Effect of Foliar Application with Chitosan and Amino Acids on Growth, Flowering, Yield and Fruit Quality of Aggizi Olive Trees Under Qena Governorate Conditions

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ABSTRACT

This investigation was conducted on 10- year- old Aggizi olive trees grown in a private orchard located at Qena Valley, Qena Governorate aiming to study the effect of foliar applications of chitosan and amino acids on growth, leaf mineral composition, yield and fruit quality during the 2019 and 2020 seasons. The beneficial effects of spraying chitosan and amino acids on growth and productivity of Aggizi olive trees under winter warm climate and hot summer in Qena Governorate, were investigated. This experiment was designed and arranged in a complete randomized block design with four replicates per treatment, one Aggizi olive tree per each. The results indicated that all treatments were effective on enhancing vegetative growth, leaf minerals content and improving the yield and fruit quality of Aggizi olive trees comparing with checked treatment. The superior treatment regarding the improvement of vegetative growth, leaf nitrogen, phosphorus and potassium contents, flowering traits, yield (Kg/tree) and fruit quality were obtained with spraying chitosan 1 % + amino acids 2 % in both seasons.

It can be concluded that, foliar application of chitosan 1 % + amino acids 2% is useful in the improvement of vegetative growth, nutritional status of Aggizi olive trees and produced a high yield with good fruit quality under Qena Governorate conditions.

Key words: Olive trees - *Oleaeuropaea* – Chitosan - Amino acids– Yield.

INTRODUCTION

Olive (*Oleaeuropaea* L.) is an evergreen fruit belonging to Oleaceae family. It is considered one of the fruit crops traditionally grown in the Mediterranean region and one of the most important fruit crops in Egypt (Baldoni and Belaj, 2009). Olive trees have adapted to severe environmental conditions *i.e*. salinity and drought and successfully growing in arid and semi-arid areas (Dag et al., 2008; Guerfel et al., 2009). Olive cultivated area is gradually increasing and reached 257896 Feddans producing 1056548 tons according to the Ministry of Agriculture and Land Reclamation (2021).

Many olive cultivars are grown in the northern region of Egypt mainly for table use and oil extraction. Upper Egypt is characterized with harsh climate with warm winter and hot summer that is not expected to provide the thermal requirements for bud induction, flowering and acceptable fruit quality of the different olive cultivars (Ahmed-Zienab et al., 2019). Aggizi olive cultivar is considered one of the most important cvs. of table olives, which grows in large areas in the newly reclaimed soil as a result of its tolerance of soil conditions, climate, lack of water and the increase in demand for Aggizi olive fruits (Gowda, et al., 2011, Ahmed-Zienab et al., 2019).

Qena governorate, Egypt has a very hot climate in summer and worm in winter.There

is a wide range between day and night temperatures. High temperature during fruit development reduces some vital functions and leads to fruit wilting and a reduction in the size of the fruits (Lombardo et al., 2008). Warmer spring temperatures can result in lower fruit yields in the form of tree closing, reduced photosynthesis, flowers dropping and cause smaller fruit, lower yields and poor quality fruits (Pope, 2012 and Beppu and Kataoka, 2011).

Chitosan is an amino polysaccharide obtained by the alkaline deacetylation of chitin extracted from the exoskeleton of crustaceans such as shrimps and crabs, or the cell walls of some fungi (Dzung et al., 2011). It has interesting properties such as biocompatibility, non-toxicity, low allergenicity and biodegradability, allowing it to be used in various applications such as coating, preservative, antioxidant, antimicrobials and soil modifiers (Katiyar et al., 2015).

In addition, foliar sprays of chitosan have been shown to stimulate growth and improve yield and quality of many fruit crops (Cheung et al., 2015 and Shehata et al., 2012). Chitosan has been widely used to stimulate plant defense (Bautista-Baños et al., 2003). Moreover, plants treated with chitosan may be less susceptible to stress caused by unfavorable conditions, such as drought, salinity, low or high temperature as well as reduce transpiration and formation of reactive oxygen species (ROS) and protect plants from senescence (Park et al., 2004;Lizarraga-Pauli et al., 2011; Jabeen and Ahmad, 2013, Ahmed et al., 2016, Esraa Hussein, 2017).

