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Effect of Bio and Organic Fertilizers on Flowering,Yield, and Fruit Quality of Kalamata Olive Trees under North Sinai Condition

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ABSTRACT

"Kalamata" olive trees (*Olea europea* L.) about 10 -years- old of nearly moderate vigor and productivity grown in sandy loam soil were selected. The trees were planted at 6 × 7 m apart and under drip irrigation system during the two consecutive seasons of 2014-2015and 2015-2016 at the Experimental Station of the Faculty of Environmental Agricultural Sciences, Arish University, North Sinai Governorate to study the effect of bio and organic fertilizers on olive trees all of them received regularly the annual horticultural practices as usually adopted in the orchards. The four organic fertilizer sources i.e. fish scrap 2.5 Kg/tree/ Year, goat manure 16.8 Kg/tree/ Year, chicken manure 7.8 Kg/tree/Year and olive pomace 8.5 Kg/tree, were applied annually in tranches. Three biofertilizers and amino acid treatments alone or combined with them i.e. Nitrobein 150 g.tree/Year in trenches, Protamine at concentration 1.5 % and dissolving in one liter of water then added to the soil at three times, at 70% full-bloom, after fruit set, and a month later and combination of Nitrobein + Protamine®. These treatments were arranged in a randomized complete block design with three replicates for each treatment and each replicate was represented by two trees. the use of organic fertilization, especially fish scrap, through the addition of bio-fertilization using nitrobein with amino acid protamine at a concentration of 1.5% combined. This treatment improved the production of high yield with characteristics and high quality of fruits in addition to protecting the environment from the problems of pollution resulting from mineral fertilization as well as the use of environmental waste.

Keywords: Bio-Fertilizers, organic Fertilizers, yield, Protamine, Nitrobein, Kalamata and fruits .
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INTRODUCTION

Egypt is considered one of the major producers of olive worldwide. Moreover, Egypt is the leader in growing olive in arid and semi-arid conditions on desert lands. According to statistics of the Ministry of Agriculture and Land Reclamation (2008), the total acreage of olive orchards reached 150320 feddans. Olives are used locally as table olives and as a source of oil. The production of table olives reached about 470000 tons in 2015, more than 71000 tons are exported and the rest are locally consumed. As for olive oil produced in Egypt, they have the reputation of being high quality oil. They are characterized as extra virgin oil. The production of olive oil reached in 2015 about 25000 tons.

Organic manure enhances cation exchange capacity and acts as a buffering agent against undesirable soil pH fluctuations (Akanni and Ojeniyi, 2008). The application of organic manure has been found to have higher comparative economic advantage over the use of inorganic fertilizer (Usman,2015).

The use of bio-fertilizers can improve productivity per unit area in a relatively short time, consume smaller amounts of energy, mitigate contamination of soil and water, increase soil fertility, and promote antagonism and biological control of phytopathogenic organisms (Corpoica, 2007), improve fruit quality and yield (Mosa *et al*., 2014).

This investigation aimed to study the effect of different organic and bio-fertilization sources and protamine amino acid on growth parameters, flowering and fruit and oil production of Kalamata olive trees under North Sinai condition.

MATERIALS AND METHODS

The investigation was carried out during the two consecutive seasons of 2015 and 2016 at the Experimental Station of the Faculty of Environmental Agricultural Sciences, Arish University, North Sinai Governorate, Egypt, to study the effect of organic and biofertilizers as well as Protamine amino acid together with the control on growth and productivity of "Kalamata" Olive trees.

Ten years old of "Kalamata" olive trees (*Olea europea* L.) planted at 6 × 7 m apart in loamy sand soil under drip irrigation system were devoted for this investigation. The mechanical and chemical analyses of the experimental soil and water quality are reported in Tables (1 and 2) respectively according to the methods described by Piper (1947) and Jackson, (1958). All trees received the regularly the annual horticultural practices as usually adopted in the orchard such as:

All control trees received the regularly annual horticultural practices as usually adopted in the orchard such as:

- Nitrogen was annually applied at the rate of 1500 g ammonium sulfate 20.6 % N / tree.
- Phosphorus as superphosphate (15.5% P2O5) was annually added at rate of 1500 g / tree.
- Potassium as potassium sulphate (48% K2O) was added at rate og 500 g / tree / year.
- control or other chemical fertilizers were used.

Seventy eight "Kalamata" olive trees healthy, nearly uniform in growth vigor and productivity were selected for this study.

Table 1. Soil physical and chemical analyses of the Experimental Station of the Faculty of Environmental Agricultural Sciences, El-Arish, North Sinai Governorate.

