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A Comparative Study on Fertilization of Washington Navel Orange Trees

Atawia, A. A. R.[1]; F. M. Abd El-Latif [1]; H. M. A. Gendia[1] ; M. A. Abdel-Rahman[2] and M. A. Khodier[2]

[1] Hort. Dept., Fac. of Agric., Moshtohor, Benha University.

[2] Hort. Res. Institute, Agricultural Research Center, Giza.

ABSTRACT

The effects of different soil application levels of Natural Elements Compound(NEC) either alone or in combination with EM soil application rates on Washington navel orange trees budded on sour orange rootstock grown under "KarKashnda" region, Qalyubeia Governorate condition to study their effects on some fruiting parameters and physical and chemical of fruit characteristics during the two successive seasons of 2013 and 2014. The obtained results revealed that all investigated treatments under study resulted in significantly increased in the most fruiting parameters and fruit characteristics as compared to the control treatment during the first and second seasons of experimental study. Moreover, data indicated that all studied treatments exhibited significantly increased fruit set % , yields either tree yield in kgs or yield expressed as tons per feddan. Furthermore, results displayed clearly that both studied fruit physical properties (fruit weight, volume, height and diameter) and fruit chemical characters such as TSS %, total acidity %, total sugers % and fruit juice vitamin C. contents were improved by subjected trees to different investigated treatments as compared with the control in the two experimental seasons of study. Generally, it could be concluded that , all investigated treatments under the study (NEC and EM) either alone or in combination with them resulted in a significant and positive effects for increasing all fruiting parameters and improving most studied fruit quality. However, the treatment of (NEC_4 x EM_2) i.e. (6.0 kgs of NEC x 900 ml^3/l of EM /tree /year) exhibited statistically the best and the most effect for increasing and improving all investigated fruiting parameters and fruit characteristics of Washington navel orange trees.

INTRODUCTION

Citrus is considered one of the major and the most important common popular fruits in the world and it ranked second after grapevines. Citrus fruits have been cultivated for over four thousands years. They are grown in many tropical and subtropical countries i.e., in nearly every country within 40 north- south latitude (Davis and Albrigo,1994). In Egypt, citrus has a great attention due to its importance for local consumption or as a main source for foreign currencies by exportation to the European countries. The total acreage of citrus was about (533835) feddans with a total production about (4646579) tons produced from fruitful area reached about (449601) feddans according to the Egyptian Ministry of Agriculture (2015).

It is well known that, there are many problems facing fruit trees growers which affect the productivity and fruit quality of citrus trees. High costs of mineral fertilizers needed to fruit trees is one of these problems, in addition to that, in recent years the heavy used of mineral fertilizers have resulted in an increase role and serious in the health problems of mankind . Moreover, they are considered as air, soil and water polluting agent results from leached chemical fertilization into the soil led to disturbance in the natural biological balance in the soil and accumulate in plant tissue that is a major components of animal fodder human diet causing hazardous effects for human health.

Therefore, recently scientists are attempting to develop new agents which can be used for promoting growth and yield of plants and at the same time without causing problems in environment. Thus, the alternative use of natural elements compounds (NEC) with effective micro-organisms (EM) fertilizers were done and few studies as well as many attempts in order to replace partially mineral fertilizers by some reseachers , Cai and Qian (1995), Abou Sayed (1997), Joo etal (1999), Bakr etal (2003), Wang *et al*. (2006), Helial *et al*. (2003), Wu *et al*. (2000), Paschole *et al*. (1996), El-Kholy (2004), Abdel-Rahman *et al*. (2009), and Noha and Manal (2014) they reported that both NEC and EM significantly increased fruit set, fruit productivity and improved both fruit physical and chemical characteristics of Washington navel orange trees.

The present investigation was planned and conducted to evaluate the effect of soil application of both NEC and EM at different levels either alone or in combination on some fruiting parameters and both fruit physical and chemical characteristics of Washington navel orange trees.

MATERIALS AND METHODS

The present study was conducted during the two successive seasons of 2013 and 2014 at a private orchard in "Karkshndah" region at Qalyubiyah, Governorate. Egypt on 25-year-old trees of Washington navel orange (Citrus sinensis L. Osbeck) budded on the sour orange rootstock (Citrus aurantium L.), planted at 5 meters apart and grown in a clay loamy soil under flood irrigation system.

