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Effect of Algae, Humic Acid and Waste Organic Material in Culture Media on Growth Performance of "Picual" Olive Seedlings

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Abstract: This work 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 seedlings Picual cv. was used. The seedlings were planted in black polyethylene bags with 30 cm diameter fooled 10 kg, olive seedlings irrigated were irrigated twice weekly. This work included nine treatments as follows: sand + humic acid , sand + algae, sand +algae + 25 % mineral NPK, rice straw + humic acid, rice straw + algae, rice straw+ algae + 25 % mineral NPK, wheat straw + humic acid, wheat straw + algae and wheat straw + alagae + 25 % mineral NPK. The obtained results show that, planting seedling on sand culture and applying humic acid recorded the maximum values of plant height increment and K contents in leaves, however, the maximum lateral shoot number, number of leaves/seedling and dry weight of leaves were recorded with humic acid when planted into rice straw culture. Nitrogen and phosphorus were increased when planted into wheat straw and supplying with humic acid. On the other side the tallest root/seedling was obtained when planted seedling into sand culture and treated with algae extract.

Keyword: olive, seedling, humic acid, Algae, growth and mineral contents.

Introduction

Olive belongs to the botanical order, Ligustrales, family Oleaceae; this family includes 30 genus including Olea and has 600 species. Olive is botanically called (*Olea eurovaea* L.). Commercial olives belong to the Eurovaea species, this species has two subspecies: oleaster and sativa[1].

Addition of organic fertilizers improves soil structure and enhances activities of useful soil organisms. Agricultural commodities resulted from organic cultivation are good for human health [2].

Humic substances are extremely complex heterogenous mixtures, and researchers have not been able to isolate pure humic substances[3].

Reactions between metals, minerals, and humic substances can take place via one or more of the following mechanisms: (1) formation of water soluble simple metal complexes; (2) formation of water-soluble mixed ligand complexes; (3) sorption on and desorption from water-insoluble humic acids and metal-humate complexes; (4) dissolution of minerals; (5) adsorption on external mineral surfaces; (6) adsorption in clay interlayers[4].

In this regard, [5]reported that, organic wastes fertilization did not lead to significant increases in olive mineral leaf concentrations in the first year trial. [6]studied the effect of organic and bio-fertilization on vegetative growth and flowering of Picual olive trees, they recorded that, N and K contents in leaf increased significantly with applying 100% organic fertilization (poultry manure), but no significant difference was observed on leaf P content in both seasons. The same treatment gave the highest Fe leaf content in both seasons and Mn in the second season, while leaf Zn content increased in second season with using 100% mineral fertilization. [7] mentioned that, Under field conditions, foliar application of leonardite extracts (humic substances extracted) stimulated shoot growth and promoted the accumulation of K, B, Mg, Ca and Fe in leaves. However, when leaf N and leaf K values were below the threshold limit for the sufficiency range, foliar application of humic substances was ineffective to promote accumulation of these nutrients in leaves. [8] found that foliar and/or soil application of humic acid had a positive effect on yield, fruit quality, leaf chlorophylls as well as leaf mineral content of NPK. Humic acid application as foliar spray combined with soil application at 0.50% for both is the promising treatment for improving growth and fruit quality of Florida Prince peach tree.

Algae extract as a new bio-fertilizer containing macronutrients as well as micronutrients, some growth regulators, polyamines, natural enzymes carbohydrates, proteins and vitamins applied to improve vegetative growth and yield [9].

In this concern, Mansour, A.E.[10] investigated the impact of algae extract application to thirty of 12 year old Anna Apple trees. Results showed that the applied of algae extract was very effective in stimulating the shoot length, leaf area, total leaf carbohydrates and leaf mineral content. [11]EmanA. Abd El Moniem et al reported that, progressive increase on percentages of N, P, and K in the Superior grapevine leaves was observed as a results of increasing concentration of algae till 50%. Abd El-Motty, E.Z. et al [12] showed that spraying Keitte mango trees once at full bloom with algae at 2% combined with yeast at 0.2% was very effective and improved nitrogen, potassium and boron contents in the leaves. On the other hand, all treatments had no effect on leaf phosphorus percentage. [13] found that on olive foliar application of Seaweed at 2ml./l increased significantly plant height, leaf number and leaf dry weight. However, foliar application of (EM-1) at 0.5ml.l-1 increased significantly average shoot length also (EM-1) at 1ml.l-1 significantly increase shoot dry weight and root. Haggag, L. F.[14] showed that combined with bio stimulant based on algae extract (1%) gave the best results concerning lateral shoot numbers, Stem diameter, Leaves number, root numbers nitrogen, phosphor and potassium percentage. Whereas, algae extract alone achieved the highest plant height increment % lateral shoot numbers, Stem diameter, Leaves number, root length values. Regarding the effect of Humic acid data revealed that, with using humic acid alone, a Leaves dry weight %of Aggizi olive seedlings improved respectively.

