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Effect of Foliar Application of some Plant Extracts and Amino Acids on "Picual" Olive Production and Oil Quality

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ABSTRACT

The experiment was carried out during 2015 and 2016 seasons on 20 years old Picual olive trees and grown in a sandy soil at experimental Farm of Faculty of Environmental Agricultural Sciences, Arish University, North Sinai Governorate, Egypt, to examine the effects of aqueous extracts of Athir (*Artemisia monosperma*), Moringa (*Moringa oleifera*) and Kabbar (*Capparis spinosa*) at four concentrations (0, 5, 15, and 25%) with Protamine (the commercial form of amino acids mixture) at 1.5 % on growth, leaf nutrient contents, productivity, fruit quality and oil properties of "Picual" olive trees. Fresh leaves were collected, washed with tap water, chopped and pounded, soaked in distilled water and filtered to prepare extracts at 5,15 and 25%. Plant extracts were sprayed three times at 70% full-bloom, after fruit set, and a month later. A control experiment with distilled water was also set up. Treated olive trees were arranged as a factorial experiment in a randomized complete block design with three replicates, each replicate was represented by two trees. The obtained results indicated that, most plant extracts with amino acid treatments significantly increases vegetative growth (shoot length, number of leaves, leaf area, leaf pigment contents, leaf chemical constituents), fruit yield, fruit physical and chemical properties, as well as oil production compared with the control. Treatments with *A. monosperma* or *M. oleifera* at 25% with/out 1.5% amino acid (Protamine) were the most effective ones compared with the other treatments.

Keywords: Plant extracts, Artemisia monosperma, Moringa oleifera, Capparis spinosa,Vegetative growth, Fruit yield and quality

INTRODUCTION

The olive (*Olea europea* L.) is a Mediterranean evergreen tree, in the family oleaceae. Egypt is the world's top producer of table olives, Egypt produced an average of 413,000 tons of table olives per year from 2007 to 2011. In 2011 alone, Egypt produced more than 13 percent of the world's table olives, making Egypt the top global producer of this type of olive (FAO, 2012). About Some 79920 feddans of Egyptian land are currently devoted to olive cultivation, 25 percent of which is located in the North Sinai governorate, according to the Central Administration for Agriculture Education (Shahin *et al.,* 2015). The olive tree productivity is generally low due to the poor soil fertility and low water holding capacity. Accordingly, it seems that trees need to Natural sources of fertilizers avoided pollution and reduced the costs of fertilization. Also, it has drowned the attention of olive growers to use the aqueous plant extracts that would be healthy for human and safe for environment (Hagagg *et al.,* 2013).

Plant extracts which contained hormones and effective compounds can be used to increase vegetative growth and yield and can replaced chemical fertilization because they influence every phase of plant growth and development. Traditionally, there are five groups of growth regulators which are listed: auxins, gibberellins, abscisic acid, ethylene and cytokinins (Prosecus, 2006). For the most part, each group contains both naturally occurring hormones and synthetic substances. Cytokinins regulate cell division and stimulate leaf expansion (Prosecus, 2006). Cytokinins enhance fruit production as they are involved in cell growth and differentiation, and their exogenous supply delays senescence of crop plants. Zeatin is a naturally occurring cytokinin in plants. Fresh *Moringa oleifera* leaves contain zeatin (Fuglie, 2000). Moringa leaves sampled from various parts of the world were found to have high zeatin concentrations between 5 and 200 µg/g of leaves (El-Awady, 2003). Al-Yahya *et al.* (1990) isolated alkaloids and flavonoides among other chemical compounds from *Artemisia monosperma*. The extracts of *Capparis spinosa* contains many constituents, in particular some flavonoids (Kaempferol and quercetin derivatives) and hydrocinammic acids with several known biological effects such as the anti-inflammatory and the antioxidant ones (Panico *et al.,* 2005 and Al-Soqeer, 2010).

Amino acids as organic nitrogenous compounds, are the building blocks in the synthesis of proteins (Davies, 1982). Several hypotheses have been proposed to explain the role of amino acids in plant growth hormones. Available evidence suggests several alternative routes of IAA synthesis in plants starting from amino acids, (Hashimoto and Yamada, 1994). In this respect, Waller and Nowaki (1978) suggested that the regulatory effects of certain amino acids like phenylalanine and ornithine on plant development is through their influence on gibberellins. Amino acids have a chelating effect on plant extracts when applied together; the absorption and transportation of effective compounds inside the plant are easier (Westwood, 1993).

Accordingly, this study was aimed to evaluate the effect of spraying some plant extracts (*Artemisia monosperma, Moringa oleifera* and *Capparis spinosa*) and protamine amino acid on growth and productivity of "Picual" olive trees.

MATERIALS AND METHODS

The present investigation was carried out during 2015 and 2016 growing seasons in order to study the effect of foliar application of some aqueous plant extracts and amino acids on (*Olea europea* L.) "Picual" olive trees. Twenty-year-old olive trees nearly moderate

in vigor and productivity and grown in sandy soil at 6 × 7 m apart in the Olive Research Farm, Faculty of Environmental Agricultural Sciences, Arish University, North Sinai Governorate, Egypt, were chosen.

The tested trees received the same agro-technical practices adopted in this district and irrigated by using drip irrigation system. Each tree was subjected to two drip emitters (4 Lh^{-1}) located 50 cm from each side of the tree. The irrigation water was chemically analyzed (Table 1). Representative soil samples under the experimental trees were collected, physically and chemically analyzed prior to initiating and terminating the experiment according to the procedure outlined by Piper (1947; Table 2). The same trees were tested throughout both experimental seasons.

Table 1. Chemical analysis of the irrigation water.

EC	pH	Anions (meq.l^{-1})				Cations (meq.l^{-1})			
mmoh/cm		CO_3^{--}	HCO_3^-	Cl^-	SO_4^{--}	Ca^{++}	Mg^{++}	Na^+	K^+
5.65	7.22	-	2.77	40.4	16.42	7.90	16.72	34.71	0.26

Where: EC = Electrical conductivity.

Table 2. Physical and chemical analysis of soil samples collected from the experimental orchard (as an average of two seasons).

Soil Depth (cm)	Mechanical analysis				Chemical analysis											
					Cations (meq.l^{-1})					Anions (meq.l^{-1})				E.C (dS.m^{-1})	pH	OM (%)
	Sand	Silt	Clay	Soil texture	^{++}Ca	^{++}Mg	Na^+	K^+	$NH4^+$	CO_3^{--}	HCO_3^-	Cl^-	SO_4^{--}			
0-30	94.7	3.2	2.4	Sandy	6.85	8.5	16.0	0.35	0.132	-	2.85	19.6	9.15	3.12	8.00	0.08
30-60	95.3	3.4	1.6	Sandy	5.45	5.0	9.0	0.60	0.148	-	3.50	9.2	7.12	1.85	8.23	0.05

According to Piper *et al*., (1947)

Plant material preparation and extraction procedure:

Arial parts of Athir (*Artemisia monosperma*), Kabbar or Caper, (*Capparis spinosa*) and Moringa (*Moringa oleifera*) were collected in August from the western parts of Sinai, Egypt. Plants were identified and classified by Plant protection Department, Faculty of Environmental Agricultural Sciences, Arish University. Selected plants were separately shade dried, finely powdered using a blender and subjected to extraction following the method of water extraction of *A. monosperma*, *C. spinosa* and *M. oleifera* according to the method described by Abdel-Salam *et al.* (2009). Each finely powdered of sample i.e. 50, 150 and 250 g were placed in a flask (2L) with 1000 ml of distillated water, then the mixture was filtered twice, first through cheese-cloth (50% cotton and 50% polyester) and then through filter paper (Whatman No. 2). The final concentration of the prepared *A. monosperma*, *C. spinosa* and *M. oleifera* were 5, 15 and 25% as total solids. The amount of obtained aqueous extracts were preserved in sterile dark bottles (500 ml) in a cool environment (4^0 C) until used. The chemical constituents of the aqueous extracts of *A. monosperma*, *C. spinosa* and *M. oleifera* were investigated using Gas chromatography-mass GC/MS analysis spectrometry (Table 3).