Seventy two bearing trees were carefully and randomly selected, healthy. nearly uniform as possible as we could in growth vigor, free from diseases and divided into eight groups each included nine trees to receive one of the 8th investigated both NEC and EM treatments either alone or in combination. Every group was separated by guard row to prevent the leaching of NEC fertilizer taking into consideration that all trees received regularly the same other horticultural practices.

Four levels of NEC soil application i.e. (NEC1 0.0kg ; NEC2 2.0kg ; NEC3 4.0kg and NEC4 6.0kg / tree/ year) either alone or combined with two rates of EM i.e., (EM1 0.0 and EM2 900ml/ tree/ year). Each NEC level was added as soil applied in one time dose on (late of Dec.). However, EM was soil applied in three equal split doses on (early of Dec. , March and June).

Accordingly, the differential investigated treatments used in this respect were as follows:

1- NEC_1 (0.0kg) +EM_1 (0.0) / control.
2- NEC_1 (0.0kg) + EM_2 (900 ml^3) .
3- NEC_2 (2.0kg) + EM_1(without EM).
4-NEC_2 (2.0kg)+ EM_2(900 ml^3).
5- NEC_3(4.0kg) +EM_1(without EM) .
6.-NEC_3 (4.0kg) +EM_2(900 ml^3).
7- NEC_4 (6.0kg) EM_1(without EM).
8- NEC_4(6.0kg) +EM_2(900 ml^3).

The different treatments under study were laid out in a factorial experiment and arranged in a complete randomized block design where each treatment was replicated three times and each replicate was represented by three trees.

1- Fruiting parameters.

Fruit set percentage.

In both seasons of study, twenty inflorescences were selected then the total number of flowers at full bloom stage was calculated and the initial number of fruits at the end of blooming stage (set fruitlets) were recorded per each tree in all treatments then, fruit set% was estimated by the following equation according to Westwood(1978).

$$\text{Fruit set \%} = \frac{\text{Number of set fruitlets}}{\text{Number of perfect flowers at full bloom}} \text{ X100}$$

Yield and Yield increment% in relation to the control.

Average yield either as kg/tree or ton per fadden and yield increment% in relation to the control for each treatment was estimated at harvesting time using the following equation according to Kebeel (1999).

$$\text{Yield increment(\%)} = \frac{\text{Yield (kg/tree) for a giving treatment - yield (kg / tree) for control)}}{\text{Yield (kg/tree) for control}} \text{X100}$$

2-Fruit quality.

Samples of twenty mature fruits at harvesting time from each replicate were randomly collected and the following properties of both physical and chemical characters were determined as follows.

Fruit physical properties.

Average values of fruit weight (gm), fruit volume (ml^3),and fruit dimensions (fruit height and fruit diameter in mm.), were evaluated in this study.

Fruit chemical properties.

The following fruit juice of chemical properties of mature fruits were determined as follows.

*** Total soluble solids percentage (T SS %).**

Total soluble solids content in fruit juice was determined as percentage (TSS%) by using a Carlzees hand refractmeter according to Chen and Mellenthin (1981).

*** Total titratable acidity (mg. citric acid /100mg. juice).**

Total acidity in fruit juice was estimated as the percentage by the titration against u.l N- sodium hydroxide in the presence of phenol phthaline (1%) as an indicator according to A.O.A.C. (2000).

*** Total soluble solids content /acid ratio**:

TSS/ acid ratio was estimated from results recorded of fruit juice TSS an total acidity by dividing TSS% over total acidity.

*** Vit. C. content (L. Ascorbic acid) as mg. /100ml. juice :**

Vitamin C . content (Ascorbic acid) was calculated according to the method described by A.O.A.C (2000).

*** Total sugars content:**

Total soluble Sugars content were determined by phenol sulphoric acid method as described by Dubios *et al*., (1956).

Statistical analysis:

All the obtained results during the two seasons in this study were subjected to the statistical analysis of variance method according to Snedecor and Cochran (1990). However, means values of each investigated factors (specific effect) and their combination (interaction effect)for studied parameters were compared according to Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

1- Fruiting parameters.

