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Maximizing fruit quality and quantity of "Picual" olives cultured in North Sinai under saline conditions by using bio-stimulating substances.

Laila, F. Hagagg, M.F.M. Shahin, N. S. Mustafa, E.A.E. Genaidy and H.S.A. Hassan.

Pomology Department, National Research Center, Giza, Egypt

ABSTRACT

This study was carried out during the two seasons 2011, 2012 on olive trees Picual cv. the trees were 10 years old growing in sandy soil at a private orchard in north Sinai governorate, Egypt. This investigation was performed to study the effect of Actosal (Humic acid 20% + NPK 1:5:6) and Greenpower (Vinasse 80%+Soybean amino acid 20%) as soil application under the drippers of each tree at (150, 75 and 50 cm^3) from April till June. At the end of the season, yield (kg/tree) and Fruit quality: average fruit size, weight, shape index (length/diameter) and pulp/pit ratio also fruit chemical characterizes: fruit oil and acidity percentage were recorded.The obtained results showed that, picual olive trees received humic acid soil application at 150 cm^3 per tree once at full bloom gained the highest yield (kg/tree) as while as fruit oil rather than dividing humic acid soil application dose into two doses (75 cm^3 at full bloom and 75 cm^3 after one month from full bloom) or into three doses (50 cm^3 at full bloom, 50 cm^3 after one month from full bloom and 50 cm^3 after two month from full bloom).

Key words: olive Picual cv, yield, Fruit quality, fruit oil percentage, fruit acidity, organic fertilizer, Humic acid, Greenpower, Vinasse, Soybean amino acid.

Introduction

Olive (*Oleaeuropaea L.*) is one of the oldest agricultural tree crops of remarkable cultural and economic importance in the Mediterranean Basin. It also represents a widely distributed fruit tree in the world (FAO, 2008). Olive is considered one of the important fruit crops in Egypt, The Egyptian olive production reachedabout 507053 tons produced from 110764 feddan (one feddan = 4200m^2) and the total area reached about 135692 feddan (M.A.L.R., 2007).

Adani *et al.,* (1998) mentioned that, humic acid (HA) is a heterogeneous mixture of many compounds with generally similar chemical properties which performs various functions in the soil and on plant growth. One of the functions of humic acid is the positive effect on the promotion of root development. Tattini *et al.* (1990 and 1991) reported that humic acid increased the root/shoot ratio as well as the production of thin lateral roots of olive plants. In addition, HA, prepared from leonardite coal, stimulated both shoot and root growth.

Forthermore, humic acid is known to improve nutrient absorption and plant growth. In many soils, phosphate readily forms in almost insoluble mineral compounds, such as apatite. Experimental data conducted by Lobartini *et al*. (1994) reported that increasing the amount of HA increased the rate of dissolution of apatite. Phanuphong and Partid (2003) showed that the application of humic acid has a positive influence in promoting overall tree vigor. Treated avocado trees were larger and the root system was better developed than the untreated trees.

Aml *et al.,* (2011) indicated that treatment Chemlali olive with (Humic acid +amino acids+ macro elements+ trace elements) was the most effective one compared with the other treatments since this treatments gave the best results concerning plant height, brunch numbers, leaf numbers, also it increased plant diameter and leaves area comparing with control. On the other hand, this treatment raised root length and root weight than the control plant.

Humic materials may increase root growth in a manner similar to auxins (Donnell, 1973, Tatini*et al.,* 1991). Fernández-Escobar *et. al.(*1999) who mentioned that, foliar application of leonardite extracts (humic substances extracted) to young olive plants stimulated shoot growth when they were growing without the addition of mineral elements to the irrigation water, but did not promote growth when applied to plants watered with a nutrient solution, although growth of fertilized plants was greater than that of unfertilized ones. Under field conditions, foliar application of leonardite extracts stimulated shoot growth and promoted the accumulation of K, B, Mg, Ca and Fe in leaves.

Aşik *et al*., (2009) reported that soil application of humus increased the N uptake of wheat, while foliar application of humic acid increased the uptake of P, K, Mg, Na, Cu and Zn.

Magdi*et al.,* (2011) reported that, humic substances could be used as a complementary for mineral fertilizers to improve yield and quality of cowpea under sandy soil conditions which protect the environmentchemical pollution and its harmful effect on human and animal health.

Cavalcante*et al.,* (2011) demonstrated that humic substances sprayed positively affect aerial part and root system of papaya seedlings and seedling quality of papaya were improved by humic acids foliar spray.

