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The Efficient Use of Thermally Treated Poultry Slaughterhouses Remnants Fertilizer on Growth and Fruit Quality of Picual Olive Trees

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Abstract: This investigation was carried out during two successive seasons 2018 and 2019 on Picual olive cv., (10 years old), planted in a private farm located at 64 kilometer from Cairo. The trees were planted at 6*4 meters, grown in sandy soil and irrigated with drip irrigation. This work aimed to evaluate the effect of organic fertilization, concentrations of (humic acid and thermal treated poultry slaughterhouses remnant) at first of March, April, May, June and July on vegetative growth, flowering characteristics, fruit set, yield, fruit characteristics and leaves NPK content of Picual olive cv. Results obtained showed that treatment of humic acid (5.71 kg Neutral (7-5-4) + 5 kg humic acid/tree/year) enhanced vegetative growth parameters (leaf density, leaf surface area and dry leaf content). Flowering characteristics, fruit set, total production/tree, physical characteristics of olive fruits were also improved. Leaf content of nitrogen, P and K were increased.

Key words: Olive · Picual · Poultry slaughterhouses · Humic acid · Vegetative growth · Flowering and fruiting characters

INTRODUCTION

The olive tree (*Olea europaea* L.) is one of the oldest oil trees in the world. Olive oil production is mainly concentrated in the Mediterranean region; the olive tree is considered a wealth because of its economic and environmental benefits. Its fruit has many benefits. The extracts of olive oil arehealthyfood and also cosmetic benefits. According to International Olive Council (IOC) data of (2018) world wide olive oil production ranges from 3.1 to 3.45 million metric tons [1].

Transformative systems such as organic farming have proven to be sustainable effects, including improvement soil and water quality, enhance biodiversity, higher nutritional value, reduce pollution and increase farm incomes, but in many contexts result in lower yields so that their sustainability per unit product is sometimes questioned [2-5].

Humic substances are end products of microbial decomposition and chemical degradation of dead biota in soils [6, 7]. In soil, humic substances are reported to play key roles in various soils and plant functions, such as controlling nutrient availability, carbon and oxygen exchange between the soil and the atmosphere. In addition, humic substances in soils affect plant physiology and the composition and function of rhizosphere microorganisms [8, 9]. The activity of humic substances is related to their structural characteristics [8].

"Organic fertilizer" refers to concentrated organic manures (*e.g.* Slaughterhouse waste) and they must normally contain a minimum 5 % of nutrients ($N + P_2O_5 + K_2O$) [10]. The production processes of poultry slaughterhouses are responsible for a large amount of organic solid by-products and wastewater generation, which is rich in organic matter, nutrients, oils and fats. If is not properly treated it can cause environmental impacts in the final disposal [11]. Approx. 25% of the total farm animal weight slaughtered is not used for food consumption. During the last 50-60 years, a slaughter house waste product, rich in proteins and lipids, has been treated and used for production of animal fodder [12]. The total number of poultry slaughterhouses was reported to be 309 units in 2015, according to the data and statistics of The General Organization for Veterinary Services at the Ministry of Agriculture. The slaughtering capacity of all slaughterhouses is indicated to be around

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2 million birds per day at two shift operating schedule according to the Egyptian Poultry Association [13]. According to Moraes and Paula [14] during the poultry processing, there are three major sources of discharges. Examples of poultry industry by-products include offal, bone, blood, viscera, feet, wins, necks, internal organs, heads and feathers.Which generally contain organic matter, fats, suspended solids, phosphates, nitrates, nitrites and sodium chloride [15]. Concentration of N and P in slaughterhouse wastewater is 150-10000 mg N/l and 22-217 mg P/l. Van Dijk *et al.* [16] estimate that residues from slaughterhouses contain 0.28 Mt P in total. Animal bones were one of the first materials used to produce phosphate fertilizers in the nineteenth century.Stabilizing organic matter through microbial activity provides humus that can be used as a farm fertilizer and/or to improve soil texture [17].

Therefore, this investigation aimed to study the effect of thermally treated poultry slaughterhouses organic fertilizer (abattoirs) and humic acid on vegetative growth, flowering and fruiting characteristics of Picual olive cv.