Treatments:

The selected trees were subjected to following treatments as follow:

Control treatment (tap water).

Aqueous extracts of *Artemisia monosperma* at 5, 15 and 25% concentration + Protamine amino acid at 1.5 % .

Aqueous extracts of *Capparis spinosa* at 5, 15 and 25% concentration + Protamine amino acid at 1.5 % .

Aqueous extracts of *Moringa oleifera* at 5, 15 and 25% concentration + Protamine amino acid at 1.5 % .

Olive trees were sprayed with the above extracts three times, at 70% full-bloom, after fruit set, and a month later. Foliar sprays were applied using a hand pressure sprayer. Triton-B emulsifier at a rate of 0.1% was used at 1.5 ml. 5 $liter^{-1}$ extract as a surfactant. Each tree received 2 liters of aqueous plant extract; and two rows of trees were left surrounded each treatment as a guard border.

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 in one liter of water then added to the soil in the area of drippers and these doses applied through growing season three times similarly as the aqueous plant extracts.

Measurements:

Vegetative Growth: Twenty five uniform shoots of the spring cycle distributed around the tree canopy were labeled in each season. On mid-October, when the growth was ceased, the new shoots were detached and the average length of shoots (cm), shoot fresh weight (g) and number of leaves per shoot were determined. The leaf area (cm^2) was measured by using Area Meter.

Leaf pigments content: Leaf photosynthetic pigments, i.e. chlorophyll A, B and carotenoids (mg/100g fresh weight) were colourimetrically measured at wave length of 662, 644 and 440 m in the fresh leaves according the procedure outlined by Moran and Porath (1980).

Leaf macronutrients content: Nitrogen and phosphorus contents were determined colorimetrically according to Pregl, (1945) and Jackson (1958), respectively. Potassium content was determined by flame photometer according to Brown and Lilliland (1946).

Yield, Physical and chemical fruit characteristics: At harvest time, in late October of both seasons, the mature fruits were harvested at the violescent skin color stage and

the yield per tree was expressed by weight of fruits/tree (kg). A sample of 50 fruits was taken from each tested tree for fruit quality determinations. In each fruit sample, fruit weight, length, width and thickness were measured. The fruit shape indexes (L/D) and flesh/fruit ratios were also recorded. The moisture content was determined in 10 grams of the flesh dried at 60ºC to a constant weight using the method descripted by A.O.A.C. (1980).

Table 3. Main phyto-constituents of tested plant extracts.

Artemisia monosperma		*Capparis spinosa*		*Moringa oleifera*	
Constituents	mg/ 100 g	Constituents	mg/ 100 g	Constituents	mg/ 100 g
Total phenols	38.62	Rutin	26.01	9-octadecenoic acid	21.09
Total flavonoids	16.91	Quercetin 3-O-glucoside	11.40 ± 1.52	L-(+)-ascorbic acid- 2,6-dihexadecanoate	18.96
Total antioxidant activity	33.98 %	Quercetin-3-O-glucoside-7-O-rhamnoside	3.01	14–methyl-8-hexadecenal	8.41
oils	18.54%	Isothiocyanate	24.37	4-Hydroxyl-4-methyl-2-pentanone	6.97
Quercetin 3-O-glucoside	9.39	Polyprenols	3.09	3-ethyl-2,4- imethylpentane	6.15
Quercetin 3-O-galactoside	7.35	Cappariside (4-hydroxy-5-methylfuran-3-carboxylic acid)	0.370± 0.21 mM	Phytol	5.04
Quercetin 3-O-glucosylgalactoside	7.34	Cappaprenols-12, 13, 14-sopreneunit	0.078	Octadecamethyl-cyclononasiloxane	1.23
Quercetin 3-O-rutinoside	9.31	P-methoxy benzoic acid	1.180	1, 2-benzene dicarboxylic acid	2.46
Isorhamnetin 3-O-rutinoside	4.51	Quercetin3-O-[6-α-L-rhamnosyl-6-β-D-glucosyl]-β- D-glucoside	2.401	3, 4-Epoxyethanone comprising	1.78
1,3,6 tri-O-galloyl-β-glucopyranose	5.93	Phenolic acids:Quinic acid P-coumaroyl quinic acid Chlorogenic acid	13.94 ± 1.62 (mg GA-Eq/g)	N-(-1-methylethyllidene) - benzene ethanamine	1.61
1,6 di-O-galloyl-β-glucopyranose	4.98	Ascorbic acid	69.8%	4, 8, 12, 16-Tetramethylheptadecan-4-olide	2.62
1-O-galloyl-β-glucopyranose	3.39	Resins	4.75%	3-5-bis (1, 1- dimethylethyl)-phenol	2.35
Reducing sugars	200.9	Reducing sugar	3.9%	1-Hexadecanol	1.18
Free amino-N-	0.85	Titratable acid	14.1%	3, 7, 11, 15-Tetramethyl-2 hexadecene-1-ol	1.22
		Alkaloids	0.02 %	Hexadecanoic acid	2.10
Free ammonia	20.95	Glucosides	0.083 %	1, 2, 3-propanetriyl ester-9 octadecenoic acid	1.19
		Fats	0.75 %		

Oil quality: Flesh oil was determined by extracting the oil from the flesh, immediately, after harvesting by Soxhelt fat extraction apparatus using petroleum ether. Moisture and acidity (as oleic acid) percentages were determined in the extracted oil (A.O.A.C., 1980). Antioxidant activity of oil samples were determined spectrophotometrically at 593 nm or µm and results were calculated as mg vitamin E equivalent.100 ml^{-1} oil (Benzie and Strain 1999). Total phenolic compounds of olive oil samples were determined according to the Folin-Ciocalteu procedure adapted from Hajimahmoodi *et al.* (2008) at 725 nm or µm. Gallic acid was used as the calibration standard and results were expressed as mg gallic acid equivalent.100 ml^{-1} oil).

Statistical analysis: Appropriate analysis of variance was performed on the obtained results of both experimental seasons. This experiment was set in a randomized complete block design (RCBD) with three replicates. Data were statistically analyzed using MSTATEC computer program . Means comparisons were carried out by Duncan's multiple range test at (0.05) level of significance (Duncan, 1955).

RESULTS AND DISCUSSION

Vegetative growth

Shoot length:

The present results in Table (4) revealed that *A. monosperma* and *M. oleifera* extracts at 25% aqueous extracts had resulted in a significantly higher shoot length (16.82, 16.87 and 16.77, 17.59 cm) compared with other treatments in both seasons, respectively. Concerning, amino acid application effects, it was obvious that Protamine application at 1.5 % gave the highest increase in shoot length over the untreated trees in both season.

