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STUDIES ON SOME TREATMENTS TO IMPROVE THE PRODUCTIVITY OF "PICUAL" OLIVE FRUITS AND FRUIT QUALITY

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ABSTRACT

The present study was carried out during two successive seasons (2011 and 2012) on "Picual" olive trees (Oleaeuropaea L.), at a private orchard of El-Arish located on El-Arish Airport Road, North Sinai Governorate, Egypt to study the effect of some growth regulators (Gibberellic acid (GA_3) at 75 ppm, Ethephon at 150 ppm, Naphthalene Acetic Acid (NAA at 50 ppm) and antioxidants (aqueous extract Roselle (Hibiscus sabdariffa), Cumin (Cuminumcyminum) and Ginger (Zingiberofficinale) on leaf nutrient content, as well as fruit and oil qualities of picual olive trees. The trees were sprayed with growth regulators three times, at late February (one month before beginning of the flowering), during full bloom period and 10 days after fruit set. While, Different antioxidant applications were sprayed transaction in three stages: the first application was applied after the first contract and prior to flowering, the second application wasz applied after two weeks from first spraying, and the third one was applied two weeks before harvest. This study were exposed to proper statistical analysis of variance for a randomized complete block design RCBD (two factors split plots) with three replicates and each replicate was represented by two trees.

The results showed that NAA treatment recorded the highest value of N% content, while, Ethephon treatment had the highest values of P and K. The highest values of N% were found with H.sabdariffa and C. cyminum extract gave the highest increase in P and K% during both seasons. GA_3 and H. sabdariffa gave the highest values of fruit and oil yields as well as Fruit physical and chemical properties in both seasons.

Key word: Productivity, picual olive, fruit quality, Gibberellic acid (GA_3), Naphthalene Acetic Acid (NAA).

INTRODUCTION

Olive tree (*Oleaeuropaea*, L.) is an evergreen tree belongs to Oleaceae family has used for high quality edible oil extraction and pickling and consider is one of the most important fruit trees in the Mediterranean Basin, and its economic role in these countries, is well recognized in which accounting for almost 98% of the world crop **Cuindo *et al.,* (2004)**. It is mostly grown in Spain, Italy, Greece, Turkey, Syria, Morocco and U.S.A **(Griggs *et al.,* 1975)**.

The objective of this study was to evaluate the effect of some antioxidants and growth regulators on leaf nutrient content, fruit set, yield and fruit quality as well as oil quality of 'Picual' olive trees. Consequently, this investigation was initiated to find the possibility of reducing harvesting costs of olive fruits through the use of some fruit abscission chemical agents i.e NAA and to determine the most effective agents, the most appropriate concentration and more safety agent like Roselle (Hibiscus sabdariffa), Cumin (Cuminumcyminum) and Ginger (Zingiberofficinale)

MATERIALS AND METHODS

The present study was carried out during two successive seasons 2011 and 2012 on "Picual" olive trees (*Oleaeuropaea* L.), at a private orchard of El-Arish located on El-Arish Airport Road, North Sinai Governorate, Egypt. 96 olive trees were about 21 years old, spaced at 5 × 6 m, cultivated in sandy soil under drip irrigation system, similar in growth vigor and received with common agricultural practices in both seasons.

The work was conducted to study the effect of some growth regulators and antioxidants on leaf nutrient content, fruit set, fruit and oil yield, as well as fruit and oil qualities of olive trees. Soil physical and chemical analysis were analyzed at soil and water laboratory, Faculty of Environmental Agricultural Sciences at El-Arish, Suez Canal University, Egypt according to **Piper (1947) (Table 1).**

1. Growth regulators treatments:

The trees were sprayed three times, at late February (one month before beginning of the flowering), during full bloom period and 10 days after fruit set with 4 treatments:

1.Control (spraying with water only).

2.Gibberellic acid (GA_3) at 75 ppm.

3.Ethephon at 150 ppm.

4.Naphthalene Acetic Acid (NAA) at 50 ppm. All trees were sprayed until the run off point with Triton B at 0.1% as a wetting agent.

Antioxidant applications

The experiment include 3 natural antioxidant sources i.e. aqueous extract Roselle (Hibiscus sabdariffa), Cumin (Cuminumcyminum) and Ginger (Zingiberofficinale) and control were applied using water.

The plants used were washed thoroughly, sun dried and ground into powder. Stock solutions of tested plants were done using fifty grams (50g) of the plant and soaked in double distilled water (500 mL) and refluxed for 5 h. The aqueous solution was filtered and concentrated to 100 ml.

Different antioxidant applications were sprayed transaction in three stages:

The first application was applied after the first contract and prior to flowering, the second application was applied after two weeks from first spraying, and the third one was applied two weeks before harvest.