MATERIALS AND METHODS

The present study was carried out during 2018 and 2019 growing seasons on Picual olive trees cv. (10 years old) uniform in shape and size and planted 6x4 meters apart in an olive private farm located at 64 kilometer distant from Cairo - Cairo Alexandria desert Road, Latitude (30°268` 215`` N) and Longitude (30°806` 534`` E).The selected olive trees of Picualcv. were originated from vegetative propagation by stem leafy cutting. The trees were planted at 6×4 meter apart (175 trees/fed.), in sandy soil, under drip irrigation system with the same amount of water (2400 m^3/fed.), 12 drippers/tree with discharge 4 liters/hour. The experiment was subjected to the regularly recommended culture practices during the two years of the study.

The following treatments were thus considered in the trials:

- (T1) Control (farm program) (30 kg compost/tree) at mid of December.
- (T2) 600g N/tree taken from Poultry slaughterhouses remnants "Neutral" (7-5-4) which equal 8.571 kg /tree at mid of December.
- (T3) 500g N /tree taken from Poultry slaughterhouses remnants "Neutral" (7-5-4) which equal 7.142 kg /tree at mid of December +100gN/tree taken from Humic Acid which equal 2.5 kg dissolved in 10 L of water before added to the soil and added with equal doses (500g) at first of March, April, May, June and July.
- (T4) 400g N /tree taken from Poultry slaughterhouses remnants "Neutral" (7-5-4) which equal 5.71 kg /tree at mid of December +200 g N/tree taken from Humic Acid which equal 5 kg dissolved in 10 L of water before added to the soil and added with equal doses (1 kg) at first of March, April, May, June and July.
- (T5) 300g N /tree taken from Poultry slaughterhouses remnants "Neutral" (7-5-4) which equal 4.285 kg/tree at mid of December +300gN/tree taken from Humic Acid which equal 7.5 kgdissolved in 10 L of water before added to the soil and added with equal doses (1.5 kg) at first of March, April, May, June and July.
  - The used organic fertilizers (compost and neutral) were spread on soil surface at the two sides of the plants and covered with 10 cm soil.
  - Plant compost from (Arab Organization for Industrialization) was added as 100% Nitrogen in control treatment equal 30 Kg/tree.
  - Poultry slaughterhouses remnants "Neutral" (7-5-4) from (AL-Mahalliah Organic Co.- The Kingdom of Saudi Arabia) was added on soil surface at the two sides of the plants and covered with 10 cm soil.
  - Humic acid powder (humic acid 68% - potassium 10% - vulvic acid 15.1%) dissolved in water 1/10 solid: water ratio with liquid state was added to each tree by irrigation beside the tree.

General Properties Of soil, Water, Compost, Humic and Poultry Slaughterhouses: Soil samples were taken from the major root zone, chemical and physical characteristics, water chemical characteristics and physical and chemical analysis of characteristic of potassium humo fulvate (Humic and fulvic acid) were determined by Soil, Water and Environmental Research Institute, Agric. Res. Center, according to the methods as described by Jackson [17] and presented in Tables (1, 2 and 3).

The physical and chemical properties of the used compost are determined according to Page *et al.* [18] as shown in Table (4). Compost added in control (the first treatment) was mixed with the surface soil under the tree at a rate of 30 kg/tree/year during soil preparation one time at December.

The chemical and microbial characteristics of thermally treated poultry slaughterhouses remnants were determined by IDAC Merieux NutriSciences Laboratories and were summarized in Tables (5 and 6).

