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Effect of NPK and Yeast on "Manzanillo" Olive Seedlings Growth under Greenhouse Conditions

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ABSTRACT

This study was carried out in greenhouse of National Research Center, Dokki, Giza government, Egypt on the olive seedlings of "Manzanillo" cv during 2014 to study the influence of different levels of mineral fertilizers using Three rates of NPK (0, 45 and 90g/ seedling) in the form of Crystalon (20% N: 20% P: 20% K) applied as soil application in combination with The bio-fertilization treatments included yeast (0% and 1%) as a foliar application . In general, it was found that using yeast at 1% concentration plus 50% of mineral fertilization (N P K) leading to the improvement of "Manzanillo" olive seedlings parameters under greenhouse condition including vegetative, rooting growth and leaf mineral content followed by 90g of mineral fertilization only, yeast at 1% concentration plus 25% of mineral fertilization (NPK), without significant differences between them (third and fifth treatments, respectively), 45g of mineral fertilization, 1% yeast then 0% yeast respectively. The interaction between foliar application with yeast extract and fertilization with NPK were more effective when compared with individual application of each of them, while spraying with 1g/L yeast extract combined 90g of mineral fertilization (NPK) increased parameters under greenhouse condition including vegetative, rooting growth and leaf mineral content of "Manzanillo" olive seedlings .

Key words: Manzanillo, NPK, yeast, olive seedlings, leaf mineral content, vegetative and rooting growth parameters.

Introduction

The olive tree (*Olea europaea* L.) family Oleaceae is a widely distributed tree grown in many arid areas of the world. The Mediterranean region is its native habitat. Olive is adapted to extremely arid conditions because of its special leaf structure and ramified root system. The olive tree is an evergreen, one of the oldest cultivated tree, about 8000 years ago.

Intensive use of chemical fertilizers and other chemicals has produced environmental problems and increased production costs. The recent economic crisis and environmental problems has raised interest in environmental friendly sustainable agricultural practices, which can reduce input costs (Salantur *et al.*, 2005).

In spite of everything mineral nutrition is one of the most important, factors for plant growth and yield. Mineral fertilizers, particularly mineral-nitrogen, are important means of 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*., 2001). Bio-fertilizers are considered as eco-friendly way to sustainable agriculture. They positively affect plant growth and yield, reduce the negative effects of chemical fertilizers and minimize. Some chemicals such as NO2 and NO3 ions in the soil and consequently in plant. Bio-fertilizers, microbial inoculants that can promote plant growth and productivity, are internationally accepted as an alternative source of N- fertilizer.

Many studies indicated that, dry yeast is a natural bio-substance suggested to have stimulating, nutritional and protective functions when used on plants. Yeast is natural source of cytokinins and has stimulatory effects on bean plants (Amer, 2004). Moreover, yeast extract was suggested to participate in a beneficial role during vegetative and reproductive growths through improving flower formation and their set in some plants due to its high auxin and cytokinins content and enhancement carbohydrates accumulation (Barnett *et al.,* 1990). Also, it was reported its stimulatory effects on cell division and enlargement, protein and nucleic acid synthesis and chlorophyll formation (El- Desouky *et al.*, 1998 ; Wanas, 2002 and Wanas, 2006) in addition to its content of

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cryoprotective agent, i.e. sugars, protein , amino acids and also several vitamins (Mahmoued, 2001). Moreover, the improving growth, flowering and fruit set of some plants by using foliar application with yeast extract was reported by Fathy *et al.*, (2000); Abou-Aly, (2005) and Wanas (2006). Recently, Mady,(2009) reported that strongly admit the use of foliar application with yeast extract at 50 ml/l after sowing of faba bean plants for getting the highest yield and seed quality.

Materials and Methods

This study was carried out in the experimental research shade house of National Research Center, Dokki, Giza, Egypt during 2014. For this purpose, healthy one years old olive and almost uniform "Manzanillo" olive seedlings seedlings was used. The seedlings were planted in black polyethylene bags with 30 cm diameter fooled 10 kg washed sand mixed very good with 2.5 kg pigeon manure (organic matter), 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:

Chemical fertilizer:

Three rates of NPK (0, 45 and 90 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.
This investigation included the following five treatments:
T1= without N P K
T2= 45g of N P K
T3= 90g of N P K
T4= without N P K + 1% yeast
T5= 45g of N P K +1% yeast
T6= 90g of N P K +1% yeast
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, yeast extract added one time at the beginning of the growing season at the rate of 1 % as a foliar applicationin the first week of March. In October the following parameters were measured:

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).

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).

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

Shoot growth characteristics

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.

