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Influence of mineral and bio-N fertilization on productivity and fruit quality of Washington navel orange trees

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Abstract

This study was carried out during the 2019 & 2020 seasons on 15-year-old Washington navel orange trees budded on sour orange rootstock grown at 5 x 5 meters a part in loamy sand soil under surface irrigation on the private farm at Kom Hamada, El-Behera Governorate, Egypt. The main goal of this investigation was directed towards improving productivity and fruit quality of Washington navel orange trees associated with lower production cost through investigating the minimizing of chemical N fertilizers by Bio-N. Anyhow, the eight treatments involved in this study were summarized as follows: T1- Chemical N (adopted N fertilization in the farm) at 3.5kg/tree from $(NH4)_2SO_4$, T2- Urea, T3- Ammonium sulphate $(NH4)_2SO_4$, T4- Ammonium nitrate $(NH_4)_2NO_3$, T5- Nitroben (bio-N), T6- Urea + Nitroben (bio-N), T7- Ammonium sulphate + Nitroben (bio-N) and T8- Ammonium nitrate + Nitroben (bio-N). Data obtained revealed that all investigated treatments positively responded to fruit (set % and retention %), and yield/tree and fruit quality were also improved. However, T8- Ammonium nitrate+ Nitroben (bio-N) was statistically superior in this concern. Moreover, T7 - Ammonium sulphate + Nitroben (bio-N) ranked statistically second in this concern. Consequently, it can be recommended that minimizing 50 % chemical N fertilizers by Nitroben at the rate of 500cm^3 per tree + 50% chemical-N (Ammonium nitrate 2.5 Kg per tress) enhanced productivity and fruit quality of Washington navel orange trees under the same conditions.

Keywords: Washington Navel Orange, Mineral-N, Bio-N, Nitroben Productivity and Fruit Quality.

Introduction

According to the **Annual Reports of Statistical Institute and Agricultural Economic Research in Egypt, (2020)** Citrus is one of the most important horticultural crops in Egypt due to its high economic value for the local markets and export. The total exportation of citrus reached 1,667,750 and 1,616,821 tons of fruits in 2020 and 2017, respectively. The total area occupied by citrus in 2020 was 469912 feddans produced 434458 tons of fruits. From such area; 147022 feddans were cultivated by Washington navel orange trees representing 33.74 % of the total area; producing 1,559,288 tons of fruits; representing about 34.86% of total citrus production. Oranges take the foreground of citrus varieties, especially the Washington navel orange (*Citrus sinensis* [L.] Osbeck). Navel orange plays a dominant role not only in the local market but also in exportation as one of the major citrus fruit crops in Egypt. June drop and pre-harvest fruit drop are extensive in many Egyptian orchards, as the Navel orange is a parthenocarpic cultivar and consequently eliminating yield and fruit quality **(Saleem *et al.*, 2007).**

Washington Navel orange is the favorite and the most popular fresh fruit in Egypt due to its seedless, large size, nutritive value, and flavor and aroma characteristics. It is also a valuable source of early-season income for citrus growers in some commercial citrus areas of the world.

Costs of mineral fertilizers have significantly been going up. As a result, it has become necessary to seek alternatives that would supply the poor soil with more economical sources of fertilizers **(Wardowski *et al.*, 1985)**. Moreover, one of the most important cultural practices is the fertilization program. Foliar fertilizer rates are typically lower than soil fertilizer rates, but applications can be costlier. These applications that only minimally added to production costs were able to increase returns by several pounds per acre yearly. Foliar fertilization also reduces nutrient accumulation in soil, and groundwater, where they contribute to salinity with negative consequences for humans and the environment.

Fertilization is one of the important management tools in increasing growth and crop yield, especially with nitrogen. Nitrogen (N) is known to be one of the major elements for plant nutrition and development. It plays an important role as a constituent of all proteins, nucleic acids, and enzymes (**Nijjar, 1985**). The role of NPK fertilization in promoting vegetative growth characters, as well as stimulating the photosynthetic pigments and nitrogen, phosphorus and potassium content of plants could be explained by recognizing their fundamental involvement in the very large number of an enzymatic reaction that depends on NPK fertilization. NPK reflected directly on increasing the content of chlorophyll a, b and carotenoids as well as NPK and content in the leaves were indirectly the cause for enhancing the augmenting of all other vegetative growth traits.