Table 1: Mechanical and Chemical analysis of the experimental soil:

Mechanical analyses (%)				
Coarse sand	Fine sand	Silt	Clay	Texture class
38.4	43.3	13.0	5.3	Sandy

Chemical analyses (Anions and Cations) mg/L									
pH	ECds /m	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{--}	HCO_3^{-}	Cl^{-}	SO_4^{--}
7.99	0.56	1.8	0.87	2.5	1.25	ND	1.51	4.51	0.4

Available nutrients (mq/ Kg Soil)		
N	P	K
127.3	15.8	99.8

Table 2: Chemical properties of the irrigation water

pH	EC	CO_3	HCO_3	Cl	SO_4	Ca	Mg	Na	K	SAR
	mmohs/cm	----------mq/L----------				----------mq/L----------				
7.12	6.10	ND	1.52	18.75	47.91	22.69	16.54	16.54	0.17	6.56

Table 3: The Physical and chemical analysis of Potassium humate and fulvate (Humic acid and Fulvic acid)

Physical properties	
Appearance	Flake
Color	Black brown
Smell	Mild order
Solubility in water	100%
pH value (10% solution at 20 °C)	10
Specific Gravity	0.48
Stability	Stable under light
Chemical properties	
Humic Acid (Dry Basis)	65 %
Fulvic Acid (Dry Basis)	15.1 %
Potassium (as K2O dry basis)	10.1%

Table 4: The Physical and chemical properties of compost

Character	Compost
Physical properties	
Bulk density (g/cm_3)	0.78
Moisture content %	14
Chemical properties	
pH	8.43
EC (ds/ m)	4.09
Organic matter (%)	18.39
Organic carbon (%)	10.67
Ash (%)	81.61
Total nitrogen (%)	1.22
C: N ratio	15:1
Total phosphorus (%)	0.77
Total potassium (%)	1.18
Available NH_4N ppm	256
Available NO_3N ppm	142

Table 5: Chemical analysis of Poultry slaughterhouses (Neutral 7-5-4)

Description	Unit	Result
Moisture	% w/w	7.09
pH-20% solution	pH	7.57
EC for 1:5 solution	Ms/cm	3.20
Organic Matter on dry matter basis	% w/w	68
Total Nitrogen	% w/w	7.1
Total Phosphorus	% w/w	4.8
Total Potassium	% w/w	3.9
Total Magnesium	% w/w	1.6
Total Cadmium	mg/kg	31
Total Mercury	mg/kg	15
Total Copper	mg/kg	800
Total Nickel	mg/kg	420
Total Zinc	mg/kg	700
Total Selenium	mg/kg	85

Table 6: Microbiological analysis of Poultry slaughterhouses (Neutral7-5-4)

Description	Unit	Result
Total Coliform Plate Count	Cfu/g	<10
Molds Isolation and Identification	----	0
Nematode Detection	----	No Nematode seen (microscopic)
Salmonella	----	Negative

The experimental trees were grown in a sandy soil and irrigated with drip irrigation from well having a salt concentration of 3904 ppm and subjected to the regularly recommended culture practices and free from pathogens and physiological disorders.

The following characteristics were recorded according to Methodology for primary characterization of olive varieties, according to Barranco and Trujillo [19] and Cimato and Attilio [20].

Vegetative Characteristics: At first of August in both seasons leaves density and leaf area were measured as follows: Leaves density: (Number of leaves/meter): Ten shoots were taken of one year old shoots from each replicate and length of each shoot was measured with (cm) and number of leaves/ shoot and then number of leaves / meter was calculated.

Samples of approximately 40 adult leaves taken from the middle section of selected shoots of one year old shoot to determine average leaf surface area according to Ahmed and Morsy [21] using the following equation: Leaf area = 0.53 (length x width) + 1.66

Leaf Chemical Analysis: The content of (N, P&K) in leaves were determined. Nitrogen and phosphorous: Were determined calorimetrically according to Evenhuis [22]. Potassium: Was measured against a standard using Flame Photometer as described by Jackson [17].

Floral Characteristics: The following floral characteristics were studied for cultivar: Floral biology: Samples of 20 floral shoots were taken randomly from each replicate (Three trees as replicates) to study the following:

- Flowering density: (number of inflorescences per meter).
- Average length of inflorescence (cm).
- Total number of flowers/inflorescence.
- Total number of male flowers/inflorescence.
- Total number of perfect flowers/inflorescence.
- Percentage of perfect flowers expressed as percentage of perfect flowers to total number of flowers according to Hegazi and Stino [23] and Hegazi [24].

