

---

## **Beneficial Effect of NPK, Pigeon Manure Tea and Microbial Fertilizers as Soil Application on Growth of "Toffahi" and "Picual" Olive Seedlings**

---

**Haggag, L. F.<sup>1\*</sup>, Shahin, M. F. M.<sup>1</sup>, Mahdy, H. A.<sup>2</sup>, Atteya, A. K. G.<sup>3</sup> and Hassan, H. S. A.<sup>1</sup>**

<sup>1</sup>Pomology Department, National Research Center, Giza, Egypt.; <sup>2</sup>Plant Department, National Research Center, Giza, Egypt.; <sup>3</sup>Horticulture Department (Floriculture), Faculty of Agriculture, Damanhour University, Egypt.

Haggag, L. F., Shahin, M. F. M., Mahdy, H. A., Atteya, A. K. G. and Hassan, H. S. A. (2015). Beneficial effect of NPK, pigeon manure tea and microbial fertilizers as soil application on growth of "Toffahi" and "Picual" olive seedlings. International Journal of Agricultural Technology 11(7):1581-1598.

**Abstract** This study was carried out in greenhouse of National Research Center, Dokki, Giza government, Egypt on the olive seedlings of "Toffahi" and "Picual" cv to study the influence of different levels of mineral fertilizers using NPK (25, 50, 75 and 100 %) in combination with a mixture of three commercial bio-fertilizes named: Nitrobein, Potassin and Phosphorine and organic fertilizer by using Pigeon manure tea. In general, the application of the second treatment (75% of N P K + 100 gm pigeon manure tea +2.5 nitrobein+ 2.5 gm Phosphorine+ 2.5 gm Potassin) gave the best results for increasing all vegetative growth such as plant height increment %, Lateral shoot numbers, Stem diameter, number of leaves/ seedling, dry weight of leaves %, and root numbers per seedling as well as nitrogen, potassium and phosphorus contents in leaf seedlings comparing with the other treatments. From the other hand, the third treatment (50% of N P K + 100 gm pigeon manure tea +2.5 nitrobein + 2.5 gm Phosphorine + 2.5 gm Potassin) gave the maximum root length comparing with the other studied treatments.

**Keywords:** olive, seedling, "Toffahi" and "Picual", NPK, pigeon manure tea, microbial fertilizers.

---

\* **Coressponding author:** Haggag, L. F.; **E-mail:** -

## Introduction

Olive (*Olea europaea* L.) is one of the oldest cultivated tree crops in the history of the world about 8000 years age. It was originated in the ancient times in the eastern side of the Mediterranean Sea. Olive has speared to all the countries around the Mediterranean basin, which is still the major region of olive production until today.

Mineral nutrition is one of the most important factors for plant growth and yield. Mineral fertilizers, particularly mineral-nitrogen, are important element for plant nutrition; however, they are also a potential source of environmental pollution (Hartman, 1988). An attention has therefore focused on alternative fertilizers, including bio-fertilizers in Middle East. Nowadays, there is renewed interest in bio-fertilizers for nutrient supply and improve soil fertility and productivity in this region. The integrated use of bio-fertilizers and mineral fertilizers is considered as the best option not only to reduce the intensive consumption of chemical fertilizers, but also to sustain the soil with minimum undesirable impacts and to maximize fertilizer use efficiency in soil (Palm *et al.*, 1999 and Singh *et al.*, 1999).

Bio-fertilization is biological preparations containing primarily patent strains of micro- organisms in sufficient numbers. These micro- organisms have definite beneficial roles in the fertility of soil rhizosphere and the growth of seedlings. The multistrain of biofertilizers might contain different strains of symbiotic associative diazotrophes, phosphate solubilizing micro- organisms and silicate dissolving microorganisms (Saber, 1993)

Bio-fertilizers are formulations of beneficial microorganisms, which upon application can increase the availability of nutrients by their biological activity and help to improve the soil health for increasing soil fertility with objective of increasing the number of such microorganisms and to accelerate certain microbial processes. The main idea behind organic also secrete various plant growth and health promoting substances (Pandya and Saraf, 2010). Bio-fertilizers are low cost, effective and renewable source of plant nutrients to supplement chemical fertilizers (Boraste *et al.*, 2009).

Bio-fertilizers are considered as eco-friendly way to sustainable agriculture. They positively affect plant growth. Bio-fertilizers can promote plant growth and productivity. They are internationally accepted as an alternative source of

N-fertilizer. In the bio-fertilizer technology, new systems are being developed to increase the biological N<sub>2</sub>-fixation with cereals and other non-legumes by establishing N<sub>2</sub>-fixing bacteria within the roots (Cockin, 2000).