2. Study measurements:

Leaf nutrient contents

During late September of both seasons, mature leaves were taken from the third leaf of labeled fruit shoot base from current season, Thereafter, in each leaf sample the mineral content was determined as follows:

Nitrogen content (%) was determined using the micro kjeldahl method as described by **Pregl, (1945).**

Phosphorus content (%) was determined colorimetrically using the Spectrophotometer **(Model 1600 Jenway Co.)** according to **Jackson (1958).**

Potassium content (%) was determined using the flame photometer according to **Brown and Lilliland (1946).**

Fruit-Set percentage:

Twenty shoots (one - years - old) on each tree were labeled for counting the initial number of flowers at full bloom.

Table (1): Soil and irrigation water analyses of the investigated orchard at El-Arish region in North Sinai Governorate.

Soil depth	Mechanical analysis					Chemical analysis								E.C	pH
						Cations (meq.l^{-1})				Anions (meq.l^{-1})					
	Sand (%)	Silt (%)	Clay (%)	Soil texture	Bulk density ($g.cm^{-3}$)	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{--}	HCO_3^{-}	Cl^{-}	SO_4^{--}	($dS.m^{-1}$)	
at 0-45 cm	93.39	2.51	4.10	Sandy	1.55	2.50	2.20	2.22	0.08	-	1.30	3.01	8.03	0.5	8.4
Chemical analysis of artesian well water used for irrigation.						12.00	16.00	31.50	0.50	-	6.10	40.20	10.91	6.00	7.6

Soil analyses were according to Piper (1947).

Number of fruitlets and fruits were recorded at monthly intervals up to harvest.

A- Fruit -set of Picual olive trees was counted and recorded after 15 days full bloom date in the both seasons. Numbers of fruits were recorded on each of the selected shoots according to **Ferguson *et al.,* (1994)** as follows:

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

Fruit yield:

Mature fruits from all the tested olive trees under study were collected on 5th November in 2011 season and on 29th October in 2012 season 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) per tree. Adequate number of fruits taken at random and transferred to the laboratory for fruit quality measurements.

Oil yield:

The olive oil was extracted by pressing olive fruits using the pressure system to estimate oil yield (kg. tree^{-1}) according to **(A.O.A.C., 1990).**

Fruits and oils quality Physical properties:

The fruit weight (g) was determined by weighing the sample of each studied tree. Fruit volume (ml) was determined from the volume of water displaced method.The fruit length (L), diameter (W) and flesh thickness (cm) were measured by using vernier caliper and the average was calculated. The fruit shape indexes (L/W) was recorded. The average weight of Flesh and stone per olive fruits (g) were determined for all fruits samples and flesh: stone ratio was also calculated.

Chemical properties:

The moisture content (%) was determined in 10 grams of fruits. A sample was dried at 60^{o}C in an electric oven until constant weight was attained. The average dry weight was determined and the percent of moisture per fruit was calculated according to **(A.O.A.C., 1990).**

Oil content (%) was determined by extraction the oil from the dried flesh samples using the Soxhlet fat extraction apparatus and using petroleum ether (60-80^{o}C) boiling point as a solvent for about 16 continuous hours and the percentage of oil on dry weight was calculated **(A.O.A.C., 1990).**

The acid value (%) was determined according to the methods of **A.O.A.C. (1990).**

Statistical analysis:

The results in this study were exposed to proper statistical analysis of variance for a randomized complete block design RCBD (two factors split plots) using MSTATC computer program **(Russell, 1986)** with three replicates and each replicate was represented by two trees.

Duncan's multiple range test was used for comparison between means. Different alphabetical letters in the column are significantly differed at (0.05) level of significance **(Duncan, 1955).**

The same trees were used throughout both experimental seasons.

RESULTS AND DISCUSSION

Leaf nitrogen, phosphorus and potassium content (%):

Concerning the specific effect of growth regulators, table (2) shows that N% generally ranged from (2.0 to 2.50 %) in the first seasons and from (2.17 & 2.88%) in the second season. The highest values (2.50 & 2.88%) were found with NAA treatment, while, Ethephon treatment had the highest values of P and K (0.19 and 0.21 %) and (1.58 and 2.14%)

in 2011 and 2012 seasons respectively. On the contrary, the least N% content (2.0 & 2.17%) came from trees treated by $GA_3$and untreated trees (control) gave the least P and K% (0.15 and 0.16 %) and (1.22 and 1.45%) in both seasons, respectively.

Regarding, the specific effect of antioxidant applications, Table (2) shows that, the highest values of N% were found with H.sabdariffa (2.48 and 2.40 %) but C. cyminum extract gave the highest increase (0.19 and 0.28 %) and (1.51and 1.99%) in P and K% during 2011 and 2012 seasons respectively.

While, the lowest ones were came from untreated trees (control). Regarding, the interaction effect between growth regulators and antioxidant applications, Table (2) shows thatthe interaction effect between control group and Z. officinale extract, proved to be the most effective in increasing leaf N% (3.28 and 2.59 %) and Ethephon with spraying C. cyminum extract, gave the highest values of P% content (0.19 and 0.27 %), but control group with C. cyminum extract, gave the highest values of K% (1.71 and 2.55 %) in both seasons.While, the interaction effect between control group and sprayed with NAA gave the least values (1.67 and 2.00 %).