Plant height increment %

Percentage of plant height increment varied according to its cultivars as well as its treatments. Table (1) indicates that using 90g mineral fertilization with 1% yeast gave the highest average of plant height increment

percentage (39.39) across all the level of mineral fertilization with NPK. Addition of 1% yeast significantly gave the highest response to plant height increment percentage (37.71%) as compared with the addition of mineral fertilization (27.16%). The interaction was significantly between the treatments and cultivars. Moreover, the highest values of plant height increment percentage (49.61) were obtained at last treatment by using the 90g of NPK plus 1% yeast. Insignificant differences among first, second, third treatment (mineral fertilization plus zero percent yeast) and fourth treatment (zero mineral fertilization plus 1% yeast). Moreover, the first treatment which was done by using zero of NPK and yeast (Table 1).

Table 1: The means values of the Percentage of plant height increment for "Manzanillo" olive seedlings under greenhouse condition as affected by NPK and yeast application.

Treatments	0% yeast	1% yeast	Mean
0	24.8 c	24.22 c	24.51 C
45 g NPK	27.52 c	39.29 b	33.41 B
90 g NPK	29.17 c	49.61 a	39.39 A
Mean	27.16 B	37.71 A	

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

Lateral shoot numbers

Comparison between the treatments means for lateral shoot number (Table 1) indicated that adding 90g mineral fertilization(NPK) gave the highest lateral shoot number (9.00) with insignificant differences between zero and 45 g of NPK treatments across two yeast treatment (0 and 1%). On the other hand, spraying seedlings with 1% yeast gave the highest number of the lateral shoot (7.78) across mineral fertilization treatments (0, 45 and 90g NPK). The highest significant value of lateral shoot number (12.00) was obtained on the last treatment (90g NPK and 1% yeast).On the contrary, the differences between the other treatment were insignificant and the lowest value was recorded with the first treatment (0% NPK plus 0% yeast).

Table 2: The means values of the Percentage of Lateral shoot numbers for "Manzanillo" olive seedlings under greenhouse condition as affected by NPK and yeast application.

Treatments	0% yeast	1% yeast	Mean
0	3.67 b	4.33 b	4.00 B
45 g NPK	4.67 b	7.00 b	5.84 B
90 g NPK	6.00 b	12.00 a	9.00 A
Mean	4.78 B	7.78 A	

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

Stem diameter

The best value of Stem diameter (6.31) was obtained with using 90 g NPK fertilization across two yeast concentration (Table 3). Adding 1% yeast led to increase stem diameter (5.73). However, the differences between two yeast concentration (0 and 1%) were insignificant across all mineral fertilization with NPK (Table 3). The highest value of stem diameter (6.37) for Manzanillo olive seedlings was obtained from adding 90g NPK plus 1% yeast. Insignificant differences were detected between first, second, third, fourth and fifth treatment and the same situation was found among second, third, fifth and sixth treatment , respectively (Table 3).

Table 3: The means values of the Percentage of Stem diameter for "Manzanillo" olive seedlings under greenhouse condition as affected by NPK and yeast application.

Treatments	0% yeast	1% yeast	Mean
0	4.61 b	4.61 b	4.61 C
45 g NPK	5.61 ab	6.20 ab	5.91 B
90 g NPK	6.25 ab	6.37 a	6.31 A
Mean	5.49 A	5.73 A	

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

Leaves number

Table (4) shows the effect of different concentration of mineral fertilization with NPK plus two levels of yeast on the leaves number of Manzanillo olive seedling cultivar. The response of leaves number varied according to its treatments. Table 4 indicated that the third concentration of NPK gave the highest average of leaves number (199.65) across two yeast levels. On the other hand, the first concentration of NPK (without NPK) had the lowest significant leaves numbers (103.00) across two yeast concentration (0 and 1%yeast). One

percent yeast gave the significantly higher leave number (166.90) compared with zero percent yeast (142.67) across all mineral fertilization concentration in this study. The interaction between treatments and cultivars was significant. The variation ranged from (230.00) for last treatment to (90.00) for first treatment insignificant (Table 4).

Table 4: The means values of the Percentage of Leaves number for "Manzanillo" olive seedlings under greenhouse condition as affected by NPK and yeast application.

Treatments	0% yeast	1% yeast	Mean
0	90.00 c	116.00 c	103.00 C
45 g NPK	168.70 b	154.70 b	161.70 B
90 g NPK	169.30 b	230.00 a	199.65 A
Mean	142.67 B	166.90 A	

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

Leaves dry weight

The highest value of leaves dry weight (54.27) was obtained in the third concentration of mineral treatment (90 g NPK) across two yeast concentration. It was noticed that the differences among 45 and 90 g of mineral concentration were insignificant across two yeast concentration in this work. Moreover, the leaves dry weight of one percent of yeast (52.15) was significantly higher than leaves dry weight of zero percent of yeast (47.68) across all NPK treatments. On the other hand, the first treatment had the lowest significant leaves dry weight (42.27). While the sixth treatment (90 g NPK plus 1% yeast) gave the maximum value of leaves dry weight with insignificant differences between fifth and sixth treatment respectively (Table 5).