The mechanisms by which bio-fertilizers can exert a positive effect on plant growth can be through the synthesis of phytohormones, N<sub>2</sub>-fixation, reduction in membrane potential of roots, synthesis of some enzymes (such as ACC deaminase) that modulate the level of plant hormones. Free living nitrogen-fixing bacteria such as *Azotobacter* and *Azospirillum* have the ability not only to fix nitrogen but also to release certain phytohormones i.e. GA<sub>3</sub>, IAA, and cytokinins which could stimulate plant growth and increase the availability of nutrients for plant roots by the increase in their dissolution. In addition, the increase in the capacity of photosynthesis (Ibrahim & Abd El-Aziz, 1977 and Abdel-Latif *et al.*, 2001).

Compost tea there is a global impact for organic farming through recycling of organic waste for persistent agriculture as well as for a pollution-free environment. For the development of sustainable farming, waste enrichment is of interest. Involvement of earthworms (*Eiseniafoetida*) for the degradation of organic wastes and production of vermicompost is near commercialization (Kumar and Singh, 2001). Compost tea, in modern terminology is a compost extract, plant extracts, liquid manures and compost teas can be further understood in the context of their influences on the rhizosphere and phyllosphere. Also, manure and compost tea production is a brewing process that extracts microorganisms from compost or manure followed by microbial growth and multiplication including beneficial bacteria, fungi and protozoa (Ingham, 2005). Soil application of compost with compost tea gave better effect on all vegetative characteristics and leaves chemical constituents of macro and micro elements, total carbohydrates and C/N ratio compared to control of pear trees (Mohammed *et al.*, 2010). Using organic manure and the application of bio-fertilizers such as vermicompost and nitrogen fixing bacteria has led to a decrease in the use of chemical fertilizers and has provided high quality products free of harmful agrochemicals for human safety (Mahfouz and Sharaf Eldin, 2007; Moradi *et al.*, 2010).

The objective of this study was examining the effect of replacing mineral fertilizers partially by using organic and bio- fertilizers on growth of "Toffahi" and "Picual" olive seedlings grown in shade house. Thus, this present work

intended to evaluate the effects of pigeon manure tea and three microbiological fertilizers on the growth of "Toffahi" and "Picual" olive seedlings. The three bio-fertilizers used included Nitrobein, Phosphorine and Potassin.

## **Materials and methods**

This study was carried out in the experimental research shade house of National Research Center, Dokki, Giza, Egypt during 2012. For this purpose, healthy one year old olive and almost uniform seedlings "Toffahi" and "Picual" cvs were used. The seedlings were planted in black polyethylene bags with 30 cm diameter filled 10 kg washed sand mixed very good. Olive seedlings were irrigated twice weekly. These seedlings which grown under greenhouse conditions were distributed in completely randomized design, included 6 treatments were resulted from combination between:

### **1. Chemical fertilizer**

Four rates of NPK (25, 50, 75 and 100 %) equal 45, 90, 135 and 180 g/ seedling in the form of Crystalon (20% N: 20% P: 20% K) applied as soil application divided into 16 doses from March to October about one dose every 15 days.

### **2. The bio-fertilization treatments included**

- a- **Nitrobein:** bio-fertilizer containing *Azospirillum* sp. (nitrogen fixing bacteria). Nitrobein was obtained from General Organization for Agriculture Equalization Fund (GOAEF) Ministry of Agriculture ,Egypt.
- b- **Potassin:** is a commercial biofertilizer contains a highly active potassium solubilizing bacteria (*Bacillus mucilaginosus*). Potassin was obtained from General Organization for Agriculture Equalization Fund (GOAEF) Ministry of Agriculture, Egypt.
- c- **Phosphorine:** is a commercial products of bio-fertilizers contains a highly active dissolving bacteria (*Bacillus megatherium*), which converse the insoluble tricalcium phosphate to the soluble mono-calcium phosphate and supplying the plants with its needs during different growth stages. This commercial products (Phosphorine) produced by General Organization of Agriculture Equalization Fund (GOAEF) oversight of Ministry of Agriculture, Egypt.

### **3. source of organic fertilizer**

Pigeon manure tea was used as organic fertilizer and prepared by collect a good sized amount of Pigeon manure. Make sure they are dry. If they are not dry, allow them to dry (spread them out somewhere to dry). Put them in an old burlap bag. Weight them. Fill a large plastic barrel with a lid with 10 times the weight of water to Pigeon manures. Place the closed old burlap bag in the barrel Add a brick or large rock to give it some weight so that it won't float and let sit 3-4 weeks, stirring regularly stir it well once or twice daily. Haul the bag of manure out of the water. Squeeze it to remove all the excess liquid. Use the tea fertilizer by diluting it 4:1 with water. Use about 30 cm<sup>3</sup> of organic fertilizer in the form of compost tea applied as soil drench application every 15 days from March to October.

