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Response of Newhall Naval Orange to Bio-Organic Fertilization under Newly Reclaimed Area Conditions I: Vegetative Growth and Nutritional Status

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Abstract: This study was carried out during two successive seasons (2007/2008 and 2008/2009) on three years old Newhall naval orange trees budded on Volkamer lemon rootstock grown in sandy soil under drip irrigation system in a private orchard located at Elbostan region, Behaira governorate. The main objective of the study is to examine the possibility of providing the basic needs of nitrogen, phosphorus and potassium from organic fertilization, organic fertilization plus EM as biofertilizer or organic fertilization plus humic acid in line with the organic production system for organic citrus orchards compared to the traditional system of fertilization, also to examine and detect the optimum dose of the fertilization sources. Results showed that, organic fertilization at high level plus humic acid enhanced vegetative growth by increasing trunk circumference, tree canopy volume, leaf area and total leaf chlorophyll content. The studied growth parameters increased significantly with increasing the dose of application for all fertilizers sources. Organic fertilization plus humic acid at high level significantly improved leaves nutritional status through increasing their contents of nitrogen, phosphorus and potassium compared to the chemical fertilizers. Leaf nitrogen, phosphorus and potassium were increased significantly with increasing fertilization levels.

Key words: Newhall naval orange · Organic fertilization · EM bio fertilizer · Humic acid · Mineral fertilization · vegetative growth · Nitrogen · Phosphorus · Potassium

INTRODUCTION

Citrus (*Citrus spp*.) is the largest horticultural industry in Egypt. Navel orange is the principal of citrus in Egypt and is considered the most popular citrus fruits for the Egyptians. Citrus harvested areas increased rapidly from year to year and reached 335,000 ha in 2010 which produced an average of 9.5tons/feddan [1]. Extension of the cultivated area is due to fit environmental conditions, has a great attention due to its importance for local consumption, its highly economic value as a main source for exportation to the European countries and the Gulf States and introducing new cultivars.Newhall navel orange (*Citrus sinensis* Osb.) was originated as a limb sport of a Washington navel orange in the Duarte area and selected by Paul Hackney of Newhall Land and Water Company of Piru. The maturation of Newhall fruit is slightly earlier and slightly smaller in size with deeper rind color and flesh color than Washington navel orange. Newhall navel orange trees are somewhat less vigorous and have leaves that are slightly darker in color than Washington navel orange trees [2]. Adequate supply of nitrogen (N), phosphorus (P) and potassium (k) is important for citrus tree growth [3]. Nitrogen is the key component in mineral fertilizers applied to citrus groves; it has more influence on tree growth, appearance and fruit quality than any other element [4]. Excess mineral nitrogen fertilization application enhances vegetative tree growth and may cause groundwater contamination if leached with excess irrigation [5]. Potassium is necessary for basic physiological functions such as formation of sugars and starch, synthesis of proteins and cell division and growth [6, 7]. It is important in fruit formation and enhances fruit size, flavor and color. Phosphorus is necessary for many life processes such as photosynthesis, synthesis and breakdown of carbohydrates and the transfer of energy within the plant [4]. The organic matter content of compost is high and its addition to soil often improves soil physical and chemical properties and enhances biological activities. Most agricultural benefits from compost application to soil are derived from improved physical properties related to increase organic matter content rather than its value as a fertilizer. Compost provide a stabilized form of organic matter that improves

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the physical properties of soil by increasing nutrient and water holding capacity, total pore space, aggregate stability, erosion resistance, temperature insulation and decreasing apparent soil density. Application of compost improves the chemical properties by increasing cation exchange capacity and soil nutrient content [8]. Bio fertilizers are microbial inoculants (preparations containing living micro organisms) which enhance production by improving the nutrient supplies and their crop availability. There are a number of inoculants with possible practical application in crops where they can serve as useful components of integrated plant nutrient supply systems, may help in increasing crop productivity by increasing biological N fixation availability or uptake of nutrients through convert insoluble P in the soil into forms available to plants or increasing absorption, stimulation of plant growth through hormonal action or antibiosis or by decomposition of organic residues [9].