Parameters		Soil depth (cm)		
		(0 – 25)	(25 – 50)	(50 – 75)
Physical analysis				
Sand (%)		89.39	83.73	78.65
Silt (%)		4.51	8.93	12.70
Clay (%)		6.10	7.34	8.65
Soil texture		Loamy sand	Loamy sand	Sandy Loam
Chemical analysis				
Cations ($meq.l^{-1}$)	Ca^{++}	6.72	7.95	12.37
	Mg^{++}	5.10	5.87	8.03
	Na^{+}	8.67	11.28	13.37
	K^{+}	0.40	0.36	0.35
Anions ($meq.l^{-1}$)	CO_3^{--}	-	-	-
	HCO_3^{-}	2.45	2.36	2.69
	Cl^{-}	10.41	12.63	13.22
	SO_4^{--}	8.03	10.47	18.21
E C (dSm^{-1})		2.89	2.55	3.43
pH		7.9	8.3	8.7
Organic matter (%)		0.18	0.13	0.09

According to Piper (1947)

Table 2. Chemical analysis of well water used for irrigation.

Parameters	Value
E C (dS m^{-1})	3.20
Concentration (ppm)	2048
pH	7.5
Soluble cations (meq.l^{-1})	
Ca^{++}	8.64
Mg^{++}	6.03
Na^{+}	15.05
K^{+}	0.50
Soluble anions (meq.l^{-1})	
CO_3^{--}	-
HCO_3^{-}	2.62
Cl^{-}	22.26
SO_4^{--}	5.34

According to (Jackson, 1958)

However two factors (organic fertilizers sources and biofertilizers as well as amino acid) studied during the present investigation as follows.

Organic fertilization sources

In mid- December of each seasons, different organic fertilizer sources were applied in two trenches were digged on both sides of the tree at 75 cm apart from the trunk, and covered with trench soil. Different sources of organic fertilizations were applied excreta (chicken and goat manures), plant residues (olive pomace) and animal byproducts (fish scrap). The Chemical analysis of tested organic fertilizer materials were measured Table 3.

According to the recommendation of Water and Soils Research Institute Ministry of Agriculture, Egypt, the actual nitrogen (g /tree / year) required to olive tree older than 6 years is 500 g.tree / year.

Thereupon, half of the required nitrogen (250 g N/tree) was suggested to be satisfied through one of the organic manure sources according to its content of nitrogen as follows:

- Chicken manure: (3.12 % N about 8.01 Kg. tree / year).
- Fish scrap: (8.1 % N about 3.09 Kg. tree / year).
- Goat manure: (1.05 % N about 23.81 Kg. tree / year).
- Olive pomace: (2.1% N about 11.90 Kg. tree / year)

Table 3. Chemical analysis of tested organic fertilizer materials.

Materials	Total N (%)	Total P_2O_5(%)	Total K_2O (%)	Total CaO(%)	Total MgO(%)
Chicken manure	3.12	1	0.9	0.4	0.3
Fish scrap	8.1	6.2	-	7.9	0.4
Goat manure	1.05	1.1	2.2	1.5	0.1
Olive pomace	2.1	1.2	1.3	0.5	0.4

The biofertilizer and amino acid treatments

Biofertilizer N-fixing bacteria (Nitrobein)

The remaining N-requirement for each tree was assumed to be partially satisfied through using N-fixing fertilizers. Nitrobein fertilizer containing *Azospirillum spp* and *Azotobacter chroococcum*. This products are produced by the General Organization for Agric. Equalization Fund, Ministry of Agriculture, Egypt (GOAEF Ministry of Agric. bulletin, 1999). In early March of each season, dose of the biofertilizers application were 150 g from Nitrobein per tree and applied in trenches (40 cm length × 20 cm width × 15 cm depth).

Protamine Amino acid

Amino acid mixture (commercial name "Protamine®) is a plant growth biostemulating amino acid 84 / 45 which contains 18 mixed amino acids. The total percent of amino acids in the product is 84 % (16 % as free amino acids in L-α type) + 10.08 % organic nitrogen + 3.36 % potassium oxide). The previous mixture was added to tree by dissolving the previously mentioned doses at concentration 1.5 % and dissolving in one liter of water then added to the soil in the area of drippers and these doses applied through growing season three times at 70% full-bloom, after fruit set, and a month later. Olive trees were treated with bio-fertilizer and amino acid alone or in both as follow:

- Nitrobein alone (150 g/$tree^{-1}$).
- Protamine alone at 1.5 %.
- Nitrobein (75 g.$tree^{-1}$) + Protamine at 1.5 %.

Consequently, this investigation is considered an experiment including 4 organic manure sources × 3 biofertilizers together with amino acid). The treatments were arranged in a randomized complete block design and each replicate was represented by two trees in three replications. Additionally to control treatment content two trees in three replication.

The effect of organic manure sources and biofertilizers (N fixing bacteria) plus protamine amino acid as well as their interaction on flowering, fruit set, fruiting and fruit quality was handled as follows:

Blooming and fruiting

Number of flowers per inflorescences

Ten (one –year- old) shoots were chosen at random and labeled on each tree for each season's during full bloom (late April) to count the total number of inflorescences per shoot and number of flowers per inflorescences.