Fruit set percentage and yield either kg per tree or ton/feddan as well as yield increment % in relation to the control were the studied fruiting parameters in response to specific and interaction effects of the two investigated factors in this study. Data represented in Tables (1 & 2) displayed obviously both specific and interaction effects for all fruiting parameters under study.

A. Specific effect:

With respect to the specific effect of NEC as soil applied at four levels i. e., (0.0, 2.0, 4.0 and 6.0 kg / tree) on fruit set% and yield either kg / tree or ton per feddan as well as yield increment % in relation to the control of Washington navel orange trees, data tabulated in Tables (1 & 2) revealed that all fruiting parameters were responded statistically to the investigated NEC at various levels. Whereas, all investigated parameters under study increased significantly by increasing the level of NEC. However, supplying of Washington navel orange trees with the highest level of NEC_4 (6.0kg /tree) during both seasons of study resulted in statistically the highest values of fruit set % , the greatest yield (kg/tree and ton/ fed.) and the highest value of yield increment % in relation to the control. On the contrary , Washington navel orange trees which received the lowest amount of NEC i.e. ($NEC_1$0.0kg/no NEC added/control) showed and gave significantly the least values of all investigated fruiting parameters. Moreover , both NEC_3 i.e. (4.0kg/t) and NEC_2 i.e. (2.0kg/t) soil applied levels more statistically in between when fruit set percentage, yield expressed as either kg per tree or ton per feddan . as well as yield increment % in relation to the control were compared to that of the two other NEC soil applied levels. In addition, the differences between the four investigated NEC soil applied levels were significant as they were compared each other pertaining their effectiveness on all investigated fruiting parameters for most cases during the first and second seasons of study.

Regarding the response of aforesaid four investigated fruiting parameters to the specific effect of EM soil application rate, data obtained in the same Tables during the two seasons of study displayed that, all fruiting parameters (fruit set %, yield as either kg /tree or ton /fed., and yield increment % in relation to the control) were significantly responded to application of EM soil rate. However, treatment of EM at ($900ml^3$/ L/tree/ year) soil applied rate increased significantly all investigated fruiting parameters over that of treated trees with EM at ($0.0ml^3$/ L/control treatment) . Whereas, the latest one exhibited statistically the lowest values of all fruiting parameters. Such trend was detected during both the first and second seasons of experimental study.

B- Interaction effect:

Considering the interaction effect due to the different (NEC X EM) combinations treatments on abovementioned four investigated fruiting parameters, data presented in Tables(1&2) obviously reveal that, the highest values of each fruiting parameters under study was always in

significant relationship to the NEC_4 XEM_2 i.e (NEC = 6.0kg X EM=900 ml^3/tree/year) treated trees. Whereas, the opposite trend was observed with Washington navel orange trees subjected to NEC_1 XEM_1 i.e. (NEC=0.0kg X EM= 0.0ml^3/tree/year/ control) treatment . On the other hand , other remain (NEC X EM) combinations treatments were in between the abovementioned two extents regarding their interaction effect on fruiting parameters under study i.e (fruit set %, yield either as kg/tree or ton/ fed and yield increment % in relation to the control) with tendency of variability in their effectiveness . Such trends were detected during both the first and second seasons of experimental study.

The obtained results with respect to the response of fruiting parameters under study to the different levels of NEC were supported by the findings of several investigators, Singh and Singh (1995)on mango trees; Cai and Qian (1995) on apple trees; Wutschen (1989), Wang *et al*. (2006), Abdel-Rahman *et al*. (2009) and Noha and Manal (2014) on citrus, they mentioned that all investigated fruiting parameters were positively influenced by the different treatments of Natural Elements Compound soil applied fertilization. As for the effect of the Effective Micro-organisms soil added rate was concerned the present results are in conformity with those reported by some researchers,Pachoel *et al*. (1996), Wibisono *et al*. (1996) on citrus trees; Chages *et al*. (2000) on papya trees and El-Kholy (2004) on banana plants., who indicated that, EM soil applied significantly increased all investigated fruiting parameters in most cases.

Table 1. Response of some fruiting parameters (fruit set % and yield increment % in relation to the control) of Washington navel orange trees to different treatments of NEC soil application, EM added rate and their combinations during both 2013 and 2014 seasons.