AL-Kahtani S.H. et al[15] indicated that (1 Date palm: 1 olives: 1 maize) waste + 10% sheep manure gave the highest values of all vegetative growth parameters including; Leaf length, width and area, shoot length, pigments content and leaf mineral contents (N, K and Fe) in Picual Olive.

The aim of this work is spotlight on importance of natural extracts (humic acids and algae extract) and recycling rice and wheat residues to reducing the use of mineral nutrients in olive nurseries and to obtain the best growth of seedlings cv. Picual.

Materials and Methods

This work was carried out in the experimental Research shade house of National Research Center, Dokki, and Giza, Egypt during 2014. For this purpose, healthy one years old olive and almost uniform seedlings Picual cv. was used. The seedlings were planted in black polyethylene bags with 30 cm diameter fooled 10 kg, Olive seedlings irrigated were irrigated twice weekly.

This work included nine treatments as follows:

1. Sand + humic acid
2. Sand + Algae
3. Sand +Algae +25 % mineral NPK
4. Rice straw+ humic acid
5. Rice straw+ Algae
6. Rice straw+ Algae+25 % mineral NPK

7. Wheat straw + humic acid
8. wheat straw+ Algae
9. Wheat straw+Alagae+25 % mineral NPK

Humic acid in the form of Actosol was added to seedling at the rate of 4 cm/seedling every 15 days. Algae extract was added to seedling with the irrigation water at 1 % every 15 days. The mineral NPK fertilizer (45 g/ seedling) used in the form of Cristalon (20% N: 20% P: 20% K) which applied as soil application divided into 16 doses from March to October during growing season about one dose every 15 dayas.

These treatments were distributed in completely randomized design with six replicates, each replicate included six seedlings.

Data recorded

1. Growth parameters

In September and October the following parameters were measured:

Plant height increment, lateral shoot numbers, stem diameter (cm), leaves number/ seedling, leaves dry weight, root numbers and root length

2. Chemical constituents

Nitrogen and phosphorus in leaves were calorimetrically determined according to the methods described by [16,17] ,respectively. Potassium was determined flame photometrically according to the method[18].

Data Analysis:

All the obtained data during the two seasons 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 [19].

Results and Discussion

1. Plant height increment (%)

Data in Table (1) shows the effect of waste organic materials such as rice straw and wheat straw and some biostimulants humic acid and algae extract on plant height increment % of olive seedling cv. Picual grown under shade house. There were significant differences between different culture types or bio-stimulants and their combination between them on plant height increment (%). Planting olive seedling under wheat straw gave the maximum plant height increment (30.28 %), followed by rice straw than sand culture. Concerning, biostimulants, treating seedling with humic acid under different types of culture had significant effect on plant height increment (35.32 %) than using algae or algae + 25 mineral NPK. As for the combination treatments, planting seedling on sand culture and applying humic acid recorded the maximum values of plant height increment (39.97 %), while the lowest value was obtained when planted seedling in rice straw and treated with algae +25 mineral NPK (13.70 %).

Table (1). Effect of waste organic materials and some bio-stimulants on plant height increment % of olive seedling cv. Picual grown under shade house

Treatment	Humic acid	Algae	Algae + 25%	Mean
Sand	39.97 a	21.80 d	21.50 d	**27.76 B**
Rice straw	33.87 b	32.80 b	13.70 e	**26.79 B**
Wheat straw	32.13 b	30.57 bc	28.13 c	**30.28 A**
Mean	**35.32 A**	**28.39 B**	**21.11 C**	

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

2- Lateral shoot numbers

There were no significant differences between different culture types or biostimulants and had significant effect between different culture types and biostimulants on lateral shoot numbers (Table 2). Treated seedling with humic acid under planting in rice straw gave the highest values of Lateral shoot numbers /seedling (9.67), followed by treated seedling with humic acid under planting in wheat straw (7.67), while the lowest value was obtained hen planted seedling in sand culture and treated with algae + 25 mineral NPK (5.00).