Recently, biofertilization is considered an important tool to enhance the yield and fruit quality of citrus and it becomes, as positive alternative to chemical fertilizers. It is safe for human and environmental and using them was accompanied with reducing the great pollution occurred on our environment as well as for producing organic foods for export, Application of organic fertilizers in citrus orchard is a production system avoids or largely excludes the use of synthetic chemical fertilizers [10]. Humic acid (polymeric polyhydroxy acid) is the most significant component of organic substances in aquatic systems. Humic acid is highly beneficial to both plant and soil; it is important for increasing microbial activity, it is considered as a plant growth bio-stimulant, an effective soil enhancer; it promotes nutrient uptake as chelating agent and improves vegetative characteristics, nutritional status and leaf pigments [11, 12]. However the high cost of mineral fertilization is a big problem facing fruit tree grower, in addition the recent research revaluated that mineral fertilizers have a role in the health problems and environmental pollution [13].

The main objective of this investigation is to study the effect of replacement mineral N, P and K fertilization through using organic and biofertilizer sources on vegetative growth and leaf mineral content of Newhall navel orange.

MATERIALS AND METHODS

This study was carried out during the two successive seasons 2007/2008 and 2008/2009 on three years old Newhall naval orange trees grown in a private orchard, located at Elbostan district, Behaira Governorate, Egypt. The trees were budded on Volkamer lemon rootstock, planted at 4X6 m distance (175 tress / feddan) and the drip irrigation system was used. The trees were grown in sandy soil, physical and chemical properties of experimental soil are given in Table 1. All chosen trees were similar in size and shape and received the recommended agricultural practices. The experiment was arranged in randomized complete blocks design and each treatment was replicated three times with one tree per replicate.

Experimental Treatments

Organic Fertilization:

- Organic fertilization at low level: 15 kg compost +200 g rock phosphate+ 1 kg feldspar (175 N + 87.5 P + 175K g /tree / year).
- Organic fertilization at medium level: 30 kg compost + 400 g rock phosphate + 2 kg feldspar (350 N + 175 P + 350K g /tree / year).
- Organic fertilization at high level: 45 kg compost + 600 g rock phosphate + 3 kg feldspar (525 N + 262.5 P + 525K g /tree / year).

Organic Fertilization + EM Biofertilizer:

- Organic fertilization at low level: 15 kg compost +200 g rock phosphate + 1 kg feldspar + 300 cm^3 EM biofertilizer /tree.
- Organic fertilization at medium level: 30 kg compost + 400 g rock phosphate + 2 kg feldspar + 300 cm^3 EM biofertilizer/tree.
- Organic fertilization at high level: 45 kg compost + 600 g rock phosphate + 3 kg feldspar + 300 cm^3 EM biofertilizer/tree.

Organic Fertilization + Humic Acid:

- Organic fertilization at low level: 15 kg compost +200 g rock phosphate + 1 kg feldspar + 150 cm^3 humic acid/ tree.
- Organic fertilization at medium level: 30 kg compost + 400 g rock phosphate + 2 kg feldspar + 150 cm^3 humic acid/tree.
- Organic fertilization at high level: 45 kg compost + 600 g rock phosphate + 3 kg feldspar + 150 cm^3 humic acid /tree.

Table 1: Physical and chemical characteristics of experimental soil.

Physical characteristics (%)		Chemical characteristics	
Field capacity	11	$CaCO_3$ %	12.1
Available water	1.5	Organic matter %	0.31
Wilting point	4.22	pH(1:2.5 soil water suspension)	8.82
Coarse sand	47	EC(dS/m)	0.92
Fine sand	38	Ca^{2+} (meq/l)	0.15
Silt	12	Na^{+} (meq/l)	0.29
Clay	3	K^{+} (meq/l)	0.21
Texture class	Sandy	Cl^{-} (meq/l)	0.47

Table 2: Chemical and physical analysis of the compost used in the study.

Parameter	Value	Parameter	Value	Parameter	Value
Dry weight	550 kg	C/N ratio	15.8	Total Mg %	0.92
Moisture %	30	Total N %	1.52	Total Fe (mg/Kg)	330
Organic matter %	33.7	Total P %	0.51	Total Mn (mg/Kg)	111
pH (1:2.5 soil water suspension)	8.5	Total K %	0.70	Total Zn (mg/Kg)	25
EC(dS/m)	4.33	Total Ca %	1.91	Total Cu (mg/Kg)	185

All marked data were analyzed in dry compost.

Mineral Fertilization:

- Mineral fertilization of NPK at low level: (175:87.5:175 g /tree).
- Mineral fertilization of NPK at medium level: (350:175:350 g /tree) (control).
- Mineral fertilization of NPK at high level: (525:262.5:525 g /tree).

