Specific effect.

Regarding leaf mineral contentof Washington navel orange trees as affected by each individual investigated factor (fertilization substances and

irrigation levels) data in **Tables (7-14)** display that, the highest value of leaf mineral content was achieved where the trees were sprayed with yeast extract at 150 ml/liter+lithovit at4.0g/liter or yeast extract at 150 ml/liter+lithovit at2.0g/liter.

With respect to the specific effect of irrigation levels, data indicated that, Washington navel orange trees irrigated with 3894.1 m^3 water / feddan / year increased leaf mineral content during both seasons of study.

B-Interaction effect:

With respect to the interaction effect between fertilization substancesand irrigation levels on leaf mineral content, data in**Tables (7-14)** display that, the highest value of leaf mineral content was detected with those sprayed trees with yeast extract at 150 ml/liter + lithovit at 4.0g/liter combined with irrigation with 3894.1 m^3 water / feddan / year.

On the other hand, the least value of leaf mineral content were recorded with untreated trees (water spray) and irrigated with 3127.8 m^3 water /feddan/year during two seasons.

These results are in general agreed with the findings of **Badawy-Sabah (2005)** on Baladymandarin;**Bakry (2007)** on Jafa orange trees; **Ahmed *et al.*, (2013)** on Washington Navel orange, they reported that sprays trees with yeast extract increased leaf mineral contents i.e. nitrogen, phosphorus, potassium, calcium, magnesium, manganese, iron and zinc.

The present results, concerning the effect of lithovit are in harmony with those reported by**Abd El-Aal and Rania – Eid (2018)** on soya beanand**Ghatas and Mohamed (2018)** on *Cymbopogoncitratus* indicated that the application of lithovit gave the highest values leaf chemical compositions (N, P, K, Ca, Mg % and Fe ppm).

The present results regarding the response of nutritional statusare supported by the early findings of **Youssef (1990)**oncitrus rootstocksand **Maurer *et al.*, (1995)** on grapefruit trees, theyfound that, nitrogen, potassiumand phosphorus were increased as available soil water of irrigation increased.

Table 1. Response of No. of shoots / one meter limb of fruitfulWashington navel orange trees to some bio and nano fertilizers (foliar spray) and two irrigation levels during 2016&2017 experimental seasons**.**

Treatments	No. of shoots / one meter limb					
	Irrigation1	Irrigation2	Mean	Irrigation1	Irrigation 2	Mean
	First season			Second season		
1	14.33 de	11.67 e	**13.00 C**	19.50 bc	19.30 bc	**19.40 BC**
2	19.00 abc	19.33 ab	**19.17 AB**	20.25 ab	20.50 ab	**20.36 AB**
3	19.33 ab	20.33 ab	**19.83 AB**	19.81 bc	21.50 a	**20.65 AB**
4	16.67 bcd	17.33 bcd	**17.00 B**	18.50 b	19.50 bc	**19.00 BC**
5	17.33 bcd	18.67 abc	**18.00 AB**	18.50 b	18.50 b	**18.50 B**
6	20.33 ab	20.67 ab	**20.50 A**	21.00 a	22.34 a	**21.67 A**
7	22.33 a	19.33 ab	**20.83 A**	23.50 a	22.50 a	**22.83 A**
8	21.67 a	15.06 cde	**18.36 AB**	21.00 a	21.34 a	**22.17 A**
Mean	**18.88 A**	**17.80 A**		**20.11 A**	**20.84 A**	

Table2. Response of shoot length (cm) of fruitful Washington navel orange trees to some bio and nano fertilizers (foliar spray) and two irrigation levels during 2016&2017 experimental seasons**.**