Chitosan stimulates the vital processes of plants at every level of biological organization, from single cells and tissues, through physiological and biochemical processes, to changes at the molecular level related to expression of genes (Limpanavech et al., 2008, Hadwiger, 2013; Nguyen Van et al., 2013).

Amino acids, as organic nitrogenous compounds, are the building blocks in the synthesis of proteins (Davies, 1982). The role of amino acids as a source for IAA synthesis in plants (Hashimoto and Yamada, 1994 and Rai, 2002). Waller and Nowaki (1978) reported that some amino acids such as phenylalanine and ornithine have a regulatory effect on plant growth through their effects on plant hormones which play a vital role in the regulation of plant growth, development and responses to environmental conditions(O'Brien and Benková, 2013).

Therefore, the present study aimed to study the response of Aggizi olive cultivar grown under Qena Governorate conditions to foliar application with Chitosan and amino acids.

MATERIALS AND METHODS

The present study was conducted through two successive seasons 2019 and 2020 in a private orchard located at Qena valley, Qena governorate, Egypt. Experimental trees used for the current investigation were 10-years- old olive trees cv. Aggizi, propagated from leafy cuttings, planted at 5 x 5 meters, in sandy loam soil and irrigated with a drip irrigation system, each tree has four dippers and irrigated with well water.

The chemical and mechanical properties of soil are presented in Table (1).

Data of monthly air temperature and relative humidity of Qena governorate conditions as average during the two studied seasons are presented in Table (2).

Table (1). Analytical data of the studied soil of the experimental orchard.

Character	Value	Character	Value
Particle sizedistribution %			
Coarse sand	58.3	EC (mm/cm)	3.3
Fine sand	19.8	pH	7.9
Silt	12.9	organic matter%	0.70
Clay	10.0	$CaCo_3$	10.4
Soil texture	Sandy loam		
Soluble cationsmq/100g soil		**Soluble anions mq/100g soil**	
Ca^{2+}	0.41	Co_3	--
Mg2+	0.18	HCO_3	0.86
Na+	0.21	Cl	0.57
K+	0.12	SO_4	0.20
Available macronutrients %		**Available micronutrients ppm**	
N	0.46	Fe	1.11
P	0.12	Zn	1.09
K	0.41	Mn	1.67

Table (2): Monthly air temperature and relative humidity during 2019 and 2020 seasons.

	2019 season			2020 season		
Months	**T.min.**	**T.max.**	**RH**	**T.min.**	**T.max.**	**RH**
January	5.62	20.78	37.03	7.12	20.88	36.55
February	7.81	23.40	40.86	10.23	23.54	42.13
March	9.96	26.73	28.89	10.74	27.11	30.10
April	14.55	32.17	23.09	15.62	33.24	24.15
May	21.89	40.01	13.76	22.13	41.28	15.11
June	25.09	41.55	19.09	25.81	41.91	20.21
July	24.71	41.30	20.16	25.11	41.85	20.44
August	24.84	40.96	22.11	24.13	41.12	25.13
September	21.85	38.72	26.63	20.18	39.23	27.42
October	20.48	36.12	29.12	20.02	36.87	30.12
November	14.95	30.08	37.71	15.21	30.11	37.69
December	8.14	23.29	49.12	8.43	22.45	49.75

T.min.: Temperature minimum. **T.max.**: Temperature maximum.
RH: Relative Humidity.

Olive trees under study were selected at random after harvesting in October 2018 to carry out the treatments during the two successive seasons. The selected trees were almost uniform, in their vigor growth, free from pathological and physiological disorders and all received the same horticulture management (irrigation, fertilization, weeds, pests and disease control usually applied in the orchard except for the foliar application of Chitosan and amino acids).

Treatments

T1.Control (spraying trees with water).
T2.Spraying trees with Chitosan 0.5 %
T3.Spraying trees with Chitosan 1.0 %
T4.Spraying trees with amino acids 1 %
T5.Spraying trees with amino acids 2 %
T6.Spraying trees with Chitosan 0.5 % + amino acids 1 %

T7. Spraying trees with Chitosan 0.5 % + amino acids 2 %
T8. Spraying trees with Chitosan 1.0 % + amino acids 1 %
T9. Spraying trees with Chitosan 1.0 % + amino acids 2 %

Preparation of chitosan – based solutions

Chitosan solution at 2% (w/v) was prepared by dissolving 0.5 g of chitosan in glacial acetic acid (v/v) under keep stirring and adjusting the pH solution to 5.6. The prepared solution was then sterilised at 121°C for 20 min. After cooling, different concentrations of {0.5 and 1 % (v/v)} were prepared from the sterilised chitosan stock solution (Du et al., 1997).