Fruit set percentage (%)

Ten (one –year- old) shoots on each tree were labeled for counting the initial number of flowers at full bloom. Number of fruitlets and fruits were recorded at monthly intervals up to harvest. The percentage of fruits set was calculated according to Ferguson *et al.*, (1994) as follows:

$$\text{Fruit set percentage (\%)} = \frac{\text{No.of developing fruitlets}}{\text{Total initial No.of flowers at full bloom}} \times 100$$

Fruit retention was calculated on the basis of initial number of fruit set on the one hand and the total number of fruitlet drop on the other during each season.

Fruit yield (Kg / tree)

Fruits harvesting was carried out in November at the normal time and ripening stage as soon as the 75 % of olive fruits reached the violet skin color (the suitable stage for olive extraction). Fruits of each tree were weighed (kg).

Fruit and oil quality

A sample of 22 fruits from each tree was randomly chosen to determine fruit weight, fruit volume, fruit length, diameter, flesh weight, stone weight and flesh: stone ratio as follows:

Fruit physical properties

Fruit weight (g)

The average fruit weight (g) was determined by weighing the sample of each studied tree.

Fruit volume (ml)

Average fruit volume (ml) was determined from the volume of water displaced method.

Fruit dimensions (cm)

The average fruit length (L) and width (W) were measured by using Vernier caliper and the average was calculated. The fruit shape indexes (L/W) was recorded.

Flesh weight (g)

The average weight of flesh per olive fruits (g) were determined for all fruits samples

Stone weight (g)

The average weight of stone per olive fruits (g) was determined for all fruits samples and flesh: stone ratio was also calculated.

Fruit firmness (Kg.cm2)

Fruit firmness was measured using 10-15 fruit samples per tree. A handheld pressure tester was used to measure fruit firmness.

Fruit moisture content (%)

Ten grams of fruits. A sample was dried at 60^0C until constant weight was attained. The average dry weight was determined and the percent of moisture per fruit was calculated according to the methods (A O; A C0 2005).

Fruit oil content (%)

Fruit oil content as a dry weight was determined according to A O A C, (2005) method by extraction the oil from the dried flesh fruit with Soxhelt for extraction apparatus using petroleum ether 60-80 ° C of boiling point.

The obtained data were statistically analyzed according the method desorbed by snedecor and Cochran (1994). Duncain multiple range test was used for comparison among the means (Duncan 1958).

RESULTS AND DISCUSSION

The use of some organic and biofertilizers N-fixing bacteria as well as amino acid for "Kalamata" olive trees fertilization under North Sinai conditions have been handled as follow:

Effect of some organic fertilizer sources and Biofertilizers N-fixing bacteria as well as amino acid treatments on some flowering and fruit-set parameters of 'Kalamata' olive trees.

No. of inflorescences/ shoot

Respecting, the interaction effect between organic fertilizer sources and biofertilizers N-fixing bacteria as well as amino acid treatments, the results in Table 4 clear that the highest value of the No. of the inflorescences/ shoot was noticed by fish scrap with protamine in first season and goat manure with protamine in second season. The least values were gave by the control trees in both season. The other interactions revealed in between effect.

The No. of the flowers/ Inflorescence

Respecting, the interaction effect between organic fertilizer sources and biofertilizers N-fixing bacteria as well as amino acidk table (4) shows that number of flowers per inflorescence was significantly increased by the fish scrap with protamine application treatment, which induced more stimulative effect on No of flowers/ Inflorescence in both season. While, the control treatment had the least values in this respect. The other interactions came in between. This pattern is similar to that reported by Mohamed (2014) who reported that the compost combined with olive pomace, rock phosphate besides bio-fertilizers treatment detected the highest significant values for number of flowers / inflorescence as compared with control and other treatments.

Table 4. The interaction effect between organic fertilizer sources and biofertilizers N-fixing bacteria as well as amino acid treatments on some flowering parameters of 'Kalamata' olive trees during 2015 and 2016 seasons.

Treatments		No of inflorescences/ shoot		No of flowers/ Inflorescence	
		2015	2016	2015	2016
Goat manure	Nitrobein	22.74 d	29.15 c	115.1 f	98.58 b
	Nitrobein + protamine	21.96 f	23.00 f	122.8 cde	88.11 c
	Protamine	28.09 b	30.30 b	132.8 ab	77.83 d
Olive pomace	Nitrobein	13.18 l	15.87 i	87.28 g	79.41 d
	Nitrobein + protamine	19.95 h	21.00 g	116.9 ef	86.64 c
	Protamine	21.18 g	21.84 g	128.8 bc	66.34 e
Chicken manure	Nitrobein	14.19 k	16.68 i	121.3 de	65.91 e
	Nitrobein + protamine	15.73 j	14.81 j	91.09 g	52.07 f
	Protamine	17.63 i	19.53 h	113.8 f	62.81 e
Fish Scrap	Nitrobein	22.43 e	24.95 e	130.8 ab	75.36 d
	Nitrobein + protamine	24.62 c	27.14 d	123.5 cd	100.2 b
	Protamine	30.12 a	31.76 a	135.7 a	119.6 a
Control		8.740 m	13.84 k	59.42 h	48.31 f

Means followed by the same letter(s) within each column are not significantly different at the 0.05 level, according to Duncan's multiple range test.