Treatments	Shoot length (cm)					
	Irrigation 1	Irrigation 2	Mean	Irrigation 1	Irrigation 2	Mean
	First season			Second season		
1	38.60 e	30.53 f	**34.57 E**	33.54 c	33.00 c	**33.27 C**
2	43.37 abc	41.57 b-e	**42.47 BCD**	44.08 a	40.00 b	**42.04 B**
3	44.10 abc	42.53 a-d	**43.32 ABC**	45.02 a	43.12 a	**44.07 A**
4	41.43 cde	39.00 de	**40.22 D**	41.76 b	41.10 b	**41.43 B**
5	42.37 bcd	39.30 de	**40.83 CD**	42.20 b	40.30 b	**41.25 B**
6	45.10 ab	43.50 abc	**44.30 AB**	45.86 a	43.00 a	**44.43 A**
7	46.00 a	44.37 abc	**45.18 A**	45.70 a	43.00 a	**44.35 A**
8	45.13 ab	43.80 abc	**44.47 AB**	46.00 a	44.20 a	**45.10 A**
Mean	**43.26 A**	**40.58 B**		**43.27 A**	**40.47 B**	

Table 3. Response of shoot diameter (cm) of fruitful Washington navel orange trees to some bio and nano fertilizers (foliar spray) and two irrigation levels during 2016&2017 experimental seasons.

Treatments	Shoot diameter (cm)					
	Irrigation 1	Irrigation2	Mean	Irrigation1	Irrigation2	Mean
	First season			Second season		
1	0.240 ij	0.233 j	**0.237 F**	0.255 c	0.245 c	**0.250 D**
2	0.270 hij	0.290 ghi	**0.280 E**	0.320 b	0.310 b	**0.310 CD**
3	0.337 d-g	0.317 fgh	**0.327 D**	0.340 b	0.336 b	**0.338 BC**
4	0.367 b-f	0.333 efg	**0.350 CD**	0.360 b	0.346 b	**0.352 BC**
5	0.373 b-e	0.353 c-f	**0.363 BCD**	0.390 b	0.390 b	**0.390 AB**
6	0.373 b-e	0.357 c-f	**0.365 BC**	0.410 a	0.396 a	**0.403 A**
7	0.450 a	0.417 ab	**0.433 A**	0.450 a	0.450 a	**0.450 A**
8	0.407 abc	0.390 bcd	**0.398 AB**	0.370 ab	0.350 ab	**0.360 B**
Mean	**0.352 A**	**0.336 A**		**0.362 A**	**0.353 A**	

Table 4. Response of No. of leaves / shoot of fruitful Washington navel orange trees to some bio and nano fertilizers (foliar spray) and two irrigation levels during 2016&2017 experimental seasons.

Treatments	No. of leaves / shoot					
	Irrigation 1	Irrigation2	Mean	Irrigation1	Irrigation 2	Mean
	First season			Second season		
1	38.00 gh	37.33 h	**37.67 F**	37.00 c	39.34 c	**38.17 C**
2	40.00 e-h	38.00 gh	**39.00 EF**	40.67 b	39.67 c	**39.67 C**
3	41.67 def	38.33 gh	**40.00 E**	42.00 b	44.00 a	**43.00 B**
4	42.00 de	39.00 fgh	**40.50 DE**	40.45 b	40.21 b	**40.33 C**
5	44.33 bcd	40.67 efg	**42.50 CD**	45.30 a	41.36 b	**43.33 B**
6	45.67 ab	42.33 cde	**44.00 BC**	46.66 a	42.00 b	**44.33 B**
7	47.33 a	45.00 abc	**46.17 A**	46.80 a	46.86 a	**46.83 A**
8	46.67 ab	44.00 bcd	**45.33 AB**	46.00 a	44.00 a	**45.00 A**
Mean	**43.21 A**	**40.58 B**		**45.62 A**	**42.18 B**	

Table 5. Response of leaves fresh weight (g) of fruitful Washington navel orange trees to some bio and nano fertilizers (foliar spray) and two irrigation levels during 2016&2017 experimental seasons.