Aminoacids compound was (AminoLybra R) every 100 ml of the solution contains 13.5 g free amino acids and prepared by adding 1 or 2 %. This compound contains (w/v) 2.5 % Proline, 1.5 % Glycine, 2.5 % Tryptophan, 2 % Valine, 1.5 % Cysteine and 1.5 % Phenylalanine; super film at 0.1% was added to the spraying solution.

The experiment followed a complete randomized block design on 36 trees as nine treatments were applied with four replicates per each treatment; each tree was considered a replicate. All spraying treatments were carried out three different times, *i.e.*, the first one two weeks before flowering, the second one after the final fruit set and the third one month after fruit set.

In early March of each season, twenty healthy one year old shoots well distributed around the tree canopy were randomly selected and labelled, for carrying out the following measurement:

I. Vegetative growth:

The following growth measurements were recorded at the end of each growing studied season during the first week of September:

1. Shoots lengths (cm).
2. Number of new shoots/twig.
3. Leaf area (cm^2) according to the following equilibration = 0.53 (length× width) +1.66. (Ahmed and Morsy, 1999).

II. Flowering characteristics

1. **Total number of flowers/inflorescence:** A sample of twenty inflorescences for each tree was collected and the total number of flowers for each inflorescence was counted.
2. **Flowering density**: the average number of inflorescences per shoot was recorded and calculated the number of inflorescences per meter**.**

Flowering density = No. of inflorescences x 100/shoot length (cm)

3. **Percentage of perfect flowers/inflorescence:** Twenty inflorescences from each tree were collected from the middle parts of shoots in the balloon stage. The number of perfect and total flowers on each inflorescence was recorded and % of perfect flowers was calculated.

The perfect flowers (%) = No. of perfect flowers/No. of total flowers × 100

III. Fruit set and yield:

1- **Fruit set percentage:** the initial fruit set % was calculated after 20 days from full bloom and the final fruit set % was calculated after 60 days from full bloom according to Fernandez and Gomez (1985).

Initial fruit set (%) = {total number of fruitlet/shoot} × 100/total number of flowers/shoot).

Final fruit set (%) = {total number of fruitlet/ shoot} × 100/total number of flowers/shoot).

2- **Yield:** Average yield per tree was calculated from each treatment as kg/tree.

IV. Fruit quality

Fruits were randomly harvested at the end of August in 2019 and 2020 seasons. Fifty fruits per tree were randomly selected and used to determine the following fruit quality characteristics according to A.O.A.C (1995).

1- Fruit dimensions (fruit length (cm), fruit diameter (cm) and fruit shape (L/D).
2- Fruit weight (g).
3- Flesh weight (g).
4- Seed weight (g).
5- Flesh/fruit weight ratio.

Flesh/fruit weight (%) =flesh weight (g)/fruit weight × 100

6- Fruit moisture content % determined by drying the flesh in an oven at 60-80°C until a constant weight according to A.O.A.C. (1995).
7- Fruit oil content (%) was determined by extracting the oil from the dried fruits with Soxlet apparatus using Hexan of 60- 80°C boiling point as described by A.O.A.C. (1995).

V. Leaf mineral content:

Leaves samples were randomly taken during the first week of September of each growing season from the middle part of the shoot (Piper, 1950). It was cleaned, washed several times and air dried. Leaves sample were dried at 70°C till constant weight. The finely ground sample as the known weight of the dry leaves was digested using an acid mixture consisting of perchloric and sulfuric acids in the ratio of 4:1 (v/v) to determinate the leaves N, P and K % as follows:

1. **Nitrogenpercentage** was determined using the modified micro Kjeldahl method as lined by (Black, et al., 1965**)**.
2. **Phosphorous percentage** was estimated by spectrophotometer as described by Chapman and Pratt (1978).
3. **Potassium percentage** was determined by flame- photometer according to Brown and Lilleland (1946).