Control group with GA_3 and Ethephon with C. cyminumtreatments recorded the least P and K% contents (0.12 and 0.11 %) and(1.11 and 1.50 %) during all seasons, respectively. These results go in line with those reported by **Fayed (2010)** on Thompson Seedless grapevine who showed that leaf N, P and K% contents were affected by different antioxidant treatments.

Also **Wahdanet al., (2011)** found that the nitrogen and potassium content in mango cv. "Succary Abiad", leaves increased within NAA and GA_3 higher than control.

2. Initial fruit set:

With regard to the specific effect of growth regulators application, data in Table (3) shows that the highest values of initial fruit set were obtained when trees were applied with GA_3at 75 ppmin the both seasons (30.91 and 34.24 %). While, meanwhile, treated trees with Ethephon gave the least ones for initial fruit set (%) (21.57 and 21.74) in the both seasons.

The present result is in agreement with that obtained by **Daood (2002)** who cleared that spraying Picual olive trees with 25, 50 or 100 ppm of GA_3 significantly increased the Initial fruit set percentage in comparison with the control. The results also are in agreement with those of **Abdrabboh (2009)** who cleared that Initial fruit set of Picual olive trees was increased by spraying the trees with GA3 at 30 or 60 ppm in comparison to that of control.

Chaari-Rkhis *et al.,* (2006) reported that gibberellic acid play an important role in the induction of flowering process in olive tree.

Concerning the specific effect of antioxidant treatments, data presented in Table (3) show that H. sabdariffa treatment gave the highest values of initial fruit set (28.96 and 31.22 %) in the both seasons. However untreated trees (control) gave the least ones for initial fruit set (24.40 and 26.70 %) in the both seasons. The present result is in agreement with that obtained by **(Omar, 1999 and Maksoud *et al.,* 2009).**

As for the interaction effect between growth regulators and antioxidant treatments, data in Table (3) revealed that

Table (2): Effect of some growth regulators and antioxidant treatments on some leaf nutrients content of 'Picual' olive trees during 2011 and 2012 seasons.

	Ncontent (%)					Pcontent (%)					Kcontent (%)				
	Control	C. :yminum	H. sabdariffa	Z. officinale	Mean	Control	. cyminum	H. sabdariffa	Z. officinale	Mean	Control	C. :yminum	H. abdariffa	Z. officinale	Mean
Season I (2011)															
Control	3.20 a	2.31 b	2.19 ab	3.28 a	2.74	0.16 ab	0.19 a	0.14 abcd	0.20 a	0.17	1.14 d	1.71 a	1.48 b	1.64 a	1.49
Ethephon	2.25 bc	2.19 bc	2.16 bc	2.23 bc	2.20	0.16 ab	0.19 a	0.14 bc	0.20 a	0.17	1.06 d	1.11 d	1.47 d	1.08 d	1.18
NAA	1.67 c	2.11 bc	2.16 bc	2.23 bc	2.04	0.13 d	0.19 a	0.13 abcd	0.16 a	0.15	1.32 c	1.47 b	1.64 a	1.42 a	1.46
GA_3	1.92 c	2.00 c	2.19 bc	2.07 ab	2.04	0.12 d	0.15 abc	0.15 abc	0.12 abc	0.13	1.26 a	1.09 d	1.11 d	1.06 d	1.13
Mean	2.62	2.15	2.17	2.45		0.14	0.18	0.14	0.17		1.19	1.34	1.42	1.30	
Season II (2012)															
Control	2.48 a	2.27 bcd	2.38 ab	2.59 a	2.43	0.17 de	0.16 a	0.19 bc	0.20 b	0.18	1.78 c	2.55 a	2.10 b	2.16 ab	2.14
Ethephon	2.12 bcd	2.31 ab	2.04 cd	2.35 b	2.20	0.17 de	0.27 a	0.14 abcd	0.20 b	0.19	1.58 ef	1.50 f	1.60 def	1.37 cde	1.51
NAA	2.00 d	2.19 bcd	2.19 bcd	2.35 b	2.18	0.13 abc	0.20 b	0.17 bcd	0.21 ab	0.17	1.70cdef	1.61 def	1.81 cd	2.11 ab	1.80
GA_3	2.21 bcd	1.89 bc	2.38 ab	2.16 abc	2.16	0.11 e	0.20 e	0.21 d	0.17 de	0.17	2.11 ab	1.50 f	1.60 f	1.57 ef	1.69
Mean	2.20	2.16	2.24	2.36		0.14	0.20	0.17	0.19		1.79	1.79	1.77	1.80	

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.

Table (3): Effect of some growth regulators and antioxidant treatments on fruit set, fruit and oil yields of 'Picual' olive trees during 2011 and 2012 seasons.