Corresponding Author: Laila, F. Hagagg, Pomology Department, National Research Center, Giza, Egypt

One of the main factors affecting plant growth in sandy soils is the types and amounts of fertilizers. However, the cost of mineral fertilizers has been significantly going up. As a result, it has become necessary to seek alternatives that would supply the poor soil with more economic sources of fertilizers (Rodriguez, 2000).

Organic materials have the benefit or disadvantage of being slow release fertilizers and are less likely to leach into ground or surface waters. Conventional fertilization has traditionally been used because they are cheap, less bulky and easy to apply. The line between has been becoming blurred with slow release conventional fertilizers and high analysis organic fertilizers that are easily applied and less bulky.

Vinasse is a byproduct of distilleries during alcohol production. In terms of volume, approximately 13 L of vinasse are produced by each L of alcohol obtained from cane must (Copersucar. 1986). Vinasse has high levels of potassium, calcium and organic matter in its chemical composition as well as moderate amounts of nitrogen and phosphorus (Gloria, N. 1985) and could represent an alternative to supply such nutrients in crop production (García, A. 1994, Gloria, N. 1985). Various research works carried out in other countries, particularly in Brazil, report that vinasse increases sugarcane productivity (Copersucar. 1980, Copersucar. 1986, Gloria, N. 1985) as well as they have demonstrated that under controlled conditions, it can partially or completely replace mineral fertilization.

On the other hand, Bioregulator substances were shown to enhance the biosynthesis of certain chemical constituents in plants. In this respect the amino acids which have a high integrity with different metabolic pools in plants were used to promote plant growth (Coruzzi and Last, 2000). Maxwell and Kieber (2004) indicated the link of methionine to the biosynthesis of growth regulating substances, e.g. cytokinins, auxins and brassinosteroids in plants. Whereas the link of tryptophan to the biosynthesis of auxins, the phytoalexincamalexin, phenyl propanoids and other related natural products in plants was recently reported (Tao *et al.* 2008). Studies have proved that amino acids can directly or indirectly influences the physiological activities of plant growth and development.

The aim of this study was evaluating fruit physical and chemical properties and yield of Picual trees treated with of organic matter (humic acid or Green power) as soil applications in Sinai soil to mitigate the adverse the adverse effect of such soil on plant nutrition and growth.

Material and Methods

This study was conducted during two successive seasons, 2011 and 2012, on 10 years old olive trees Picual cv. Grown in a private orchard in north Sinai (Glbana) – Egypt. The trees spaced 5 x 5 meter apart (168 trees/acre) in a sandy soil (Table1). The trees received the same cultural practices that were recommended. The farm is depending on wells in irrigation (Table 2).

Table 1: Chemical characteristics of sandy soil used for the present study.

parameters	Depth of simple (cm)		
	Surface sample	30 cm depth	60 cm depth
pH	7.75	7.59	7.66
EC(dSm-1)	3.7	3.4	4.1
	Soluble cations (meq\l)		
Ca++	15.0	4.0	7.0
Mg++	9.5	2.0	6.0
Na+	12.0	29.2	31.1
K+	0.6	0.49	0.26
	Soluble anions (meq\l)		
CO3=	-	-	-
HCO3-	4.5	6.0	2.2
Cl-	13.8	28.0	14.5
SO4=	18.8	8.09	27.66

Table 2: Chemical characteristics of well water used for the present study.

parameters	values
pH	6.89
EC(dSm-1)	8.4
Soluble cations (meq\l)	
Ca++	34.5
Mg++	18.5
Na+	38.2
K+	0.57
Soluble anions (meq\l)	
CO3=	-
HCO3-	1.6
Cl-	62.0
SO4=	28.17

Greenpower (Vinasse 80% + Soyabean amino acid 20%) and Actosal (Humic acid 20% + NPK 1:5:6) was added in this study to the trees as soil applications under the drippers of each tree.

Complete randomized design was applied. Seven treatments were applied in three replicates; all of the 21 trees conducted in this study were vigorous and similar in growth and canopy.