The chemical analysis of compost (Table 2) was used to calculate the required amounts to supply the three rates of NPK based on compost dry weight. In addition, Feldspar rocks that used in this study contained 8.5% K_2O. Also, phosphate natural rock contained 12 % P_2O_5 and the bio-fertilizer (EM) was obtained from Ministry of Agriculture, produced by the General Organization for Agriculture Equalization Found (GOAEF).

The Application Method of Organic Manure: During the first and second seasons in first December, two trenches (100 cm length x 30 cm width x 30 depth) were dogged on both side of the trees, the compost, nurture rooks(rock phosphate-feldspar) and part of surface soil were mixed and added then irrigated.

The Application Method of Bio-Fertilizers: EM (Effective Micro-Organisms) was used in a solution, it was added to the wetted compost as soil application during studies seasons, the bio-fertilizer (EM) was added in three equal doses in the first week of March, May and July while the irrigation was conducted after all application.

EM is biofertilizer, created in Japan over 25 years ago in University of the Ryukyus in Okinawa and marketed by EMRO (EM Research Organization). The basic purpose of EM is the restoration of healthy ecosystem in both soil and water by using three major genera of microorganisms which are found in nature: phototrophic bacteria (*Rhodopseudomonas*), lactic acid bacteria (*Lactobacillus*) and yeast (*Saccharomyces*). EM contains *Lactobacillus plantarum*, *Lactobacillus casei*, *Lactobacillus fermentum*, *Lactobacillus delbrueckii*, *Saccharomyces cerevisiae* and *Rhodopseudomonas palustris* [14, 15].

The Application Method of Humic Acid: Humic acid was used in a solution, it was added to the wetted compost as soil application during the two seasons, were added in three equal doses, first was add in first week of March and repeat again in the first week of May and the first week of July. Irrigation was conducted after all application.

The Application Method of Chemical Fertilizers: The chemical fertilizers doses were added as soil application from mid February until mid October in two doses per week as solution under drippers.

Ammonium nitrate (NH_4NO_3, 33.5 % N) was used as a source of nitrogen, phosphoric acid (45 % P_2O_5) was used as a source of phosphorus and potassium sulphate (high soluble, 50% K_2O) was used as a source of potassium.

Studied Parameters

Vegetative Growth

Increment in Trunk Circumference (I.T.C.): The increment in trunk circumference (ITC) was calculated as cm/ year at about 10 cm from the trunk base according to the following equation:

I.T.C = Final trunk circumference (December) - Initial trunk circumference (January)

Tree Canopy Volume: The tree canopy volume (CV) was calculated according to the following equation: CV= 0.528 X H X D2. Where H = tree height, D = tree diameter.

Leaf Area (cm^2): Twenty mature leaves per replicate were taken at mid June for determining average leaf area by using leaf area meter (GI- 203 AREA METER CID, Inc. USA).

Leaf Mineral Content: In the first week of September in both seasons twenty mature leaves were taken from non fruiting shoots of the previous spring growth cycle for determining the leaf content of N, P and K%.

The leaf samples were cleaned, dried at 70C in an electric oven till a constant weight, grounded in electric mill and digested according to Chapman and Prat [16]. Total nitrogen was determined according to Pregl [17], phosphorus was colorimetrically determined according to Murphy and Riley [18]. Potassium was flame photometrically determined by using a bye unican sp 1990 Atomic absorption spectrometer according to Brandifeld and Spincer [19].

Statistical Analysis: Experimental design followed randomized complete blocks design with two factors, (A) sources of fertilizer and (B) level of fertilization. Factor A comprised of four sources of fertilizer, factor B comprised three levels of fertilization. The obtained data were tabulated and subjected to analysis of variance (ANOVA) according to Snedecor and Cochran [20], using Mstat software and mean of the treatments were compared using LSD at 5% level of probability.

RESULTS AND DISCUSSION

Increment of Trunk Circumference: Trunk circumference was significantly affected by the different sources of fertilization. In both seasons the highest significant value was recorded with organic fertilization plus humic acid treatment, followed by organic fertilization plus EM and Mineral fertilization treatments (Table 3). Trunk circumference increased significantly with increasing the dose of application for all fertilizer sources. Interaction results showed significantly highest trunk circumference when trees applied with organic fertilizer at high dose plus humic acid. Meanwhile, the lowest value was recorded with mineral fertilization at low level.