Biofertilizers are not usually used solitary to stimulate growth since they need organic matter to stimulate activity **(Garcia *et al*., 1994).** Moreover, it is known that compost is required to improve the quality of soil organic matter **(Rivero *et al*., 2004)** in various ways. When composts are applied to soil, not only degradable substrates and nutrients are supplied, but also a wide range of microorganisms **(Ryckeboer *et al*., 2003)** including harmless heterotrophy but potentially also plant and human pathogens. Compost is an organic material that influences agricultural sustainability by improving the chemical, physical, and biological properties of soils, the fertility and structure of the soil and the moisture-holding capacity **(Saha *et al*., 2008)**.

Thereupon, this work was designed to examine the possibility of reducing the high cost of chemical fertilizer (N) which directly impacts human health by cheaper alternatives and environment friendly by using bio fertilizer and their impact on productivity and fruit quality of Washington navel orange trees.

Materials and Methods

This study was carried out during the 2019 & 2020 seasons on 15-year-old Washington navel orange trees budded on sour orange rootstock grown at 5x5 meters a part in loamy sand soil under surface irrigation on the private farm at Kom Hamada, El-Behera Governorate, Egypt, to investigate the effect of different nitrogen sources on yield, physical and chemical quality of Washington navel orange trees. Random soil samples were collected from the experimental soil at the depth of 0-60 cm from the soil surface for Physical and chemical analysis and the Physical and chemical characteristics of the used soil as the average of both seasons are shown in Table 1. Physical analysis was estimated according to **Jackson (1973)** whereas, chemical analysis was determined according to **Black *et al*. (1982).**

Table 1. Soil mechanical and chemical analyses of the used soil.

Particle size distribution (%)				Organic matter (O.M)	E.C. (dS/m)	pH	Cations (meq/L)				Anions (Meq/L)			
Coarse Sand	Fine sand	Silt	Clay				Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{--}	HCO_3^{-}	Cl^{-}	SO_4^{--}
8.25	16.15	26.5	51	1.1	1.4	7.1	3.5	1.2	6.53	1.16		5.38	5.93	5.9
Available N					Available P						Available K			
22.5 mg/kg					9.1 mg/kg						120 mg/kg			

It was devoted to investigating the influence of different Nitrogen sources in recommended doses in addition to controlling (adopted N fertilization in the farm) on productivity and fruit quality of Washington navel orange trees.

The eight treatments involved in this study were summarized as follows:

T1- Chemical N (adopted N fertilization in the farm) at 3.5kg/tree from $(NH4)_2SO_4$.

T2- Urea.

T3- Ammonium sulphate $(NH4)_2SO_4$.

T4- Ammonium nitrate $(NH4)_2NO_3$.

T5- Nitroben (bio-N).

T6- Urea + Nitroben (bio-N).

T7- Ammonium sulphate+ Nitroben (bio-N).

T8- Ammonium nitrate+ Nitroben (bio-N).

All the mineral-N was added at the rate of 1200 gram of net nitrogen from the different sources of mineral nitrogen as a recommended dose and 600 grams of net nitrogen when adding Bio-N.

Experiment layout:

The complete randomized block design with three replications was employed for arranging the eight investigated fertilization treatments, whereas a single tree represented each replicate. Consequently, 24 healthy fruitful Washington navel orange trees were carefully selected, as being healthy, disease-free and in the on-year state. Chosen trees were divided according to their growth vigor into three categories (blocks) each included eight similar trees for receiving the investigated eight treatments (a single tree was randomly subjected to one treatment).

Application time:

Taking into consideration that all treatments were applied two times (in early March and in early May) in both seasons**.**

Bio-fertilizers treatment:

Nitroben preparation was added as soil drench two times at the rate of 500 cm^3 per tree were added in early March and in early May of both seasons, which supplied by the Department of Microbiology, Agric. Res. Inst., Giza was used in this study as biological activator.