	Initial Fruit set (%)					Fruit yield (Kg. tree^{-1})					Oil yield (Kg. tree^{-1})				
	Control	**C. cyminum**	**H. sabdariffa**	**Z. officinale**	**Mean**	**Control**	**C. cyminum**	**H. sabdariffa**	**Z. officinale**	**Mean**	**Control**	**C. cyminum**	**H. sabdariffa**	**Z. officinale**	**Mean**
							Season I (2011)								
Control	24.00 f	21.22 g	26.23 de	25.45 e	24.22	70.25 i	75.50 h	84.56 de	81.12 f	77.85	9.76 h	10.49 g	11.75 cde	11.25 ef	10.81
Ethephon	19.49 i	20.11 h	24.4 f	22.29 fg	21.57	83.67 e	8.27bcd	90.25 ab	88.90 bc	87.77	11.62 de	12.26 bc	12.54 ab	12.35 b	12.19
NAA	26.17 de	30.41 bcd	31.73 ab	29.55 cd	29.46	79.25 g	81.67 f	86.00 cd	81.12 f	82.01	11.01 f	11.34 def	11.95 c	11.27 def	11.39
GA$_3$	27.94 d	31.64abc	33.49 a	30.57 bc	30.91	85.55 cde	89.14 b	95.33 a	89.14 b	89.79	11.88 cd	12.38 b	12.94 a	12.38 b	9.30
Mean	24.40	25.84	28.96	24.64		79.86	83.64	89.03	85.07		11.06	11.61	12.29	11.81	
							Season II (2012)								
Control	25.37 fg	26.55 ef	27.58 e	26.13 efg	26.40	116.33 j	124.25 f	133.5 b	120.00 h	123.52	16.68 g	17.82 e	19.14 ab	17.21 fg	17.71
Ethephon	17.78 i	18.45 h	25.62 fg	25.10 g	21.73	117.33 i	32.35 bc	129.45 d	127.33 e	126.61	16.83 g	18.98 b	18.56 bcd	18.26 cd	18.15
NAA	31.27 cd	34.58 b	34.13 b	30.51 d	32.62	121.33 g	129.00 d	140.00 a	126.78 ef	129.27	17.40 efg	8.50 bcd	19.68 a	18.18 d	8.88
GA$_3$	32.36 c	32.87 bc	37.55 a	34.19 b	34.24	123.23 fg	131.35 c	144.25 a	127.45 e	131.57	17.67 ef	18.84 bc	19.69 a	18.28 cd	18.62
Mean	32.94	28.11	31.22	28.98		113.30	129.21	136.80	125.39		17.14	18.53	19.26	17.98	

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.

highest values of initial fruit set (33.49 and 37.55 %) in the both seasons.

Meanwhile, the interaction between Ethephon and control group gave the least ones for initial fruit set (19.49 and 17.78%) in the both seasons.

3. Fruit and oil yields:

Concerning the specific effect of growth regulators application, data in Table (3) shows that the highest values fruit and oil yields (kg/tree) were obtained when trees were applied with GA_3at 75 ppm(89.79 and 131.57 kg/tree) and (12.47 and 18.87 kg/tree) in the both seasons. While, untreated trees (control) gave the least ones (77.86 and 123.52 kg/tree) and (10.81 and 17.71 kg/tree) in the both seasons, respectively. This increase in yield may be attrib uted to the ability of GA_3 in reducing fruit drop and consequently increasing fruit yield / tree and the effect of GA_3 on cell elongation.

This results are in agreement with that obtained by **Abd El-Naby *et al.,* 2012; Sadrollah *et al.,* 2010 and Shabaq and Halala, 2014)** working on olive trees, they reported that GA_3 greatly increased fruit oil percentage compared with control**.**

Ramezani and Shekafandeh (2009) who found that spraying olive trees with GA_3 at different concentrations 10 days after fruit set significantly increased yield of trees. Regarding the specific effect of antioxidant treatments, data presented in Table (3) show that H. sabdariffa treatment gave the highest values of fruit and oil yields (89.04 and 136.80 kg/tree) and (12.37 and 19.62 kg/tree) in the both seasons.

On the other hand untreated trees (control) gave the least ones for fruit and oil yields (79.68 and 119.56 kg/tree) and (11.07 and 17.14 kg/tree).

As for the interaction effect between growth regulators and antioxidant treatments, data in Table (3) revealed that trees treated with the combination between GA_3 and H. sabdariffa gave the highest values of fruit and oil yields (95.33 and 144.25 kg/tree) and (12.94 and 19.69 kg/tree) in the both seasons. While, untreated trees (control) gave the least ones (70.25 and 116.33 kg/tree) and (9.76 and 16.68 kg/tree) in the both seasons, respectively. This results are in harmony with that obtained by **Maksoud *et al.,* (2009)** who observed that the antioxidants treatment appears to be a powerful tool for improving fruit and oil yields of olive trees (Chemlali Cv.) planted in calcareous soil.

Fruit physical and chemical properties:

Fruit length, width and shape index (L/W)

Table (4) shows that all trees treated with Ethephon gave a significant increase in fruit length (3.18 and 3.28 cm), followed by GA_3 (3.04 and 3.21 cm).