EM rate / NEC level	Fruit set%			Yield increment % in relation to the control		
	EM_1	EM_2	Mean *	EM_1	EM_2	Mean *
Season 2013						
NEC_1 (0.0 kg)	17.93 e	22.13 d	20.03 D	00.01 h	10.412 g	5.211 D
NEC_2 (2.0 kg)	19.72 e	23.93 c d	21.83 C	22.745 f	64.630 c	43.687 C
NEC_3 (4.0 kg)	25.33 b c	26.87 b	26.10 B	47.848 e	75.162 b	61.505 B
NEC_4 (6.0 kg)	26.73 b	32.47 a	29.60 A	53.330 d	80.812 a	67.071 A
Mean**	22.40 B	26.35 A		30.983B	57.754 A	
Seasons 2014						
NEC_1 (0.0 kg)	15.90 d	26.17 b	21.03 D	00.01 h	10.22 g	5.115 D
NEC_2 (2.0 kg)	19.60 c	26.10 b	22.85 C	18,692 f	60.206 c	39.445 C
NEC_3 (4.0 kg)	26.23 b	26.50 b	26.36 B	48.715 e	66.330 b	57.522 B
NEC_4 (6.0 kg)	26.63 b	36.07 a	31.35 A	53.463 d	74.862 a	64.162 A
Mean**	22.09 B	28.71 A		30.242 B	52.904 A	

*** and** refer to specific effect of NEC soil added levels and EM soil applied rates, respectively. Values of each investigated characteristic obtained in every season were significantly distinguishing by capital and small letters for specific and interaction effects, respectively.**

Table 2. Response of Washington navel orange trees productivity either (yield in kg/tree) or (yield per tons/fed.) to different levels of NEC soil application, EM added rate and their combinations during both 2013 and 2014 seasons.

EM rate / NEC level	Yield (kg/tree)			Yield (ton/fed)		
	EM_1	EM_2	Mean *	EM_1	EM_2	Mean *
Season 2013						
NEC_1 (0.0 kg)	41.59 h	48.00 g	44.80 D	6.99 f	8.07 e	7.53 D
NEC_2 (2.0 kg)	51.08 f	68.47 c	59.78 C	8.58 d	11.50 b	10.04 C
NEC_3 (4.0 kg)	61.49 e	72.85 b	67.17 B	10.33 c	12.24 a	11.28 B
NEC_4 (6.0 kg)	63.77 d	75.20 a	69.49 A	10.71 c	12.64 a	11.68 A
Mean**	54.48 B	66.13 A		9.15 B	11.11 A	
Seasons 2014						
NEC_1 (0.0 kg)	43.60 h	48.06 g	45.83 D	7.33 h	8.09 g	7.71 D
NEC_2 (2.0 kg)	51.75 f	69.85 c	60.80 C	8.69 f	11.73 c	10.21 C
NEC_3 (4.0 kg)	64.84 e	72.52 b	68.68 B	10.89 e	12.18 b	11.54 B
NEC_4 (6.0 kg)	66.91 d	76.24 a	71.57 A	11.24 d	12.83 a	12.03 A
Mean**	56.78 B	66.67 A		9.54 B	11.21 A	

*** and** refer to specific effect of NEC soil added levels and EM soil applied rates, respectively. Values of each investigated characteristic obtained in every season were significantly distinguishing by capital and small letters for specific and interaction effects, respectively.**

2- Fruit characteristics .

Physical fruit characteristics

Referring the specific and interaction effects of the two investigated factors on fruit physical characteristics under study i.e., (fruit weight, volume, fruit height and fruit diameter) of Washington navel orange trees were evaluated during both 2013 and 2014 seasons of study and represented in Tables (3&4).

A- Specific effect:

In this regard the average fruit weight (gms), volume (ml^3), dimensions (height and diameter in mm) of Washington navel orange trees in response to the specific effect of the different four levels of NEC as soil added i.e. (0.0, 2.0, 4.0 and 6.0 kg/tree) . Showed that Tables (3&4) fruit physical properties were responded significantly to all treatments used in comparison with the control treatment. during both the first and second seasons of study. Whereas,. it could be observed that, the aforesaid fruit characters were significantly increased by increasing NEC levels as soil application. In other words, the heaviest fruit weight, the biggest fruit volume and the highest values of both fruit height and fruit diameter were resulted from trees fertilized with the highest level of NEC (6.0 kg/tree) .

