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


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


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-fertilizers 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.

* Corresponding 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 ago. It was originated in the ancient times in the eastern side of the Mediterranean Sea. Olive has spread 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 elements 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 (Sabed, 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 N₂-fixation with cereals and other non-legumes by establishing N₂-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, N₂-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. GA₃, 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 (*Eisenia fetida*) 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 fooled 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 monocalcium 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$^3$ 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 nitrobein+ 2.5 gm Phosphorine + 2.5 gm Potassin.
T3= 50% of N P K + pigeon manure tea +2.5 nitrobein+ 2.5 gm Phosphorine + 2.5 gm Potassin.
T4= 25% of N P K + pigeon manure tea +2.5 nitrobein+ 2.5 gm Phosphorine + 2.5 gm Potassin.
T5= pigeon manure tea +2.5 nitobin+ 2.5 gm Phosphorine + 2.5 gm Potassin without NPK.
T6= 25% of N P K +2.5 nitrobein+ 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, Nitrobein, Microbein and Biogein 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 nitrobein+ 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.

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

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.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Leaves number</th>
<th>Leaves dry weight %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Toffahi</td>
<td>Picual</td>
</tr>
<tr>
<td>T1</td>
<td>186 abc</td>
<td>100 de</td>
</tr>
<tr>
<td>T2</td>
<td>241 a</td>
<td>214 ab</td>
</tr>
<tr>
<td>T3</td>
<td>220 ab</td>
<td>169 bcd</td>
</tr>
<tr>
<td>T4</td>
<td>214 ab</td>
<td>169 bc</td>
</tr>
<tr>
<td>T5</td>
<td>162 bcd</td>
<td>152 bcd</td>
</tr>
<tr>
<td>T6</td>
<td>115 cde</td>
<td>72 e</td>
</tr>
<tr>
<td>Mean</td>
<td>227.6 A</td>
<td>174.17 B</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Root numbers</th>
<th>Root length</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Toffahi</td>
<td>Picual</td>
</tr>
<tr>
<td>T1</td>
<td>4 ab</td>
<td>4 ab</td>
</tr>
<tr>
<td>T2</td>
<td>6 a</td>
<td>7 a</td>
</tr>
<tr>
<td>T3</td>
<td>5 ab</td>
<td>6 a</td>
</tr>
<tr>
<td>T4</td>
<td>4 ab</td>
<td>4 ab</td>
</tr>
<tr>
<td>T5</td>
<td>4 ab</td>
<td>4 ab</td>
</tr>
<tr>
<td>T6</td>
<td>2 b</td>
<td>2 b</td>
</tr>
<tr>
<td>Mean</td>
<td>5 A</td>
<td>5 A</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>N%</th>
<th>K%</th>
<th>P%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Toffahi</td>
<td>Picual</td>
<td>Mean</td>
</tr>
<tr>
<td>T1</td>
<td>1.68 efg</td>
<td>1.76 efg</td>
<td>1.72 CD</td>
</tr>
<tr>
<td>T2</td>
<td>2.49 ab</td>
<td>2.63 a</td>
<td>2.56 A</td>
</tr>
<tr>
<td>T3</td>
<td>2.31 bc</td>
<td>2.20 bcd</td>
<td>2.26 A</td>
</tr>
<tr>
<td>T4</td>
<td>2.00 cde</td>
<td>1.94 def</td>
<td>1.97 C</td>
</tr>
<tr>
<td>T5</td>
<td>1.48 gh</td>
<td>1.65 fg</td>
<td>1.57 DE</td>
</tr>
<tr>
<td>T6</td>
<td>1.47 gh</td>
<td>1.23 h</td>
<td>1.35 E</td>
</tr>
<tr>
<td>Mean</td>
<td>2.24 A</td>
<td>2.23 A</td>
<td>0.64 A</td>
</tr>
</tbody>
</table>

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 cm3/ 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 effects on phosphorus 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 Origanummajora. 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 macronutrients. 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


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