While, trees treated with GA_3 had the highest values of fruit width and shape index (2.29 and 2.39 cm) and (1.62 and 1.65 cm) in 2011 and 2012 seasons respectively. Moreover, the least fruit length, width and shape index were given in untreated trees (2.17 and 2.59 cm), (1.36 and 1.61 cm) and (1.34 and 1.36 cm) in this respect respectively.The present results were in general agreement with those were reported by **Taleb, (2014)** showed that Ethephonat 3000 ppm increased the fruit length of olive fruits.

For the GA_3 **Abdrabboh, (2013)** clearly showed that spraying Manzanillo olive trees with GA_3, 10 days after fruit set at 50 or 75 ppm significantly increased fruit length in comparison to those of control treatment.

Table (4): Effect of some growth regulators and antioxidant treatments on fruit length, width and shape index (L/W) of 'Picual' olive trees during 2011 and 2012 seasons.

	Fruit length (cm)					Fruit diameter (cm)					Fruit shape index (W)/(L				
	Control	**C. cyminum**	**H. sabdariff**	**Z. officinal**	**Mean**	**Control**	**C. cyminu**	**H. sabdariff**	**Z. officinale**	**Mean**	**Control**	**C. cyminu**	**H. sabdariff**	**Z. officinal**	**Mean**
							Season I (2011)								
Control	2.07 h	2.29 f	2.15 g	2.16 g	2.16	1.04 h	1.62 de	1.45 e	1.34 f	1.36	1.86 ab	1.41 cde	1.48 cd	1.61 bc	1.59
Ethephon	3.02 bcd	3.19 abc	3.24 ab	3.15 bc	3.15	1.99 cd	2.16 bc	2.34 b	2.12 bc	2.15	1.52 bcd	1.48 cd	1.44 cde	1.49 cd	1.48
NAA	2.07 h	2.49 e	2.91 cde	2.64 de	2.52	1.11 g	1.46 e	2.03 bcd	1.78 d	1.59	1.99 a	1.71 b	1.43 cde	1.48 cd	1.65
GA_3	2.89 cde	3.07 bcd	3.37 a	2.97 cd	3.07	1.97 cd	2.17 bc	2.56 a	2.46 ab	2.29	1.47 cd	1.41 cde	1.21 e	1.27 de	1.34
Mean	2.51	2.76	2.91	2.73		1.52	1.85	2.09	1.92		1.71	1.50	1.39	1.46	
							Season II (2012)								
Control	2.58 g	2.71 efg	2.87 ef	2.38 h	2.63	1.50 f	1.68 ef	1.84 e	1.35 g	1.59	1.66 ab	1.61 bc	1.56 c	1.76 a	1.64
Ethephon	3.24 bcd	3.22 bcd	3.31 b	3.21 cd	3.24	2.21 cd	2.19 cd	2.42 b	2.18 cd	2.25	1.47 cd	1.47 cd	1.43 cde	1.47 cd	1.46
NAA	2.37 h	2.67 fg	3.17 d	2.23 i	2.61	1.34 g	1.64 ef	2.14 d	1.84 e	1.74	1.77 a	1.63 abc	1.48 cd	1.21 e	1.52
GA_3	3.00 e	3.25 bcd	3.45 a	3.29 bc	3.24	2.23 c	2.22 c	2.83 a	2.26 c	2.38	1.35 de	1.46 cd	1.17 e	1.46 cd	1.36
Mean	2.79	2.67	3.20	2.77		1.82	1.93	2.30	1.90		1.56	1.54	1.41	1.47	

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.

Concerning, the specific effect of antioxidant applications, data in Table (4) indicate that sprayed trees with H. sabdariffa extract induced the highest values of fruit length and width followed by C. cyminum, but Z. officinal recorded the highest values of shape index in both seasons.

While, untreated trees gave the lowest during all study seasons. These results are similar to those obtained by **Wang *et al.*, (2009)** on the yield and quality of waxberry, cherry and peach cv. Yanhong.

Regarding, the interaction effect between growth regulators sources and antioxidant applications, Table (4) reveals that, the highest values of fruit length, width and shape index in both seasons were found with the interaction effect between GA_3 with H.sabdariffa extract.

While, the least ones came from control groups in two seasons.

Fruit weight, volume and flesh thickness:

Concerning, the specific effect of growth regulators sources, data in Table (5) shows that Ethephon provide to be the most effective treatment on fruit weight, volume and flesh thickness in both seasons. On the other hand, untreated trees (control) gave the least ones.

Similar observations were reported by **Taleb, (2014)** showed that Ethephon at 3000 ppm increased the fruit weight of olive fruits. As for the specific effect of antioxidant applications, the Table (5) clears that H. sabdariffa gave the significant increase fruit weight, volume and flesh thickness followed by Z. officinal in both seasons. While, the untreated tress gave the least ones in this respect. This pattern is similar to that reported by **Dina Khalil (2013)** who found that treated Earli Grande peach treated with H. sabdariffa gave the highest values of fruit weight as antioxidant resource.

With regard to the interaction effect between growth regulators sources and antioxidant applications, Table (5) reveals that trees treated with Ethephon and sprayed with H. sabdariffa extract gave the highest values of fruit weight, volume and flesh thickness in both seasons. While, untreated trees gave the least ones in fruit weight in 2011 and 2012 seasons.