The investigation aimed at studying the effect of different doses and applications time of Actosal as the following:

1- Without humic acid or Greenpower application (control)
2- 150 cm^3 humic acid add to the soil once time at the first week of April (during full bloom).
3- 75 cm^3 humic acid add to the soil two times during growth season the first application at the first week of April while the second application at the first week of May (75 cm^3 at full bloom and 75 cm^3 after one month from full bloom).
4- 50 cm^3 humic acid drenched to the soil three times during growth season the first application at the first week of April, the second application at the first week of May, while the third application at the first week of June (50 cm^3 at full bloom, 50 cm^3 after one month from full bloom and 50 cm^3 after two month from full bloom).
5- 150 cm^3Greenpower add to the soil once time at the first week of April (during full bloom).
6- 75 cm^3Greenpower add to the soil two times during growth season the first application at the first week of April while the second application at the first week of May (75 cm3 at full bloom and 75 cm3 after one month from full bloom).
7- 50 cm^3Greenpower drenched to the soil three times during growth season the first application at the first week of April, the second application at the first week of May, while the third application at the first week of June (50 cm^3 at full bloom, 50 cm^3 after one month from full bloom and 50 cm^3 after two month from full bloom).

Yield and Fruit Quality:

In both seasons, samples of 10 random mature fruits per tree were used for the determination of average fruit size (volume), weight, shape index (length/ diameter) and pulp/pit ratio was measured.

Fruit chemical characteristics:

- Fruit oil percentage: Fruit oil content was determined by means of the Soxhlett fat extraction apparatus using Hexan of 60-80°C boiling point as described by (A.O.A.C. 1975).
- Fruit acidity (%): Fruit juice total acidity % as Malic acid (mgs/100 gms fruit juice) according to Vogel (1968) and A.O.A.C (1975).

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 (Duncan, 1955).

Results and Discussion

Fruit Properties:

Concerning the effect of number of applications of humic acid and Greenpower on some physical and chemical properties of Picual olive fruits during season (2011) as shown in **Tables (3,4).** It was clear that humic acid or Greenpower application doses treatments increased fruit physical and chemical parameters compared with the control in both seasons except fruit oil percentage in the second season since highest values of fruit oil percentage was obtained from trees that did not receive humic acid or Greenpower treatments (control).

It is found that, fruit physical parameters, fruit oil and acidity percentage where affected by dividing humic acid or Greenpower into two or three doses. The highest values of fruit weight, size and shape index where obtained from fruits harvested from Picual trees received humic acid or Greenpower at one dose (150 cm^3) during full bloom, followed, in a descending order, by application at two and three doses respectively for both humic acid and Greenpower treatments.

In humic acid treated trees, fruit weight, size and shape index values ranged between (5.55, 4.75 gm), (5.53, 4.88 cm^3) and (0.82, 0.75), corresponding values for greenpower treatments, the values for fruit weight, size and shape index ranged between (3.58, 3.01gm), (3.36, 2.71 cm^3) and (0.75, 0.68), respectively. Whereas, the lowest

fruit weight, size and shape index where recorded in the control treatment, the values were 2.67 gm, 2.60 cm^3 and 0.65, respectively.

Table 3: Effect of number of application of humic acid and Greenpower on some physical fruit properties Picual olive during first season.

Treatment		Fruit weight (gm)	Mean	Fruit size (cm^3)	Mean	Pulp/Pit	Mean	L/D	Mean
Humic acid	Once	5.55 a	5.20 A	5.53 a	5.2 A	3.60 ab	3.33 A	0.82 a	0.79 A
	Twice	5.30 b		5.20 a		3.12 c		0.80 ab	
	Three times	4.75 c		4.88 a		3.28 bc		0.75 ab	
Greenpower	Once	3.58 d	3.25 B	3.36 b	3.37 B	3.45 b	3.43 A	0.75 ab	0.72 B
	Twice	3.16 e		3.04 bc		3.72 a		0.73 b	
	Three times	3.01 ef		3.71 b		3.13 c		0.68 bc	
Control		2.67 f	2.67 C	2.6 c	2.6 C	3.00 c	3.00 B	0.65 c	0.65 C
Mean	Once	3.93 A'		3.83 A'		3.35 A'		0.74 A'	
	Twice	3.71 B'		3.61 A'		3.28 A'		0.73 AB'	
	Three times	3.48 C'		3.73 A'		3.14 A'		0.69 B'	

Table 4: Effect of number of application of humic acid and Greenpower on some chemical fruit properties Picual olive during first season.