Treatments	leaves fresh weight (g)					
	Irrigation 1	Irrigation2	Mean	Irrigation 1	Irrigation2	Mean
	First season			Second season		
1	43.33 j	43.07 j	**43.20 F**	43.54 f	43.58 f	**43.56 F**
2	67.76 de	54.20 gh	**60.98 D**	64.80 d	62.70 d	**63.75 D**
3	72.70 bcd	61.61 f	**67.15 C**	70.98 c	70.85 c	**71.30 C**
4	59.05 fg	47.05 ij	**53.05 E**	55.09 e	55.10 e	**55.08 E**
5	63.07 ef	50.45hi	**56.76 E**	59.12 e	59.24 e	**59.18 E**
6	75.12 abc	69.59 cd	**72.35 B**	78.95 a	72.85 b	**75.90 B**
7	80.84 a	76.28 ab	**78.56 A**	85.95 a	75.91 b	**80.93 A**
8	78.54 ab	73.81 bc	**76.17 AB**	80.44 a	78.69 a	**79.43 AB**
Mean	**67.55 A**	**59.51 B**		**67.36 A**	**64.87 B**	

Table 6. Response of leaves dry weight (g) of fruitful Washington navel orange trees to some bio and nano fertilizers (foliar spray) and two irrigation levels during 2016&2017 experimental seasons**.**

Treatments	Leaves dry weight (g)					
	Irrigation 1	Irrigation2	Mean	Irrigation1	Irrigation2	Mean
	First season			Second season		
1	24.83 ef	21.80 f	**23.32 D**	25.42 e	25.42 e	**25.42 E**
2	32.73 bcd	23.80 ef	**28.27 D**	29.78 d	29.15 d	**29.27 DE**
3	39.63 ab	28.83 de	**34.23 BC**	34.13 c	30.60 d	**32.68 CD**
4	35.30 a-d	31.87 cd	**33.58 C**	34.93 b	32.30 c	**33.93 C**
5	36.20 abc	37.90 abc	**37.05 ABC**	35.30 b	35.85 b	**35.65 BC**
6	37.50 abc	37.00 abc	**37.25 ABC**	40.00 a	36.30 b	**38.47 AB**
7	40.07 a	38.97 ab	**39.52 A**	41.30 a	39.65 a	**40.85 A**
8	39.53 ab	38.23 abc	**38.88 AB**	40.40 a	39.55 a	**39.25 AB**
Mean	**35.72 A**	**32.30 B**		**31.41 A**	**29.82 B**	

Table 7. Response of nitrogen percentage (N%) of fruitful Washington navel orange trees to some bio and nano fertilizers (foliar spray) and two irrigation levels during 2016&2017 experimental seasons.

Treatments	N %					
	Irrigation 1	Irrigation2	Mean	Irrigation1	Irrigation2	Mean
	First season			Second season		
1	1.873 c	1.650 c	**1.762 D**	1.860 d	1.866 d	**1.863 D**
2	2.823 ab	2.753 b	**2.788 BC**	2.650 c	2.670 c	**2.660 C**
3	2.880 ab	2.783 ab	**2.832 BC**	2.880 b	2.904 b	**2.892 B**
4	2.760 b	2.633 b	**2.697 C**	2.740 c	3.734 c	**2.737 BC**
5	2.790 ab	2.717 b	**2.753 C**	2.610 c	2.614 c	**2.612 C**
6	3.103 ab	2.927 ab	**3.015ABC**	3.470 b	3.494 a	**3.482 A**
7	3.500 a	3.330 ab	**3.415 A**	3.480 a	3.460 a	**3.470 A**
8	3.310 ab	3.237 ab	**3.273 AB**	3.390 a	3.330 a	**3.360 A**
Mean	**2.880 A**	**2.754 A**		**2.885 A**	**2.762 A**	

Table 8. Response of phosphorus percentage (P%) of fruitful Washington navel orange trees to some bio and nano fertilizers (foliar spray) and two irrigation levels during 2016&2017 experimental seasons**.**