The following measurements were recorded in the two trails:

Productivity measurements:

Fruit set percentage:

At full bloom during each experimental season, the number of perfect flowers per each tagged limb was counted. After 75% of petal fall fruit set as a percentage of perfect flowers were estimated according to the following equation:

$$\text{Fruit set \%} = \frac{\text{Number of set fruitlets}}{\text{Number of perfect flowers}} \times 100$$

Fruits retention %:

At a given date in December during each experimental season, the Percentage of retained fruits was estimated according to the following equations:

$$\text{Fruits retention \%} = \frac{\text{Number of presented (remained) fruits at a given date}}{\text{Number of set fruitlets}} \times 100$$

Yield:

In mid-December 2019 and 2020, the fruits of each tree were separately harvested, then counted and weighed. Tree productivity (yield) was estimated as either the number or weight (kg) of harvested fruits per tree. Besides, yield per each tree (Kg) as well as yield per feddan (ton).

Fruit quality:

Fruit physical characteristics:

In this regard, average fruit weight (g.); dimensions (polar & equatorial diameters i.e., length & width in cm. & mm.); fruit shape index (length: width); juice volume (cc) and peel/rind thickness (mm) were the fruit physical characteristics investigated in this regard.

Fruit chemical properties:

Fruit juice, total soluble solids percentage (TSS %) was determined using Carl Zeins hand refractometer. Total acidity as gms of anhydrous citric acid per 100ml fruit juice was determined after **A.O.A.C., (1995)**. Total soluble solids/ acid ratios were also estimated. Ascorbic, acid/ vitamin C content was determined using 2, 6 dichlorophenol indophenol indicator for titration after **A.O.A.C. (1995)**. Moreover, total sugars% was determined after the method described by **Smith *et al.*, (1956).**

Statistical analysis:

All data obtained during both seasons included in this investigation were subjected to analysis of variance according to (**Snedecor and Cochran, 1980**). Besides, significant differences among means were differentiated according to the Duncan, multiple test range (**Duncan, 1955**) where letter/s were used for distinguishing means of different treatments for each investigated characteristic.

Results and Discussion

Influence of mineral and bio-N fertilization on fruit set (%) and fruit retention (%) of Washington navel orange trees.

Table (2) displays obviously that, seven investigated treatments with any nutritive compound increased significantly the fruit set% and fruit retention % over control (trees subjected to only the N fertilizer program adopted on the farm). However the 8th treatment i.e., Washington navel orange trees subjected Ammonium nitrate + Nitroben (bio-N) was statistically the superior during both 2019 & 2020 experimental seasons. . However 4th treatment (Ammonium nitrate (NH_4 NO_3) ranked statistically second, descendingly followed by 7th treatment (Ammonium sulphate + Nitroben (bio-N) and 3rd treatment (Ammonium sulphate $(NH_4)_2SO_4$ during both seasons of study. In addition, the other nutritive were the least effective as they came last just before the control during two experimental seasons.

Table 2. Influence of mineral and bio-N fertilization on some fruiting aspects of Washington navel orange trees during 2019 and 2020 experimental seasons.

Parameters	Fruit set (%)		Fruit retention (%)		Average fruit weight (g)		No. of fruits /tree		Yield (kg)/tree		Yield (ton)/feddan	
Treatments	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
T1- Control (adopted N fertilization in the farm)	19.64DE	18.92E	13.63D	12.54D	261.1F	261.5A	154.3D	146.7D	40.30F	38.35AB	6.77D	6.44D
T2- Urea	19.89D	19.20D	13.74D	12.88C	262.1F	263.5A	160.7C	155.3C	42.11E	40.93AB	7.07E	6.88C
T3- Ammonium sulphate (NH4)2 SO4)	20.34C	19.66C	15.10B	13.88B	267.1E	234.4A	166.7B	159.7B	44.52C	37.59AB	7.48C	6.32E
T4- Ammonium nitrate (NH4 NO3)	21.13B	20.01B	15.85A	14.85A	272.3C	273.0A	171.3A	168.7A	46.66A	36.034AB	7.84A	6.06
T5- Nitoben (bio-N)	19.44E	18.51F	13.04E	11.96E	277.1A	259.6A	151.7D	142.7E	42.02E	37.03B	7.06E	6.22E
T6- Urea + Nitoben (bio-N)	20.53C	19.90BC	14.28C	13.01C	268.5D	262.9A	161.3C	153.3C	43.32D	40.31AB	7.28	6.77C
T7- Ammonium sulphate+ Nitoben (bio-N)	21.16B	19.96B	14.51B	13.90B	273.8B	271.5A	166.3B	163.3B	45.54B	44.35AB	7.65B	7.45AB
T8- Ammonium nitrate+ Nitoben (bio-N)	22.10A	20.60A	15.60A	14.89A	276.8A	276.8A	171.7A	168.7A	47.51A	46.68A	7.98A	7.84A

Means followed by the same letter/s within each column didn't significantly differ at 5% level.