Fruit Set and Yield Characteristics: Fruit set was expressed as number of fruits/meter of shoot length and was measured at two times (21 day after full bloom (21DAFB) as initial fruit set and at 60 day after full bloom (60DAFB) as final fruit set according to Hegazi and Hegazi [25] and Hegazi [26].Yield per tree (Kg): Fruits of each experimented tree was harvested at ripe stage (olive with superficial pigmentation on more that 50% of the exo-carp) and the average yield was calculated.

Fruit Characteristics: Ten fruits from each studied three trees at ripe stage has been described and identified by morphology description of Barranco and Trujillo [19] and Cimato and Attilio [20]. Quantitative fruit characteristics: Average fruit weight, length and diameter (cm), length/diameter (L/D ratio) and percentage of flesh/fruit weight were determined.

Statistical Analysis: The treatments will be arranged in randomized complete block design (RCBD) with three replicates for each treatment and each replicate will represented by tree. The obtained data was subjected to analysis of variance (ANOVA) according to Snedecor and Cochran [27] by using M stat c program [28]. Least significant difference (L. S. D) will used to compare between means of treatments according to Waller and Duncan [29] at probability of 5%.

RESULTS AND DISCUSSION

Results presented here represent the averages of two seasons 2018 and 2019 for vegetative growth parameters, the NPK content in leaves, flowering, fruiting and yield characteristics.

Vegetative Growth Characters

Leaves Density: Data presented in Table 7 indicated that, generally all treatments caused a significant increase in leaves density/m of Picual olive trees compared with the control. In this respect, values ranged from (118.1) in control and reach (152.4) with (4.285 kg Neutral (7-5-4) + 7.5 kg humic acid) treatment in first season. In the second, no significant differences between treatments were observed.

Table 7: Effect of humic acid and poultry slaughterhouse remnants on vegetative growth characters (leaves density (number of leaves/m), leaf surface area L.S.A. (cm^2) and moisture content of Picual oliveleaves in 2018 and 2019 seasons.

	Leaves density/m		L. S. A (cm^2)		Leaf moisture %	
Treat.*	2018	2019	2018	2019	2018	2019
T1	118.1 d	225.1a	5.57 b	5.73b	45.33a	42.33a
T2	127.2 cd	235.5a	5.94 ab	6.12ab	36.67b	36.0b
T3	132.5 bc	224.0a	5.95 ab	6.13ab	33.0b	31.33c
T4	137.0 b	236.6a	6.32 ab	7.10a	24..0c	20.0d
T5	152.4 a	219.2a	6.89 a	6.50ab	22.33c	22.33d

Means followed by the same letter(s) within each column are not significantly different at $P \leq 0.05$ level using Duncan's Multiple Range Test.

*Treatments: T1=30 kg compost/tree/year, T2= 8.57 kg Neutral (7-5-4) / tree / year, T3= 7.142 kg Neutral (7-5-4) + 2.5 kg humic acid/tree/year, T4= 5.71 kg Neutral (7-5-4) + 5 kg humic acid/tree/year and T5= 4.285 kg Neutral (7-5-4) + 7.5 kg humic acid/tree/year.

Table 8: Effect of humic acid and poultry slaughterhouse remnants on N, P and K (%) content in leaves of Picual olive trees in 2018 and 2019 seasons.

	N %		P %		K %	
Treat.*	2018	2019	2018	2019	2018	2019
T1	1.73 a	1.80b	0.43 b	0.46c	1.94 b	1.90c
T2	1.74 a	1.96ab	0.47 b	0.53b	2.11 ab	2.12b
T3	2.06 a	2.13ab	0.45 b	0.56b	2.12 ab	2.18ab
T4	2.10 a	2.33a	0.60 a	0.66a	2.13 ab	2.28a
T5	2.18 a	2.30a	0.61 a	0.64a	2.18 a	2.23ab

Means followed by the same letter(s) within each column are not significantly different at $P \leq 0.05$ level using Duncan's Multiple Range Test.

*Treatments: T1=30 kg compost/tree/year, T2= 8.57 kg Neutral (7-5-4) / tree / year, T3= 7.142 kg Neutral (7-5-4) + 2.5 kg humic acid/tree/year, T4= 5.71 kg Neutral (7-5-4) + 5 kg humic acid/tree/year and T5= 4.285 kg Neutral (7-5-4) + 7.5 kg humic acid/tree/year.