The interaction effect between aqueous plant extracts and amino acid was statistically insignificant in both experimental seasons. aqueous extract of *M. oleifera* at 25% + 1.5% protamine amino acid recorded the highest values in this concern (22.46 and 23.49 cm). These results are in harmony with those previously reported by Bashir *et al.* (2014) working on Local Tomato (*Lycopersicon esculentum*) and Emongor (2015) on Snap Beans (*Phaseolus vulgaris*).

Shoot fresh weight

Data in Table (4) show that *A. monosperma* and *M. oleifera* aqueous extracts at 25% significantly increased shoot fresh weight (2.68 and 2.67 g), in the first season, but *M. oleifera* aqueous extract recorded the highest value of shoot fresh weight in the second season (2.92g), respectively, than that of the other treatments. Regarding amino acid application, the data showed that the highest shoot fresh weights were found with Protamine application at 1.5 % in both seasons (2.50 and 2.71 g), respectively, compared with untreated trees. The interaction between aqueous plant extracts

and amino acid was statistically significant in both experimental seasons. The interaction between *A. monosperma* and *M. oleifera* aqueous extracts × Protamine amino acid at 1.5% recorded the highest values in this respect in both seasons.

Number of leaves per shoot

Results revealed that number of leaves shoot^{-1} was noticeably affected by the high concentration of aqueous plant extracts. *A. monosperma* and *M. oleifera* extracts at 25% concentration achieved the highest leaves values (12.69 and 12.82) in the first season, and *M. oleifera* extract recorded the heights ones (12.71) in the second season, respectively. (Table 4). Regarding amino acid application, the data showed that the Protamine application at 1.5 % treatment yielded higher number of leaves shoot^{-1} in both seasons (12.68 and 12.57 leaves), respectively compared to untreated trees. The interaction between aqueous plant extracts and amino acid application was statistically insignificant in both experimental seasons. The interaction between *A. monosperma* at 25% and *M. oleifera* at 25 and 15% aqueous extracts × Protamine amino acid at 1.5% recorded the highest values of number of leaves in first season. While, the interaction between *A. monosperma* at 25% and/ or *M. oleifera* at 25% aqueous extracts × Protamine amino acid at 1.5% recorded the highest values of number of leaves in second season, compared to the other extracts.

Table 4. Effect of aqueous plant extracts at different concentrations and amino acids application on some vegetative. growth parameters of "Picual" cv. olive trees during 2015 and 2016 seasons.

Treatments			Shoot length (cm)		Shoot fresh (weight (g		Number of leaves. shoot^{-1}		Leaf area (cm^2)	
			2015	2016	2015	2016	2015	2016	2015	2016
1. Specific effect of sprayed Protamine amino acid										
Without amino acid			14.72	15.19	2.35	2.39	12.19	12.08	4.01	4.20
With amino acid			15.88	16.21	2.50	2.71	12.68	12.57	4.09	4.36
F Test			*	*	*	*	*	*	NS	*
2. Specific effect of sprayed plant extracts										
A. monosperma			16.82 a	16.87 ab	2.68 a	2.69 ab	12.69 a	12.38 ab	4.05 ab	4.32 a
C. spinosa			12.31 b	12.64 b	1.93 b	2.02 b	11.80 b	11.88 b	3.96 b	4.04 b
M. oleifera			16.77 a	17.59 a	2.67 a	2.92 a	12.82 a	12.71 a	4.15 a	4.48 a
3. Specific effect of concentration of plant extracts										
0 (control)			9.07 d	9.90 d	1.57 c	1.70 d	9.99 c	10.56 c	3.79 c	3.77 c
5%			14.75 c	15.78 c	2.35 b	2.40 c	12.49 b	12.21 b	4.03 b	4.10 b
15%			17.25 b	17.62 b	2.67 ab	2.79 b	13.20 ab	12.63 ab	4.14 ab	4.55 ab
25%			20.12 a	19.51 a	3.12 a	3.29 a	14.06 a	13.90 a	4.26 a	4.71 a
4. Interaction effect of between plant extracts at different concentration and amino acid										
Without protamine amino acid	*A. monosperma*	0	8.85 l	8.94 j	1.51 i	1.57 j	9.78 k	10.20 l	3.74 e	3.75 i
		5	15.63 g	16.05 fg	2.69 de	2.29 fg	12.78 f	12.11 ghi	4.02 bcd	3.80 g
		15	18.98 cde	18.72 de	2.88 cd	2.34 efg	13.30 de	12.39 g	4.08 abcd	4.40 cd
		25	20.74 bc	21.45 abc	3.44 ab	3.54 abcd	13.84 c	13.93 b	4.16 abc	4.83 abc
	C. spinosa	0	8.85 l	8.94 j	1.51 i	1.57 j	9.78 k	10.20 l	3.74 e	3.75 i
		5	9.00 kl	13.29 hi	1.60 h	1.68 i	11.56 hi	11.55 j	3.88 d	3.98 fg
		15	12.38 i	13.23 hi	1.97 fg	1.97 gh	12.22 ghi	11.60 ij	3.93 cd	4.11 ef
		25	17.98 ef	13.77 fghi	2.34 ef	2.43 ef	13.13 e	13.22 cd	4.11 abcd	4.21 def
	M. oleifera	0	8.85 l	8.94 j	1.51 i	1.57 j	9.78 k	10.20 l	3.74 e	3.75 i
		5	16.25 fg	17.49 ef	2.50 def	2.86 cde	12.45 g	12.76 f	4.09 abcd	4.38 cde
		15	18.45 e	20.20 cd	2.91 cd	3.15 bcd	13.11 e	13.13 d	4.32 ab	4.69 bcd
		25	20.64 c	21.25 abcd	3.35 abc	3.65 abc	14.56 ab	13.68 c	4.38 a	4.77 bc
With protamine amino acid	*A. monosperma*	0	9.28 k	10.86 i	1.62 gh	1.83 hi	10.20 j	10.92 k	3.85 d	3.78 h
		5	18.89 de	16.66 efg	2.77 cde	2.7 de	13.31 de	12.24 gh	4.13 abcd	3.92 fg
		15	20.85 abc	19.33 cde	2.98 bcd	3.54 abcd	13.77 cd	12.9 e	4.15 abc	4.98 ab
		25	21.37 ab	22.98 ab	3.55 a	3.71 ab	14.54 ab	14.37 ab	4.32 ab	5.08 a
	C. spinosa	**0**	9.28 k	10.86 i	1.62 gh	1.83 hi	10.20 j	10.92 k	3.85 d	3.78 h
		5	9.76 j	13.21 hi	1.68 g	1.94 ghi	11.48 i	11.78 i	3.92 cd	4.07 efg
		15	13.65 h	13.69 ghi	2.21 efg	2.11 fgh	12.34 gh	12.05 hi	4.04 bcd	4.15 ef
		25	17.54 efg	14.11 fgh	2.54 def	2.66 def	13.66 cde	13.69 c	4.18 abc	4.30 cdef
	M. oleifera	0	9.28 k	10.86 i	1.62 gh	1.83 hi	10.20 j	10.92 k	3.85 d	3.78 h
		5	18.98 cde	17.98 def	2.88 cd	2.91 cd	13.34 de	12.82 ef	4.12 abcd	4.44 cd
		15	19.21 cd	20.52 bcd	3.08 bc	3.64 abc	14.44 b	13.68 c	4.30 ab	4.95 ab
		25	22.46 a	23.49 a	3.50 a	3.77 a	14.65 a	14.49 a	4.40 a	5.06 a

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.