Treatment		Oil % dry weight	Mean	Acidity% of fruit	Mean
A	B				
Humic acid	Once	36.52 a	36.43 A	0.27 a	0.26 AB
	Twice	36.17 b		0.26 a	
	Three times	36.61 a		0.24 a	
Greenpower	Once	36.55 a	36.44 A	0.28 a	0.27 A
	Twice	36.00 ab		0.26 a	
	Three times	36.50 ab		0.26 a	
Control		36.01 b	36.01 B	0.26 a	0.23 B
Mean	Once	36.36 A'		0.26 A'	
	Twice	36.15 B'		0.25 A'	
	Three times	36.37 A'		0.24 A'	

As shown in **Tables (5,6)** it is clear that fruit physical properties i.e. fruit weight, size, pulp/pit ratio, shape index, oil % and acidity % as a chemical properties were significantly affected by the source of material (humic acid or Greenpower) as will as number of applications. Generally, humic acid applications were superior in their impact on studied fruit quality parameters than Greenpower, Moreover, humic acid or Greenpower applications at one dose resulted in higher significant values compared with two or three times of application, while pulp/pit ratio, oil% and fruit acidity % did not follow the trend obtained for fruit weight, size and shape index as affected by humic acid or Greenpower number of application treatments. Humic acid impact on weight, size, pulp/pit ratio and shape index ranged between (3.94, 4.72 gm), (3.85, 4.55 cm3) and (1.17, 1.23), respectively. The corresponding values for Greenpower number of application treatments where (2.18, 2.65 gm), (2.10, 2.56 cm^3) and (1.06, 1.16), respectively. The highest pulp/pit ratio was accompanied with intermediate values for oil% and fruit acidity %. However, the corresponding values of Greenpower treatments on pulp/pit ratio, oil% and fruit acidity %. However, the control treatments recorded the lowest fruit weight, size, pulp/pit ratio, shape index and highest oil and acidity %. The variation in oil and acidity % could be relevant to fruit development and oil accumulation in fruits.

Yield:

Data in Table (7) showed the effect of humic acid or Greenpower rates (one, two and three doses) on yield of "Picual" olive trees during (2011 and 2012) and average of the two seasons. Results revealed that both of humic acid or Greenpower increased significantly yield (kg/tree) in both seasons as while as the average of the two seasons.

The yield obtained from humic acid treatments ranged between 20, 30 kg/tree and 24, 40 kg/tree in the first and second season, respectively. While the effect of Greenpower treatments on "Picual" yield ranged between 12, 25 kg/tree and 18, 30 kg/tree in the first and second season, respectively. Meanwhile, the corresponding values of the control yield recorded 8 and 6 kg/tree in the first and second season respectively.

It was clear that humic acid application treatments resulted in a significant increase in "Picual" olive yield than those received Greenpower, while both of humic acid and Greenpower treatments significantly increased yield than the control in both seasons. The highest yield was obtained from adding humic acid at a rate of 150 cm^3 at as one dose. However, increasing application dose number to two or three doses tended to significantly reduce the obtained increment in yield as compared with one dose application.

Yield values obtained from humic acid application treatments as one, two and three doses detected (30, 40 kg/tree), (22, 30 kg/tree) and (20, 25 kg/tree) in the first and second season respectively. The corresponding values for "Picual" olive yield (kg/tree) for Greenpower treatments application dose detected (25, 30 kg/tree),

(18, 25 kg/tree) and (12, 18 kg/tree) for one, two and three doses in the first and second season, respectively. As for the control, the yield was 8 and 6 kg/tree in the first and second seasons, respectively.

Table 5: Effect of number of application of humic acid and Greenpower on some physical fruit properties Picual olive during second season.

Treatment		Fruit weight (gm)	Mean	Fruit size (cm^3)	Mean	Pulp/Pit	Mean	L/D	Mean
Humic acid	Once	4.72 a	4.29 A	4.55 a	4.20 A	4.51 ab	4.20 A	1.23 a	1.20 A
	Twice	4.21 b		4.20 a		3.94 c		1.21 ab	
	Three times	3.94 c		3.85 a		4.13bc		1.17 ab	
Greenpower	Once	2.65 d	2.46 B	2.56 b	2.37 B	4.37 b	4.33 A	1.23 ab	1.12 B
	Twice	2.54 de		2.45 b		4.65 a		1.21 b	
	Three times	2.18 e		2.10 b		3.97 c		1.17 bc	
Control		2.11 e	2.11 C	2.02 b	2.02 B	3.87 c	3.87 B	1.01 c	1.01 C
Mean	Once	3.16 A’		3.04 A’		4.25 A’		1.13 A’	
	Twice	2.95 B’		2.89 A’		4.15 AB’		1.12 AB’	
	Three times	2.74 C’		2.66 A’		3.99 B’		1.08 B	

Table 6: Effect of number of application of humic acid and Greenpower on some chemical fruit properties Picual olive during second season.