Flesh weight, Stone weight and Flesh: stone ratio:

Data in Table (6) shows that Ethephon proved the highest flesh weight, stone weight and flesh: stone ratio in both seasons. On the other hand, GA_3 treatment gave the least ones.

This results agreement with **Abd El-Razek *et. al.*, (2013)** who found that treated olive trees by GA_3 treatment at 50 and 100 ppm concentration significantly increased flesh weight than the control groups.The Table (6) clears that the H.sabdariffa extract gave the highest flesh weight and Flesh: stone ratio followed by Z. officinale.

While, the highest values in stone weight were observed in C. cyminum in both seasons. In the contrary, the untreated tress gave the least ones in the study seasons. This results agreement with **Dina Khalil (2013)** who found that the H.sabdariffa treatment gave the highest values of flesh thickness in EarliGrande Peach during the study periods. Regarding to the interaction effect between growth regulators sources and antioxidant applications, Table (6) reveals that in both seasons trees treated with Ethephon and sprayed with H. sabdariffa extract gave the highest values of flesh weight, stone weight and flesh: stone in both seasons.While, untreated trees gave the least ones in fruit weight in both study seasons.

Table (5): Effect of some growth regulators and antioxidant treatments on fruit weight, volume and flesh thickness of 'Picual' olive trees during 2011 and 2012 seasons.

	Fruit weight (g)					Fruit volume (ml)					Flesh thickness (cm)				
	Control	C. cyminum	H. sabdariffa	Z. officinale	Mean	Control	C. cyminum	H. sabdariffa	Z. officinale	Mean	Control	C. cyminum	H. sabdariffa	Z. officinale	Mean
Season I (2011)															
Control	2.26 c	2.76 bc	2.44 c	3.27 abc	2.68	2.83b	3.00 b	3.33 ab	3.50 ab	3.16	0.26c	0.31b	0.38ab	0.39ab	0.33
Ethephon	3.56 abc	3.47 abc	4.98 a	4.10 abc	4.02	2.99 b	3.70 ab	4.66 a	4.00 ab	3.83	0.38 ab	0.38 ab	0.50a	0.41ab	0.41
NAA	2.98 abc	3.49 abc	3.63 abc	3.72 abc	3.45	2.83 b	2.93 b	2.33 bc	2.10 c	2.54	0.27c	0.38ab	0.36b	0.39ab	0.35
GA_3	2.76 abc	2.87 abc	4.88 ab	4.89 ab	3.85	2.36 bc	2.83 b	3.43 ab	2.83 b	2.86	0.31b	0.29b	0.39ab	0.30b	0.32
Mean	2.89	3.14	3.98	3.99		2.75	3.11	3.43	3.10		0.30	0.34	0.40	0.37	
Season II (2012)															
Control	3.33 d	3.78 bcd	3.61 dc	5.18 bcd	3.97	5.50 abc	4.50 abc	5.20 abc	5.16 abc	5.07	0.37 c	0.41bc	0.49abc	0.47bc	0.43
Ethephon	3.93 bcd	5.18 abcd	6.89 a	5.81 abcd	5.45	5.66 ab	5.86 ab	6.50 a	5.66 ab	5.92	0.46bc	0.57ab	0.69a	0.50abc	0.55
NAA	4.70 abcd	6.15 ab	4.52 abcd	3.64 dc	4.75	4.36 abc	4.36 abc	4.20 abc	2.90 c	3.95	0.42bc	0.48abc	0.45bc	0.42bc	0.44
GA_3	4.62 abcd	5.12 abcd	5.77 abcd	6.09 abc	5.40	3.70 bc	4.33 abc	5.33abc	4.86 abc	4.55	0.51abc	0.43bc	0.46bc	0.43bc	0.45
Mean	4.14	5.05	5.19	5.18		4.80	4.76	5.30	4.64		0.44	0.47	0.52	0.45	

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.

Table (6): Effect of some growth regulators and antioxidant treatments on flesh and stone parameters of 'Picual' olive fruits during 2011 and 2012 seasons.