* All the mineral-N was added at the rate 1200 gram of net nitrogen from the different sources of mineral nitrogen as a recommended dose and 600 gram of net nitrogen when adding Bio-N.

Influence of mineral and bio-N fertilization on tree productivity (yield) of Washington navel orange trees.

The yield of the Washington navel orange cv. expressed either as number or weight (kg) of harvested fruits per tree and yield (ton) per fadden were the investigated productivity parameters regarding the response to differential evaluated treatments. Data obtained during both the 2019 and 2020 experimental seasons are presented in **Table (2)** showed that all measurements of tree productivity of Washington navel orange fruits responded positively and significantly to various investigated treatments. Herein, the measurements were increased by all investigated treatments as compared to the control. Meanwhile, all the cropping parameters of tree productivity followed the same trend, whereas the 8th treatment (Ammonium nitrate + Nitoben (bio-N)) and the 4th treatment (Ammonium nitrate (NH_4 NO_3)) surpassed statistically all other treatments during the both 2019 & 2020 experimental seasons.

However, the 7th treatment (Ammonium sulphate + Nitoben (bio-N)) ranked statistically second after the superior treatments. In addition, four other treatments were less effective; however 3rd one was significantly more effective than the two other ones of such group.

Accordingly, it is quite too clear to be noticed from tabulated data in **Table (2)** that the positive effect (treatments efficiency) on tree productivity estimated as the weight of harvested fruits per tree was more pronounced compared to that exhibited for the number of harvested fruits/tree. Such a trend was true during both the 2019 and 2020 experimental seasons; however, the variance in response between two measurements of tree productivity was in a positive relationship to the increase exhibited over control by a given nutritive treatment.

Such pronounced response of yield, when estimated as the weight of harvested fruits/tree rather than that induced in the analogous yield parameter like the number of harvested fruits per tree, could be logically explained by the paralleled increase resulting in both average fruit weight and the average number of harvested fruits per tree.

Influence of mineral and bio-N fertilization on some fruit physical properties of Washington navel orange trees.

In this regard, fruit weight, peel thickness, fruit dimensions (equatorial & polar diameters), fruit shape index and juice percentage were the evaluated fruit physical properties of Washington navel orange cv. in response to the differential investigated fertilizers treatments. Data obtained during both the 2019 & 2020 experimental seasons are presented in **Table (3)**.

Fruit weight (g):

Fruit Peel thickness:

Concerning the response of fruit Peel thickness to the various investigated fertilizers treatments, **Table (3)** displays that differences in most cases were relatively not so pronounced to be taken into consideration from the statistical standpoint. Washington navel orange fruits of subjected trees to 3rd treatment (Ammonium sulphate $(NH_4)_2$ SO_4) had significantly the thickest fruit peel thickness i.e., 3.17 & 3.15 mm during 1st & 2nd experimental seasons, respectively. However, the other investigated treatments increased fruit peel thickness over control with variable degrees of response depending not only upon the efficiency of investigated treatments themselves but also and in some cases from one season to another.

Fruit dimensions:

The polar and equatorial fruit diameters of Washington navel orange cv. were the investigated two fruit dimensions regarding their response to the differential bio and organic nutritive compounds. **Table (3)** shows obviously that both parameters responded significantly to all treatments. However, the eighth treatment (Ammonium nitrate + Nitoben (bio-N)) was superior and resulted significantly in the tallest polar and equatorial diameters, statistically followed by the 7th treatment (Ammonium sulphate + Nitoben (bio-N)), such trend was true during both experimental seasons for both polar and equatorial fruit diameters, however, rate of response was relatively higher with former fruit dimension (polar diameter) than another one (equatorial).