Contrary to that, an opposite trend was showed when the trees treated with NEC at (0.0k/tree/ control treatment) which induced statistically the lightest fruit weight, the smallest volume and the least values of both fruit height and diameter in both seasons of study. On the other hand, the NEC_3 treated trees (4.0 kgs/tree) exhibited fruits with more values of weight, volume, height and fruit diameter than those of NEC_2 i.e. (2.0 kgs /tree). Moreover, differences in all investigated fruit physical properties of Washington navel orange trees due to the different four levels of NEC fertilization were significant as fruits of each level were compared to these of three other level.

Considering the specific effect of EM as a soil application in the same Tables revealed obviously that , on positive effect relationship between the EM soil applied and all investigated fruit physical properties of Washington navel orange trees under study (fruit weight, volume, height and diameter) Since, all fruit physical characters were significantly responded to soil application of EM solution. However, the heaviest fruit weight, the biggest volume and the highest values of both fruit height and diameter were statistically produced by the EM_2 (900ml^3/tree /year) treated trees. An opposite trend was observed with EM_1 soil applied rate at (0.0 ml^3/ control treatment) which exhibited significantly the lightest, the smallest fruits and the least values of both fruit height and diameter. In the other words, the maximum and the greatest values of fruit weight, volume, height and diameter of Washington navel orange trees were associated with the trees which treated with EM_2 solution as soil applied at rate of (900ml^3 /tree/ year) which increased significantly the four abovementioned characters over that of EM_1 treated trees (0.0ml^3/ control). Such trend was true throughout the tow seasons of study.

B- Interaction effect.

Concerning the interaction effect of various NEC and EM combinations treatments on all investigated fruit physical properties of Washington navel orange data in Tables (3&4) displayed clearly that , the specific effect of each investigated factor was reflected on the interaction effect of its combination. Whereas , Washington navel orange trees subjected to the (NEC_4 x EM_2) combination treatment i.e., (6.0kgs NEC x 900 ml^3 EM /tree /year) exhibited the heaviest fruit weight, the biggest fruit volume and the highest values of both fruit height and diameter in both seasons of study. Moreover, both combinations treatments of (NEC_3 x EM_2) i.e., (4.0kgs NEC x 900ml^3/l EM /tree/ year) and (NEC_4 x EM_1)i.e., (6.0kgs NEC x 0.0 ml^3/l EM) discendingly ranked second and third whereas, differences were significant when each compared to the other combinations. On the other hand, the opposite trend was noticed with the control treatment (0.0kg NEC x 0.0ml^3 EM) which was statistically the inferior as showed significantly the lightest weight, the smallest volume and the least values of both fruit height and diameter of Washington navel orange fruits in both the first and second seasons of study. In addition to that, the other combinations treatments were intermediate with tendency of variability in their effectiveness as compared to the above-mentioned two extents. Such trend was detected during both 2013 and 2014 seasons of study.

The obtained results concerning the response of some fruit physical properties (weigh, volume and dimensions) to the NEC and EM soil application at different levels either alone or in combined with them are in harmony with findings of several investigators, Chages *et al* (2000) on papya trees; El-Kholy (2004)on banana plants; Joo *et al*. (1999), Matichenkov and Bocharnikova (2004), Wang *et al*. (2006), Abdel-Rahman *et al*. (2009), Noha and Manal (2014) on citrus trees;.

Table 3. Fruit weight and fruit volume of Washington navel orange trees in response to different NEC soil application level, EM soil added rate and their combinations during both 2013 and 2014 seasons.