Tree Canopy Volume: Data in Table 4 showed that, tree canopy volume was significantly higher by organic fertilization plus humic acid and organic fertilization plus EM compared with the mineral fertilization. Also tree canopy volume increased significantly with increasing rate of application of all fertilizer sources. Interaction data illustrate that, highest tree canopy volume was recorded with high level of organic fertilization plus humic acid. On the other hand, the lowest tree canopy volume was recorded by low level of the mineral fertilization treatment.

Leaf Area (cm^2): There was no significant difference in leaf area between the different sources of fertilizers in both seasons of study (Table 5). On the other hand, leaf area was significantly affected by fertilization dose, since the significantly highest leaf area was obtained with highest level of the different fertilization treatments. Interaction data revealed that, the highest leaf area was recorded with organic fertilization plus humic acid followed by organic fertilization alone and organic fertilization plus EM then mineral fertilization alone (control). On the contrary, the lowest leaf area was detected with mineral fertilization at low level.

Generally the above mentioned results indicated that, organic fertilization at high level plus humic acid or EM were favorable for improving vegetative growth of Newhall naval orange trees compared to mineral fertilization, this may be attributed to the role of organic and bio-fertilizers in increasing the level of available minerals from the organic matter and the natural rocks. These results are in agreement with Abd El-Samad *et al.* [21] who revealed that, growth of Sour orange; Volkamer lemon and Cleopatra mandarin were improved by biofertilizers. Also, they added that Valencia orange budded on Volkamer lemon rootstock had higher values of stem length and diameter than those on Sour orange. Moreover, Aseri *et al.* [22] enhanced growth of pomegranate by using biofertilizers. Also, application of organic fertilizers to Balady Mandarin trees improved all the vegetative characteristics including trunk and one year old shoot diameter, shoot length, leaf area and leaf chlorophyll content and the effect of bio-organic fertilizers combination was better than the organic fertilizers only [23]. Moreover, Abd-Rabou [24] improved vegetative growth of mango seedling by using EM biofertilizes. Helaib [25] improved vegetative growth and leaf mineral content of Washington navel orange by application of organic manure and bio-fertilizers. Also organic and Bio-fertilization enhanced vegetative growth of Picual olive trees [26].

Table 3: Effect of different fertilization treatments on increment of trunk circumference (cm / year) of Newhall naval orange during 2007/2008 and 2008/2009 seasons.

	2007/2008 season				2008/2009 season			
	Fertilizer levels				Fertilizer levels			
Fertilizer sources	Low	Medium	High	Mean (A)	Low	Medium	High	Mean (A)
Organic	6.00	7.17	9.00	7.39	5.33	6.67	8.33	6.78
Organic + EM	6.50	8.00	10.00	8.17	6.17	7.33	9.33	7.61
Organic + humic acid	7.17	8.33	11.00	8.83	6.83	8.00	10.67	8.50
Mineral	5.00	7.50	9.50	7.33	5.00	7.17	8.83	7.00
Mean (B)	6.17	7.75	9.88		5.83	7.29	9.29	

LSD value at 0.05: 2007/2008 season A= 0.26 B: 0.22 AXB = 0.45 2008/2009 season A= 0.49 B: 0.42 AXB = 0.85

Table 4: Effect of different fertilization treatments on increment in tree canopy volume of Newhall naval orange during 2007/2008 and 2008/2009 seasons.

	2007/2008 season				2008/2009 season			
	Fertilizer levels				Fertilizer levels			
Fertilizer sources	Low	Medium	High	Mean (A)	Low	Medium	High	Mean (A)
Organic	2.06	2.42	2.60	2.36	3.24	3.55	3.82	3.53
Organic + EM	2.48	2.66	2.85	2.66	3.32	3.73	4.03	3.69
Organic + humic acid	2.43	2.80	2.89	2.71	3.43	3.77	4.32	3.84
Mineral	1.67	2.52	2.72	2.30	3.07	3.55	3.76	3.46
Mean (B)	2.16	2.60	2.77		3.27	3.65	3.98	

LSD value at 0.05: 2007/2008 season A= 0.20 B: 0.17 AXB = 0.35 2008/2009 season A= 0.24 B: 0.21 AXB = 0.42

Table 5: Effect of different fertilization treatments on leaf area (cm^2) of Newhall naval orange during 2007/2008 and 2008/2009 seasons.