Generally, from the previous results it can be discussed that several studies indicated that the improvement in flowering, resulted by organic fertilization, may be attributed to the all stimulative effect of the absorbed nutrients on photosynthesis process, which certainly reflected positively on the flowering characteristics (Bhangoo *et al.,* 1988). Also, the slow, release nutrients resulted from the biodegradation of manure by soil microorganisms could explain the present results (Cole *et al.,* 1987 and AL-Kahtani and Ahmed, 2012).

Initial Fruit set (%)

Respecting, the interaction effect between organic fertilizer sources and biofertilizers N-fixing bacteria as well as amino acid., table 5 shows that initial fruit set (%) was significantly increased by the fish scrap with Nitrobein + protamine application treatment and induced more stimulative effect on initial Fruit set (31.23 and 32.79 %) in both seasons. While, the control treatment gave the least values. The other interactions came in between. Similar observations were reported by Hassan *et al*. (2015), who studied that the effect of some combinations of organic

fertilizers with bio-fertilizer of '"Manzanillo"' olive trees and they found that the organic fertilizer sources treatments had a positive effect on fruit set.

Average of fruit retention (%)

As for, the interaction effect between organic fertilizer sources and biofertilizers N-fixing bacteria as well as amino acidg data of Table 5 shows that the fish scrap with (Nitrobein + protamine), treatment was highly interactive for average of fruit retention in both season. However, control treatment had the least average of fruit retention in both seasons. The other interactions came in between effect.

Table 5. The interaction effect between organic fertilizer sources and Biofertilizers N-fixing bacteria as well as amino acid treatments on fruit set and retention percentage of 'Kalamata' olive trees during 2015 and 2016 seasons.

Treatments		Initial Fruit set (%)		Average of fruit retention (%)	
		2015	2016	2015	2016
Goat manure	Nitrobein	23.65 cd	29.35 abc	4.087 e	4.017 b
	Nitrobein + protamine	19.25 e	27.87 bcd	3.543 f	3.410 cd
	Protamine	22.84 d	24.55 de	4.550 d	2.653 e
Olive pomace	Nitrobein	26.79 b	29.88 abc	3.510 f	3.297 d
	Nitrobein + protamine	16.75 ef	22.69 ef	2.930 g	2.733 e
	Protamine	14.96 g	22.38 ef	2.303 h	2.060 f
Chicken manure	Nitrobein	16.46 f	27.52 bcd	2.040 hi	1.830 fg
	Nitrobein + protamine	22.95 d	21.21 ef	2.250 h	1.853 fg
	Protamine	16.52 f	30.67 ab	2.823 g	2.677 e
Fish Scrap	Nitrobein	25.53 bcd	28.52 bc	5.010 c	3.420 cd
	Nitrobein + protamine	31.23 a	32.79 a	5.787 a	4.740 a
	Protamine	26.21 bc	26.33 cd	5.333 b	3.663 c
Control		14.42 g	19.98 f	1.897 i	1.533 g

Means followed by the same letter(s) within each column are not significantly different at the 0.05 level, according to Duncan's multiple range test.

Effect of some organic fertilizer sources and Biofertilizers N-fixing bacteria as well as amino acid treatments on some fruit yield and quality parameters of 'Kalamata' olive trees.

Fruit yield (Kg/tree)

Regarding, the interaction effect between organic fertilizer sources and biofertilizers N-fixing bacteria as well as amino acid treatment, results of Table 6 indicate that the most obvious increments in fruit yield was observed with fertilized trees by fish scrap with Nitrobein in both seasons. While, the control trees gave the least values in both seasons. Other interactions came in between. These results are in agreement with those obtained by Hassan *et al*. (2015), who found that the interaction (organic fertilizer + bio-fertilizer 2 liter/tree) was the most effective treatment for improve yield of '"Manzanillo"' olive trees.

Generally it can be concluded that enhancement plant growth and yield as affected by organic and bio-fertilizer may be explained by the ability of N_2 – fixation , and solubilizing , Indole acetic acid (IAA) and antimicrobial substance production (Khalil and Agah, 2017) on strawberry.

Fruit physical properties

Fruit volume (ml)

As regards, the interaction effect between organic fertilizer sources and biofertilizers N-fixing bacteria as well as amino acid treatments on fruit parameters of 'Kalamata' olive trees, the results in Table 6 reveal that the fish scrap with protamine caused the highest significant values of fruit volume (8.330 and 6.520 ml) in both seasons. Moreover, the control treatment had the least value of fruit volume (3.560 and 3.727 ml). The other interactions came in between effects.

