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# Impact of different doses and type of application of humic acid on vegetative growth and mineral content of Agazze olive seedling

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**ABSTRACT**

This study was carried out in the experimental research shade house of National Research Center, Dokki, Giza, Egypt, during the growing season of 2015 using the Agazze olive seedling. The experiment consisted of two factors, the first was ground addition with actosol (humic acid) (0, 4 and 8 $cm^3$) and the second factor was three levels of actosol were sprayed on the seedling (0, 0.25 and 0.5%). The results revealed that the growth was significantly increased in term of plant height, branches number, leaves number and mineral content in leaves (N, P and K) .The interaction between the two factors has highly improved the growth and mineral content.

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## INTRODUCTION

Olive (*Olea europaea* L.) is one of the oldest cultivated tree crops in the history of the world about 8000 years age. The eastern side of the Mediterranean Sea is considered the original habits of the olive. Olives have spread to all the countries Mediterranean basin, which is still the main region for the production of olive until today. The intensive use of the chemical fertilizers and other chemicals has produced environmental problems and increased production costs. The recent economic crisis and environmental problems have raised interest in environmental friendly sustainable agricultural practices, which can reduce the costs of the input (Salantur *et al.,* 2005).

Humic substances used as a soil fertilizers for improving the structure of the soil and soil microorganisms environment. Also recognized as bio-stimulant that enhances the plant growth and helps plants to resist harsh environments. The foliar application of humic acid also enhance the growth, and increases yield and fruit quality in a number of the plant species (Brownell *et al.,* 1987; Yildirim 2007 and Karakurt*et al.,* 2009) it seems that the humic acid effect on the functions of the cell membrane, by increasing the absorption of nutrients, as a source of plant nutrients, mineral and regulator of release, In this regard, also humic acid has many effects due to the increasing of the cation exchange capacity which affects the availability of nutrients, or due to its influence as hormones, or a combination of the both. Furthermore, Humic acid having the high ability for exchange, and the ability to form complexes soluble in water with the metal ions, which promote absorption of some ions by the roots. (Visser, 1986; Chen and Aviad, 1990; Pinton, 1995 and Atiyeh*et al.,* 2002). many experiments discussed the effects of humic acid, through the formation of complex among the humic substances and mineral ions, and their participation in the promotion of catalysis enzyme, their effect of stimulating respiration, photosynthesis and metabolism of nucleic acid, and activity of hormone have been reported through acting humic substances like auxins, and promote the growth of the roots of some plants (O'Donnell, 1973; Vaughan and Malcom, 1985; Nardi *et al.,* 1988; Nardi *et al.,* 1996; Muscolo *et al.,* 1999 and Serenella *et al.,* 2002). Beneficial effects of humic acid on the plant growth may be relevant to their indirect effect by increasing fertilizer efficiency or limiting soil compaction, or direct effects on improving the overall plant biomass. In particular, increasing the root growth is general more obvious than that of the shoot (Vaughan and Malcom, 1985).

The investigation aimed at studying the effect of different doses and type of application of humic acid in order to reach maximum growth of Agazze olive seedling in short time.

## MATERIAL AND METHODS

This study was carried out in the experimental research shade house of National Research Center, Dokki, Giza, Egypt during one successive season 2015, healthy and almost uniform Agazze olive seedlings (one year old) similar vigor, age and size were 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 cattle manure, olive seedlings irrigated were irrigated twice weekly.

Humic acid as Actosol® (contains 20 % humic acid + NPK 1:5:6) was added in this study to the seedlings in different techniques (soil application, foliar application and combination of two techniques) at different rates 4 or 8 $cm^3$/seedling/15days as soil application and (0.25 or 0.5 %) as foliar application every 15 days whereas olive seedlings of control treatment received mineral fertilization only 180 g/ seedling/ season 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..

Treatments were arranged in a randomized complete block design with four replicates for each treatment and each replicate was represented by three seedlings. At the end of October, the following parameters were measured:

**Data recorded**

In September and October the following parameters were measured:

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**1. Vegetative parameters**

Plant height increment%, lateral shoot numbers, leaves number/ seedling.

**2. 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 flame photometrically according to the method advocated by Jackson (1970).

**Statistical Analysis:**

The data were subjected to analysis of variance and the method of Duncan's was used to differentiate means (Duncan, 1959).