Leaf area

In both experimental seasons, all aqueous plant extracts significantly increased leaf area than the untreated trees (control). Data in **Table (4)** clarify that the *A. monosperma* and *M. oleifera* extracts at 25% were pioneer and always surpassed other extracts in leaf area (4.05 & 4.15 and 4.32 & 4,48 cm^2), in 2015 and 2016 seasons, respectively. Also for, amino acid application, the obtained data clarify the highest leaf area with the Protamine application at 1.5 % compared with the remained treatment in both seasons. The interaction between aqueous plant extracts and amino acid applications was statistically significant in both seasons in this respect.

Leaf pigments content (Chlorophyll A, B and carotenoid)

The present results (Table 5) revealed that the different aqueous plant extracts significantly affected the pigments in both seasons. In the meantime, it is obvious in most cases that the highest values in this respect were obtained by *A. monosperma* and *M. oleifera* aqueous extracts at 25%. Regarding specific effect of amino acid applications on leaf pigments content, The present results indicate that the amino acid application significantly affected most pigments in both seasons, except "carotenoids" in both seasons. It is clear that the Protamine application at 1.5 % treatment encouraged and promoted all the studied leaf photosynthetic pigments content compared to untreated trees in both seasons, chlorophyll B and carotenoids not affected with sprayed amino acid. The interaction between aqueous plant extracts and amino acid application at different concentrations was statistically significant in both experimental seasons. The interaction between *A. monosperma* and *M. oleifera* aqueous extracts × Protamine amino acid at 1.5% recorded the highest values of "chlorophyll A", "chlorophyll B", "total chlorophyll" and "carotenoids" in 2015 and 2016 seasons.

This result could be due to that the moringa leaf extract has the potential of promoting plant growth; hence, it is used as a natural plant growth enhancer, and zeatin plays an important role in cell division and cell elongation (Nagar *et al.,* 1982; Siddhuraju and Becker, 2003 and Anwar *et al.,* 2007). Also, the Moringa leaf extract induced increase in vegetative growth of olive trees that was attributed to the role of cytokinins in promoting cell division and elongation. It has been reported that Moringa leaf extract contains zeatin, dihydrozeatin and isopentyladenine which are endogenous cytokinins (Andrews, 2006). Fuglie (2000) reported that application of moringa extract increased maize growth.

Table 5. Effect of aqueous plant extracts at different concentrations and amino acids application on leaf pigments content of "Picual" cv. olive trees during 2015 and 2016 seasons.

Treatments			chlorophyll A (mg/100g fresh weight)		chlorophyll B (mg/100g fresh weight)		Total chlorophyll (mg/100g fresh weight)		Carotenoids (mg/100g fresh weight)	
			2015	2016	2015	2016	2015	2016	2015	2016
1. Specific effect of sprayed Protamine amino acid										
Without amino acid			10.55	10.45	6.34	6.19	16.89	16.64	1.35	1.78
With amino acid			10.75	10.76	6.50	6.47	17.24	17.23	1.37	1.79
F Test			*	*	NS	NS	*	*	NS	NS
2. Specific effect of sprayed plant extracts										
A. monosperma			10.90 a	10.84 a	6.56 a	6.62 a	17.46 a	17.46 a	1.35 a	1.79 a
C. spinosa			10.23 b	10.00 b	6.03 b	5.79 b	16.26 b	15.79 b	1.36 a	1.78 a
M. oleifera			10.82 a	10.97 a	6.67 a	6.58 a	17.49 a	17.55 a	1.37 a	1.78 a
3. Specific effect of concentration of plant extracts										
0 (control)			9.12 c	9.11 c	5.46 b	5.54 c	14.58 d	14.65 d	1.32 a	1.77 a
5%			10.06 b	10.48 b	6.25 ab	6.01 b	16.31 c	16.49 c	1.36 a	1.78 a
15%			11.27 ab	11.00 ab	6.93 a	6.61 ab	18.20 b	17.61 b	1.38 a	1.77 a
25%			12.16 a	11.83 a	7.03 a	7.17 a	19.19 a	19.00 a	1.38 a	1.82 a
4. Interaction effect of between plant extracts at different concentration and amino acid										
Without protamine amino acid	*A. monosperma*	0	8.6 i	8.89 h	5.45 h	5.35 i	14.05 j	14.24 j	1.32 c	1.75 c
		5	10.63 f	10.31 efg	6.48 ef	6.21 e	17.11 f	16.52 fgh	1.33 bc	1.82 a
		15	11.64 bcd	11.07 d	6.88 cde	6.94 c	18.52 bc	18.01 d	1.34 abc	1.76 bc
		25	12.70 a	12.39 abc	7.11 abcd	7.55 ab	19.81 a	19.94 abc	1.35 abc	1.84 a
	C. spinosa	0	8.6 i	8.89 h	5.45 h	5.35 i	14.05 j	14.24 j	1.32 c	1.75 c
		5	9.63 hi	9.9 g	5.46 h	5.41 h	15.09 i	15.31 hi	1.35 abc	1.83 a
		15	10.73 ef	10.11 fg	6.48 ef	5.75 g	17.21 ef	15.86 h	1.4 a	1.74 cd
		25	11.70 bc	10.53 def	6.53 def	6.12 ef	18.23 c	16.65 fg	1.34 abc	1.77 bc
	M. oleifera	0	8.6 i	8.89 h	5.45 h	5.35 i	14.05 j	14.24 j	1.32 c	1.75 c
		5	9.73 gh	10.83 de	6.73 de	6.11 ef	16.46 g	16.94 ef	1.38 ab	1.72 d
		15	11.45 cd	11.2 cd	6.97 cd	6.75 d	18.42 bc	17.95 de	1.35 abc	1.79 b
		25	12.64 a	12.34 abc	7.09 bcd	7.43 b	19.73 a	19.77 bc	1.38 ab	1.83 a
With protamine amino acid	*A. monosperma*	0	9.64 hi	9.33 gh	5.46 h	5.72 g	15.1 i	15.05 i	1.32 c	1.78 b
		5	9.88 g	10.54 def	6.39 f	6.22 e	16.27 h	16.76 f	1.35 abc	1.75 c
		15	11.75 bc	11.45 bcd	7.23 abc	7.09 c	18.98 b	18.54 cd	1.4 a	1.78 b
		25	12.39 abc	12.72 a	7.45 a	7.89 a	19.84 a	20.61 a	1.41 a	1.83 a
	C. spinosa	0	9.64 hi	9.33 gh	5.46 h	5.72 g	15.1 i	15.05 i	1.32 c	1.78 b
		5	9.67 ghi	10.41 defg	5.55 g	5.89 f	15.22 h	16.3 gh	1.34 abc	1.75 c
		15	10.81 e	10.38 efg	6.71 de	5.92 f	17.52 e	16.3 gh	1.41 a	1.79 b
		25	11.09 de	10.44 defg	6.57 def	6.18 e	17.66 de	16.62 fg	1.4 a	1.8 ab
	M. oleifera	0	9.64 hi	9.33 gh	5.46 h	5.72 g	15.1 i	15.05 i	1.32 c	1.78 b
		5	10.80 e	10.87 de	6.91 cd	6.21 e	17.71 d	17.08 e	1.4 a	1.81 ab
		15	11.21 cde	11.77 bc	7.33 ab	7.22 bc	18.54 bc	18.99 c	1.37 ab	1.74 cd
		25	12.46 ab	12.56 ab	7.42 a	7.82 a	19.88 a	20.38 ab	1.4 a	1.84 a

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.