#### ***This investigation included the following five treatments***

T1= 100% of N P K

T2= 75% of N P K + pigeon manure tea +2.5 nitrobin+ 2.5 gm Phosphorine+ 2.5 gm Potassin.

T3= 50% of N P K + pigeon manure tea +2.5 nitrobin+ 2.5 gm Phosphorine + 2.5 gm Potassin.

T4= 25% of N P K + pigeon manure tea +2.5 nitrobin+ 2.5 gm Phosphorine + 2.5 gm Potassin.

T5= pigeon manure tea +2.5 nitrobin+ 2.5 gm Phosphorine + 2.5 gm Potassin without NPK.

T6= 25% of N P K +2.5 nitrobin+ 2.5 gm Phosphorine + 2.5 gm Potassin without pigeon manure tea.

The four rates of mineral fertilizer Crystalon (20% N: 20% P: 20% K) was applied as soil application (dissolved in the irrigation water ) each rate divided into 16 equal doses from March to September during growing season, while bio-fertilizers, i.e, Nitrobin, Microbin and Biogin were added one time at the beginning of the growing season at the rate of 2.5 g per seedling in the first week of March in growing season through mixing bio-fertilizer powder with 5 cm of soil layer. In September and October the following parameters were measured:

### ***I. Growth parameters***

- a) Plant height increment percentage.
- b) Lateral shoot numbers.
- c) Stem diameter (mm).
- d) Leaves number/ seedling.
- e) Leaves dry weight percentage.
- f) Number of main roots.
- g) Root length (cm).

### ***II. Chemical constituents***

Nitrogen and phosphorus in leaves were calorimetrically determined according to the methods described by Bremner and Mulvaney (1982) and Olsen and Sommers (1982), respectively. Potassium was determined by flame photometrically according to the method advocated by Jackson (1970).

### ***4. Data Analysis***

All the obtained data during the growth season of the study was statistically analyzed of variance method, differences between means were compared using Duncan's multiple range test at 0.05 level according (Duncan, 1955).

## **Results**

### ***1. Shoot parameters***

The presented data clearly show that olive shoot growth was affected by different fertilization treatments in all vegetative parameters including percentage of plant height increment, lateral shoot numbers, stem diameter, leaves number and leaves dry weight. The statistical analysis of results indicated that the differences between the treatments were significant (Table 1).

#### ***1.1. Plant height increment %***

Percentage of plant height increment varied according to its cultivars as well as its treatments. Table 1 indicates that second treatment gave the highest average of plant height increment percentage (122.55 %) across two cultivars with insignificant differences among third and fourth treatments and the seam situation was observed between the first and the fifth treatments. Picual seedling significantly gave the highest response to plant height increment percentage (144.68 %) as compared with Toffahi seedling (99.70 %). The

interaction was significantly between the treatments and cultivars. Moreover, the highest values of plant height increment percentage for Picual and Toffahi seedling (132.50 and 112.60%) respectively were obtained at second treatment by using the 75% of N P K + 100 gm pigeon manure tea +2.5 nitrobenin+ 2.5 gm Phosphorine + 2.5 gm Potassin for two cultivars (Table 1).

### 1.2. Lateral shoot numbers

Comparison between the treatments means for lateral shoot number (Table 1) indicated that the second treatment gave the highest lateral shoot number (10) with insignificant differences between second, third and fourth treatments across cultivars. On the other hand, Toffahi seedling gave the highest number of the lateral shoot (9) across the treatments with insignificant differences between two cultivars. The interaction was significantly between the treatments and cultivars. The highest value of lateral shoot number derived from Toffahi and Picual seedling (11 and 9, respectively) was obtained on second treatment.

**Table 1.** Effect of NPK, pigeon manure tea and microbial fertilizers on plant height increment%, Lateral shoot numbers and stem diameter of Toffahi and Picual Olive seedlings.

Treatment	plant height increment %			Lateral shoot numbers			Stem diameter		
	Toffahi	Picual	Mean	Toffahi	Picual	Mean	Toffahi	Picual	Mean
T1	82.02 e	118.20 ab	100.1 1 C	8 abc	5 cd	7 B	5.82 b	6.60 ab	6.21 B
T2	112.60 abcd	132.50 a	122.5 5 A	11 a	9 ab	10 A	6.01 b	7.70 a	6.86 A
T3	95.49 cde	128.40 a	111.9 5 B	9 ab	8 ab	9 A	5.66 b	6.70 ab	6.18 B
T4	88.29 de	126.10 a	107.2 0 B	7 bc	8 abc	8 AB	5.86 b	6.20 b	6.03 B
T5	81.08 ef	118.90 ab	99.99 C	7 bc	5 cd	6 B	2.09 c	6.70 ab	4.40 C
T6	50.45 f	117.90 abc	84.18 D	2 e	3 de	3 C	1.83 c	1.60 c	1.72 D
Mean	99.70 B	144.68 A		9 A	8 A		5.52 B	6.95 A	

Means having the same letters within a column are not significantly different at 5% level.