	Flesh weight (g)					Seed weight (g)					Flesh /Seed Ratio				
	Control	C. cyminum	H. sabdariffa	Z. officinale	Mean	Control	C. cyminum	H. sabdariffa	Z. officinale	Mean	Control	C. cyminum	H. sabdariffa	Z. officinale	Mean
							Season I (2011)								
Control	1.65 c	2.27 b	2.62 ab	3.11ab	2.41	0.60c	0.92ab	0.74bc	0.79abc	0.76	2.26 d	2.47 cd	3.54 bc	3.94 ab	3.05
Ethephon	1.72 bc	3.17 ab	3.93 a	2.89 ab	2.92	0.76bc	0.79abc	1.01a	0.72bc	0.82	2.75 cd	4.01 a	3.89 abc	4.01 a	3.66
NAA	2.31 b	1.98 b	2.80 ab	2.56 ab	2.41	0.66bc	0.72bc	0.72bc	0.70bc	0.70	3.50 bc	2.75 cd	3.89 abc	3.66 bc	3.45
GA_3	2.02 b	2.19 b	2.54 ab	2.01 b	2.23	0.73bc	0.68bc	0.63c	0.69bc	0.68	2.77 cd	3.22 bcd	4.03 a	2.91 cd	3.23
Mean	1.92	2.40	2.97	2.64		0.68	0.77	0.70	0.72		2.82	3.11	3.83	3.63	
							Season II (2012)								
Control	2.52 c	4.03 abc	4.63 abc	4.26 abc	3.83	0.72d	0.98abcd	1.09abc	0.91abcd	0.92	2.97 g	4.11 cd	4.25 bcd	4.68 bc	4.00
Ethephon	3.10 bc	4.14 abc	5.73 a	4.82 ab	4.44	0.82bcd	1.04abcd	1.13a	0.80dc	0.94	3.78 def	3.98 cde	5.07 b	6.03 a	4.71
NAA	3.80 abc	5.02 ab	3.58 abc	2.91 bc	3.82	0.90abcd	1.12ab	0.93abcd	0.98abcd	0.98	4.22 bcd	4.48 bc	3.85 de	3.50 ef	4.01
GA_3	3.64 abc	2.85 bc	2.80 bc	5.09 ab	3.59	1.16a	0.92abcd	0.81cd	1.00abcd	0.87	3.14 f	3.10 f	3.46 ef	5.09 b	3.69
Mean	3.26	3.26	4.18	4.27		0.60	1.01	0.99	0.92		3.52	3.91	4.15	4.82	

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.

Table (7): Effect of some growth regulators and antioxidant treatments on some physical and chemical properties of 'Picual' olive fruits during 2011 and 2012 seasons.

	Fruit moisture percentage					Fruit oil percentage (on fresh weight basis)					Acid percentage				
	Control	C. cyminum	H. sabdariff	Z. officinal	Mean	Control	C. cyminum	H. sabdariff	Z. officinale	Mean	Control	C. cyminum	H. sabdariff	Z. officinal	Mean
Season I (2011)															
Control	68.85	65.6	60.2	61.2	63.	18.1	19.99 c	19.34	19.1	19.	0.9	0.95	0.92 a	0.81 b	0.91
Ethephon	59.2	66.27	69.65	67.91 b	65.	18.6	21.18 a	19.1	20.89 ab	19.	0.9	0.80 b	0.64	0.86 ab	0.82
NAA	58.1	63.11	66.46	69.47 a	64.	19.80 c	21.7	20.30 b	21.51	20.	0.95	0.81 b	0.76	0.75	0.72
GA_3	63.04	68.78	71.1	68.77	67.	18.1	21.15 a	19.21	20.22 bc	19.	0.92 a	0.6	0.68 c	0.65	0.71
Mean	62.	65.	66.	66.		18.	21.	19.	20.		0.	0.	0.	0.	
Season II (2012)															
Control	62.98	67.25 c	70.39 b	67.32 c	66.9	16.64	19.33 c	17.16	18.85 d	17.9	0.98	0.92 ab	0.89 bc	0.84	0.90
Ethephon	68.39	72.65 a	70.98 b	65.77 d	69.4	18.85 d	20.54	18.40 de	19.87 bc	19.1	0.96 a	0.79 de	0.68 f	0.87 c	0.82
NAA	72.56 a	71.44 ab	77.37	68.38	72.5	16.99	21.84	19.81 bc	20.30 b	19.7	0.93 ab	0.85	0.83 d	0.72 e	0.83
GA_3	67.11 cd	72.12 a	78.79	77.52	73.8	18.34	19.18	17.99	19.22	18.6	0.90 abc	0.65	0.71	0.70 ef	0.74
Mean	67.7	70.8	74.5	69.7		17.7	20.2	18.3	19.5		0.9	0.8	0.7	0.7	

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 moisture and oil contents:

Regarding the specific effect of growth regulators, data in Table (7) show that treated trees with GA_3 had the highest values of fruit moisture content (67.93 and 73.89 %), while NAA had the highest values of fruit oil content (20.83 and 20.83 %) in both seasons. On the other hands, untreated trees (control) gave the least ones.

These results were in agreement with those obtained by **Saad El-Din** ***et al.,*** **(2010) and Khalil** ***et al.,*** **(2012).**

Concerning, specific effect of antioxidant applications, the same table shows that, the highest values of fruit moisture content were found with H.sabdariffa extract (66.86 and 74.38 %), butoil content were found with C. cyminum extract (21.01 and 20.22 %). On the other hands, untreated trees (control) gave the least ones in this concern.

Regarding, the interaction effect between growth regulators and antioxidant applications,Table (7) shows that theinteraction effect between GA_3 and sprayed with H.sabdariffa extract, gave the highest values of fruit moisture (71.14 and 78.79 %) content , but NAA and sprayed with C. cyminum extract, gave the highest values of oil content (21.72 and 21.84 %) in both seasons. While, the least ones were given in control groups, the other treatment came in between.