Leaf nutrients content (N, P and K %)

The effect of different aqueous plant extracts and amino acid applications on leaf major nutrients of "Picual" olive trees in 2015 and 2016 seasons were shown in Table (6). It was obvious that the different aqueous plant extracts affected significantly leaf macronutrients content in both experimental seasons. The obtained results revealed that the leaf nitrogen percentages were the highest with both *A. monosperma* and *M. oleifera* aqueous extracts at 25% in the first season and *M. oleifera* aqueous extract at 25% in the second season. Meanwhile, the lowest values were resulted from the control. Also, leaf phosphorus and potassium percentages were significantly higher with *A. monosperma* and *M. oleifera* aqueous extracts at 25% as compared with the control.

The obtained data clearly showed that amino acid application markedly affected the leaf macronutrients level in both experimental seasons. Concerning N and K content, results illustrated that the Protamine amino acid application at 15% was significantly higher N (1.55, 1.78 %) and K (1.19, 1.23 %) content than untreated trees (1.48, 1.68 %) and (1.06, 1.12 %) in 2015 and 2016 seasons, respectively. In the meantime, leaf P content was not significantly affected by the different amino acid applications in both seasons. The interactions effect between aqueous plant extracts and amino acid applications were statistically significant for leaf N, P and K contents in both experimental seasons. The *A. monosperma* and *M. oleifera* aqueous extracts at 25% + Protamine amino acid application at 1.5 % treatments achieved the highest leaf N, P and K contents.

This result could be due to the important role of moringa extract that contain a profile of proteins, vitamins, β carotene, amino acids and various phenolics and provide a rich and rare combination of zeatin, protein, vitamins such as A, B1, B2, B3, ascorbic acid, E, phenolic compounds, sugars and minerals such as Ca, Mg, Na, Fe, P and K and several flavonoid pigments. (Nagar *et al.,* 1982; Siddhuraju and Becker, 2003 and Anwar *et al.,* 2007). Results of the present study were in agreement with those of Mona (2013) who found that fertilization of rocket (*Eruca vesicaria*) plants with *M. oleifera* at rat 2% extract potentially increased the content of, N, P and K in leaves. Yield

Table 6. Effect of aqueous plant extracts at different concentrations and amino acids application on leaf minerals content of "Picual" cv. olive trees during 2015 and 2016 seasons.

Treatments			(%) Leaf N content		(%) Leaf P content		(%) Leaf K content	
			2015	2016	2015	2016	2015	2016
1. Specific effect of sprayed Protamine amino acid								
Without amino acid			1.48	1.68	0.138	0.151	1.06	1.12
With amino acid			1.55	1.78	0.145	0.152	1.19	1.23
F Test			*	*	NS	NS	*	*
2. Specific effect of sprayed plant extracts								
A. monosperma			1.55 b	1.89 a	0.149 a	0.155 b	1.12 ab	1.23 a
C. spinosa			1.37 c	1.33 b	0.128 b	0.135 c	1.08 b	1.06 b
M. oleifera			1.62 a	1.96 a	0.148 a	0.164 a	1.18 a	1.23 a
3. Specific effect of concentration of plant extracts								
0 (control)			0.93 c	1.14 c	0.103 d	0.110 d	0.83 c	0.86 d
5%			1.33 b	1.79 b	0.132 c	0.137 c	1.17 b	1.19 c
15%			1.83 ab	1.94 ab	0.156 b	0.158 b	1.21 b	1.28 b
25%			1.97 a	2.06 a	0.174 a	0.200 a	1.30 a	1.36 a
4. Interaction effect of between plant extracts at different concentration and amino acid								
Without protamine amino acid	*A. monosperma*	0	0.88 f	1.12 g	0.09 d	0.11 c	0.6 g	0.7 h
		5	1.39 de	1.98 cd	0.13 bc	0.16 b	1.14 e	1.26 d
		15	1.85 bc	2.00 c	0.16 ab	0.17 b	1.18 cd	1.38 ab
		25	1.97 ab	2.20 bc	0.18 a	0.21 a	1.33 ab	1.42 a
	C. spinosa	0	0.88 f	1.12 g	0.09 d	0.11 c	0.6 g	0.7 h
		5	0.82 f	1.13 g	0.13 bc	0.12 c	1.11 ef	0.94 g
		15	1.72 bcde	1.41 e	0.13 bc	0.12 c	1.16 cde	1.11 f
		25	1.84 bc	1.54 de	0.17 ab	0.18 ab	1.19 cd	1.22 de
	M. oleifera	0	0.88 f	1.12 g	0.09 d	0.11 c	0.6 g	0.7 h
		5	1.74 bcd	2.00 c	0.13 bc	0.13 c	1.22 c	1.29 cd
		15	1.84 bc	2.25 abc	0.17 ab	0.18 ab	1.25 bc	1.31 bc
		25	1.98 ab	2.26 abc	0.19 a	0.21 a	1.35 ab	1.4 a
With protamine amino acid	*A. monosperma*	0	0.98 ef	1.15 fg	0.12 c	0.11 c	1.05 f	1.02 fg
		5	1.38 de	2.20 bc	0.15 b	0.13 c	1.15 de	1.31 bc
		15	1.9 abc	2.22 bc	0.18 a	0.14 bc	1.19 cd	1.35 abc
		25	2.05 a	2.28 ab	0.19 a	0.21 a	1.34 ab	1.4 a
	C. spinosa	0	0.98 ef	1.15 fg	0.12 c	0.11 c	1.05 f	1.02 fg
		5	1.04 e	1.18 f	0.13 bc	0.12 c	1.15 de	1.04 fg
		15	1.79 bcd	1.44 e	0.12 c	0.15 bc	1.17 cde	1.18 e
		25	1.88 abc	1.68 cde	0.13 bc	0.17 b	1.22 c	1.3 bcd
	M. oleifera	0	0.98 ef	1.15 fg	0.12 c	0.11 c	1.05 f	1.02 fg
		5	1.58 cde	2.23 abc	0.12 c	0.16 b	1.26 abc	1.32 bc
		15	1.89 abc	2.3 ab	0.18 a	0.19 ab	1.28 abc	1.37 ab
		25	2.1 a	2.39 a	0.18 a	0.22 a	1.39 a	1.4 a

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.

The data presented in Table (7) clearly showed that the different aqueous plant extracts significantly increased fruit yield/tree as compared with the control in both seasons. It was obvious that *M. oleifera* and *A. monosperma* aqueous extracts at 25% was most efficient as extract, since it gave the highest fruit yield/tree in both seasons (58.07, 69.35 and 54.92, 69.79 kg/tree), respectively, and the least fruit yield came from *C. spinosa* aqueous extract (48.17 and 55.75 kg/tree) in 2015 and 2016 seasons, respectively. In addition, significant differences were found among all aqueous extracts in both experimental seasons.

Table 7. Effect of aqueous plant extracts at different concentrations and amino acids application on the yield and fruit quality of "Picual" cv. olive trees during 2015 and 2016 seasons.