### 1.3. Stem diameter

The best value of Stem diameter was obtained in second treatment (6.86 mm) across two cultivars (Table 1). The Stem diameter of Picual seedling (6.95 mm) was higher than the Stem diameter of Toffahi seedling (5.52 mm) across treatments (table 1). The interaction was significantly between the treatments and cultivars. The highest value of stem diameter (7.70 and 6.01 mm) for Picual and Toffahi olive seedlings respectively was obtained from second treatment which provided with the 75% of N P K + 100 gm pigeon manure tea +2.5 nitrobein+ 2.5 gm Phosphorine + 2.5 gm Potassin for two cultivars.

### 1.4. Leaves number

Table (2) shows the effect of different concentration of NPK, pigeon manure and microbial fertilization on the leaves number and Leaves dry weight % of two olive seedling cultivars. The response of leaves number varied according to its treatments. Table 2 indicated that the second treatment gave the highest average of leaves number (227.50) across two cultivars. On the other hand, the sixth treatment had the lowest significant leaves numbers (93.50) across two cultivars. Toffahi seedling gave the higher significant leaves number (227.6) compared with Picual olive seedlings (174.17) across all treatment. The interaction between treatments and cultivars was significant. The variation ranged from (241) for Toffahi seedling on second treatment to (72) for Picual seedling on sixth treatment (table 2).

**Table 2.** Effect of NPK, pigeon manure tea and microbial fertilizers on Leaves number and dry weight of Toffahi and Picual Olive seedlings.

Treatment	Leaves number			Leaves dry weight %		
	Toffahi	Picual	Mean	Toffahi	Picual	Mean
T1	186 abc	100 de	143.00 D	53.09 b	48.60 d	50.85 A
T2	241 a	214 ab	227.50 A	53.84 a	48.50 d	51.17 A
T3	220 ab	169 bcd	194.50 B	53.20 b	48.03 e	50.62 A
T4	214 ab	169 bc	191.50 B	52.22 c	48.08 e	50.15 A
T5	162 bcd	152 bcd	157.00 C	46.43 f	46.15 f	46.29 B
T6	115 cde	72 e	93.50 E	41.13 g	44.41 g	42.77 C
Mean	227.6 A	174.17 B		58.69 A	55.31 B	

Means having the same letters within a column are not significantly different at 5% level.



### ***1.5. Leaves dry weight***

The highest value of leaves dry weight (51.27%) was obtained in the second treatments across two cultivars which were insignificantly different from other treatments except fifth and sixth treatments. Moreover, the leaves dry weight of Toffahi seedling (58.69%) was significantly higher than leaves dry weight of Picual seedling (55.31%) across all treatments.

## ***2. Root parameters***

From this investigation it was observed that olive root growth was affected by different fertilization treatments in all rooting parameters including root numbers and Root length. The statistical analysis of results indicated that the differences between the treatments were significant (Table 3).

### ***2.1. Root numbers***

It was found from table (3) that root numbers varied according to its treatments. Table 3 indicates that second treatment gave the highest average of root numbers (7) across two cultivars with insignificant differences among second and third treatments. Toffahi and Picual seedling gave the same response to root numbers (5). The interaction was significant between the treatments and cultivars. Moreover, the highest values of root numbers were 6 and 7 respectively for Toffahi and Picual olive seedlings respectively which were obtained at second treatment (Table 3).

### ***2.2 Root length***

The estimated of significance for the effects of treatments, cultivars and their interaction on root length are presented in table 3. It was observed that third treatment gave the highest average of root length (29.67 cm) across two cultivars. Picual seedling significantly gave the highest response to root length (26.89 cm) as compared with Toffahi seedling (21.78 cm). The interaction was significantly between the treatments and cultivars. Moreover, the highest values of root length for Toffahi and Picual olive seedlings were 31.00 and 32.67 cm respectively by using the third and second treatments, respectively (Table 3)

**Table 3.** Effect of NPK, pigeon manure tea and microbial fertilizers on root numbers and length of Toffahi and Picual olive seedlings.