Fruit shape index:

Concerning the fruit shape index (polar diameter: equatorial diameter) of Washington navel orange cv. in response to differential investigated treatments, **Table (3)** shows clearly that the variances were relatively too few to be taken into consideration from the statistical point of view. Herein, it could be declared that fruits of treated Washington navel orange trees with any mineral and bio-N fertilizers either solely or combined tended relatively to be slightly belonged in their shape as compared to the analogous ones of control. The difference was more pronounced in fruits of treated trees with Ammonium nitrate solely or combined with Nitroben during both the 2019 & 2020 experimental seasons. Variations in fruit shape indices due to the differential investigated mineral and bio-N fertilizers could be logically explained by the unparalleled response of two fruit dimensions (polar & equatorial diameters) to a given treatment. Since in most cases the increase in fruit length (height or polar diameter) was relatively higher than those resulting in fruit width (equatorial diameter) the response to each treatment was individually (separately) taken into consideration.

Fruit juice percentage:

The response of fruit juice percentage to various investigated treatments as shown in **Table (3)** declared that all investigated treatments increased significantly over control during both experimental seasons of study. Generally, it could be noticed the superiority of the 8th treatment (Ammonium nitrate + Nitroben (bio-N)) during both experimental seasons and the 7th treatment (Ammonium sulphate + Nitroben (bio-N)), particularly in the 2nd season. However, the other investigated treatments increased fruit juice weight and percentage over control with variable degrees of response depending not only upon the efficiency of investigated treatments themselves but also and in some cases from one season to another.

Table 3. Influence of mineral and bio-N fertilization on some fruit physical properties of Washington navel orange trees during 2019 and 2020 experimental seasons.

Parameters	Peel thickness (mm)		Polar d1amater (cm)		Equatorial diameter (cm)		Fruits shape index		Juice weight (g)		Juice (%)	
Treatments	**2019**	**2020**	**2019**	**2020**	**2019**	**2020**	**2019**	**2020**	**2019**	**2020**	**2019**	**2020**
T1- Control (adopted N fertilization in the farm)	**3.11D**	**3.12C**	**8.24D**	**8.24G**	**8.27A**	**8.26E**	**0.997A**	**0.997A**	**109.6E**	**107.6A**	**41.98C-E**	**41.13E**
T2- Urea	**3.11DE**	**3.13Bc**	**8.26CD**	**8.24FG**	**8.30A**	**8.27E**	**0.995A**	**0.997A**	**109.4E**	**109.3A**	**41.74DE**	**41.50DE**
T3- Ammonium sulphate $(NH_4)_2\ SO_4)$	**3.17A**	**3.15A**	**8.32ABC**	**8.29D**	**8.35A**	**8.32C**	**0.996A**	**0.996AB**	**112.6D**	**98.7A**	**42.14B-D**	**42.08C**
T4- Ammonium nitrate ($NH_4\ NO_3$)	**3.14B**	**3.14AB**	**8.28BCD**	**8.255EF**	**8.90A**	**8.29DE**	**0.994A**	**0.666AB**	**115.8C**	**116.5A**	**42.53B**	**42.67B**
T5- Nitoben (bio-N)	**3.04F**	**3.06E**	**8.32ABC**	**8.26E**	**8.35A**	**8.30CD**	**0.996A**	**0.994AB**	**115.1C**	**108.0A**	**41.54E**	**41.61D**
T6- Urea + Nitoben (bio-N)	**3.09E**	**3.10D**	**8.37A**	**8.30C**	**8.42A**	**8.35B**	**0.995A**	**0.994AB**	**113.5D**	**111.0A**	**42.27BC**	**42.24C**
T7- Ammonium sulphate+ Nitoben (bio-N)	**3.14BC**	**3.13BC**	**8.33AB**	**8.32B**	**8.37A**	**8.37A**	**0.995A**	**0.996AB**	**118.0B**	**115.7A**	**43.10A**	**42.61B**
T8- Ammonium nitrate+ Nitoben (bio-N)	**3.1167CD**	**3.1233C**	**8.3467AB**	**8.3467A**	**8.39A**	**8.3767A**	**0.9952A**	**0.9952AB**	**119.74A**	**121.05A**	**43.267A**	**43.740A**

Means followed by the same letter/s within each column didn't significantly differ at 5% level

* All the mineral-N was added at the rate 1200 gram of net nitrogen from the different sources of mineral nitrogen as a recommended dose and 600 gram of net nitrogen when adding Bio-N.