Table 5: The means values of the Percentage of Leaves dry weight % for "Manzanillo" olive seedlings under greenhouse condition as affected by NPK and yeast application.

Treatment	0 % yeast	1% yeast	Mean
0	42.27 e	45.86 d	44.07 B
45 g NPK	47.58 c	55.25 a	51.42 A
90 g NPK	53.18 b	55.35 a	54.27 A
Mean	47.68 B	52.15 A	

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

Root growth characteristics

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.

Root numbers

It was found from Table (6) that root numbers varied according to its NPK as well as its yeast concentration in all treatments. Table 6 indicates that second and third rate of NPK treatment gave the highest average of root numbers (5.17) across two yeast concentration with insignificant differences among first, second and third NPK treatments across two yeast concentration respectively. One percent yeast gave the maximum value of root numbers (5.22) with insignificant differences between it and the other concentration of zero percent of yeast across all studied NPK concentration in this object. The interaction was significant between the NPK and yeast concentration in all treatments. Moreover, the highest values of root numbers were 6 for fifth and sixth treatment respectively. Insignificant differences were found among second, third, fourth, fifth and sixth treatment respectively. The same situation was found between first and fourth treatment respectively (Table 6).

Table 6: The means values of the Percentage of root numbers for "Manzanillo" olive seedlings under greenhouse condition as affected by NPK and yeast application.

Treatments	0% yeast	1% yeast	Mean
0	3.67 b	3.67 ab	3.67 A
45 g NPK	4.33 a	6.00 a	5.17 A
90 g NPK	4.33 a	6.00 a	5.17 A
Mean	4.11 A	5.22 A	

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

Root length

The estimated of significance for the effects of NPK and yeast treatments and their interaction on root length are presented in Table (7). It was observed that 90 g of NPK treatment gave the highest significantly average of root length (20.00) across two yeast concentration. One percent of yeast significantly gave the highest response to root length (17.89) as compared with zero percent of yeast (9.78). The interaction was significantly between the mineral fertilization and yeast concentration treatments. Moreover, the highest significant value of root length was 27.00 by using 90g of NPK plus one percent of yeast. The differences between first, second and fourth were insignificant .Also, the differences among each of second, third and fourth treatments were insignificant 90g of NPK (Table 7).

Table 7: The means values of the Percentage of root length for "Manzanillo" olive seedlings under greenhouse condition as affected by NPK and yeast application.

Treatments	0% yeast	1% yeast	Mean
0	6.33 d	9.00 cd	7.67 C
45 g NPK	10.00 cd	17.67 b	13.84 B
90 g NPK	13.00 bc	27.00 a	20.00 A
Mean	9.78 B	17.89 A	

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

Effect of treatment on leaf mineral content:

Leaf nitrogen content:

Table (8) revealed that the effect of different concentration of NPK and yeast on leaf nitrogen content of Manzanillo olive seedling cultivar was significant. The response of leaf nitrogen content varied according to its treatments. Table (8) indicated that the 90 g treatment of NPK gave the highest significant average of leaf nitrogen content (2.40 %) across two yeast concentration. On the other hand, using zero NPK treatment had the lowest significant leaf nitrogen content (1.80 %) across two yeast concentration. One percent of yeast gave the maximum leaf nitrogen content (2.38 %) compared with zero percent of yeast across all studied concentration of NPK. The variation ranged from (1.64 %) on the first treatment (without NPK and yeast) to (2.61%) on sixth treatment (90 g NPK plus 1% yeast) (Table 8).

Table 8: The means values of the Percentage of nitrogen content for "Manzanillo" olive seedlings under greenhouse condition as affected by NPK and yeast application.

Treatments	0% yeast	1% yeast	Mean
0	1.64 e	1.96 d	1.80 B
45 g NPK	2.06 c	2.57 a	2.32 A
90 g NPK	2.18 b	2.61 a	2.40 A
Mean	1.96 B	2.38 A	

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

Leaf potassium content:

The results in table (9) showed that the leaf potassium content varied according to different concentration of NPK and yeast treatments. The same table indicates that 90 g of mineral fertilization treatment gave the highest significant average of leaf potassium content (0.051) across two yeast concentration with insignificant differences with the 45 g of NPK. Adding one percent of yeast gave the highest response to leaf potassium content (0.047) as compared with zero percent of yeast (0.02) across all NPK treatment. The interaction was significantly between mineral fertilization and yeast treatments. In addition, the highest and lowest values of leaf potassium content (0.076 and 0.01 %, respectively) were observed at sixth and second treatments, respectively in Manzanillo olive seedlings (Table 9).