Treatments	P %					
	Irrigation 1	Irrigation2	Mean	Irrigation 1	Irrigation 2	Mean
	First season			Second season		
1	0.289 de	0.144 e	**0.217 D**	0.272 c	0.248 c	**0.260 C**
2	0.508 bc	0.389 cd	**0.449 ABC**	0.450 b	0.448 b	**0.449 AB**
3	0.650 ab	0.388 cd	**0.519 AB**	0.530 a	0.516 a	**0.523 A**
4	0.486 bc	0.291 de	**0.388 C**	0.370 e	0.362 c	**0.366 C**
5	0.499 bc	0.334 cd	**0.417 BC**	0.450 b	0.418 b	**0.434 B**
6	0.650 ab	0.401 cd	**0.525 AB**	0.550 a	0.520 a	**0.535 A**
7	0.687 a	0.419 cd	**0.553 A**	0.590 a	0.588 a	**0.589 A**
8	0.657 ab	0.429 cd	**0.543 A**	0.580 a	0.570 a	**0.575 A**
Mean	**0.553 A**	**0.349 B**		**0.474 A**	**0.459 B**	

Table 9. Response of potassium percentage (K%) of fruitful Washington navel orange trees to some bio and nano fertilizers (foliar spray) and two irrigation levels during 2016&2017 experimental seasons**.**

Treatments	K %					
	Irrigation 1	Irrigation2	Mean	Irrigation 1	Irrigation2	Mean
	First season			Second season		
1	1.081 a	1.518 a	**1.300 A**	1.072 a	1.076 a	**1.074 A**
2	1.610 a	1.528 a	**1.569 A**	1.595 a	1.583 a	**1.589 A**
3	1.689 a	1.687 a	**1.688 A**	1.720 a	1.717 a	**1.714 A**
4	1.377 a	1.364 a	**1.370 A**	1. 501 a	1.509 a	**1.505 A**
5	1.471 a	1.414 a	**1.442 A**	1.571 a	1.559 a	**1.565 A**
6	1.730 a	1.717 a	**1.724 A**	1.732 a	1.742 a	**1.736 A**
7	1.807 a	1.746 a	**1.776 A**	1.989 a	1.983 a	**1.986 A**
8	1.760 a	1.720 a	**1.740 A**	1.772 a	1.756 a	**1.764 A**
Mean	**1.566 A**	**1.587 A**		**1.619 A**	**1.617 A**	

Table 10. Response of calcium percentage (Ca%) of fruitful Washington navel orange trees to some bio and nano fertilizers (foliar spray) and two irrigation levels during 2016&2017 experimental seasons.

Treatments	Ca %					
	Irrigation 1	Irrigation 2	Mean	Irrigation 1	Irrigation 2	Mean
	First season			Second season		
1	3.944 e-h	3.272 h	**3.608 D**	3.690 c	3.706 c	**3.698 C**
2	4.453 b-f	3.596 gh	**4.024 CD**	4.170 b	4.168 b	**4.169 BC**
3	4.617 a-e	3.764 fgh	**4.190 BC**	4.351 b	4.319 b	**4.330 BC**
4	4.921 a-d	4.033 efg	**4.477 BC**	4.630 ab	4.600 ab	**4.615 AB**
5	5.029 abc	4.171 efg	**4.600 AB**	4.451 ab	4.457 ab	**4.654 AB**
6	5.073 ab	4.296 d-g	**4.684 AB**	4.720 ab	4.717 ab	**4.717 AB**
7	5.262 a	4.618 a-e	**4.940 A**	5.316 a	5.300 a	**5.308 A**
8	5.173 a	4.333 c-f	**4.753 A**	4.872 ab	4.882 ab	**4.877 AB**
Mean	**4.809 A**	**4.010 B**		**4.525 A**	**4. 159 B**	

Table11. Response of magnesium percentage (Mg%) of fruitful Washington navel orange trees to some bio and nano fertilizers (foliar spray) and two irrigation levels during 2016&2017 experimental seasons**.**