VI. General evaluation of the tested treatments:

Scoring evaluation of studied treatments were estimated on the standard of 100 units that were shared though some measurements of the vegetative growth, flowering, final fruit set, yield and fruit quality. Hundred units were divided among the studied treatments 30 units for vegetative growth (shoot length, number of shoots/twig and leaf area), 30 units for the flowering, fruit set and yield (flowering density, final fruit set and yield/tree), and 40 units for fruit quality and leaf nitrogen content (fruit weight, flesh weight, fruit oil content in dry weight and leaf nitrogen content) 10 units for each. Within each of these traits, the trait was registered the maximum values given 10 units for it. Relative values due to the other tested treatments were calculated. The following equation was used to estimate these traits.

$$\text{Trait} = \sum \frac{B}{A} \text{ x10}$$

Where:A=The highest values recorded for studied traits.
B= Value recorded for the specific trait of considered treatments.

Statistical Analysis:

The obtained data were subjected to analysis of variance (ANOVA) according to (**Snedecor and Cochran 1967**) using the MSTAT program. Differences between treatments were compared according to **Duncan (1955)** at the probability of 5%.

RESULTS AND DISCUSSIONS

I. Vegetative Growth:

Data in Table (3) showed the effect of chitosan and amino acids on vegetative growth parameters of Aggizi olive treesunder Qena governorate conditions in 2019 and 2020 seasons. Results revealed that chitosan and amino acids significantly improves the shoot length, number of shoots/twig and leaf area in both seasons as compared with the control treatment. The highest values of shoot length were (40.78 and 41.51 cm), number of branches/twig (5.5 and 6.10) and leaf area (5.09 and 5.12 cm^2) were obtained for Aggizi olive trees sprayed with chitosan at 1% + amino acids at 2% (T9) through the two studied seasons, respectively. On the other

hand, the least ones were recorded for the control treatment during the two studied seasons.No significant differences were found in shoot length, number of shoots / twig and leaf area due to spray with chitosan and free amino acids (T7, T8 and T9).Therefore, spraying of chitosan and amino acids significantly increased the total leaf surface area and vegetative growth of Aggizi olive trees as well as reduced the adverse effects of heat stress under the environmental conditions of Qena Governorate, consequently.

Table (3).Effect of Chitosan and amino acids on vegetative growth parameters of Aggizi olive treesin 2019 and 2020 seasons.

Treatments	Shoot length (cm)		Number of branches/ twig		Leaf area (cm^2)	
	2019	2020	2019	2020	2019	2020
T1: Control.	24.50F	26.73D	2.1B	2.5B	4.02D	4.11C
T2: Chitosan 0.5 %.	29.42E	31.11C	2.5B	2.3B	4.21CD	4.30BC
T3: Chitosan 1.0 %.	35.61CD	38.76B	2.8B	2.7B	4.34B-D	4.41BC
T4: Amino acids 1 %.	30.79E	30.91C	2.2B	2.3B	4.38 B-D	4.42BC
T5: Amino acids 2 %.	33.81D	33.20C	2.4B	2.4B	4.42B-D	4.51A-C
T6: Chitosan 0.5 % + amino acids 1 %.	37.61BC	38.84B	4.8A	5.2A	4.82A-C	4.80AB
T7: Chitosan 0.5 % + amino acids 2 %.	39.22AB	40.07A	5.0A	5.2A	4.88AB	4.90AB
T8: Chitosan 1.0 % + amino acids 1 %.	40.11AB	41.39A	5.4A	5.8A	4.96AB	4.90AB
T9: Chitosan 1.0 % + amino acids 2%.	40.78A	41.51A	5.5A	6.10A	5.09A	5.12A

Values within each column followed by different letters are significantly different at $p < 0.05$ according to the Duncan's multiple range tests.

II. Flowering characteristics:

Data represented in Table (4) showed the effect of chitosan and amino acids on flowering characteristics of Aggizi olive trees (total number of flowers/inflorescence, flowering density and perfect flowers %) during 2019 and 2020 seasons. Data showed that all spraying treatments significantly increased these traits compared to the untreated control. The maximum value of number of total flowers/inflorescence (22.11 and 20.85), flowering density (49.21 and 50.61) and perfect flowers % (60.02 and 61.11 %) in 2019 and 2020 seasons, respectively were recorded for spray with Chitosan 1 % and amino acids 2 % (T9), whereas, the differences between the (T 8) and (T 9) were not significant in both seasons. In the contrary; the control treatment gave the least values of all the studied flowering characteristics.