Leaf Surface Area (L.S.A): Regarding to the value of average leaf surface area (cm^2) (Table, 7), there is no significant differences between (T1, T2, T3 and T4), whereas the values reached the maximum rate (6.89 and 7.10 cm^2) with treatment (T5 and T4) in both seasons, respectively. In addition, the value decreased to the minimum rate (5.57 and 5.73 cm^2) with control treatment in two seasons.

Leaf Moisture: Data presented in Table (7) explained that, generally all treatments caused a significant increase in average leaf moisture content of Picual olive trees, especially with control treatment (30 kg compost/tree) (45.33 and 42.33 %) in both seasons, respectively. Reversely, the moisture content decreased to (22.33 % and 22.33 %) and (24 and 20 %) with treatments (4.285 kg Neutral (7-5-4) + 7.5 kg humic acid and 5.71 kg Neutral (7-5-4) + 5 kg humic acid) in 2018 and 2019 seasons, respectively.

These results are in line with those reported by Yousef *et al.* [30], on olive seedlings Chemlali cv. who showed that the positive effects of humic acid application, concluded that leaves density and leaves area increased as the rate of the mixture of humic acid and amino acids increased comparing with the control, Also, Magdi *et al.* [31] reported that, bio-fertigation of microbial inoculums and humic substances could be used as a complementary for mineral fertilizers to improve yield and quality of cowpea under sandy soil conditions. Barakat *et al.* [32] reported that organic fertilization at high level plus humic acid enhanced vegetative growth of trees Newhall Navel orange by increasing leaf area. Furthermore, Vines received compost (plant + animal residues) at 11 kg compost/vine + bio-fertilizers + NPK + humic acid gave the highest values of shoot length, leaf area and cane thickness according to Gawad *et al*. [33]. While the application of compost with bio- fertilizers plus humic acid plus compost tea gave a better effect in this respect[34].

Effect of Humic Acid and Poultry Slaughterhouse Remnants on Nutrients Content in Leaves (N, P and K) of Picual Olive Trees:

Leaf Nitrogen Content: It is obvious from data listed in Table (8) that, generally the differences between treatments of leaf nitrogen contentare not significant, values ranged from (1.73 to 1.80 %),while in control reached (2.18 and 2.30 %) with 4.285 kg Neutral (7-5-4) + 7.5 kg humic in the 2018 and 2019 seasons, respectively.

Leaf Phosphorus Content : Regarding to leaf P content, treatments (5.71 kg Neutral + 5 kg humic acid and 4.285 kg Neutral + 7.5 kg humic acid) were superior (0.60 and 0.66 %) and (0.61 and 0.64 %) in both season,than the control and other treatments, respectively (Table, 8).

Table 9: Effect of humic acid and poultry slaughterhouse remnants on flowering density/m, average inflorescence length (cm), total number of flowers/inflorescence and percentage of perfect flowers of Picual olive trees in 2018 and 2019 seasons

	Flowering density (inflorescence/m)		Average of inflorescence length (cm)		Total number of flowers /inflorescence		Percentage of perfect flowers	
Treat.*	2018	2019	2018	2019	2018	2019	2018	2019
T1	44.87c	53.10b	2.12c	2.26c	9.52b	11c	52.57b	50.06b
T2	45.60c	57.70ab	2.31b	2.49b	11.08a	13.67b	52.26b	61.29b
T3	52.75b	55.40b	2.23bc	2.45b	11.45a	14.33b	63.41a	70.82a
T4	51.80b	62.77a	2.59a	2.75a	11.57a	16.33a	61.94a	74.38a
T5	62.05a	58.10ab	2.68a	2.64a	11.32a	15.0ab	63.06a	70.71a

Means followed by the same letter(s) within each column are not significantly different at $P \leq 0.05$ level using Duncan's Multiple Range Test.
*Treatments: T1=30 kg compost/tree/year, T2= 8.57 kg Neutral (7-5-4) / tree / year, T3= 7.142 kg Neutral (7-5-4) + 2.5 kg humic acid/tree/year, T4= 5.71 kg Neutral (7-5-4) + 5 kg humic acid/tree/year and T5= 4.285 kg Neutral (7-5-4) + 7.5 kg humic acid/tree/year.