**RESULTS**

It is obvious from this study that the olive vegetative measurements represented in plant height percentage, number of lateral shoot and number of leaves was affected by different actosol treatments. The statistical analysis of data demonstrated that the differences between concentrations of spray and ground addition of actosol. were significant.

**Plant height increment %**

Percentage of plant height increment values different depending on technique of addition of actosol (spraying or ground addition). Table 1 indicates that ground addition for olive seedling with 8 $cm^3$ actosol gave the highest plant height increment percentage (209%) significantly through all spraying seedling treatment with actosol. spraying 0.25 of actosol for seedling gave the highest significant response to plant height increment percentage (201%). The interaction was significant between the spraying and ground addition of actosol treatments. Moreover, the highest values of plant height increment percentage (249%) were obtained after spraying seedling with 0.25% and ground addition with 8 $cm^3$ of actosol treatment (Table 1).

**Table (1): The mean percent of the increase of plant high (%) as affected with different concentration of spray and ground addition of actosol**

| Treatment | 0 % | 0.25 % | 0.5 % | Mean |
|---|---|---|---|---|
| **0** | 129 e | 141 de | 197 bc | 156 C |
| **4 $cm^3$** | 178 bc | 183 bc | 196 bc | 186 B |
| **8 $cm^3$** | 167 cd | 249 a | 210 a | 209 A |
| **Mean** | 158 B | 191 A | 201 A | |

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

**Leaves number**

Table (2) shows the influence of the different concentration of actosol (spray and ground addition) on the increase in leaves number of Agazze seedling. leaves number diverse according to actosol treatments. Table 2 indicated that added 8 $cm^3$ of humic acid gave the highest average of leaves number (219) across the three concentration of actosol spray. otherwise, the first treatment had the lowest significant leaves numbers (155) through all spray concentration. Spray actosol with 0.5% concentrate gave the significantly higher leave number (216) compared with the other spray concentrations across all treatment of ground addition. The interaction between spraying and ground addition treatments was significant. The variation ranged from (145) for control treatment to (245) by adding 8 $cm^3$ and spray (0.5%) treatment (table 2).

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**Table (2): The mean percent of the increase of leaf number (%) as affected with different concentration of spray and ground addition of actosol.**

| Treatment | 0 % | 0.25 % | 0.5 % | Mean |
|---|---|---|---|---|
| **0** | 145 e | 153 de | 166 de | 155 C |
| **4 $cm^3$** | 177 cd | 200 bc | 238 a | 205 B |
| **8 $cm^3$** | 183 cd | 229 ab | 245 a | 219 A |
| **Mean** | 168 C | 194 B | 216 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 3) mention that the third rate of ground addition (8 $cm^3$) achieved the highest lateral shoot number (217) with insignificant differences demonstrated between 0.25% and 0.5% spray treatments Otherwise, spraying actosol (0.5%) achieved the highest number of the lateral shoot (246) through the ground addition treatments. The highest value of lateral shoot number (244) derived from adding 8 $cm^3$ and spraying actosol (0.5%).

**Table (3): The mean percent of the increase of shoot number (%) as affected with different concentration of spray and ground addition of actosol.**

| Treatment | 0 % | 0.25 % | 0.5 % | Mean |
|---|---|---|---|---|
| **0** | 53 d | 244 ab | 233 ab | 177 B |
| **4 $cm^3$** | 185 c | 213 bc | 244 ab | 214 A |
| **8 $cm^3$** | 177 c | 211 bc | 262 a | 217 A |
| **Mean** | 138 C | 223 B | 246 A | |

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

**Leaf nitrogen content:**

Table (4) expose the effect of varied concentration of actosol spray and ground addition on nitrogen content of Agazze seedling leaves was significant. The response of leaf nitrogen content different in response to actosol ground addition treatments. Data in Table (4) demonstrated that adding 8 $cm^3$ actosol as ground addition achieved the highest leaf nitrogen content value (2.55%) significantly through ground addition treatments. otherwise; control treatment achieved lowest leaf nitrogen content (1.99%) significant through spraying treatments. Spray (0.5%) on seedling average of leaf nitrogen content (2.38%) had a highest significant value of leaf nitrogen content (2.38%). The variation ranged from (1.76 %) to (2.80 ).