III. Fruit set percentage and yield (kg/tree):

Regarding the fruit set, data in Table (5) reveled that all spraying treatments increased initial fruit set and final fruit set percentages in compared to control treatment in both seasons. Initial fruit set percentage was significantly affected with spraying different treatments in both seasons. Chitosan 1 % and amino acids 2 % (T 9) recorded the highest initial fruit set percentages (41.56 and 42.16 %), followed byChitosan 1 % and amino acids 1 % T 8 (41.31 and 41.68 %) in both seasons, respectively. While, control treatment gave the lowest values (30.24 and 31.02 %) in this respect, in both seasons, respectively. No significance differences appeared between the treatments(T 9), (T 8) and (T 7) in both seasons. As for final fruit set, data presented in Table, (5) showed that all used compounds significantly increased final fruit set compared with the control treatment. The maximum values (6.23 and 6.42 %) were recorded on the Aggizi olive trees that received Chitosan 1 % and amino acids 2 % (T 9), the untreated trees gave the lowest values in this respect. No significant differences were observed among between T

6, T 7, T 8, T 9 in 2019 and 2020 seasons. Concerning the yield (kg/tree), data in table (5) indicated that all treatments were statistically increased tree yield (kg/tree) compared with the control treatment in the two seasons. Chitosan 1% + amino acids 2 % treatment (T 9) gave the highest yield (24.11 and 25.80 kg/ tree), followed by Chitosan 1 % + amino acids 1 % treatment (T 8) (22.82 and 23.22 kg/tree) in both seasons, respectively. Control treatment gave the lowest yield (18.21 and 20.41 kg/tree) in both seasons.Hence the corresponding increment percentages for the highest yield (T 9 and T 8) over control treatment were (32.40 & 26.41 %) and (25.32 & 16.81 %), in both seasons respectively.

Table (4).Effect of Chitosan and amino acids on flowering characteristics of Aggizi olive trees in 2019 and 2020 seasons.

Treatments	Total number of flowers/ infl.		Flowering density		Perfect flowers (%)	
	2019	2020	2019	2020	2019	2020
T1: Control.	14.81E	13.20D	35.23D	36.11D	44.20E	46.80C
T2: Chitosan 0.5 %.	16.66C-E	17.81BC	36.88CD	38.24CD	47.56D	47.10C
T3: Chitosan 1.0 %.	17.88B-D	19.20AB	39.28C	40.13C	47.12D	48.63C
T4: Amino acids 1 %.	15.81DE	16.24C	35.84D	36.24D	41.93E	42.16D
T5: Amino acids 2 %.	16.88C-E	17.70BC	37.70CD	38.91C	43.36E	42.01D
T6: Chitosan 0.5 % + amino acids 1 %.	18.20B-D	17.90BC	45.88B	46.61B	54.02C	55.10B
T7: Chitosan 0.5 % + amino acids 2 %.	18.63BC	18.82AB	46.89AB	46.55B	55.67BC	56.08B
T8: Chitosan 1.0 % + amino acids 1 %.	19.89AB	20.12AB	48.19AB	49.20A	57.98AB	59.20A
T9: Chitosan 1.0 % + amino acids 2%.	22.11A	20.85A	49.21A	50.61A	60.02A	61.11A

Values within each column followed by different letters are significantly different at $p < 0.05$ according to the Duncan's multiple range tests.

Table (5).Effect of Chitosan and amino acids on initial, final fruit set percentages and yield of Aggizi olive treesin 2019 and 2020 seasons.

Treatments	Initial fruit set (%)		Final fruit set (%)		Yield (kg / tree)		Yield increment (%)	
	2019	2020	2019	2020	2019	2020	2019	2020
T1: Control.	30.24E	31.02D	3.89D	4.01C	18.21F	20.41E	0.00I	0.00G
T2: Chitosan 0.5 %.	33.45DE	32.11D	4.78BC	5.21B	19.22EF	21.12DE	5.55H	3.48F
T3: Chitosan 1.0 %.	36.92BC	36.02BC	4.61BC	4.89B	20.85D-F	21.95CD	14.50E	7.55E
T4: Amino acids 1 %.	32.00E	30.81D	4.22CD	4.62B	19.56C	21.11DE	7.41G	3.43F
T5: Amino acids 2 %.	35.57CD	34.21CD	5.09B	5.25B	20.48C-E	21.98CD	12.47F	7.69E
T6: Chitosan 0.5 % + amino acids 1%.	38.63A-C	38.86AB	5.72A	6.01A	21.13B-D	22.77BC	16.04D	11.56D
T7: Chitosan 0.5 % + amino acids 2%.	40.11AB	39.22AB	5.93A	6.00A	22.14BC	23.22BC	21.50C	13.77C
T8: Chitosan 1.0 % + amino acids 1%.	41.31A	41.68A	6.12A	6.27A	22.82AB	23.84B	25.32B	16.81B
T9: Chitosan 1.0 % + amino acids 2%.	41.56A	42.16A	6.23A	6.42A	24.11A	25.80A	32.40A	26.41A