EM rate	Fruit weight (gm)			Fruit volume (ml^3)		
NEC level	EM_1	EM_2	Mean *	EM_1	EM_2	Mean *
Season 2013						
NEC_1 (0.0 kg)	216.3 f	222.7 e	219.5 D	200.7 e	221.3 d	211.0 D
NEC_2 (2.0 kg)	228.3 d	228.3 d	228.3 C	225.7 d	226.7 d	226.2 C
NEC_3 (4.0 kg)	236.7 c	242.0 b	239.4 B	226.0 d	242.7 b	234.3 B
NEC_4 (6.0 kg)	241.3 b	273.0 a	257.2 A	234.7 c	248.0 a	241.4 A
Mean**	230.7 B	241.5 A		221.8 B	234.7 A	
Seasons 2014						
NEC_1 (0.0 kg)	213.0 f	222.3 e	218.2 D	203.0 e	218.0 d	210.5 D
NEC_2 (2.0 kg)	228.7 d	230.7 d	229.7 C	224.7 c	226.3 c	225.5 C
NEC_3 (4.0 kg)	240.0 c	246.0 b	243.0 B	231.3 b	232.3 b	231.8 B
NEC_4 (6.0 kg)	240.0 c	255.0 a	247.5 A	234.0 a b	237.7 a	235.9 A
Mean**	230.4 B	238.8 A		223.3 B	228.8 A	

*** and **refer to specific effect of NEC soil added levels and EM soil applied rates, respectively. Values of each investigated characteristic obtained in every season were significantly distinguishing by capital and small letters for specific and interaction effects, respectively.**

Table 4. Fruit dimensions (height and diameter)of Washington navel orange trees in response to different NEC soil application level, EM soil added rate and their combinations during both 2013 and 2014 seasons.

EM rate	Fruit height (mm)			Fruit diameter (mm)		
NEC level	EM_1	EM_2	Mean *	EM_1	EM_2	Mean *
Season 2013						
NEC_1 (0.0 kg)	79.2 d	82.0 c	80.6 B	71.4 d	75.8 c	73.6 B
NEC_2 (2.0 kg)	82.1 b c	83.1 a b	82.6 A	75.9 c	78.8 b	77.4 A
NEC_3 (4.0 kg)	82.4 b c	83.1 a b	82.8 A	76.0 c	79.2 a b	77.7 A
NEC_4 (6.0 kg)	82.6 b	83.7 a	83.2 A	76.5 c	79.9 a	78.2 A
Mean**	81.8 B	83.0 A		75.0 B	78.5 A	
Seasons 2014						
NEC_1 (0.0 kg)	78.3 e	79.7 d	79.0 B	68.8 f	69.9 e	69.4 B
NEC_2 (2.0 kg)	81.3 c	82.6 a b	82.0 A	71.1 d	73.0 c	72.1 A B
NEC_3 (4.0 kg)	81.5 c	83.0 a b	82.3 A	71.3 d	74.0 a b	72.7 A
NEC_4 (6.0 kg)	82.0 b c	83.2 e	82.6 A	72.4 b c	74.5 a	73.5 A
Mean**	80.8 B	82.2 A		70.9 B	72.9 A	

*** and **refer to specific effect of NEC soil added levels and EM soil applied rates, respectively. Values of each investigated characteristic obtained in every season were significantly distinguishing by capital and small letters for specific and interaction effects, respectively.**

Fruit chemical properties:

In this regard, the specific and interaction effects of the investigated factors under study on fruit chemical properties i.e., (fruit juice TSS%, total acidity % , total sugars % and vitamin C content) of Washington navel orange trees were evaluated and obtained data during both 2013 and 2014 seasons of study are tabulated in Tables (5&6).

A- Specific effect :

Regarding the response of fruit juice TSS % ,vitamin C. and fruit sugar contents to the specific effects of the investigated either NEC or EM treatments alone , data in Tables (5&6) indicated that the three fruit properties

abovementioned were responded significantly to the either NEC or EM at different levels as compared to the control. However, the higher levels of NEC (6.0 kg/tree) or EM (900 ml^3/l/tree) induced the highest significant values of TSS %, vitamin C. and sugars during both seasons of study. Meanwhile, the lowest values and the poorest fruits in their contents of TSS %, vitamin C. and sugars were always in concomitant to these Washington navel orange trees treated with the control treatment. Moreover , the treatments of NEC at(2.0 and 4.0 kg/tree) exhibited an intermediate values between the two above-mentioned extents from stand point of statistic. Such trends were detected during both 2013 and 2014 seasons of study.

Concerning the specific effect of NEC on total acidity % in fruit juice was harmonious relationship between the highest value of total acidity % and the trees which were treated with the lowest level of NEC i.e (control) whereas such NEC (0.0kg/tree) level maximized significantly the values of fruit juice acidity% . Meanwhile , the least value of fruit juice acidity % was symmetrically with those fruits produced by trees which were treated with the highest level of NEC (6.0kg).