Fruit chemical properties:

In this regard fruit juice's total soluble solids (TSS) %, total acidity %, TSS/acid ratio, total sugars % and ascorbic acid (vitamin C) contents were the five investigated fruit juice chemical properties for Washington navel orange cv. regarding their response to the evaluated mineral and bio-N fertilizers treatments. Data obtained during both the 2019 & 2020 experimental seasons are presented in **Table (4)**. Herein, it is quite clear that the response of fruit juice chemical properties for Washington navel orange cv. to the differential investigated treatments followed to great extent the same trend previously detected with fruit physical properties. However, the differences were relatively more firm with fruits physical properties. Hence, T8 i.e., (Ammonium nitrate+ Nitroben (bio-N)) was statistically the most effective in this concern during both experimental seasons. Moreover, T7 and T4 i.e., (Ammonium sulphate + Nitoben (bio-N) and (Ammonium nitrate (NH_4NO_3), respectively and ranked statistically second and showed significantly the same level fruit juice chemical characteristics for Washington navel orange cv. during both experimental seasons. The reverse was true with T2-Urea that induced significantly the poorest fruits in their fruit juice chemical properties during both seasons. Besides, other investigated treatments were in between the abovementioned two extremes. Such a trend was true during both seasons of study with few exceptions, especially with the TSS/acid ratio, which was slightly influenced by the differential investigated treatments.

Table 4. Influence of mineral and bio-N fertilization on some fruit chemical properties of Washington navel orange trees during 2019 and 2020 experimental seasons.

Parameters	T.S.S (%)		Total acidity (%)		TSS/acid ratio		Total sugars (%)		Vitamin (C) (mg/100 g j.w.)	
Treatments	**2019**	**2020**	**2019**	**2020**	**2019**	**2020**	**2019**	**2020**	**2019**	**2020**
T1- Control (adopted N fertilization in the farm)	**11.71C**	**11.38C**	**1.04A**	**1.00AB**	**11.23D**	**11.103D**	**8.37E**	**8.59D**	**61.19C**	**61.27F**
T2- Urea	**11.73C**	**11.61C**	**1.04AB**	**1.03A**	**11.33D**	**11.24D**	**8.39DE**	**8.67D**	**61.47BC**	**61.74E**
T3- Ammonium sulphate (NH4)2 SO4)	**12.16B**	**12.16B**	**1.00C**	**0.99CD**	**12.20C**	**12.18C**	**8.53C**	**8.95C**	**62.14A-C**	**62.71CD**
T4- Ammonium nitrate (NH4 NO3)	**12.33AB**	**12.51A**	**0.99C**	**0.99CD**	**12.46C**	**12.65B**	**8.62B**	**9.18B**	**63.00AB**	**63.09B**
T5- Nitoben (bio-N)	**11.60C**	**11.47C**	**1.01BC**	**1.02A-C**	**11.54D**	**11.28D**	**8.32E**	**8.60D**	**61.99A-C**	**63.20AB**
T6- Urea + Nitoben (bio-N)	**12.11B**	**12.09B**	**0.99C**	**0.99CD**	**12.17C**	**12.18C**	**8.47CD**	**9.04C**	**62.12A-C**	**62.56D**
T7- Ammonium sulphate+ Nitoben (bio-N)	**12.27AB**	**12.60A**	**0.94D**	**0.97D**	**12.99B**	**12.95B**	**8.70AB**	**9.18B**	**63.11AB**	**62.96BC**
T8- Ammonium nitrate+ Nitoben (bio-N)	**12.39A**	**12.59A**	**0.88E**	**0.92E**	**14.18A**	**13.66A**	**8.73A**	**9.38A**	**63.29A**	**63.54A**

Means followed by the same letter/s within each column didn't significantly differ at 5% level.

* All the mineral-N was added at the rate 1200 garm of net nitrogen from the different sources of mineral nitrogen as a recommended dose and 600 gram of net nitrogen when adding Bio-N.