Treatments	Mg %					
	Irrigation 1	Irrigation2	Mean	Irrigation1	Irrigation 2	Mean
	First season			Second season		
1	0.237 hi	0.233 i	**0.235 E**	0.250 c	0.230 c	**0.240 E**
2	0.469 def	0.342 gh	**0.405 D**	0.430 b	0.406 b	**0.418 B**
3	0.482 cde	0.366 fg	**0.424 D**	0.450 a	0.420 a	**0.435 B**
4	0.482 cde	0.405 efg	**0.444 CD**	0.450 b	0.436 b	**0.443 B**
5	0.508 b-e	0.423 d-g	**0.465BCD**	0.520 b	0.495 b	**0.505 B**
6	0.603 ab	0.459 def	**0.531 AB**	0.540 b	0.532 b	**0.536 B**
7	0.580 abc	0.455 def	**0.517ABC**	0.650 a	0.626 a	**0.638 A**
8	0.621 a	0.522 a-d	**0.572 A**	0.620 a	0.606 a	**0.613 A**
Mean	**0.498 A**	**0.401 B**		**0.489 A**	**0.469 B**	

Table 12. Response of iron at ppm (Fe) of fruitful Washington navel orange trees to some bio and nano fertilizers (foliar spray) and two irrigation levels during 2016&2017 experimental seasons.

Treatments	Fe (ppm)					
	Irrigation1	Irrigation2	Mean	Irrigation 1	Irrigation2	Mean
	First season			Second season		
1	82.00 f	79.67 f	**80.83 E**	90.40 e	72.60 e	**81.50 D**
2	111.3 cd	98.00 e	**104.7 D**	115.80 c	101.90 d	**108.7 C**
3	117.7 abc	105.7 de	**111.7 C**	115.40 c	117.00 bc	**116.2 BC**
4	119.3 abc	115.0 bcd	**117.2 BC**	114.90 c	122.50 b	**118.7 AB**
5	121.0 ab	119.7 abc	**120.3 AB**	124.00 ab	120.00 b	**122.0 AB**
6	124.0 ab	125.3 a	**124.7 A**	125.50 ab	117.50 b	**123.0 AB**
7	125.3 a	124.3 ab	**124.8 A**	130.00 a	122.00 b	**126.0 A**
8	124.7 a	122.7 ab	**123.7 AB**	128.30 a	120.30 b	**124.3 AB**
Mean	**115.7 A**	**111.3 B**		**118.04 A**	**111.73 B**	

Table 13. Response of manganese at ppm (Mn) of fruitful Washington navel orange trees to some bio and nano fertilizers (foliar spray) and two irrigation levels during 2016&2017 experimental seasons.

Treatments	Mn (ppm)					
	Irrigation1	Irrigation 2	Mean	Irrigation 1	Irrigation2	Mean
	First season			Second season		
1	38.67 i	37.00 i	**37.83 F**	39.21 f	39.45 f	**39.33 F**
2	76.00 de	59.93 gh	**67.97 D**	71.81 bc	69.75 bc	**70.78 CD**
3	85.03 bc	64.77 fg	**74.90 C**	79.88 ab	73.66 ac	**76.72 BC**
4	69.63 ef	54.63 h	**62.13 E**	65.90 cd	59.94 e	**62.92 E**
5	73.47 de	56.10 h	**64.78 DE**	70.60 bc	60.60 d	**65.60 DE**
6	88.70 ab	68.27 ef	**78.48 BC**	81.34 a	79.40 ab	**80.37 AB**
7	94.40 a	79.50 cd	**86.95 A**	90.00 a	86.26 a	**87.13 A**
8	93.30 a	73.43 de	**83.37 AB**	89.80 a	81.70 a	**85.75 A**
Mean	**77.40 A**	**61.70 B**		**73.57 A**	**68.85 B**	

Table 14. Response of zinc at ppm (Zn) of fruitful Washington navel orange trees to some bio and nano fertilizers (foliar spray) and two irrigation levels during 2016&2017 experimental seasons.