Treatments			Yield.tree^{-1} (Kg)		Fruit weight (g)		Flesh weight (g)		Flesh: Fruit weight	
			2015	2016	2015	2016	2015	2016	2015	2016
1. Specific effect of sprayed Protamine amino acid										
Without amino acid			52.21	61.74	4.06	4.10	3.19	3.22	78.05	78.06
With amino acid			55.24	68.18	4.56	4.25	3.21	3.42	76.45	80.09
F Test			*	*	*	*	*	*	*	*
2. Specific effect of sprayed plant extracts										
A. monosperma			54.92 ab	69.79 a	4.16 a	4.17 ab	3.21 ab	3.32 ab	77.79 ab	79.09 a
C. spinosa			48.17 b	55.75 b	3.79 b	4.02 b	2.91 b	3.18 b	76.48 b	78.73 b
M. oleifera			58.07 a	69.35 a	4.38 a	4.33 a	3.47 a	3.46 a	78.48 a	79.41 a
3. Specific effect of concentration of plant extracts										
0 (control)			36.63 d	45.04 d	3.32 c	3.39 c	2.35 c	2.49 c	70.91 c	73.40 c
5%			51.63 c	64.31 c	3.89 b	4.24 b	3.06 b	3.43 b	78.52 b	80.82 b
15%			60.52 b	70.07 b	4.51 a	4.47 ab	3.52 ab	3.61 a	78.03 b	80.77 b
25%			66.11 a	80.43 a	4.73 a	4.61 a	3.86 a	3.75 a	81.54 a	81.33 a
4. Interaction effect of between plant extracts at different concentration and amino acid										
Without protamine amino acid	*A. monosperma*	0	34.73 n	40.32 o	3.28 g	3.35 h	2.38 g	2.41 f	72.56 j	71.94 j
		5	45.84 l	68.24 hi	3.86 ef	4.23 ef	3.05 ef	3.38 cd	79.02 de	79.91 fg
		15	63.49 def	72.8 f	4.46 bcd	4.38 cde	3.39 cde	3.55 bc	76.01 h	81.05 de
		25	67.1 bc	84.93 b	4.85 abc	4.56 bc	4.01 ab	3.59 b	82.68 ab	78.73 hi
	C. spinosa	0	34.73 n	40.32 o	3.28 g	3.35 h	2.38 g	2.41 f	72.56 j	71.94 j
		5	45.71 lm	45.07 n	3.3 fg	3.78 fg	2.54 fg	3.05 de	76.97 f	80.69 e
		15	50.98 j	57.5 k	4.12 de	4.27 def	3.32 de	3.41 c	80.58 b	79.86 fgh
		25	56.69 h	65.41 i	4.24 cde	4.32 de	3.36 de	3.42 c	79.25 cde	79.17 gh
	M. oleifera	0	34.73 n	40.32 o	3.28 g	3.35 h	2.38 g	2.41 f	72.56 j	71.94 j
		5	59.44 f	69.84 h	4.38 cd	4.45 bcd	3.54 bcd	3.56 bc	80.82 b	80.00 f
		15	64.41 d	71.74 g	4.74 abcd	4.58 bc	3.82 abcd	3.61 b	80.59 b	78.82 h
		25	68.63 abc	84.4 b	4.95 ab	4.63 abc	4.11 a	3.83 ab	83.03 a	82.72 bcd
With protamine amino acid	*A. monosperma*	0	38.52 m	49.75 m	3.35 f	3.42 g	2.32 h	2.56 e	69.25 k	74.85 i
		5	49.87 jk	74.38 e	3.96 def	4.35 de	3.03 ef	3.61 b	76.52 g	82.99 b
		15	66.89 c	78.81 c	4.5 bcd	4.42 cd	3.46 cd	3.58 b	76.89 fg	81.00 de
		25	72.94 ab	89.08 a	5.00 a	4.67 ab	4.07 ab	3.84 ab	81.4 b	82.23 cd
	C. spinosa	0	38.52 m	49.75 m	3.35 f	3.42 g	2.32 h	2.56 e	69.25 k	74.85 i
		5	47.36 k	54.48 l	3.39 f	3.88 efg	2.66 f	3.13 d	78.47 e	80.67 e
		15	53.29 i	63.3 j	4.32 cd	4.48 bcd	3.22 def	3.63 b	74.54 i	81.03 de
		25	58.1 g	70.16 gh	4.35 cd	4.68 ab	3.49 cd	3.82 ab	80.23 bc	81.62 cde
	M. oleifera	0	38.52 m	49.75 m	3.35 f	3.42 g	2.32 h	2.56 e	69.25 k	74.85 i
		5	61.58 ef	73.85 ef	4.45 bcd	4.75 a	3.53 bcd	3.83 ab	79.33 cd	80.63 e
		15	64.05 de	76.28 d	4.90 ab	4.66 ab	3.90 abc	3.86 ab	79.59 c	82.83 bc
		25	73.2 a	88.62 ab	5.01 a	4.79 a	4.14 a	4.00 a	82.63 ab	83.51 a

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.

From the same table, the data revealed similar pattern of response as affected by amino acid application. The Protamine amino acid at 15% produced the highest fruit yield/tree (55.24 and 68.18 Kg/tree) compared to the untreated trees (52.21 and 61.74 Kg/tree) in both seasons, respectively.

The interaction effect between aqueous plant extracts and amino acid applications was significant in both experimental seasons. In addition, it is obvious that aqueous plant extracts and amino acid applications augmented the fruit yield more than two folds in the second season as compared to fruit yield in the first one and partially improved the alternate bearing pattern in Picual olive trees. There are some known physiological effects caused by the application of hormones like cytokinin which depend on the type of cytokinin and crop species (Salisbury and Ross, 1992; Davies, 1995).

Physical fruit characteristics

The obtained data revealed that fruit and flesh weights, flesh: fruit weight percentages, fruit length, fruit diameter and fruit shape followed nearly similar trends in response to aqueous plant extracts. The aqueous plant extracts of *A. monosperma* and *M. oleifera* at 25% significantly gave higher values for the considered parameters in both seasons. On the contrary, control treatment recorded the least values in this respect in both seasons.

Concerning, the effect of amino acid applications, the data revealed that higher significant values of the considered fruit characteristics by the Protamine amino acid application at 15%. As such, in 2015 and 2016 seasons, the Protamine amino acid application gave 4.56 & 4.25 fruit weight, 3.21 & 3.42 g flesh weight, 76.45 & 80.09 % flesh: fruit weight, 2.75 & 3.07 cm fruit length, 2.22 & 2.36 cm fruit diameter and 1.23 & 1.29 fruit shape "L/D", respectively. On the other hand, the least values resulted always from the untreated trees in both seasons (Tables 7 & 8).

Table 8. Effect of aqueous plant extracts at different concentrations and amino acids application on some fruit characteristics of "Picual" cv. olive trees during 2015 and 2016 seasons.