Moreover, regarding the specific effect of EM on fruit juice acidity %, data in the same Table displayed that fruit juice acidity % did not responded specifically to the investigated EM treatments whereas , the differences between the two investigated treatments of EM did not reach to the level of significance during both seasons of study.

B- Interaction effect:

With respect to the interaction effect of the two investigated factors on fruit juice TSS%, vitamin C. and fruit sugars contents as well as fruit juice acidity % of Washington Navel orange trees, data presented in Tables (5 & 6) displayed clearly that, the effect of the different combinations on the abovementioned investigated parameters were an image to the specific effect of such investigated factor whereas the Washington Navel orange trees which were treated with the highest levels of (NEC_4 x EM_2) combizather treatment i.e. (NEC 6.0kg x EM 900ml^3) exhibited statistically maximized fruit juice TSS%, vitamin C and total sugars contents in Washington Navel orange fruits during the 1st and 2nd seasons of study . In addition, the other remain combinations treatments were intermediate .Moreover, data revealed that the highest value of fruit juice acidity % was observed when the trees were treated with the control treatment (NEC_1 0.0kg x EM_1 0.0ml^3). Hence, Washington navel orange trees which were fertilized with the highest level of (NEC_4 x EM_2)i.e (NEC 6.0kg x EM 900ml^3) induced fruits characterized by the lowest value of fruit juice acidity % . Such trend was tree during both 2013 and 2014 seasons of study.

Table 5. TSS % and acidity % of Washington navel orange trees in response to different NEC soil application level, EM soil added rate and their combinations during both 2013 and 2014 seasons.

EM rate	TSS %			Total Acidity %		
NEC level	EM_1	EM_2	Mean **	EM_1	EM_2	Mean **
Season 2013						
NEC_1 (0.0 kg)	10.00 c	11.00 b c	10.50 D	1.02 a	0.99 b	1.01 A
NEC_2 (2.0 kg)	12.10 a b	12.33 a b	12.22 C	0.98 a c	0.96 b d	0.97 A B
NEC_3 (4.0 kg)	12.33 a b	13.00 a	12.67 B	0.94 b e	0.93 c e	0.94 B
NEC_4 (6.0 kg)	13.00 a	13.33 a	13.17 A	0.91 d e	0.90 e	0.90 B C
Mean*	12.86 B	12.43A		0.95 A	0.94 A	
Seasons 2014						
NEC_1 (0.0 kg)	10.67 c	12.33 b	11.50 C	1.04 a	1.02 b	1.03 A
NEC_2 (2.0 kg)	12.33 b	12.67 b	12.50 B	1.00 c	1.00 c	1.01 B
NEC_3 (4.0 kg)	13.00 a b	13.67 a	13.34 A	0.96 d	0.94 e	0.95 C
NEC_4 (6.0 kg)	13.67 a	13.67 a	13.67 A	0.92 e f	0.91 f	0.91 D
Mean*	12.42 B	13.08 A		0.98 A	0.97 A	

*** and **refer to specific effect of NEC soil added levels and EM soil applied rates, respectively. Values of each investigated characteristic obtained in every season were significantly distinguishing by capital and small letters for specific and interaction effects, respectively.**

Table 6. Total sugars % and Vitamin C content of Washington navel orange trees in response to different NEC soil application level, EM soil added rate and their combinations during both 2013and 2014 seasons.

EM rate	Total sugers%			Vitamin C content		
NEC level	EM_1	EM_2	Mean *	EM_1	EM_2	Mean *
Season 2013						
NEC_1 (0.0 kg)	7.05 e	7.86 d	7.45 D	39.00 g	41.67 f	40.34D
NEC_2 (2.0 kg)	7.95 c d	7.93 c d	7.94 C	44.67 e	52.00 c	48.33 C
NEC_3 (4.0 kg)	7.97 c d	8.01 c	7.99 B	47.33 d	56.33 b	51.33 B
NEC_4 (6.0 kg)	8.15 b	8.48 a	8.32 A	50.33 c	60.33 a	55.33 A
Mean**	7.77 B	8.10 A		45.33 B	52.28 A	
Seasons 2014						
NEC_1 (0.0 kg)	6.41 g	6.78 f	6.60 D	40.00 g	41.67 f g	40.83 D
NEC_2 (2.0 kg)	6.88 e f	6.95 d e	6.91 C	43.00 f	57.67 c	50.34 C
NEC_3 (4.0 kg)	7.00 d	7.24 c	7.12 B	47.33 e	60.00 b	53.67 B
NEC_4 (6.0 kg)	7.50 b	7.98 a	7.74 A	53.00 d	62.00 a	57.50 A
Mean**	6.95 B	7.24 A		45.83 B	55.33 A	