Acidity value:

Regarding the specific effect of growth regulators, data in Table (7) show that untreated trees had the highest acid value in both seasons (0.92 and 0.91 %). On the other hands, trees treated with GA_3 gave the least ones (0.72and 0.74 %) in both seasons. The significant decrease in total fruit acidity could be attributed to the promotion occurred in fruit maturity, whereas the fruit ripened earlier than those of control trees **(Hifnyet al.,2009).**

This result agreed with those of **Abdrabboh, (2013)** who found that spraying Manzanillo olive trees 10 days after fruit set with GA_3 and/or NAA either individually or in combinations at all tested concentrations resulted a decrease in total acidity percentage in comparison with control group. Concerning, specific effect of antioxidant applications, the same data in Table (7) shows that, the highest acid value were found with untreated trees (0.96 and 0.94 %) during all seasons. On the other hands, trees sprayed with H. sabdariffa gave the least ones (0.75 and 0.78 %) in this concern.

Regarding, The interaction effect between growth regulators and antioxidant applications, Table (7) shows that the control group gave the highest acid value (0.98 and 0.98 %) in both seasons. While, the least ones (0.61 and 0.65 %) were given with the interaction between GA_3 and sprayed with C. cyminum extract in both seasons.

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الملخص العربى

دراسات على بعض المعاملات لتحسين إنتاجية ثمار الزيتون "البيكوال" و جودة ثمار

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أجريت الدراسة بمزرعة خاصة بمنطقة مطار العريش - مركز العريش، محافظة شمال سيناء، خلال موسمي ٢٠١١، ٢٠١٢ على أشجار الزيتون صنف بيكول عمر ٢١ عام والمنزرعة في تربة رملية على مسافات ٥ × ٦ م تحت نظام الري بالتنقيط بهدف دراسة تأثير ثلاثة من منظمات النمو (حامض الجبريلك بتركيز٧٥ جزء في المليون - ونفثالين حمض الخليك بتركيز١٥٠ جزء فى المليون والأثيفون بتركيز٥٠جزء فى المليون)، وثلاثة من المستخلصات المائية لبعض النباتات والمحتوية على مضادات أكسدة (الكركدية، الكمون، الجنزبيل) بالإضافة إلى معاملة الكنترول والتداخل فيما بينها على المحتوى المعدني للأوراق من النيتروجين والفسفور والبوتاسيوم، والمحصول و صفات جودة الثمار وانتاج الزيت. تم رش منظمات النمو فى اخر شهر فبراير، وقبل شهر من بداية التزهير، بينما تم رش مضادات الأكسدة على ثلاث مراحل بعد العقد حتى ما قبل الحصاد. وتم استخدم تصميم القطاعات كاملة العشوائية تحت نظام المنشقة مرة واحدة في ثلاث مكررات كل مكررة ممثلة بشجرتين. اظهرت النتائج أن المعاملة بالأثيفون أو مستخلص الكمون أدى الى الحصول على اعلى قيمة من محتوى الاوراق من الفسفور والبوتاسيوم خلال الموسمين، بينما اظهرت المعاملة بمستخلص الزنجبيل الى زيادة مستوى النيتروجين فى الاوراق بالمقارنة بباقي المعاملات خلال موسمي الدراسة. وسجلت اشجار الزيتون المعاملة بحامض الجبريلك أو الرش بمستخلص الكركدية اعلى إنتاج لمحصول الثمار والزيت بالمقارنة بباقي المعاملات. كما أوضحت النتائج أن المعاملة بالاثيفون أو الرش بمستخلص الكركدية أعطت زيادة معنوية مع كل الصفات الطبيعية للثمار (طول الثمرة، حجم الثمرة وزنها، وزن اللحم، سمك اللحم، وزن البذرة). بينما حامض الجبريلك زيادة في عرض الثمار خلال موسمي الدراسة.

أوضحت النتائج أن المعاملة بحامض الجبريلك أعطت زيادة معنوية فى المحتوى الرطوبي والحموضة للثمار مقارنة بباقي المعاملات خلال موسمي الدراسة. بينما أعطى نفتالين حامض الخليك اعلى محتوى للثمار من الزيت خلال موسمي الدراسة. كما أظهرت النتائج أن المعاملة بمستخلص الكركدية أعطى اعلى النتائج في المحتوى الرطوبي. بينما أدت المعاملة بمستخلص الكمون الى زيادة محتوى الثمار من الزيت خلال موسمي الدراسة. فى حين اعطت الاشجار الغير معاملة باى من مضادات الاكسدة الى زيادة محتوى الثمار من الحموضة خلال موسمي الدراسة. يمكن التوصية من خلال نتائج التجربة برش أشجار الزيتون البيكوال بمستخلص الكركدية تحت ظروف شمال سيناء مع الرش بحامض الجبريلك للحصول على أفضل محتوي معدني للأوراق من النيتروجين والفسفور والبوتاسيوم، ومحصول الثمار والزيت وجودة الثمار.

الكلمات الاسترشادية: الإنتاجية ، صنف بيكوال، جودة الثمار، حامض الجبريلك، حامض الخليك، الاثيفون.

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