Treatment	Root numbers			Root length		
	Toffahi	Picual	Mean	Toffahi	Picual	Mean
T1	4 ab	4 ab	4 B	11.00 fg	23.00 cd	17.00 E
T2	6 a	7 a	7 A	12.00 fg	32.67 a	22.34 C
T3	5 ab	6 a	6 A	31.00 ab	28.33 abc	29.67 A
T4	4 ab	4 ab	4 B	15.00 efg	23.67 bcd	19.34 D
T5	4 ab	4 ab	4 B	28.67 abc	21.00 cde	24.84 B
T6	2 b	2 b	2 C	18.00 def	9.00 g	13.50 F
Mean	5 A	5 A		21.78 B	26.89 A	

Means having the same letters within a column are not significantly different at 5% level.

### ***3. Effect of treatment on leaf mineral content***

#### ***3.1. Leaf nitrogen content***

Table (4) revealed that the effect of different concentration of NPK, pigeon manure and microbial fertilization on leaf nitrogen content of two olive seedling cultivars was significant. The response of leaf nitrogen content varied according to its treatments. Table 4 indicated that the second treatment gave the highest significant average of leaf nitrogen content (2.56%) across two cultivars. On the other hand, the sixth treatment had the lowest significant leaf nitrogen content (1.35 %) across two cultivars. Toffahi and Picual seedling average of leaf nitrogen content (2.24 and 2.23 %) had insignificant differences between them across all treatments. The interaction was significantly between the treatments and cultivars. The variation ranged from (2.49%) on second treatment to (1.23 %) on sixth treatment for Picual seedling (table 4).

#### ***3.2. Leaf potassium content***

The results in table (4) showed that the leaf potassium content varied according to treatments and cultivars. The same table indicates that second treatment gave the highest average of leaf potassium content (0.89%) across

two cultivars with insignificant differences with the third and fourth treatments. Picual seedling gave the highest response to leaf potassium content (0.77%) as compared with Toffahi seedling (0.64%) across all treatment. The interaction was significantly between the treatments and cultivars. In addition, the highest and lowest values of leaf potassium content (1.10 and 0.29%), respectively were observed at second and sixth treatments respectively in Picual olive seedlings (Table 4).

**Table 4.** Effect of NPK, pigeon manure tea and microbial fertilizers on percent of nitrogen, potassium and phosphorus in leaves of Toffahi and Picual olive seedlings.

Treatment	N%			K%			P%		
	Toffahi	Picual	Mean	Toffahi	Picual	Mean	Toffahi	Picual	Mean
T1	1.68 efg	1.76 efg	1.72 CD	0.52 e	0.49 e	0.51 B	0.06 b	0.07 b	0.07 A
T2	2.49 ab	2.63 a	2.56 A	0.68 c	1.10 a	0.89 A	0.12 a	0.08 b	0.10 A
T3	2.31 bc	2.20 bcd	2.26 B	0.64 cd	0.78 b	0.71 A	0.09 ab	0.08 b	0.09 A
T4	2.00 cde	1.94 def	1.97 C	0.64 cd	0.67 cd	0.66 AB	0.08 b	0.07 b	0.08 A
T5	1.48 gh	1.65 fg	1.57 DE	0.35 f	0.61 d	0.48 BC	0.06 b	0.06 b	0.06 A
T6	1.47 gh	1.23 h	1.35 E	0.36 f	0.29 g	0.33 C	0.06 b	0.05 b	0.06 A
Mean	2.24 A	2.23 A		0.64 A	0.77 A		0.09 A	0.08 A	

Means having the same letters within a column are not significantly different at 5% level.

### 3.3. Leaf phosphorus content

The estimated of significance for the effects of treatments, cultivars and their interaction on leaf phosphorus content are presented in table 4. It was found that second treatment gave the highest average of leaf phosphorus content (0.10%) across two cultivars with insignificant differences among other treatments. Toffahi seedling gave the highest response to leaf phosphorus content (0.09%) as compared with Picual seedling (0.08%) across all treatment.

The interaction was significant between the treatments and cultivars. Also, the highest values of leaf phosphorus content for Toffahi olive seedlings (0.12%) was found by using the second treatment. The same situation was observed with Picual olive seedlings (0.08%) at second and third treatment (Table 4).