**Table (4): The mean percent of nitrogen content as affected with different concentration of spray and ground addition of actosol.**

| Treatment | 0 % | 0.25 % | 0.5 % | Mean |
|---|---|---|---|---|
| **0** | 1.76 c | 2.11 b | 2.10 b | 1.99 C |
| **4 $cm^3$** | 2.12 b | 2.13 b | 2.24 b | 2.16 B |
| **8 $cm^3$** | 2.27 b | 2.57 a | 2.80 a | 2.55 A |
| **Mean** | 2.05 C | 2.27 B | 2.38 A | |

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

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**Leaf phosphorus content:**

There are insignificant differences for the effects of spray and ground addition of actosol treatments on olive seedling and their interaction on leaf phosphorus content are available in table (5).It turns out that there was no significant noticed between type or rate of addition of actosol on leaf phosphorus content of Agazze seedling. Whereas the highest average of leaf phosphorus content (0.093%) obtained through all ground addition treatment. spray seedling with (0.5%) actosol gave the highest response to leaf phosphorus content (0.106) as compared with 0% concentration (0.071%). whereas values of interaction between treatments gave the highest value of leaf phosphorus content (0.14%) was obtained by spraying Agazze seedling with 0.5% actosol without ground addition treatment (Table 5).

**Table (5): The mean percent of phosphorus content as affected with different concentration of spray and ground addition of actosol.**

| Treatment | 0 % | 0.25 % | 0.5 % | Mean |
|---|---|---|---|---|
| **0** | 0.02 a | 0.12 a | 0.14 a | 0.093 A |
| **4 $cm^3$** | 0.10 a | 0.10 a | 0.07 a | 0.090 A |
| **8 $cm^3$** | 0.09 a | 0.08 a | 0.11 a | 0.094 A |
| **Mean** | 0.071 A | 0.099 A | 0.106 A | |

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

**Leaf potassium content:**

The results in table (6) showed that the leaf potassium content varied according to its spray as well as its ground addition of actosol treatments. The same table indicates that ground addition (8 $cm^3$) treatment gave the highest significant average of leaf potassium content (1.73) across two cultivars with insignificant differences between using (4 and 8 $cm^3$, respectively). Spray seedling (0.5%) gave the highest response to leaf potassium content (1.62 %) as compared with the other spray treatment across all treatment. The interaction was significant between the treatments and cultivars. In addition, the highest and lowest values of leaf potassium content (1.29 and 1.71, respectively) were observed at first and last treatments respectively olive seedlings.

**Table (6): The mean percent of potassium content as affected with different concentration of spray and ground addition of actosol.**

| Treatment | 0 % | 0.25 % | 0.5 % | Mean |
|---|---|---|---|---|
| **0** | 1.29 c | 1.51 b | 1.5 b | 1.44 B |
| **4 $cm^3$** | 1.51 b | 1.69 a | 1.65 a | 1.62 A |
| **8 $cm^3$** | 1.77 a | 1.71 a | 1.71 a | 1.73 A |
| **Mean** | 1.53 B | 1.64 A | 1.62 A | |

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

**DISCUSSION**

From the above mentioned results it is clear that with increasing the level of actosol in the ground addition and spraying treatment and with the interaction between them improves seedling growth parameter such as Plant height increment percentage, leaves number, lateral shoot numbers beside leaves mineral content like Leaf nitrogen, phosphorus and potassium content. The gained results are in understanding with those obtained by Fernandez-Escobar et al. (1999) who mention that humic acid treatments activated growth of young olive plants. These improvements in shoot characters might be due to the effect of humic acid which provides nutrient minerals that share in biological activities and finally increase the growth (Abdel-Mawgoudet

al., 2007) furthermore humic acid cause increase in soil porosity so it shared in its ventilation and root respiration and easily penetration in soil and increase root system and reflect an increase in vegetative growth (Garcia et al., 2008). Also humic acid effect as a chelating and considered as induce for nutrient element act to increase capable capacity and increase availability of nutrient elements and then easier absorbed by plants and increase its concentration in plant tissue and building root system with highly efficiency for absorption of macro and micro nutrient elements which help to increase the quality of synthesized substances in leave to build plant tissues (AL- Niemi, 1999). This result could be reverse to humic acid influence in increasing growth of root through similar effect of auxin (Donnell, 1973), furthermore, raising minerals uptake (Russo and Berlyn, 1990), (Senn and Kingman, 1973) and (Fernandez-Escobar et al., (1999) which subsequently activate growth of plant. Collectively, the results of the present study suggest that soil and/or foliar humic substances treatment might efficiently be utilized to obtain higher Vegetative growth and can significantly enhance leaf mineral content in Agazze olive seedling.

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