Leaf Potassium Content: It is worthy to mention (Table, 8) that, the differences are not significant between some treatments of leaf potassium content (%) in the 2017/2018 and 2018/2019 seasons. The highest value of K content were (2.18and 2.23 %) and (2.13 and 2.28 %) at T4 and T5 treatment in both seasons, respectively. On the other hand, the control treatment gave the lowest value of potassium content (%) in leaf (1.94 and 1.90 %) in studied seasons.

These results are in agreement with those stated by Abd El-Razek *et al.* [35] on Florida Prince peach trees, who found that, soil application of humic acid had a positive effect on leaf mineral content of NPK.In addition, El- Haggar *et al.* [36] reported that humic acid improve plant nutrition by stimulating the absorption of mineral elements through the roots, stimulating root growth especially in the vertical direction. Barakat *et al.* [32] reported that organic fertilization at high level plus humic acid improved leaves nutritional status through increasing their content of nitrogen, phosphorus and potassium compared to the chemical fertilizers of trees Newhall Navel orange. El-Gioushy *et al.* [37] found that replacement of mineral fertilization with organic fertilization with compost and EM biofertilizers improve nitrogen, phosphors and potassium content in leaves of Fagri Klan Mango trees.

Effect of Humic Acid and Poultry Slaughterhouse Remnantson Flowering Characteristics of Picual Olive Trees

Flowering Density: Influence of humic acid and poultry slaughterhouse remnants on flowering density, found in Table (9) displayed clearly that, flowering density increased significantly with treatment (4.285 kg Neutral + 7.5 kg humic acid) (62.05 inflorescence/m) in 2018 season and (62.77 inflorescence/m) in 2019 season at T4. On the other hand, control gave the lowest values of flowering density (44.87 and 53.10 inflorescence/m) in both seasons, respectively.

Average of Inflorescence Length: Data illustrated in Table (9) in 2018 season proved that, average length of inflorescence (cm) significantly increased by increasing humic acid doses to (5 and 7.5 kg/tree) T4 and T5 treatments gave the highest values (2.59 and 2.75 cm) and (2.68 and 2.64 cm) in both seasons, respectively. Reversely, control treatment gave the lowest value of average of inflorescence length (2.12 and 2.26 cm) in both seasons.

Total Number of Flowers/inflorescence: Data of the present investigation (Table, 9) showed that, the differences between treatments were not significant between the treatments but the control treatment recorded the lowest value (9.52 flowers/inflorescence) in the first season. Regarding the second season treatments (T4) gave the highest value of total number of flowers/inflorescence (16.33 flowers / inflorescence).

Percentage of Perfect Flowers: Results in Table (9) showed that, all humic acid treatments caused a significant increase inpercentage of perfect flowers/inflorescence in 2018 and 2019 seasons, compared to the control which recorded the lowest value.

The obtained results are in general agreement with results reported by Hegazi *et al*. [38] who studied the effect of organic and bio-fertilization on flowering of Picual olive trees, they recorded that, the highest values of the studied growth characters were obtained with 100% organic fertilization (poultry manure). El-Gioushy *et al.* [37] found that replacement of mineral fertilization with organic fertilization with compost and EM biofertilizers improve flowering characters of Fagri Klan Mango trees.

Effect of Humic Acid and Poultry Slaughterhouse Remnants on Fruit Set and Yield/tree of Picual Olive Trees: Fruit set (average number of fruits/m) 21DAFB: Results detected in Table (10) showed that, treatments

Table 10: Effect of humic acid and poultry slaughterhouse remnants on fruit set and total yield/tree of Picual olive trees in 2018 and 2019 seasons.