	2007/2008 season				2008/2009 season			
	Fertilizer levels				Fertilizer levels			
Fertilizer sources	Low	Medium	High	Mean (A)	Low	Medium	High	Mean (A)
Organic	22.15	24.65	28.88	25.23	25.22	27.65	32.21	28.36
Organic + EM	23.43	24.77	28.23	25.48	24.10	27.11	31.56	27.59
Organic + humic acid	22.23	24.11	29.44	25.26	23.89	28.11	34.77	28.92
Mineral	19.21	24.11	28.44	23.92	20.54	25.11	32.44	26.03
Mean(B)	21.75	24.41	28.75		23.44	26.99	32.75	

LSD value at 0.05: 2007/2008 season A= 2.37 B: 2.05 AXB = 4.11 2008/2009 season A= 3.61 B: 3.13 AXB = 6.26

Table 6: Effect of different fertilization treatments on leaf total chlorophyll of Newhall naval orange during 2007/2008 and 2008/2009 seasons.

	2007/2008 season				2008/2009 season			
	Fertilizer levels				Fertilizer levels			
Fertilizer sources	Low	Medium	High	Mean (A)	Low	Medium	High	Mean (A)
Organic	42.3	45.0	45.7	44.3	40.67	44.00	45.67	43.44
Organic + EM	41.0	46.0	48.0	45.0	41.00	46.00	48.00	45.00
Organic + humic acid	47.0	48.0	50.0	48.3	45.67	47.00	51.00	47.89
Mineral	39.7	41.3	45.7	42.2	39.33	41.67	45.33	42.11
Mean (B)	42.5	45.1	47.3		41.67	44.67	47.50	

LSD value at 0.05: 2007/2008 season A= 1.81 B: 1.57 AXB = 3.14 2008/2009 season A= 2.21 B: 1.91 AXB = 3.83

Table 7: Effect of different fertilization treatments on leaf nitrogen (%) of Newhall naval orange during 2007/2008 and 2008/2009 seasons.

	2007/2008 season				2008/2009 season			
	Fertilizer levels				Fertilizer levels			
Fertilizer sources	Low	Medium	High	Mean (A)	Low	Medium	High	Mean (A)
Organic	2.04	1.95	2.38	2.12	2.04	2.06	2.44	2.18
Organic + EM	2.12	2.33	2.32	2.26	2.24	2.46	2.51	2.41
Organic + humic acid	2.44	2.52	3.00	2.65	2.46	2.52	3.10	2.69
Mineral	1.70	2.50	2.73	2.31	1.70	2.47	2.70	2.29
Mean (B)	2.08	2.33	2.61		2.11	2.38	2.69	

LSD value at 0.05: 2007/2008 season A= 0.04 B: 0.04 AXB = 0.08 2008/2009 season A= 0.12 B: 0.11 AXB = 0.22

Table 8: Effect of different fertilization treatments on leaf phosphorus (%) of Newhall naval orange during2007/2008 and 2008/2009 seasons.

	2007/2008 season				2008/2009 season			
	Fertilizer levels				Fertilizer levels			
Fertilizer sources	Low	Medium	High	Mean (A)	Low	Medium	High	Mean (A)
Organic	0.13	0.15	0.17	0.15	0.12	0.14	0.16	0.14
Organic + EM	0.21	0.24	0.26	0.24	0.20	0.24	0.26	0.24
Organic + humic acid	0.22	0.25	0.28	0.25	0.23	0.24	0.29	0.25
Mineral	0.18	0.23	0.28	0.23	0.17	0.23	0.26	0.22
Mean (B)	0.18	0.22	0.25		0.18	0.21	0.24	

LSD value at 0.05: 2007/2008 season A= 0.02 B: 0.11 AXB = 0.03 2008/2009 season A= 0.02 B: 0.02 AXB = 0.04

Table 9: Effect of different fertilization treatments on leaf potassium (%) of Newhall naval orange during 2007/2008 and 2008/2009 Seasons.