Table 6. The interaction effect between organic fertilizer sources and Biofertilizers N-fixing bacteria as well as amino acid treatments on fruit yield and volume of 'Kalamata' olive trees during 2015 and 2016 seasons.

Treatments		Total fruit yield (Kg/tree)		Average fruit yield	Fruit volume (ml)	
		2015	2016	(Kg/tree)	2015	2016
Goat manure	Nitrobein	47.17 ab	86.63 c	66.90 ab	6.627 ef	6.107 bc
	Nitrobein + protamine	42.67 bc	96.53 b	69.60 ab	5.223 g	5.867 cd
	Protamine	38.17 c	87.30 c	62.74 b	6.257 f	4.963 e
Olive pomace	Nitrobein	26.50 g	54.33 ef	40.42 f	6.137 f	5.627 cd
	Nitrobein + protamine	28.42 fg	58.25 de	43.34 d	6.923 de	4.500 e
	Protamine	29.17 f	59.79 de	44.48 e	6.267 f	4.927 e
Chicken manure	Nitrobein	32.08 e	62.73 d	47.405 c	7.163 cde	5.467 d
	Nitrobein + protamine	35.75 d	56.75 e	46.25 c	7.783 ab	6.333 ab
	Protamine	32.33 de	50.76 f	41.55 f	7.163 cde	5.600 cd
Fish Scrap	Nitrobein	48.75 a	104.0 a	76.38 a	7.733 bc	6.430 a
	Nitrobein + protamine	42.83 bc	92.95 bc	67.89 ab	7.463 bcd	5.780 cd
	Protamine	44.50 b	96.57 b	70.54 a	8.330 a	6.520 a
Control		20.83 h	41.88 g	31.36 g	3.560 h	3.727 f

Means followed by the same letter(s) within each column are not significantly different at the 0.05 level, according to Duncan's multiple range test.

Fruit length (cm)

Regarding, the interaction effect between organic fertilizer sources and biofertilizers N-fixing bacteria and amino acids treatments, results of Table 7 indicate that, the fruit length was increased by adding fish scrap with Nitrobein (3.043 and 2.977 cm) compared to other interactions in both seasons respectively.

Fruit width (cm)

Respecting, the interaction effect between organic fertilizer sources and biofertilizers N-fixing bacteria as well as amino acid treatments, the results in Table 7 show that the highest number of fruit width were noticed with chicken manure with Nitrobein (2.337 cm) in first season. While, chicken and goat manures with Nitrobein

treatments achieved high values (1.933 and 1.937 cm) in second season, respectively. In the meantime, the least values were gave by The control fruits in both seasons. The other interactions revealed in between effect.

Shape index (L/ W)

Respecting, the interaction effect between organic fertilizer sources and biofertilizers N-fixing bacteria as well as amino acid under different methods of application treatments, the results in Table 7 show that the highest number of shape index were noticed by goat manure with protamine and fish scrap with Nitrobein treatments (1.653 and 1.653) in first season. While, fish scrap with Nitrobein achieved the highest shape index compared other interactions during second season.

Table 7. The interaction effect between organic fertilizer sources and Biofertilizers N-fixing bacteria as well as amino acid treatments on fruit length, width and shape index (L/W) of 'Kalamata' olive trees during 2015 and 2016 seasons.

Treatments		Fruit length (cm)		Fruit width (cm)		Shape index (L/W)	
		2015	2016	2015	2016	2015	2016
Goat manure	Nitrobein	2.933 ab	2.767 ef	1.880 bc	1.937 a	1.570 ab	1.483 bc
	Nitrobein + protamine	2.943 ab	2.867 b-e	1.880 bc	1.767 bc	1.577 ab	1.630 abc
	Protamine	2.800 abc	2.437 h	1.700 bc	1.543 cd	1.653 a	1.580 abc
Olive pomace	Nitrobein	2.863 abc	2.843 cde	1.930 b	1.690 c	1.487abc	1.587abc
	Nitrobein + protamine	2.703 bcd	2.693 fg	1.877 bc	1.713 bc	1.447 bc	1.573 abc
	Protamine	2.850 abc	2.800 de	1.947 b	1.800 abc	1.467abc	1.557 abc
Chicken manure	Nitrobein	2.740 bcd	2.650 g	2.337 a	1.933 a	1.173 d	1.467 c
	Nitrobein + protamine	2.540 d	2.900 a-d	1.707 bc	1.820 ab	1.487abc	1.593 abc
	Protamine	2.743 bcd	2.913abc	1.857 bc	1.810 abc	1.480abc	1.507 abc
Fish Scrap	Nitrobein	3.043 a	2.977 a	1.847 bc	1.877 ab	1.653 a	1.683 a
	Nitrobein + protamine	2.923 ab	2.867 b-e	1.943 b	1.833 ab	1.503abc	1.563abc
	Protamine	2.627 cd	2.950 ab	1.807 bc	1.833 ab	1.467abc	1.610abc
Control		2.247 e	2.447 h	1.650 c	1.483 d	1.363 c	1.647 ab

Means followed by the same letter(s) within each column are not significantly different at the 0.05 level, according to Duncan's multiple range test.