Treatments			Fruit length (cm)		Fruit diameter (cm)		Fruit shape (L/D)		Moisture content (%)	
			2015	2016	2015	2016	2015	2016	2015	2016
1. Specific effect of sprayed Protamine amino acid										
Without amino acid			2.72	3.01	2.19	2.29	1.24	1.31	54.58	54.59
With amino acid			2.75	3.07	2.22	2.36	1.23	1.29	55.43	55.60
F Test			NS	NS	NS	*	NS	NS	*	*
2. Specific effect of sprayed plant extracts										
A. monosperma			2.64 ab	3.05 ab	2.21 a	2.33 ab	1.19 b	1.30 a	55.25 a	54.98 b
C. spinosa			2.51 b	2.96 b	2.11 b	2.28 b	1.19 b	1.30 a	55.71 a	56.41 a
M. oleifera			3.05 a	3.10 a	2.30 a	2.38 a	1.32 a	1.30 a	55.56 a	55.40 ab
3. Specific effect of concentration of plant extracts										
0 (control)			2.38 b	2.39 c	2.09 c	2.09 c	1.14 c	1.15 b	52.99 b	54.47 b
5%			2.71 ab	3.12 b	2.17 b	2.30 b	1.25 b	1.35 a	56.63 a	56.72 a
15%			2.78 ab	3.24 ab	2.23 ab	2.41 ab	1.24 b	1.34 a	55.87 ab	55.35 ab
25%			3.07 a	3.41 a	2.34 a	2.51 a	1.31 a	1.36 a	56.55 a	55.85 ab
4. Interaction effect of between plant extracts at different concentration and amino acid										
Without protamine amino acid	*A. monosperma*	0	2.33 e	2.40 f	2.08 f	2.05 g	1.12 ef	1.17 c	53.50 f	55.45 ef
		5	2.36 de	3.09 d	2.06 fg	2.27 e	1.15 e	1.36 a	55.64 de	54.98 fgh
		15	2.48 cd	3.22 bcd	2.05 g	2.38 c	1.21 cd	1.35 ab	57.14 ab	55.25 f
		25	3.30 a	3.38 abc	2.45 a	2.47 abc	1.35 abc	1.37 a	55.98 bcd	56.28 de
	C. spinosa	0	2.33 e	2.40 f	2.08 f	2.05 g	1.12 ef	1.17 c	53.50 f	55.45 ef
		5	2.56 bcd	2.98 e	2.14 cde	2.21 ef	1.20 cde	1.35 ab	58.97 a	58.25 ab
		15	2.64 bc	3.11 cde	2.15 cde	2.29 de	1.23 c	1.36 a	54.67 e	54.87 gh
		25	2.65 bc	3.25 bc	2.13 cde	2.39 c	1.24 c	1.36 a	55.64 de	55.00 fg
	M. oleifera	0	2.33 e	2.40 f	2.08 f	2.05 g	1.12 ef	1.17 c	53.50 f	55.45 ef
		5	3.20 abc	3.17 cd	2.3 cd	2.31 d	1.39 ab	1.37 a	56.00 bcd	56.45 d
		15	3.22 abc	3.28 bc	2.36 abcd	2.50 ab	1.36 abc	1.31 b	55.67 de	54.37 hi
		25	3.27 ab	3.45 ab	2.4 ab	2.56 a	1.36 abc	1.35 ab	56.8 b	55.31 f
With protamine amino acid	*A. monosperma*	0	2.42 d	2.38 f	2.1 e	2.13 f	1.15 e	1.12 d	52.47 g	53.48 i
		5	2.38 de	3.15 cd	2.12 de	2.36 cd	1.12 ef	1.33 b	54.36 ef	54.67 h
		15	2.51 bcd	3.27 bc	2.36 abcd	2.42 bc	1.06 f	1.35 ab	55.78 cde	54.74 h
		25	3.33 a	3.50 a	2.48 a	2.57 a	1.34 bc	1.36 a	57.12 ab	55.00 fg
	C. spinosa	0	2.42 d	2.38 f	2.1 e	2.13 f	1.15 e	1.12 d	52.47 g	53.48 i
		5	2.48 cd	3.04 d	2.08 f	2.29 de	1.19 de	1.33 b	57.68 ab	58.64 a
		15	2.50 bcd	3.18 cd	2.09 ef	2.37 cd	1.20 cde	1.34 ab	56.14 bc	57.98 b
		25	2.53 bcd	3.35 abc	2.12 de	2.49 ab	1.19 de	1.35 ab	56.64 b	57.58 bc
	M. oleifera	0	2.42 d	2.38 f	2.1 e	2.13 f	1.15 e	1.12 d	52.47 g	53.48 i
		5	3.30 a	3.26 bc	2.33 bcd	2.38 c	1.42 a	1.37 a	57.12 ab	57.33 c
		15	3.32 a	3.35 abc	2.38 abc	2.52 ab	1.39 ab	1.33 b	55.80 bcde	54.87 gh
		25	3.35 a	3.54 a	2.43 ab	2.56 a	1.38 ab	1.38 a	57.11 ab	55.90 e

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.

The interaction of aqueous plant extracts and amino acid applications was significant in most cases in both experimental seasons and reflected the effects of the major factors, i.e. each of *A. monosperma* and *M. oleifera* aqueous extracts at 25% and Protamine amino acid application at 15% on increasing fruit and flesh weights and flesh %. Moringa aqueous extract content of high minerals and hormones positively affected fruit growth and development process and consequently increase number of fruit/tree (Swietlik , 1999 and Abdalla, 2013). These results are in agreement with the results obtained by Sheren and El-Amary (2015) and Nasira *et al.*(2016). They reported that foliar application of moringa leaf extract increased the yield (weight and total number of fruits), total number and percentage of

marketable fruit and decreased the number and percentage of unmarketable fruits.

Chemical fruit and oil characteristics

Data concerning the flesh oil percentages, acidity, moisture content, antioxidant activity and phenolic compounds indicated nearly similar trends in response to aqueous plant extracts in both seasons (Tables 8 and 9). The uppermost values always resulted from the *A. monosperma* and *M. oleifera* aqueous extracts at 25%, descendingly followed by *M. oleifera* aqueous extract at 15%, the control recorded the least values in this concern during 2015 and 2016 seasons. As for, the effect of amino acid applications on chemical fruit and oil characteristics, the data revealed that the highest significant values of oil percentages, moisture content, antioxidant activity and phenolic compounds were achieved by the Protamine amino acid application at 15% (27.81 & 27.27 and 28.58 % oil content, 55.43, 55.60 % moisture content, 0.91, 1.03 mg Vitamin E .100 ml^{-1} oil antioxidant activity and 20.46 & 23.41 mg GAE.100 ml^{-1} oil phenolic compounds) in both seasons, respectively. The least acidity value (0.68 and 0.71 %) was obtained with Protamine amino acid application in both seasons.