## **Discussion**

Previous studies showed that application of the suitable N through inorganic and organic fertilization was preferable rather than using mineral N fertilization alone in enhancing growth. These results are in agreement with those obtained by (Mahfouz, 2011; Abdelaal *et al.*, 2012 and Farag, 2013). They reported that soil fertility and fruiting of all evergreen fruit crops particularly date palms, bananas, citrus and mangoes

Based on the analysis of variance, the overall effects of NPK, pigeon manure tea and microbial fertilizers were significant on seedlings parameters including shoot and root growth characteristics and leaf mineral content. Adding the pigeon manure tea and microbial fertilizers with decreasing the percentage of NPK (75%) led to increase the seedlings parameters. These results are in agreement with those obtained by Fernández and Marín (1999) they reported that, live trees often undergo a rather contradictory fertilizing management. In some cases they are occasionally fertilized due to the wrong belief that this species has small nutritional requirements; in others, the fertilizing routines are carried out using excessive doses which do not reflect the real needs of the plant but are managed in this way because it is a tradition or because it is thought that this may lead to ever-increasing production. NPK are considering to be essential element for plant growth and development as different NPK levels had significant influence on various growth parameters of olive tree. Osman *et al.* (2010) revealed that bio and NPK fertilizer treatments significantly increase number of shoots/ branch/ meter, number of leaves per shoot, shoot length, shoot diameter, leaf area, leaf fresh and dry weights, N,P and K contents in olive leaves. Haggag *et al.* (2014) on olive found that, application of compost tea at 15 cm<sup>3</sup>/ seedling as soil drench with or without mineral NPK gave the best results for increasing all vegetative growth such as plant height increment %, number of leaves/ seedling, dry weight of leaves %, root length and number per seedling as well as nitrogen and potassium contents in leaf seedlings such as compared to control treatments without using mineral

NPK or compost tea in growing season. Moreover Haggag *et al.* (1994) found that bio-fertilizers had significant effect on phosphorous content and dry matter of guava seedlings growing in sandy soil. Helmy and Azzazy (1996) found that application of bio-fertilizers such as Biogein, Microbein and Phosphorein enhanced growth and nutritional status of mango seedlings. Ahmed *et al.* (1999) who found that, applying Phosphorein improved growth of Shemlali olive seedlings in comparison to the phosphate fertilizer alone. Abd El-Hameed (2002) mentioned that the interaction between 100% N and BF + BS gave the highest significant number of shoots / twigs and N, P and K contents in citrus leaves. Fawzi *et al.* (2010) found that all treatments including bio-fertilizers used significantly increased percentage of N, P, K and Mg in the leaves of Le-Conte" pear trees as compared to the control. The positive effects of bio-fertilizers on growth and productivity of plants could be attributed to the effect of different strain groups of microorganisms such as nitrogen fixers, nutrients mobilizing group which improve the availability of metals and increase the levels of extractable N, P, K, Fe, Zn and Mn as stated by El-Karamany *et al.* (2000). This may help minimizing the amounts of chemical fertilizers and improve their application efficiency and subsequently avoiding environmental pollution by the access of these chemicals In addition to their role in enhancing the growth of the plants, bio-fertilizers can act as biocontrol agents in the rhizosphere at the same time. This synergistic effect, when present, increases the role of application of bio-fertilizers in the sustainable agriculture. Bio-fertilization is generally based on altering the rhizosphere flora, by seed or soil inoculation with certain organisms (microbial inoculants), capable of inducing beneficial effects on a compatible host (El- Haddad *et al.*, 1993).

Khalil (2012) showed that, on Flame seedless grapevines, the highest values of mineral contents in leaves were obtained with microbial inoculated treatment and received 75% of recommended doses of mineral fertilizers. Furthermore, Haridy *et al.* (2001) on lemongrass and El-Ghadban *et al.* (2002) on *Origanum majorana*. In this respect, it is possible that the favourable effect of compost and microorganisms on growth characteristics may be due to their ability to enhance the physical, chemical and biological properties of the soil. A similar suggestion was made by Hanafy *et al.* (2002) on rocket plants. This stimulative effect may be related to the good equilibrium of nutrients and water in the root medium (Abd Elaziz *et al.*, 2007) or to the beneficial effects of

bacteria on vital enzymes and hormonal, stimulating effects on plant growth (Bashan *et al.*, 1989). Furthermore, these organisms may affect their host plant by one or more mechanisms such as nitrogen fixation, production of organic acids, enhancing nutrients uptake, synthesis of vitamins, amino acids, auxins and gibberellins which stimulate growth, or increasing the resistance against plant pathogens. (Sprenat, 1990). Moreover, both Hammoda (2001), and El-Ghadban *et al.* (2002), studying marjoram, mentioned that both compost and bio-fertilizer led to an increase in carbohydrate percentage and some macro-nutrients. These increases might be related to the positive effect of compost and microorganisms in increasing the root surface area per unit of soil volume, water-use efficiency and photosynthetic activity, which directly affects the physiological processes and utilization of carbohydrates.