Table (2). Effect of waste organic materials and some bio-stimulants on Lateral shoot numbers of olive seedling cv. Picual grown under shade house

Treatment	Humic acid	Algae	Algae + 25%	Mean
Sand	6.67 ab	6.33 ab	5.00 b	**6.00 A**
Rice straw	9.67 a	5.67 b	5.00 b	**6.78 A**
Wheat straw	7.67 ab	6.00 ab	6.67 b	**6.78 A**
Mean	**8.00 A**	**6.00 A**	**5.56 A**	

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

3. Stem diameter

Data given in Table (3) show that there were no significant differences between different culture types or biostimulants and their combination between them on stem diameter of olive seedling cv. Picual grown under shade house.

Humin is water insoluble under all pH conditions, while humic acid is water soluble when pH is about 2 . Metal-humic acid and metal-fulvic acid complexes may play an important role in the availability of metals to roots and then increased shoot length and leaf surface area[20].

Table (3). Effect of waste organic materials and some biostimulants on stem diameter of olive seedling cv. Picual grown under shade house

Treatment	Humic acid	Algae	Algae + 25%	Mean
Sand	7.33 a	5.67 a	5.33 a	**6.11 A**
Rice straw	7.33 a	7.00 a	6.00 a	**6.78 A**
Wheat straw	5.33 a	6.00 a	5.67 a	**5.67 A**
Mean	**6.66 A**	**6.22 A**	**5.67 A**	

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

Seedling growth is influenced indirectly and directly by humic. The indirect effects, are those factors which provide energy for the beneficial organisms within the soil, influence the soil's water holding capacity, influence the soil's structure, release of plant nutrients from soft minerals, increased availability of trace minerals, and in general improved soil fertility. The direct effects include those changes in plant metabolism that occur following the uptake of organic[21].

These results are in accordance, [8]Abd El-Razek, E. et al found that found that foliar and/or soil application of humic acid had a positive effect on growth of Florida Prince peach tree.

4. Leaves number/ seedling

There were significant differences between different culture types or biostimulants and their combination between them on leaves number of olive seedling cv. Picual grown under shade house (Table 4). Treating seedling with algae extract when planed under sandy culture recorded the maximum values of number of leaves/seedling (252 leaves/ seedling), followed by the seedling treated with humic acid a when planted under rice straw culture (244 leaves/ seedling). On the contrary the, the lowest value was obtained by seedling treated with humic acid and planted under sand culture (128 leaves/ seedling).

Table (4). Effect of waste organic materials and some biostimulants on Leaves number of olive seedling cv. Picual grown under shade house

Treatment	Humic acid	Algae	Algae + 25%	Mean
Sand	128 e	252 a	155 de	**178 B**
Rice straw	244 a	220 ab	183 cd	**216 A**
Wheat straw	132 e	231 a	194 bc	**186 B**
Mean	**168 B**	**234 A**	**177 B**	

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

5. Leaves dry weight %

Table (5) show the effect of different waste organic materials and some biostimulants on leaves dry weight % of olive seedling cv. Picual grown under shade house. There were significant differences between different culture types or bio-stimulants and their combination between them regarding leaves dry weight % of olive seedling. Adding humic acid at the rate of 4 cm/ seedling when planting under rice straw culture gave the maximum values of leaves dry weight (51.9 %), followed by humic acid under wheat straw (50.42 %) and Algae extracts under rice straw (50.23 %) . while treated seedling with algae +25 mineral NPK under wheat straw gave the minimum value in this respect (39.39 %). Algae extract as a new bio-fertilizer containing macronutrients as well as micronutrients, some growth regulators, polyamines, natural enzymes carbohydrates, proteins and vitamins applied to improve vegetative growth and yield [9].

These results agreement with those obtained by [10] on Anna Apple trees and [11] on Superior grapevine reported that, treated plants with algae progressive increase on leaves dry weight.

Table (5). Effect of waste organic materials and some biostimulants on leaves dry weight % of olive seedling cv. Picual grown under shade house

Treatment	Humic acid	Algae	Algae + 25%	Mean
Sand	44.35 bc	45.49 b	41.17 d	**43.67 B**
Rice straw	51.9 a	50.23 a	43.76 c	**48.63 A**
Wheat straw	50.42 a	45.88 b	39.39 d	**45.23 B**
Mean	**48.89 A**	**47.20 A**	**41.44 B**	

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

6- Root numbers/ seedling

Data in Table (6) illustrate that there were no significant differences between different culture types or biostimulants and their combination between them on number of roots/ seedling of olive cv. Picual grown under shade house