and **refer to specific effect of NEC soil added levels and EM soil applied rates, respectively. Values of each investigated characteristic obtained in every season were significantly distinguishing by capital and small letters for specific and interaction effects, respectively.

The obtained results regarding the response of both physical and chemical of fruit properties to the different of NEC soil applied levels are in accordance with these reported by Helial *et al*(2003),Abd El-Rahman *et al*(2009) and Noha and Manal (2014), they revealed that a significant increase in most fruit physical and chemical properties were increased with raising the NEC soil applied levels . Moreover, the trend of response to EM soil added rates goes in line with those mentioned by Abou Sayed (1997) , Joo *et al* (1999). Tayeh *et al* (2003), Bakr *et al*., (2003) and Wu *et al* (2000) on fruit quality of citrus trees.

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دراسة مقارنه على التسميد في أشجار البرتقال أبو سرة

احمد احمد رزق عطويه[1] , فواد محمد عبد اللطيف[1], حسن السيد منصور جنديه[1] ,عبد الرحمن محمد عبد الرحمن[2] و محمود عبد السميع يوسف خضير[2].

[1] قسم البساتين بمشتهر جامعة بنها.

[2] قسم الموالح معهد بحوث البساتين مركز البحوث الزراعية

اجري هذا البحث بغرض دراسة الإضافة الأرضية بمستويات مختلفة من كل من-EM NEC سواء منفردة أو معا على أشجار البرتقال أبو سرة المطعومة على أصل النارنج و النامية بمزرعة خاصة بقرية قرقشنده التابعة لمحافظة القليوبية وتأثير تلك المعاملات على بعض القياسات الثمرية وكذلك بعض خصائص الثمار الطبيعية والكيماوية خلال عامين متتاليين 213- 2014. * فلقد أوضحت النتائج المتحصل عليها أن كل المعاملات المختبرة تحت الدراسة أدت إلى تأثير ايجابي وزيادة معنوية لكل أو معظم قياسات الإثمار وخصائص الثمار المدروسة مقارنة بمعاملة الكنترول خلال موسمي الدراسة . * كذلك أشارت النتائج إلى أن كل المعاملات المختبرة أدت إلى زيادة معنوية في النسبة المئوية لعقد الثمار والإنتاجية سواء محصول الشجرة بالكيلوجرام أو المحصول مقدرا بالطن للفدان وكذلك النسبة المئوية لزيادة محصول المعاملات مقارنة بمعاملة الكنترول خلال موسمي الدراسة. *إضافة إلى ذلك فلقد أظهرت النتائج بوضوح أن الصفات الطبيعية للثمار (الوزن –الحجم- أبعاد الثمار) وكذلك الصفات الكيماوية (النسبة المئوية للمواد الصلبة الذائبة الكلية- الحموضة الكلية- السكريات الكلية- محتوى الثمار من فيتامين C) قد أظهرت تحسنا معنويا نتيجة لمعاملة الأشجار بالمعاملات التسميدية المختلفة المختبرة مقارنة بمعاملة الكنترول خلال موسمي التجربة تحت الدراسة. **وبصفة عامة فانه يمكن القول بان كل المعاملات المختبرة تحت الدراسة من EM,NEC سواء منفردة أو متداخلة معا أدت إلى تأثير ايجابي ومعنوي في زيادة قياسات الإثمار وتحسين صفات جودة الثمار إلا إن المعاملة (6كجم EM + 900سم3 \ شجرة\ سنويا) كانت أفضل المعاملات وأكثرها فاعلية وتأثيرا على المستوى الاحصائى من حيث زيادة وتحسين قياسات الإثمار المختبرة وكذلك صفات جودة الثمار لأشجار البرتقال أبو سرة.