Fruit weight (g)

the results in Table 8 illustrate that the highest fruit weight was noticed by the interaction between fish scrap × Nitrobein in first season. While, the interaction between fish scrap × Nitrobein and chicken manure × Nitrobein + protamine achieved the highest fruit weight in second season. On the contrary, the least values were gave by The control trees in both seasons. The other interactions revealed in between effect.

Table 8. The interaction effect between organic fertilizer sources and Biofertilizers N-fixing bacteria as well as amino acid treatments on fruit yield, volume and firmness of 'Kalamata' olive trees during 2015 and 2016 seasons.

Treatments		Fruit weight (g)		Flesh thickness (mm)		Fruit firmness (kg.cm^{-2})	
		2015	2016	2015	2016	2015	2016
Goat manure	Nitrobein	5.947 d	5.297 cd	0.5367 cd	0.4667 de	0.9633 a	0.85 cde
	Nitrobein + protamine	6.543 c	5.643 b	0.5767 bc	0.4833 cd	0.8767 ab	0.9667abc
	Protamine	5.177 f	3.753 fg	0.5167 cd	0.4167 ef	0.8533 ab	0.9567abc
Olive pomace	Nitrobein	5.247 ef	3.953 f	0.5367 cd	0.4633 de	0.8500 ab	0.650 f
	Nitrobein + protamine	6.463 c	4.740 e	0.5533 bc	0.3667 fg	0.7633 b	0.8133 de
	Protamine	5.293 ef	4.760 e	0.5533 bc	0.5333abc	0.8367 ab	0.8767 cd
Chicken manure	Nitrobein	5.510 ef	5.600 b	0.4867 d	0.5567 ab	0.7067 b	0.7433 ef
	Nitrobein + protamine	5.203 f	6.037 a	0.5367 cd	0.5333abc	0.7100 b	0.9400abc
	Protamine	5.557 e	5.683 b	0.6033 ab	0.5000bcd	0.8267 ab	1.033 a
Fish Scrap	Nitrobein	7.890 a	6.207 a	0.6400 a	0.5667 a	0.8667 ab	1.000 ab
	Nitrobein + protamine	6.957 b	5.523 bc	0.6533 a	0.5467 ab	0.7667 b	0.8567cde
	Protamine	6.653 bc	5.200 d	0.6400 a	0.5667 a	0.8167ab	0.8767 cd
Control		0.4300 e	0.3400 g	3.883 g	3.623 g	0.8633 ab	0.9067bcd

Means followed by the same letter(s) within each column are not significantly different at the 0.05 level, according to Duncan's multiple range test.

Flesh thickness (mm)

Respecting, the interaction effect between organic fertilizer sources and biofertilizers N-fixing bacteria as well as amino acid, the results in Table 8 illustrate that the highest number of flesh thickness was noticed by fish scrap with Nitrobein alone, protamine alone and Nitrobein + protamine in first season. While, fish scrap with Nitrobein alone, protamine alone gave the highest values in the second season. The least values were gave by The control trees in both seasons. The other interactions revealed in between effect.

Fruit firmness (kg.cm)

Regarding, the interaction effect between organic fertilizer sources and biofertilizers N-fixing bacteria as well as amino acid treatments on fruit firmness of 'Kalamata' olive trees, data of Table 8 shows that the goat manure application with Nitrobein in first season and chicken manure application with protamine in second season were highly interactive for fruit firmness compared to other interactions which came in between effects.

Flesh weight (g)

Respecting, the interaction effect between organic fertilizer sources and biofertilizers N-fixing bacteria as well as amino acid treatments on flesh weight of 'Kalamata' olive trees, the results in Table 9 clear that the highest weight was noticed by fish scrap with Nitrobein in first season. While, fish scrap with Nitrobein and chicken manure with Nitrobein + protamine treatments recorded

highest weight (5.270 and 5.067 g) respectively in second season. On the contrary, the least values were gave by the control fruits in both seasons. The other interactions revealed in between effect.

Stone weight (g)

Respecting, the interaction effect between organic fertilizer sources and biofertilizers N-fixing bacteria as well as amino acid treatments, the results in Table 9 clear that the highest value of stone weight was noticed by olive pomace with Nitrobein alone and Nitrobein + protamine (1.193 and 1.240 g) in first season. While, chicken manure with Nitrobein + protamine and protamine alone as well as fish scrap with Nitrobein gave high values of stone weight (0.9700, 0.9600 and 0.9333 g) in second season, respectively. The least values were gave by The control trees (control) in second season and fish scrap with Nitrobein in first season. The other interactions revealed in between effect.