Treatments	Zn (ppm)					
	Irrigation1	Irrigation 2	Mean	Irrigation1	Irrigation2	Mean
	First season			**Second season**		
1	65.30 ef	64.80 f	**65.05 E**	70.30 c	60.44 d	**65.37 D**
2	90.90 a	73.10 de	**82.00 C**	82.54 b	80.74 b	**81.64 BC**
3	90.00 ab	75.43 cd	**82.72 C**	85.51 ab	81.31 b	**83.41 AB**
4	82.07 bc	67.14 ef	**74.61 D**	80.58 b	72.42 c	**76.50 C**
5	88.33 ab	72.09 def	**80.21 CD**	80.40 b	78.54 bc	**79.47 C**
6	92.00 a	77.40 cd	**84.70 BC**	90.00 a	78.08 ab	**84.04 AB**
7	93.10 a	88.02 ab	**90.56 A**	96.02 a	90.02 a	**93.02 A**
8	92.10 a	85.97 ab	**89.03 AB**	92.65 a	88.61 a	**90.63 A**
Mean	**86.73 A**	**75.49 B**		**84.75 A**	**78.77 B**	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different at 5% level.

1-Control(watersprayoftreessubjectedtoonlythe N, P, K fertilizersprogramsadoptedinthefarm).
2-Foliarspraywithyeast extract at 150 ml/liter.
3-Foliar spraywithyeast extract at 200 ml/liter.
4-Foliarspraywithlithovit at2.0g/liter.
5-Foliarspraywithlithovit at4.0g/liter.
6-Foliarspraywithyeast extract at 150 ml/liter+lithovit at2.0g/liter.
7-Foliarspraywithyeast extract at 150 ml/liter+lithovit at4.0g/liter.
8-Foliarspraywithyeast extract at 200 ml/liter+lithovit at4.0g/liter.
Irrigation 1=(3894.2 m3 /year) Irrigation 2=(3127.8 m3 /year)

References

Abd El-Aal, M. M. and Rania- Eid, S. M. (2018): Effect of foliar spray with lithovit and amino acids on growth, bio constituents, anatomical and yield features of soybean plant. 4th International Conference on Biotechnology Applications in Agriculture (ICBAA), Benha University, Moshtohor and Hurghada , 4-7 April 2018 , Egypt . Plant Biotechnology, 187-201.

Abd El ghafar, M. S.; M. T. Al-Abd; A. A. Helaly and A. M. Rashwan (2016): Foliar application of lithovit and rose Water as factor for increasing onion seed production, Nat. Sci. 14(3): 53 – 61.

Abo Sedera, F. A.; N. S. Shafshak; A. S. Shams; M. A. Abuo-Soud and M. H. Mohammed (2015): The utilize of vermicomposting outputs in substrate culture for producing snap bean. Annals Agric. Sci., Moshtohor, 53(2):139–151.

Ahmed, F.F.; A.E.M. Mansour; M.A.A. Montasser; M.A. Merwad and E.A.M. Mostafa (2013): Response of Valencia orange trees to foliar application of roselle, turmeric and sea-weed extracts. J. Appl. Sci. Res., 9(1): 960-964.

Amer, S.S.A., (2004). Growth, green pods yield and seeds yield of common bean (*Phaseolus vulgaris* L) as affected by active dry yeast, salicylic acid and their interaction. J. Agric. Sci. Mansoura. Univ., 29(3): 1407- 1422.

Ayed, M.E., (2016). Physiological Studies on Washington navel orange trees grown in new reclaimed soils. M.Sc. Thesis, Faculty of Agric, Moshtohor, Benha University.

Badawy-Sabah, M. (2005). Histophysiological effects of yeast and kinetin application on fruit characteristics and fruit growth stages of Balady mandarin cultivar. Ph. D. Thesis Hort. Pomology Fac. of Agric, Assuit University Egypt.

Bakry, KH. A. (2007): Response of Jaffa orange cultivar to spray with yeast extract and promalin. Egyptian J. of app. Sci., 22(10A) : PP. 195-210.

Bilal, B.A. (2010): Lithovit: An innovative fertilizer. The 3rd e Conference on Agricultural Biosciences (IeCAB 2010), 1st- 15th June 2010. http://www.slideserve.com/madison/lithovitan-

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.