Discussion

Fertilization is one of the important management tools in increasing growth and crop yield, especially with nitrogen. Nitrogen (N) is known to be one of the major elements for plant nutrition and development. It plays an important role as a constituent of all proteins, nucleic acids and enzymes (**Nijjar, 1985**). Recently, bio fertilization is considered a tool to enhance the yield and fruit quality of citrus and it becomes a positive alternative to chemical fertilizers. It is safe for humans and the environment and using them was accompanied by reducing the great pollution occurring in our environment as well as producing organic foods for export. The application of organic fertilizers in the citrus orchard is a production system that avoids or largely excludes the use of synthetic chemical fertilizers (**Abdelaal *et al.*, 2010**). This result may be attributed to the relatively higher uptake of easier N forms that could be absorbed and/or trans-located within tissues as a direct result of applying such N richer compounds (Ammonium nitrate (NH_4NO_3), where an adequate and sufficient N level is needed at such critical stage of flower–fruit development. Such superiority may be attributed to the that applying bio–fertilizers stimulate the living microorganisms in the soil to work on the organic matter included and consequently convert the organic forms of some unavailable nutrients to an available mineral form that is certainly reflected in increasing nutrient uptake. Anyhow, These results go in parallel with those of **Mansour and Shaaban (2007)** and **Sharaf *et al.*, (2011)** on Washington Navel orange trees, **Zaghloul and Knany, (2012)** on Navel orange**, El-Badawy *et al.*, (2017)** on Washington Navel orange trees, **El-Badawy, (2017)** on Valencia orange**, Samra *et al.* (2017)** on Washington Navel orange, **El-Gioushy and Eissa (2019),** on Washington Navel orange, **Fikry *et al.*, (2020)** on Murcott Tangerine trees and **EL-Khwaga *et al.* (2021)** on Washington Navel orange.

Conclusion

It can be recommended that minimizing 50 % chemical N fertilizers by Nitroben at the rate of 500 ml/tree enhanced productivity and fruit quality of Washington navel orange trees which is associated with lower production cost under the same conditions.

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تأثير التسميد النيتروجيني المعدني والحيوي على إنتاجية وجودة ثمار أشجار البرتقال أبو سرة صنف (واشنجطن)

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أجريت هذه الدراسة خلال موسمين متتاليين 2019 &2020 علي أشجار البرتقال أبو سرة (واشنجطن) عمر 15سنه المثمرة والمطعومة علي أصل النارنج وعلي مسافة زراعة 5 × 5م في أرض طمبية تحت نظام الري السطحي في مزرعة خاصه–كوم حماده– محافظة البحيره– مصر. وقد وقسمت الأشجار بغرض تقييم إستجابتها للاستبدال الجزئى للأسمدة النيتروجينية بالنيتروبين وعليه كانت المعاملات المختبرة كالتالى : 1– الكنترول (التسميد النيتروجيني المتبع في المزرعة)، 2– التسميد النيتروجيني باليوريا، 3– التسميد النيتروجيني بسلفات الامونيوم، 4– التسميد النيتروجيني بنترات الامونيوم، 5– التسميد النيتروجيني الحيوي بالنيتروبين 6– التسميد النيتروجيني باليوريا + التسميد النيتروجيني الحيوي بالنيتروبين، 7– التسميد النيتروجيني بسلفات الامونيوم + التسميد النيتروجيني الحيوي بالنيتروبين و8– التسميد النيتروجيني بنترات الامونيوم + التسميد النيتروجيني الحيوي بالنيتروبين. هذا وقد تم تقييم إستجابة أشجار البرتقال أبو سرة (واشنجطن) للمعاملات المختلفة من خلال إختبار مدي التباين في قياسات المحصول وكذلك صفات الجوده، ويمكن تلخيص النتائج التي تم الحصول عليها وذلك بتسميد أشجار البرتقال أبو سرة صنف "واشنجطن" بنرتات الأمونيوم + النيتروبين أو التسميد بسلفات الأمونيوم + النيتروبين أو التسميد باليوريا + النتروبين الذي يحسن من المحصول وصفات الجودة مقارنة بباقي المعاملات وخاصة الكنترول.

وعلية يمكن التوصية بتقليل 50 ٪ من الأسمدة الكيماوية (N) عن طريق السماد الحيوي (النيتروبين) بمعدل 500 مللي/شجرة لتحسين الإثمار والمحصول وجودة الثمار لأشجار البرتقال أبو سرة (واشنجطن) كمحاولة لتقليل استخدام الأسمدة الكيماوية النيتروجينية مع خفض تكاليف الإنتاج وذلك في ظل نفس ظروف الدراسة.