Table 9. Effect of aqueous plant extracts at different concentrations and amino acids application on some chemical fruit properties of "Picual" cv. olive trees during 2015 and 2016 seasons

Treatments			Oil content (%)		Acidity (%)		Antioxidant activity (mg Vitamin E .100 ml^{-1} oil)		Phenolic compounds (mg GAE.100 ml^{-1} oil)	
			2015	2016	2015	2016	2015	2016	2015	2016
1. Specific effect of sprayed Protamine amino acid										
Without amino acid			0	27.20	0.78	0.90	0.78	0.90	18.85	20.95
With amino acid			27.27	28.58	0.68	0.71	0.91	1.03	20.46	23.41
F Test			*	*	*	*	*	*	*	*
2. Specific effect of sprayed plant extracts										
A. monosperma			27.12 a	28.17 ab	0.77 b	0.89 b	0.85 b	1.02 a	20.93 a	22.52 b
C. spinosa			26.13 b	27.22 b	0.81 a	0.97 a	0.67 c	0.77 b	17.72 b	17.91 c
M. oleifera			27.29 a	29.79 a	0.76 b	0.84 b	1.01 a	1.11 a	20.31 a	26.13 a
3. Specific effect of concentration of plant extracts										
0 (control)			24.55 d	25.90 c	0.82 a	1.00 a	0.50 c	0.68 c	8.18 d	9.69 d
5%			26.91 c	28.67 b	0.80 a	0.96 a	0.80 b	0.86 b	18.36 c	22.17 c
15%			27.56 b	28.94 b	0.79 a	0.87 ab	0.96 ab	1.06 ab	22.57 b	26.66 b
25%			28.81 a	30.05 a	0.70 b	0.79 b	1.12 a	1.26 a	29.51 a	30.23 a
4. Interaction effect of between plant extracts at different concentration and amino acid										
Without protamine amino acid	*A. monosperma*	0	24.52 i	25.65 j	0.82 a	0.98 ab	0.44 i	0.58 i	7.46 n	8.22 l
		5	26.84 fg	28.65 ef	0.81 a	0.92 cd	0.78 f	0.85 fg	19.78 i	17.34 i
		15	26.98 efg	28.87 de	0.78 abc	0.87 de	0.92 de	1.07 cde	22.9 fg	26.11 f
		25	28.56 abc	29.54 cde	0.61 e	0.76 ef	1.08 bcd	1.33 bc	30.97 a	32.61 b
	C. spinosa	0	24.52 i	25.65 j	0.82 a	0.98 ab	0.44 i	0.58 i	7.46 n	8.22 l
		5	25.78 ghi	25.65 j	0.81 a	0.98 ab	0.57 h	0.67 hi	14.18 l	15.31 j
		15	26.58 fgh	27.38 gh	0.82 a	0.95 bcd	0.60 gh	0.73 h	18.88 ij	20.27 h
		25	27.35 b	28.45 efg	0.81 a	0.97 abc	0.75 fg	0.89 efg	26.13 de	23.27 fgh
	M. oleifera	0	24.52 i	25.65 j	0.82 a	0.98 ab	0.44 i	0.58 i	7.46 n	8.22 l
		5	27.11 ef	31.2 abc	0.80 ab	0.98 ab	0.84 ef	0.94 def	18.33 j	29.23 d
		15	27.45 def	30.28 cd	0.74 bc	0.75 f	1.07 bcd	1.21 bcd	22.01 fgh	30.34 cd
		25	28.00 c	31.45 ab	0.68 c	0.65 g	1.38 ab	1.41 ab	30.6 c	32.30 bc
With protamine amino acid	*A. monosperma*	0	24.58 hi	26.15 i	0.82 a	1.01 a	0.56 hi	0.77 gh	8.89 m	11.15 k
		5	27.65 cde	27.68 g	0.81 a	0.97 abc	0.91 de	0.94 def	21.38 gh	22.34 gh
		15	28.24 bc	28.28 fg	0.82 a	0.88 cde	1.03 cd	1.18 cd	24.71 e	28.39 e
		25	29.57 ab	30.54 abcd	0.65 d	0.76 ef	1.11 abcd	1.42 ab	31.34 b	34.00 a
	C. spinosa	0	24.58 hi	26.15 i	0.82 a	1.01 a	0.56 hi	0.77 gh	8.89 m	11.15 k
		5	26.24 gh	27.2 h	0.81 a	0.96 bc	0.73 fgh	0.75 h	15.55 k	17.38 i
		15	27.54 cdef	28.45 efg	0.82 a	0.96 bc	0.84 ef	0.81 g	23.45 f	22.23 gh
		25	27.65 cde	28.79 def	0.78 abc	0.97 abc	0.89 def	0.93 ef	27.19 d	25.41 fg
	M. oleifera	0	24.58 hi	26.15 i	0.82 a	1.01 a	0.56 hi	0.77 gh	8.89 m	11.15 k
		5	27.83 cd	31.65 a	0.78 abc	0.97 abc	0.99 cde	1.03 de	20.94 h	31.39 bcd
		15	28.55 abc	30.4 bcd	0.75 bc	0.79 def	1.28 abc	1.36 abc	23.45 f	32.62 b
		25	30.25 a	31.54 a	0.66 cd	0.60 h	1.49 a	1.57 a	30.82 ab	33.76 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.

The interactions of aqueous plant extracts and amino acid applications were insignificant for oil percentages, moisture content, antioxidant activity and phenolic compounds while acidity was decreased. *A. monosperma* and *M. oleifera* aqueous extracts at 25% and Protamine amino acid application at 15% achieved the highest values in this concern in both seasons. Control treatment recorded the least values in this respect while other treatments came in between effects

CONCLUSION

Generally, it can be concluded that the aqueous extracts of *A. monosperma* and / or *M. oleifera* at 25% in combination with 1.5 % amino acids (Protamine®) increased vegetative growth, leaf pigment contents, leaf nutrient contents, yield and fruit and oil quality of "Picual" Olive trees during experimental seasons, compared to other treatments.

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تأثير الرش الورقي لبعض المستخلصات النباتية والأحماض الأمينية على إنتاجية وجودة الزيت لصنف الزيتون البيكوال

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أجريت هذه التجربة خلال موسمي 2015 ، و 2016 على أشجار الزيتون البيكوال عمر عشرون عاماً ونامية فى تربة رملية في المزرعة التجريبية لكلية العلوم الزراعية البيئية ، جامعة العريش، محافظة شمال سيناء ، مصر، لدراسة آثار المستخلصات المائية من نباتات العادر واللصف والمورينجا على ثلاثة تركيزات 0 و 5 و 15 و 25٪ ، رشاً على الأوراق منفرده أو مع مركب البروتامين (الشكل التجاري لخليط من الأحماض الأمينية) بتركيز 1.5٪ على النمو الخضري و المحتوى المعدني للأوراق ، و الإنتاجية ، و جودة الثمار ، وخصائص الزيت من أشجار الزيتون البيكوال. تم تجميع نباتات الدراسة خضراء ، وغسلها بمياه الصنبور تم تجفيفها ونقعها ترشيحها لإعداد المستخلصات. تم رش المستخلصات النباتية ثلاث مرات عند 70٪ من الإزهار الكامل ، بعد العقد مباشرة ، وبعد شهر من الرشة الثانية. كما تم رش معاملة المقارنة بالماء. تم ترتيب أشجار الزيتون المعالجة كتجربة عاملية في تصميم قطاعات كاملة العشوائية مع ثلاث مكررات ، وكان كل مكررة ممثلة بشجرتين. وقد أظهرت النتائج أن معظم المستخلصات النباتية مع معاملات الأحماض الأمينية تزيد بشكل ملحوظ من النمو الخضري (طول الأفرخ وعدد الأوراق للفرخ و ومحتوى الصبغات الورقية والمكونات الكيميائية للأوراق) والمحصول والخصائص الفيزيائية والكيميائية للثمار وكذلك إنتاجية الزيت وجودته مقارنة مع معاملة الكنترول. وكانت معاملات مستخلصات العادر والمورينجا عند تركيز 25% + الرش بالأحماض الأمينية (بروتامين) بتركيز 1.5% الأكثر فعالية مقارنة مع المعاملات الأخرى.