	Fruit set (fruits/m) 21DAFB		Final fruit set (fruits/m) 60DAFB		Yield /tree (kg)	
Treat*.	2018	2019	2018	2019	2018	2019
T1	17.24 b	16.62b	16.29 b	17.93b	3.67 d	33.67d
T2	31.55 a	31.18a	24.08 ab	25.05ab	4.50 d	37.67c
T3	20.18 b	20.59b	19.56 ab	20.34ab	8.33 c	41.67b
T4	34.08 a	34.76a	32.09 a	33.37a	10.25 b	48.0a
T5	24.31 ab	19.96b	19.57 b	25.29ab	11.50 a	42.0b

Means followed by the same letter(s) within each column are not significantly different at P ≤ 0.05 level using Duncan's Multiple Range Test.

*Treatments: T1=30 kg compost/tree/year, T2= 8.57 kg Neutral (7-5-4) / tree / year, T3= 7.142 kg Neutral (7-5-4) + 2.5 kg humic acid/tree/year, T4= 5.71 kg Neutral (7-5-4) + 5 kg humic acid/tree/year and T5= 4.285 kg Neutral (7-5-4) + 7.5 kg humic acid/tree/year.

Table 11: Effect of humic acid and poultry slaughterhouse remnants on fruit physical characteristics (weight (g), length (cm), diameter (cm), L/D ratio and flesh/fruit weight (%) of Picual olive trees in 2018 and 2019 seasons

	Fruit characteristics									
	Weight (g)		Length (cm)		Diameter (cm)		L/D fruit		Flesh/fruit weight %	
Treat*.	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
T1	5.30 b	5.28b	2.70 c	2.76b	2.08 a	2.0b	1.30 a	1.38a	80.42 b	80.56b
T2	5.11 b	5.13b	2.73 bc	2.76b	2.10 a	2.1ab	1.30 a	1.32a	80.05 b	80.53b
T3	5.13 b	5.2b	2.82 ab	2.83ab	2.03 a	2.1ab	1.39 a	1.37a	79.35 b	81.87b
T4	5.78 a	5.78a	2.90 a	2.91a	2.17 a	2.2a	1.34 a	1.32a	84.68 a	84.97a
T5	5.63 a	5.66a	2.87 a	2.90a	2.11 a	2.13ab	1.36 a	1.36a	81.87 ab	82.35b

Means followed by the same letter(s) within each column are not significantly different at P ≤ 0.05 level using Duncan's Multiple Range Test.

*Treatments: T1=30 kg compost/tree/year, T2= 8.57 kg Neutral (7-5-4) / tree / year, T3= 7.142 kg Neutral (7-5-4) + 2.5 kg humic acid/tree/year, T4= 5.71 kg Neutral (7-5-4) + 5 kg humic acid/tree/year and T5= 4.285 kg Neutral (7-5-4) + 7.5 kg humic acid/tree/year.

(T2) and (T4) significantly increased fruit set (31.55 and 31.18 fruits/m) and (34.08 and 34.76 fruits/m) in 2018 and 2019 seasons, respectively.On the other hand, the rest of treatments including (T1, T3 and T5) treatment gave the lowest value in both studied seasons.

Fruit set 60DAFB: Result in Table (10) cleared that, application of (T4) enhance fruit set (%) at 60DAFB (32.09 and 33.37 fruits/m) of Picual olive trees. Reversely, the lowest values of fruit set were recoded with control (16.29 and 17.93 fruits/m) in 2018 and 2019 seasons, respectively.