Table (6). Effect of waste organic materials and some biostimulants on root numbers/seedling of olive cv. Picual grown under shade house

Treatment	Humic acid	Algae	Algae + 25%	Mean
Sand	4.33 a	5.00 a	4.33 a	**4.55 A**
Rice straw	4.33 a	4.67 a	4.33 a	**4.44 A**
Wheat straw	3.33 a	3.67 a	2.67 a	**2.89 A**
Mean	**4.00 A**	**4.45 A**	**3.44 A**	

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

7- Root length/ seedling

There were significant differences between different culture types or bio-stimulants and their combination between them on root length / seedling of olive cv. Picual grown under shade house (Table 7). In general planting seedling on sandy soil gave the maximum root length (30.00 cm) than rice or wheat straw.

Tread seedling with algae + 45 g mineral NPK Cristalon recorded the tallest root (27.78 cm) than humic acid or algae alone. As for the combination between type of culture and biostimulants , data in the same table show that, applying algae extract alone or with 25% mineral NPK gave the tallest root/ seedling (32.67 and 32.0 cm) , respectively, while the shortest root/seedling was obtained by treated seedling with algae extract when planted in wheat straw (10.10 cm).

Table (7). Effect of waste organic materials and some biostimulants on root length/seedling of olive cv. Picual grown under shade house

Treatment	Humic acid	Algae	Algae + 25%	Mean
Sand	25.28 b	32.67 a	32.00 a	**30.00 A**
Rice straw	24.33 b	20.00 c	33.21 a	**25.89 B**
Wheat straw	14.03 d	10.10 e	18.00 c	**14.00 C**
Mean	**21.22 B**	**20.89 B**	**27.78 A**	

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

Algae extracts is due to the antimicrobial activity of seaweeds against bacteria, yeast, and moulds whereas the increased plant growth, is resulted from the influence of these extracts on cell metabolism via the induction of the synthesis of antioxidant molecules which could improve plant growth and plant resistance to stress [22] .These reports reveal that organic compounds rather than mineral elements are responsible for the effects.

These results are agreement with [13,14] showed that combined with bio stimulant based on algae extract (1%) gave the best results root numbers and root length of Aggizi olive seedlings .

8- Nitrogen, Phosphor and potassium contents in leaves

Table (8) show the effect of different waste organic materials and some biostimulants and their combination between them on N,P and K contents in leaves of olive seedling cv. Picual grown under shade house, except waste organic materials regarding K content. Treading seedling olive with humic acid under wheat straw recorded the highest concentration of N and P in leaves seedling (2.54 and 1.73% respectively) **.** As for K content in leaves the same data in such table indicate that, the maximum K concentration in leaves was obtained by application of algae extract +25 % mineral NPK to seedling under rice straw culture (1.62 %).

Table (8). Effect of waste organic materials and some biostimulants on N, P and K content in leaves of olive seedling cv. Picual grown under shade house.

Treatment	Humic acid	Algae	Algae + 25%	Mean
		N (%)		
Sand	0.66 d	1.66 b	1.25 bc	**1.19 C**
Rice straw	2.04 a	0.95 cd	1.74 b	**1.55 B**
Wheat straw	2.54 a	1.53 b	1.49 b	**1.87 A**
Mean	**1.75 A**	**1.38 B**	**1.48 B**	
		P (%)		
Sand	0.92 b	0.07 c	0.07 c	**0.35 C**
Rice straw	1.56 a	0.09 c	1.07 b	**0.91 A**
Wheat straw	1.73 a	0.10 c	0.11 c	**0.65 B**
Mean	**1.40 A**	**0.09 C**	**0.42 B**	
		K (%)		
Sand	1.58 a	1.50 ab	1.21 bc	**1.43 A**
Rice straw	1.02 c	0.58 d	1.62 a	**1.07 C**
Wheat straw	1.06 c	1.10 c	1.33 abc	**1.16 B**
Mean	**1.22 A**	**1.06 A**	**1.39 A**	

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

In this respect, humic acid has many effects due to their increase of cation exchange capacity which affects the retention and availability of nutrients, or due to a hormonal effect, or a combination of both [23]. Therefore, it can face many problems in calcareous soil such soil nutrient availability and chemical reactions that affect the loss or fixation of almost all nutrients. Moreover, there is growing interest of the use of humic acid and K-humate as a substitute to chemical fertilizers which have potential polluting effects in the environment [24].

These results are in harmony with those reported by[5,6,7] on olive and on peach[8] they found that treated plant with biostimulants increased the contents of N, P and K in leaves .

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