Treatment		Oil % dry weight	Mean	Acidity% of fruit	Mean
A	B				
Humic acid	Once	37.30 b	37.24 B	0.24 a	0.23 AB
	Twice	37.00 b		0.25 a	
	Three times	37.41 ab		0.22 a	
Greenpower	Once	37.46 ab	37.31 B	0.27 a	0.26 A
	Twice	37.21 b		0.26 a	
	Three times	37.27 b		0.26 a	
Control		37.27 a	37.72 A	0.21 a	0.21 B
Mean	Once	37.49 A’		0.24 A’	
	Twice	37.31 A’		0.24 A’	
	Three times	37.47 A’		0.23 B’	

Table 7: Effect of number of application of humic acid and Greenpower on yield Picual olive during (2011 – 2012).

Treatment		Yield (Kg) 2011	Mean	Yield (Kg) 2012	Mean	Average yield (Kg)	Mean
Humic acid	Once	30.0 a	24.0 A	40.0 a	31.7 A	35.0 a	27.8 A
	Twice	22.0 c		30.0 b		26.0 b	
	Three times	20.0 d		25.0 c		22.5 c	
Greenpower	Once	25.0 b	18.3 B	30.0 b	24.3 B	27.5 b	21.3 B
	Twice	18.0 e		25.0 c		21.5 d	
	Three times	12.0 f		18.0 d		15.0 e	
Control		8.0 g	8.0 C	6.0 e	6.0 C	7.0 f	7.0 C
Mean	Once	21.0 A’		25.3 A’		23.2 A’	
	Twice	16.0 B’		20.3 B’		18.2 B’	
	Three times	13.3 B’		16.3 C’		14.8 B’	

Vinasse improves most factors involved in soil fertility, provides favoring conditions for nitrogen assimilation into the soil, protects nutrients against washing out in winter and maintains them as reserve nutrients as a slow release during the vegetative period. These are the most important affect, leading to increase yield and quality of crops.

Amino acids as organic nitrogenous compounds are the building blocks in the synthesis of proteins (Davies, 1982). Amino acids are particularly important for stimulation cell growth, they act as buffers which help to maintain favorable PH value within the plant cell, since they contain both acid and basic groups; they remove the ammonia from the cell.

This function is associated with amid formation, so they protect the plants from ammonia toxicity. They can serve as a source of carbon and energy, as well as protect the plants against pathogens. Tyrosine is hydroxyl phenyl amino acid that is used to build neurotransmitters and hormones. Hass (1973) reported that the biosyntheses of cinamic acids (which are the starting materials for the synthesis of phenols) are derived from phenylalanine and tyrosine.

The role of Tryptophan is well known: it has an indirect role on the growth via its Influence on auxin synthesis. Phillips (1971) reported that alter native routes of IAA synthesis exist in plants, all starting from Tryptophan. Thus, when Tryptophan was supplied to some plant tissues, IAA was formed. Thiamine (vitamin B1) could serve as coenzyme in decaboxylation of a-keto acids, such as Pyruvic acid and keto-glutamic acid

which has its importance in the metabolism of carbohydrates and fats (Bidwell, 1974). Thiamine is an important cofactor for the transketolation reactions of the pentose phosphate cycle, which provides pentose phosphate for nucleotide synthesis and for the reduced NADP required or various synthetic pathways (Kawasaki, 1992).

Conclusion:

Soil application of humic acid once at bloom stage at 150 cm^3\tree to "Picual" olive trees is recommended for high yield and oil% under Sinai condition.These results were in the same trend with those reported by Maggioni *et al.* 1987; De Kreij&Basar 1995; Mackowiak *et al.* 2001) that, humic acid is especially beneficial in freeing up nutrients in the soil so that they become available to the plant as needed. In several studies, humic and folic acids preparations were reported to increase the uptake of mineral elements, and to increase the yield of crop plants (Kauser *et al.* 1985; Chen *et al.* 2004 a, b). Due to the positive effect of humic substances on the visible growth of plants, these chemicals have been widely used by the growers instead of other substances such as pesticides etc. This, however, has led to growers using excessive amounts of these substances.

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