	2007/2008 season				2008/2009 season			
	Fertilizer levels				Fertilizer levels			
Fertilizer sources	Low	Medium	High	Mean (A)	Low	Medium	High	Mean (A)
Organic	1.23	1.33	1.50	1.36	1.28	1.33	1.50	1.37
Organic + EM	1.20	1.50	1.60	1.43	1.20	1.50	1.60	1.43
Organic + humic acid	1.40	1.60	1.80	1.60	1.40	1.60	1.83	1.61
Mineral	1.17	1.30	1.57	1.34	1.17	1.30	1.53	1.33
Mean (B)	1.25	1.43	1.62		1.26	1.43	1.62	

LSD value at 0.05: 2007/2008 season A= 0.06 B: 0.05 AXB = 0.11 2008/2009 season A= 0.06 B: 0.05 AXB = 0.11

Total Chlorophyll: It appeared from data presented in Table 6 that, leaf content of total chlorophyll was affected by the different fertilization treatments. Organic fertilization plus humic treatments improved leaf total chlorophyll significantly compared with other treatments, while the chemical fertilization treatments resulted in the significantly lowest leave chlorophyll content. The effect of fertilization dose showed a liner correlation between fertilization dose and total chlorophyll content. Interaction results showed significantly highest leaf area with organic fertilization plus humic acid or EM at high level. Meanwhile, the lowest significant leaf area was observed with organic fertilization plus EM at low level in both studied seasons.

The important role of biofertilizers on enhancing the formation of leaf chlorophyll might be attributed to their action on increasing availability of water and minerals. The results obtained by Ahmed and El-Dawwey [27]; El-Sayied [28] and Ragab [29] supported the stimulating effect of biofertilizers on chlorophyll. Also, Tiwary *et al.* [30] recorded higher chlorophyll content in leaves of Banana inoculated with N2-fixing bacteria. Moreover, Kohler *et al.* [31] reported that the high chlorophyll content might be result from enhancing plant growth.

Leaf Mineral Content

Leaf Nitrogen (%): Data in Table 7 showed that, the highest leaf nitrogen (%) was found with organic fertilization plus humic acid followed by mineral fertilization and organic fertilization plus EM then organic fertilization alone which recorded the lowest value. Leaf nitrogen increased significantly with increasing fertilization levels. Interaction data cleared that, the highest leaf nitrogen (%) was recorded with the high level of organic fertilization plus humic acid or mineral fertilization. On the other hand, the lowest values were recorded with organic fertilization alone at low and medium levels in both seasons.

Leaf Phosphorus (%): Leaf phosphorus (%) was the highest with organic fertilization plus humic acid followed by organic fertilization plus EM and mineral fertilization then organic fertilization alone which contained the lowest phosphorus (%). A direct relationship was found between fertilization levels and leaf phosphorus (%). Interaction data show that, the highest recorded leaf phosphorus (%) was due to fertilization with organic plus humic acid or plus EM at high levels. Meanwhile, the leaf phosphorus (%) was significantly at the least value with organic fertilization alone at low and medium levels (Table, 8).

Leaf Potassium (%): Fertilization sources significantly affected leaf potassium (%) in both seasons. The highest values were found in leaves of trees fertilized with organic plus humic acid followed by organic fertilization plus EM and organic then mineral fertilization which recorded the lowest values in both seasons. Interaction data demonstrate that, leaf potassium (%) was the highest with organic fertilization plus humic at high level (Table, 9). Statistical equal results were due to organic fertilization plus humic acid at high level and organic fertilization plus humic acid at medium level. Meanwhile, the lowest leaf potassium (%) was detected with mineral and organic fertilizations plus EM at low level in both studied seasons.

Organic fertilization plus EM or humic acid treatments resulted in increasing NPK content in Newhall navel orange leaves compared with the chemical fertilization alone, this may be attributed to the efficient of EM biofertilizers in releasing phosphorus from rock phosphate. Regarding the effect of fertilization dose, within each source of fertilizers, leaf content of NPK was increased with increasing fertilization dose. The great availability and release of N, P and K due to the application of biofertilizers were announced by Ahmed and El-Dawwey [27] on olive and Chokha and Sharma [32] on sweet orange; Abd El-Samad *et al.* [21] on citrus and Al-Ashkar [33] on banana. Also, using biofertlizers to improve nutritional status of different fruit crops were reported by Izquierdo *et al.* [34] on volkamer lemon seedling; Singh and Sharma [35] on sweet orange;; Abou Taleb *et al.* [36] on olive; El-Sharkawy and Mehisen [37] on guava; Abd-Rabou [24] on avocado and mango.

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