Flesh : Stone ratio

As for, The interaction effect between organic fertilizer sources and biofertilizers N-fixing bacteria as well as amino acid treatments, the results in Table 9 illustrate that the highest values of flesh: stone ratio were noticed by fish scrap × Nitrobein interaction in first season. While, the highest values of flesh: stone ratio were noticed with Nitrobein and goat manure, fish scrap and chicken manure in second seasons. The least values of flesh: stone ratio were gave by the control treatment in both seasons.

Table 9. The interaction effect between organic fertilizer sources and Biofertilizers N-fixing bacteria as well as amino acid treatments on Flesh weight, Stone weight and Flesh : Stone ratio (F/S) of 'Kalamata' olive trees during 2015 and 2016 seasons.

Treatments		Flesh weight (g)		Stone weight (g)		Flesh : Stone ratio (F/S)	
		2015	2016	2015	2016	2015	2016
Goat manure	Nitrobein	4.810 e	4.527 cd	1.137 ab	0.7700 bc	4.250 def	6.000 a
	Nitrobein + protamine	5.423 cd	4.783 b	1.123 ab	0.8600 ab	5.043 cd	5.583 ab
	Protamine	4.123 gh	2.987 fg	1.057 abc	0.7633 c	3.920 def	3.943 c
Olive pomace	Nitrobein	4.057 h	3.167 f	1.193 a	0.7900 bc	3.433 f	4.057 bc
	Nitrobein + protamine	5.223 d	3.883 e	1.240 a	0.8600 ab	4.257 def	4.943 abc
	Protamine	4.160 gh	3.973 e	1.133 ab	0.7900 bc	3.723 ef	5.060 abc
Chicken manure	Nitrobein	4.470 efg	4.840 b	1.040 abc	0.7567 c	4.343 def	6.423 a
	Nitrobein + protamine	4.313fgh	5.067 a	0.8933 c	0.9700 a	4.843cde	5.373 abc
	Protamine	4.647 ef	4.723 bc	0.9100 bc	0.9600 a	5.140 cd	5.033 abc
Fish Scrap	Nitrobein	7.060 a	5.270 a	0.8300 c	0.9333 a	7.923 a	5.683 a
	Nitrobein + protamine	6.037 b	4.647 bc	0.9233 bc	0.8733 ab	6.550 b	5.360abc
	Protamine	5.637 c	4.377 d	1.013 abc	0.8200 abc	5.703 bc	5.377abc
Control		2.987 i	2.900 g	0.8933 c	0.7267 c	3.347 f	4.003 c

Means followed by the same letter(s) within each column are not significantly different at the 0.05 level, according to Duncan's multiple range test.

Generally, it can be discussed that the previous results of fruit physical properties may due to the synergistic effect of macronutrients NPK supplied by organic and bio-fertilizer as well as Protamine amino acid which improved vegetative characteristics and affect the synthesis of chlorophyll that hence the process of photosynthesis and the assimilation of carbon dioxide which lead to increment fruit quality. In parallel organic manure increasing peach fruit weight and size. The positive effect of organic fertilization on fruit weight and size may be due to its effect in enhancing both leaf area and total chlorophyll. Hence increasing net photosynthesis, as well as, the effect of organic matter in increasing water holding capacity, which was reflected on fruit weight and size of peach fruit Gabr and Nour El-Dein (2005).

Fruit chemical properties

Fruit moisture content (%)

Regarding, the interaction effect between organic fertilizer sources and biofertilizers N-fixing bacteria as well as amino acid treatments on fruit moisture content of 'Kalamata' olive fruits, data of Table 10 shows that, the highest values of fruit moisture content were observed in goat manure with (Nitrobein + protamine) and fish Scrap with Nitrobein + protamine in both seasons. While, olive pomace with protamine and the control trees were the least values in both seasons.

Table 10. The interaction effect between organic fertilizer sources and Biofertilizers N-fixing bacteria as well as amino acid treatments on fruit moisture, oil contents and T.S.S. of 'Kalamata' olive trees during 2015 and 2016 seasons.