Brown, L. R. (1999). Feeding nine billions. In L. Storke (ed. State of the world).

Carmen, B.; R. Sumalan; S. Gadea and S. Vatca (2014): Physiological indicators study involved in productivity increasing in tomato. Pro-environment, 7: 218 – 224.

Cathoun, F. G. (1975). Influence of particle size and organic matter on water tension in selected Florida soils. Proc. Soil and Crop Sci. of Florida, 32: 111-113.

Chapman, H. D. and P. F. Pratt (1975): Methods of Analysis for Soils, Plant and Waters. Univ. of California. Division of Agric. Sci.7th Ed. P. 172-173.

Crouch, I.J. andJ.VanStaden (1993): Commercial Sea weeds products as bio stimulants in horticulture. Home and Consumer Horti.1:19–76.

Demir, D.; Günes, A.; Inal, A. and **Alpaslan, M. (2004**). Effects of humic acids on the yield and mineral nutrition of cucumber (*cucumissativus* L.) grown with different salinity levels. Acta Horticulture, 492.

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

El-Shazly, S. M. and**Moustafa, N. S. (2013).** Enhancement yield, fruit quality and nutritional status of Washington navel orange trees by application ofbiostimulant. Journal of Applied Sciences Research;. 9(8):5030-5034.

Fareg, A. A. (2007): Evaluation of water flow measurement methods appropriate for on-farm management in Egypt. M. Sc. Thesis, Agric. Mechanization Dep. Fac, of Agric. Benha Univ.

Fletcher, R. A.; A. Gilley; N. Sankhla and T. D. Davis (1988): Triazoles as plant growth regulators and stress protectants. Horticultural Reviews 24: 55–138.

Ghatas Y.A. and Mohamed Y.F. (2018): Influence of Mineral, Micro-nutrients and Lithovit on Growth, Oil Productivity and Volatile Oil Constituents of *Cymbopogoncitruts*L. Plants. *Middle East J. Agric. Res., 7(1): 162-174, 2018*

Ismail, A. F.; Hussien, S. M.; El- Shall, S. A. and Fathi, M. A. (2007). Effect of irrigation and humic acid on Le-Conte pear trees. J. Agric. Sci., Mansoura Univ., 32(9): 7589-7603.

Kandil, E.A. and S. El-Feky (2006). Effect of soil matric potential on "Canino" apricot trees in sandy soil under drip irrigation. J. Agric. Sci. Mansoura Univ., 31 (9): 5867-5880.

Kumar, P. (2011): Nanotechnology in agriculture. Financing Agriculture, 34: 8-10.

Levin, I.; R. Assaf and B. A. Bravdo (1980). Irrigation water status and nutrient uptake in an apple orchard. Butterworths, Borough Green UK p.230.

Lu, C. M.; C. Y. Zhang; J. Q. Wen; G. R. Wu and M. X. Tao (2002): Research of the effect of nanometer materials on germination and growth enhancement of Glycine max and its mechanism. Soya Bean Science 21: 168–172.

Marschner, H. (1995): Mineral nutrition of higher plants. 2nd ed. Acadimic press. Pub. New York (USA).

Maurer, M. A.; F. S. Davies and D. A. Craetz (1995). Reclaimed waste water irrigation and fertilization of mature "Redblush" grape fruit trees on Spodosols in Florida. J. Amer. Soc. Hort. Sci. 120 (3): 394-402, USA. (Hort. Abst. 65 No. 8: 7425).

Ministry of Agriculture & Land Reclamation; Economic Affairs Sector, Egypt 2017.

Nadi, E.; A. Aynehband and M. Mojaddam (2013): Effect of nano-iron chelate fertilizer on grain yield, protein percent and chlorophyll content of Faba bean (*Viciafaba*L.). Inter. J. of Biosci ., 3 (9): 267-272.

Nel, A.; T. Xia; L. Madler and N. Li (2006): Toxic potential of materials at the Nano level. Science 311: 622–627.