Table 9: The means values of the Percentage of potassium content for "Manzanillo" olive seedlings under greenhouse condition as affected by NPK and yeast application.

Treatments	0% yeast	1% yeast	Mean
0	0.015 b	0.010 b	0.013 B
45 g NPK	0.019 b	0.056 ab	0.038 A
90 g NPK	0.025 ab	0.076 a	0.051 A
Mean	0.020 B	0.047 A	

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

Leaf phosphorus content:

The estimated of significance for the effects of NPK and yeast concentration treatments, and their interaction on leaf phosphorus content are presented in Table (10). It was found that the maximum concentration of mineral fertilization treatment gave the highest average of leaf phosphorus content (0.81) across two yeast concentration. One percent of yeast gave the highest response to leaf phosphorus content (0.72%) as compared with zero percent of yeast concentration (0.63%) across all concentration of mineral fertilization treatments. The interaction was significant between the NPK and yeast treatments. Also, the highest significant values of leaf phosphorus content (0.87%) was found by using 90 g of NPK plus one percent of yeast treatment. While, the lowest significant value of leaf phosphorus content (0.50 %) was observed without using NPK and yeast concentration at first treatment (Table 10).

Table 10: The means values of the Percentage of phosphorus content for "Manzanillo" olive seedlings under greenhouse condition as affected by NPK and yeast application.

Treatments	0% yeast	1% yeast	Mean
0	0.50 d	0.59 c	0.55 C
45 g NPK	0.63 c	0.70 b	0.67 B
90 g NPK	0.75 b	0.87 a	0.81 A
Mean	0.63 A	0.72 A	

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

Discussion

From the above mentioned results ,In general, it was found that using yeast at 1% concentration plus 90g of mineral fertilization (NPK) Leading to the improvement "Manzanillo" olive seedlings parameters under greenhouse condition including vegetative, rooting growth and leaf mineral content followed by 90g of mineral fertilization, yeast at 1% concentration plus 45g of mineral fertilization (N P K) , without significant differences between them (third and fifth treatments, respectively) , 45 g of mineral fertilization, 1% yeast then 0% yeast respectively

Bio-fertilizers contain microorganisms that help in availability of minerals as well as modification of nutrient uptake by the plant. Haggag *et al.* (2014). Similar results were obtained by Xiloyannis *et al.* (2000) and Abd El-Hameed (2002) they found that the interaction between 100% N and bio-fertilizers gave the highest significant leaf content of N, P and K in Manzanillo olive trees. Also 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.

This is in agreement with Xiloyannis *et al.* (2000) working on mineral nutrient uptake from the soil in irrigated olive trees, cultivar Coratina, over six years after planting they recorded that, the nutrient demand was relatively Steady during the different stages of the year. The results showed that demand for P and K is minimal during the first four years after planting and can be fulfilled by naturally supplied soils. Low doses of N should be applied through localized fertilization during the year. Nawaf and Yara (2006) found that, young olive trees benefit from low levels of NPK and N alone and additional fertilizers would not be significant. However, NPK are consider to be essential element for plant growth and development

The stimulatory effect of yeast extract on the estimated characteristics of "Manzanillo" olive seedlings growth could be attributed to increase the endogenous phytohormones specially the growth promoters, i.e. Auxins, gibberellins and cytokinins (Shehata *et al.*, 2000; Sridhar *et al*., 2009). Also, these findings are in agreement with the results of El-Tohamy and El-Greadly (2007); El-Tohamy *et al.,* (2008) who's indicated that the application of yeast increased eggplant growth. Moreover, the improvement of plants growth in response to the foliar application of active dry yeast may be attributed to its contents of different nutrients, higher percentage of amino acids, higher values of vitamins, especially B and growth regulators like adenine and betaines which may play an important role in improving growth.

Foliar application with yeast extracts increased N, P and K content in Manzanillo" olive seedlings leaves compared with those of control seedlings. This might be attributed to the large photosynthetic area and high content of photosynthetic pigments large mass of leave in Table (5). These results are in harmony with the findings of Fathy *et al.* (2000) who's found that the application of yeast to tomato plants resulted in increases in nitrogen, potassium contents of leaves. Our data also confirmed the positive effect of yeast extract as reported by Bevilacqua *et al.* (2008).

It could be concluded that spraying with 1% yeast extract combined 90 g of mineral fertilization (NPK) increased parameters under greenhouse condition including vegetative, rooting growth and leaf mineral content of "Manzanillo" olive seedlings .As shown, the interaction between foliar application with yeast extract and fertilization with NPK as soil application were more effective when compared with individual application of each of them.

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