## References

- Abd El- Hameed, S. A., (2002). A comparative study of some citrus rootstocks grown in different soil types inoculated with mycorrhizae fungi. (Master's Thesis). Moshtohor, Zagazig University, Egypt.
- Abd Elaziz, M. E., Hanafy Ahmed, A. H., Shaaban, M. M. and Pokluda, R., (2007). Fresh weight and yield of lettuce as affected by organic manure and bio-fertilizers. Zonference of organic farming, Czech Univ. Agric. Czech Republic 212-214.
- Abdelaal, A. M. K., Ahmed, F. F. and Hassan, K. M., (2012). Partial replacement of chemical N fertilizers in Balady mandarin orchard through application of extracts of yeast, seaweed and farmyard manure. *Minia Journal of Agricultural Research and Development* 32:129- 148.
- Abdel-Latif, M. R., El-Bana, A. A. and Galal, A. A. (2001). Effect of bio-fertilizers Microbein and Phosphorine on bacterial pod blight of guar and black cumin damping off root rot and with diseases. *Proceedings of the fifth Arabian Horticulture Conference, Ismailia, Egypt, March 2001.* pp. 24-28, and pp. 133-140.

- Ahmed, F. F., El-Dawwey, G. M. and Papadopoulos, A. P. (1999). Efficiency of phosphorene (as a source of phosphate solubilizing bacteria) in enhancing growth and P nutrition of Chemlali olive seedlings. International symposium on growing media and hydroponics, Windsor, Ontario, Canada, 19- 26 May (1997) Volume II. Acta Horticulture 481:701-705.
- Bashan, Y., Ream, Y., Levanovy, H. and Sade, A. (1989). Nonspecific responses in plant growth, yield and root colonization of non cereal crop plant to inoculation with *Azospirillum brasilense*. Canadian Journal of Botany 67:1317-1324.
- Boraste, A., Vamsi, K. K., Jhadav, A., Khairnar, Y., Gupta, N., Trivedi Patil, S. P., Gupta, G., Gupta, M., Mujapara, A. K. and Joshi, B. (2009). Bio-fertilizers: A novel tool for agriculture. International Journal of Microbiology Research 1:23-31.
- Bremner, J. M. and Mulvaney, C. S. (1982). Total nitrogen In: Page, A. L., R. H. Miller, and D. R. Keeney (Eds.). Methods of Soil Analysis. Part 2, Amer. Soc. Agron. Madison, W. I. USA. pp. 595- 624.
- Cockin, E. C. (2000). Helping plants get more nitrogen from air. European Review 8:193-200.
- Duncan, D. B. (1955). Multiple rang and multiple F test. Biometrics 11:1-42.
- EL-Karamany, M. F., Ahmed, M. K. A., Bahr, A. A. and Kabesh, M. O. (2000). Utilization of bio-fertilizers in field crop production. Egypt. Journal of Applied Sciences 15:137.
- El-Ghadban, E. A. E., Ghallab, A. M. and Abd El-Wahab, A. F. (2002). Effect of organic fertilizer (Biogreen) and bio-fertilization on growth, yield and chemical composition of Marjoram plants growth under newly reclaimed soil conditions, 2nd Congress of Recent Technologies in Agriculture 2:334-361.
- El-Haddad, M. E., Ishac Y. S. and Mostafa M. I. (1993). The role of bio-fertilizers in reducing agricultural costs, decreasing environmental pollution and raising crops yield. Journal of Agricultural Science 1:147-195.

- Farag, M. H. A. (2013). Reducing the amount of chemical fertilization partially by using organic and bio-fertilization in Balady mandarin orchards. (Master's Thesis). Minia University in Egypt.
- Fawzi, M. I. F., Shahin, M. F., Daood, E. A. and Kandil E. A. (2010). Effect of organic and bio- fertilizers and magnesium sulphate on growth yield, chemical composition and fruit quality of "Le-Conte" pear trees. *Nature and Science* 8: 273-280.
- Fernández-Escobar, R. and Marín, L. (1999). Nitrogen fertilization in olive orchards. *Acta Hort* 474:333- 335.
- Laila, F. Haggag., Merwad, M. A., Shahin, M. F. M., Hoballah, E. M and Mahdy, H. A. (2014). Influence of Mineral NPK and Compost Tea as Soil Applications on Growth of "Aggizi" Olive Seedlings under Greenhouse Condition. *Middle East Journal of Agriculture Research* 3:701-706.
- Haggag, L. F., Azzazy, M. A. and Maksoud, M. A. (1994). Effect of Bio-fertilizer "Phosphorine" on phosphorus content and dry matter of guava seedlings growing in sandy soil conditioned with composted town refuse. *Annals of Agricultural Science Cairo, Egypt* 39:345-353.
- Hammoda, S. S. (2001). Effect of some agricultural treatments on growth and productivity of moghat plant under Sinai conditions. (Master's Thesis). Cairo University in Egypt.
- Hanafy Ahmed, A. H., Kahlil, M. K. and Farrag, A. M. (2002). Nitrate accumulation, growth, yield and chemical composition of Rocket (*Erucavesicaria* Sub sp. *sativa*) plant as affected by NPK fertilization, kinetin and salicylic acid. *Annals of Agricultural Sciences* 47:1-26.
- Haridy, I. M. A., Soliman, S. G. I, Mervat, T. A. (2001). Physiological, chemical and biological studies on Lemongrass *Cymbopogon citratus* (DC) stapf in response to diazotrophic bacteria. *Journal of Agricultural Science* 26:6131-6152.
- Hartman, A. (1988). Ecophysiological aspects of growth and nitrogen fixation in *Azospirillum* species. *Plant Soil* 110:225-238.