Treatments		Moisture content (%)		Oil content (% on fresh weight basis)		Fruit T.S.S (%)	
		2015	2016	2015	2016	2015	2016
Goat manure	Nitrobein	62.24 c	46.72 c	12.84 bc	15.01 b	20.11 ef	18.22 cd
	Nitrobein + protamine	67.61 a	60.42 a	13.73 ab	14.99 b	25.04 ab	18.87 cd
	Protamine	52.60 h	53.17 abc	13.66 abc	13.88 cd	23.22 bc	20.67 a
Olive pomace	Nitrobein	59.15 e	57.09 ab	12.54 d	12.97 de	22.18 cd	19.00 bc
	Nitrobein + protamine	60.42 d	59.24 ab	11.57 e	14.06 c	23.72 bc	18.66 cd
	Protamine	52.42 h	53.17 abc	14.17 a	16.17 a	26.44 a	20.59 a
Chicken manure	Nitrobein	55.14 g	54.14 abc	11.21 ef	11.77 e	24.27 bc	16.33 ef
	Nitrobein + protamine	57.69 f	55.75 ab	11.28 ef	13.41 cde	18.24 fg	17.78 cd
	Protamine	59.33 e	58.42 ab	10.59 f	12.98 de	21.00 de	20.19 ab
Fish Scrap	Nitrobein	63.52 b	59.00 ab	12.73 cd	16.17 a	18.44 fg	17.78 cd
	Nitrobein + protamine	67.25 a	60.58 a	12.38 de	13.80 cd	19.38 ef	17.56 de
	Protamine	63.33 b	61.18 a	11.58 e	14.59 bc	18.69 fg	15.56 fg
Control		53.05 h	51.78 bc	10.06 g	11.26 f	16.74 g	14.89 g

Means followed by the same letter(s) within each column are not significantly different at the 0.05 level, according to Duncan's multiple range test.

Fruit oil content (%)

As for, the interaction effect between organic fertilizer sources and biofertilizers N-fixing bacteria as well as amino acid data of Table 10 shows that the olive pomace with protamine was highly interactive for fruit oil content in both season. However, fish scrap with Nitrobein in second season recorded the highest values of fruit oil content. The other interactions came in between effect.

Total Soluble solids (T S S) content

Regarding, the interaction effect between organic fertilizer sources and biofertilizers N-fixing bacteria as well as amino acid, table 10 reveals that TSS was significantly increased due to interaction effects. Furthermore, the olive pomace application with protamine (26.44%) in first season and goat manure application with protamine and olive pomace application with protamine (20.67 and 20.59 %) in second season were highly interactive for T.S.S. Meanwhile, the control fruits produced the least significant effect in both seasons.

CONCLUSION

However, under the same conditions and from the aforementioned results it can concluded and recommended the following points:

1- The use of fish scrap at 2.5 Kg.tree-1. Year-1 showed an increase in vegetative growth, leaf pigments content, flowering, fruit set, yield and fruit quality as well as oil production and properties of Kalamata olive trees compared to other organic fertilization sources.
2- The use of Nitrobein biofertilizer N-fixing bacteria at 50 g. tree-1. Year-1 + Amino acid mixture (commercial name "Protamine®) at concentration 1.5 % showed an increase in leaf carotenoid content, flowering, yield and fruit quality .

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دراسة تأثير التسميد الحيوي والعضوي علي الإزهار والمحصول وجودة الثمار لأشجار الزيتون الكالاماتا تحت ظروف شمال سيناء

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أجريت الدراسة خلال عامي 2015 و2016 في المزرعة التجريبية بكلية العلوم الزراعية البيئية - جامعة العريش، محافظة شمال سيناء، مصر على أشجار الزيتون صنف كلاماتا عمر 10 سنوات، والمنزرعة في تربة رملية طميه على مسافات 6 × 7 م تحت نظام الري بالتنقيط، وتم دراسة التأثير المنفرد والمتداخل لكل من: مصادر مختلفة من التسميد العضوي (مسحوق الأسماك بمعدل 2.5 كيلوجرام للشجرة، وزبل الماعز بمعدل 16.8 كيلوجرام للشجرة، وسبلة الدواجن بمعدل 7.8 كيلوجرام للشجرة، وتفل الزيتون بمعدل 8.5 كيلو جرام للشجرة) في خنادق ارضية في شهر ديسمبر من كل عام. كما تم دراسة تأثير التسميد الحيوي بمثبت نيتروجيني النيتروبين بمعدل 150 جرام للشجرة الواحدة والحمض الأميني البروتامين " بتركيز 1.5% كلاهما معاً، وتمت الإضافة أرضيا في على ثلاث دفعات الأولى عند 70% من الإزهار الكامل والثانية بعد العقد والثالثة بعد شهر من الإضافة الثانية. طبقاً للنتائج المتحصل عليها في هذه الدراسة فإنه يمكن التوصية باستخدام التسميد العضوي خاصة مسحوق الأسماك من خلال إضافة التسميد الحيوي مستخدماً النيتروبين مع الحمض الأميني البروتامين بتركيز 1.5% مجتمعين حيث أدت هذه المعاملة إلى تحسين الازهار والحالة الغذائية لأشجار الزيتون مع إنتاج محصول عال ذو خصائص ثمريه جيدة بالإضافة للمحافظة على البيئة من مشاكل التلوث الناشئ عن التسميد المعدني وكذلك استخدام المخلفات البيئية.

الكلمات الاسترشادية: التسميد العضوي – التسميد الحيوي – الكالاماتا – مسحوق السمك – المحصول الكلي –جودة الثمار.