Nelson W.R. and **Van Staden, J. (1984).** The effect of seaweed concentrate on wheat culms. J. Plant Physiol. 115:433–437.

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

Pregl, F. (1945): Quantitive organic micro-analysis. 4th Ed, and A. Churchill. LTD. London.

Saeed, W. T.; A. M. Abou el khashab and S. A. Aboutaleb (2005): Physiological studies on jojoba plants. B- Effect of some ecology stress on jojoba seedlings. Bulletin of Fac, of Agric, Cairo Univ., 56: 121-142.

Salisbury, F. B. and C.W. Ross (1985). Plant physiology. Wadsworth Pub. Co., Calif. USA p.185.

Sanchez, M. J.; A. Torrecillos and F. Del-Amor (1989). Effect of irrigation regimes on the stage of reproduction in *Citrus limon* L. cv. Verna. Advances in Horticultural Sciences, 3: 13-16.

Smirnoff, N. (1995). Antioxidant systems and plant response to the environment. In N. Smirnoff (Ed.), Environment and plant metabolism: Flexibility and acclimation (pp. 217–243). Oxford, UK: BIOS Scientific Publishers Ltd.

Snedecor, G. W. and W. G. Cochran (1980). Statistical Methods. Oxford and J.B.H. publishing com. 7th edition, pp 593.

Wright, J. L. and J. C. Stark (1990). Irrigation of agricultural crops. Amer. Soc. Agron., 30: 112-117.

Youssef, A. M. (1990). Physiological and morphological studies on some new citrus rootstocks. Ph.D. Thesis, Hort. Dept., Fac. Agric., Al-Azhar Univ., Cairo.

Zekri, M. (1991): Effects of PEG- induced water stress on two citrus cultivars. Journal of Plant Nutrition, 14 (1): 59-74.

تحسين انتاجية أشجار البرتقال أبو سرة والحالة الغذائية باستخدام بعض مركبات النانو والمستخلصات الطبيعية تحت انظمة رى مختلفة

1- النمو الخضرى والحالة الغذائية

احمد احمد رزق عطوية* فؤاد محمد عبداللطيف* حامد الزعبلاوى البدوى* ابوسريع احمد فرج رقية عبدالعاطى الاطرونى***

*قسم البساتين ** قسم هندسة النظم الزراعية – كلية الزراعة مشتهر – جامعة بنها

أجريت هذه الدراسة خلال موسمين متتاليين **هما 2017/2016** على أشجار البرتقال أبو سرة والبالغة من العمر (58 سنة) والمطعومة على أصل النارنج والنامية فى تربة طينية وذلك بمزرعة كلية الزراعة بمشتهر التابعة لمركز طوخ – محافظة القليوبية. وتهدف هذه الدراسة إلى تقييم رش اشجار البرتقال أبو سرة ببعض المواد المنشطة للنمو (مركبات النانو والمستخلصات الطبيعية) مثل الليثوفيت ومستخلص الخميرة بتركيزات مختلفة ، وكذلك رى الأشجار بمستويين من الماء وتاثير ذلك على تحسين بعض قياسات النمو الحضري والحالة الغذائية حيث تم رى الاشجار بمستويين من الماء (3894,2 متر مكعب ماء للفدان سنويا و 3127,8 متر مكعب ماء للفدان سنويا).

وقد اوضحت الدراسة ان افضل قياسات النمو الخضرى والحالة الغذائية قد تم الحصول عليها عند رش الاشجار بمستخلص الخميرة بتركيز 150مل /لتر + رش الاشجار بالليثوفيت بتركيز 4.0 جرام /لتر + الري بالمستوى العالى (3894,2 متر مكعب ماء للفدان سنويا) وعلى العكس من ذلك تم الحصول على اقل القيم فى قياسات النمو الخضرى والحالة الغذائية عند رى اشجار اشجار البرتقال أبو سرة بالمستوى الاقل (3127,8 متر مكعب ماء للفدان سنويا) + الرش بالماء خلال موسمى الدراسة.