- Helmy, L. F. and Azzazy, M. A. (1996). Evaluation of Microbein as a multistrainsbiofertilizer for production of improved Mango seedlings with appropriate vigour for grafting in shorter time. *Annals of Agricultural Sciences* 41:321-331.
- Ibrahim, A. N. and Abd El-Aziz, I. M. (1977). Solubilization of rock phosphate by streptomyces. *Agrokemia es Talajton* 26:424-434.
- Ingham, E. (2005). The compost tea brewing manual as printings. *Soil Food Web Incorporated* 3:31-32.
- Jackson, M. L. (1970). *Soil Chemical Analysis*. Englewood Ceiffs, N.J.: Prentic Hall.
- Khalil, H. A. (2012). The Potential of Biofertilizers to Improve Vegetative Growth, Nutritional Status, Yield and Fruit Quality of Flame Seedless Grapevines. *American-Eurasian Journal Of Agricultural & Environmental Sciences* 12:1122-1127.
- Kumar, V. and Singh, K. P. (2001). Enriching vermicompost by nitrogen fixing and phosphate solubilizing bacteria. *Bioresource Technology* 76:173-175.
- Mahfouz, S. A. and Sharaf Eldin, M. A. (2007). Effect of mineral Vs. bio-fertilizer on growth, yield, and essential oil content of fennel (*Foeniculum vulgare* Mill). *International Agrophysics* 21:361-366.
- Mahfouz, M. S. M. (2011). Partial replacement of chemical fertilizers by some organic and bio-fertilizers in Williams banana plants under Minia region conditions. (Doctor of Philosophy's Thesis). Minia University in Egypt.
- Mohammed, S. M., Fayed, T. A., Esmail, A. F. and Abdou, N. A. (2010). Growth, nutrient statues and yield of Le-Conte pear trees as influenced by some organic and bio-fertilizer rates compared with chemical fertilizer. *Bulletin of Faculty of Pharmacy, Cairo University* 61:17-32.
- Moradi, R., Rezvani, M. P., Nasiri, M. M. and Lakzian, A. (2010). The effect of application of organic and biological fertilizers on yield, yieldcomponents and essential oil of *Foeniculumvulgare* (Fennel). *Iranian Journal Agronomy Research* 7:625-635.

- Olsen, S. R. and Sommers, L. E. (1982). Phosphorus. In: Page, A. L., R. H. Miller, and D. R. Keeney (Eds.). *Methods of Soil Analysis. Part 2.* Madison, W. I. USA: American Society of Agronomy. pp. 403-430.
- Osman, S. M. (2010). Effect of mineral, Bio-NPK soil application of young olive trees and foliar fertilization on leaf and shoot chemical composition. *Research journal of agriculture and biological sciences* 6:311-318.
- Palm, C. A., Gachengo, C. N., Delve, R. J., Cadisch, G. and Giller, K. E. (2001). Organic inputs for soil fertility management in tropical agro ecosystems: application of an organic resource database. *Agriculture, Ecosystems & Environment* 83:27-42.
- Pandya, U. and Saraf, M. (2010). Application of fungi as a biocontrol agent and their biofertilizer potential in agriculture. *Journal Advanced of Development Research* 1:90-99.
- Saber, S. M. (1993). The use of multi - strain biofertilizer in Agriculture. Theory and practice. *Proceedings of the Sixth International symposium on Nitrogen fixation with non- legumes, Ismailia, Egypt.*
- Singh, N. P., Sachan, R. S., Pandey, P. C. and Bisht, P. S. (1999). Effect of a decade long fertilizer and manure application on soil fertility and productivity of rice-wheat system in Molisols. *Journal of the Indian Society of Soil Science* 47:72-80.
- Sprent, M. (1990). *Nitrogen-Fixing Organisms.* London: P.S. Chapman and Hall.

(Received: 28 September 2015, accepted: 25 October 2015)