Yield/Tree: When Picual olive trees were treated by (T5) treatment produced significantly the maximum yield (11.5 kg/tree) in 2018 season.On the other hand, treatment (T4) in the second season in 2019 gave the highest total olive production (48 kg/tree), these results it can be illustrated in Table (10).Whereas, the lowest values can be observed with control (3.67 and 33.67 kg/tree) in 2018 and 2019 seasons, respectively.These results confirmed byfindings of El-Sayed and Mohamed [39]on olive. They mentioned that, K-humate significantly enhanced yield and fruit physio-chemical properties in both studied seasons, either singly or in combinations. Using 200 g/tree of hydrogel with 80 g/tree K-humate were surpassed control on Egazy olive trees. Fathy *et al.* [40] showed that fruit set and yield of "Canino" apricot trees sprayed with 15 cm^3 and received 75 cm^3 as soil application of humic acid had the highest significant values of fruit set, retained fruit %, number of fruits/tree and fruit yield/tree. Fruit set and yield of "Le- Conte" pear trees was improved when the trees fertilized with humic acid (HA) followed in descending order by HA + compost and compost alone, as well as yield was affected as N doses application decreased from 100 % (14.48 and 20.0 Kg/tree) to 75 % (14.98 and 19.19 Kg/tree) and 50 % (14.51 and 18.34 Kg/tree) in the 1st and 2nd season, respectively, [41]. Also, El-Gioushy *et al.* [37] found that replacement of mineral fertilization with organic fertilization with compost and EM biofertilizers improve total yield/tree of Fagri Klan Mango trees.

Effect of Humic Acid and Poultry Slaughterhouse Remnants on Fruit Physical Properties of Picual Olive Trees

Fruit Weight: Regarding the increment in fruit weight (g) of Picual olive fruits as affected by humic acid andpoultry slaughterhouse remnants, data tabulated in Table (12) revealed obviously that the investigated character was significantly affected by the different treatments. However, the highest significant values (5.78 and 5.78 g) and (5.63 and 5.66 g) with treatments (T4 and T5) in 2018 and 2019 seasons, respectively. On the other hand, the least values of fruit weight (g) were detected with (T1), (T2) and (T3) treatments during 2018 and 2019 seasons of study.

Fruit Length: With regard to the response of average fruit length (cm) of Picual olive fruits as affected by humic acid and poultry slaughterhouse remnants, data presented in Table (12) indicated that the investigated character had been significantly affected by the various investigated treatments. Moreover, the Picual olive trees which were fertilized by (T4, T5 and T3) reflected the highest significant values of fruit length (2.90and 2.91cm), (2.87 and 2.90 cm) and (2.82 and 2.83 cm) in the two seasons of study, respectively. On the other way around, the reverse was true with those trees which were fertilized with (T1) and (T2), whereas those reflected the least values of average fruit length (cm) during both seasons.

Fruit Diameter and Fruit L/D Ratio: As seen in Table (12), there was no significance difference between all treatments could enhance fruit diameter of and fruit L/D ratio of Picual olive fruits in 2018 and 2019 seasons.

Flesh/Fruit Weight (%): The analysis of variance in Table (12) also corroborated that, treatment (T4) in 2018 and 2019 seasons caused a significant increase in flesh/fruit weight (84.68 and 84.97 %), respectively. On the other hand, the minimum values of flesh/fruit weight (%) were recorded with the rest of treatments in bothseasons.

These results can agree with obtained by Hegazi *et al.* [38] they observed that poultry manures proved to be the most efficient manures source in enhancing fruit physical properties of olive trees. The obtained results of Shahin *et al.* [42] showed that, "Kalamata" olive trees received humic acid soil application at 150 cm^3 per tree once at full bloom gained the highest yield (kg/tree) rather than dividing humic acid soil application dose into two or three doses. Whereas, fruit physical properties were significantly affected by the source of material (humic acid or Green power) as will as number of applications. Abd El-Razek *et al.* [35] found that soil application of humic acid had a positive effect on yield and fruit quality. Kabeel *et al.* [43] studied the response of "Le-Conte" pear trees to the different combinations of nitrogen, potassium and humic acid soil applied rates on some fruit physical properties i.e., (fruit weight, volume, firmness, height, diameter and fruit shape index). They mentioned that all the investigated combination treatments under study exhibited a significant response and beneficial effects on improving the majority of physical fruit characteristics of "Le-Conte" pear fruits.

Ferraral and Brunetti [44] found that, a soil humic acid was able to produce some positive effects in table grape cv. "Italia". In particular, significant increases in berry size and a significant reduction of titratable acidity have been observed when the humic acid was applied at full bloom with respect to the control treatment.

It can be concluded under the same conditions of this study that, the application of (5.71 kg Neutral (7-5-4) + 5 kg humic acid/tree/year) improve vegetative characters, yield and producegood quality ofPicual olive fruits.

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