Values within each column followed by different letters are significantly different at $p < 0.05$ according to the Duncan's multiple range tests.

IV. Fruit quality:-

1- Fruit Dimensions

Data in Table (6) show the effect of chitosan and amino acids on fruit dimensions; fruit length (cm), fruit diameter (cm) and fruit shape index (L/D) of Aggizi olive trees during 2019 and 2020 seasons. Generally, data indicated that all spraying treatments significantly increased these traits compared to the control. The maximum value of fruit length (2.83 and 2.87 cm), fruit diameter (2.25 and 2.26 cm) and fruit shape index (1.26 and 1.28) were recorded due to spray with Chitosan 1 % + amino acids 2 % (T 9) in both seasons respectively. In the contrary, the control treatment gave the minimum values of

all the studied fruit dimensions traits in both seasons.

2- Fruit weight (g)

Data presented in Table (7) indicated that spraying chitosan and amino acids significantly increased the fruit weight of Aggizi olive trees compared to the control treatment, chitosan 1 % + amino acids 2 % (T 9) recorded the maximum values of fruit weight (8.71 and 9.95) followed by spraying chitosan 1 % + amino acids 1 % (T 8). On the other hand, the least values of fruit weight were recorded for untreated trees in both seasons.

3- Flesh weight, seed weight (g) and flesh/fruit weight ratio.

Data presented in Table (7) indicated that the effect of chitosan and amino acids on Aggizi olive trees during 2019 and 2020 seasons. It is obvious that, flesh weight and flesh percentage of Aggizi olive fruits were significantly increased when trees sprayed with chitosan and amino acids in both seasons. The highest values in this concern, were 7.66 and 8.92 for flesh weight, and 87.94 and 89.65 % for flesh/fruit weight (%) when spraying the trees with chitosan 1 % + amino acids 2 % (T 9) in 2019 and 2020 seasons, respectively. While, spraying with chitosan 1 % + amino acids 1 % (T 8) came in the 2nd rank in both seasons. Contrary, the least values of these traits were recorded in untreated Aggizi olive trees. Regarding the effect on seed weight, the differences weren't significant between treatments in both seasons.

Table (6).Effect of Chitosan and amino acids on fruit length(cm), fruit diameter (cm) and fruit shape index (L/D) of Aggizi olive treesin 2019 and 2020 seasons.

Treatments	Fruit length (cm)		Fruit diameter (cm)		Fruit shape index (L/D)	
	2019	2020	2019	2020	2019	2020
T1: Control.	2.41F	2.40 G	2.08C	2.09B	1.16F	1.15F
T2: Chitosan 0.5 %.	2.52E	2.51F	2.14B	2.15AB	1.18E	1.17EF
T3: Chitosan 1.0 %.	2.62D	2.63D	2.17B	2.19AB	1.21CD	1.20CD
T4: Amino acids 1 %.	2.60D	2.59E	2.17B	2.18AB	1.20D	1.19DE
T5: Amino acids 2 %.	2.73 C	2.70C	2.22A	2.21AB	1.23BC	1.22BC
T6: Chitosan 0.5 % + amino acids 1%.	2.74BC	2.70C	2.23A	2.22A	1.23BC	1.22BC
T7: Chitosan 0.5 % + amino acids 2%.	2.75BC	2.76B	2.24A	2.23A	1.23BC	1.24B
T8: Chitosan 1.0 % + amino acids 1%.	2.78B	2.87A	2.24A	2.25A	1.24B	1.28A
T9: Chitosan 1.0 % + amino acids 2%.	2.83A	2.87A	2.25A	2.26A	1.26A	1.28A

Values within each column followed by different letters are significantly different at $p < 0.05$ according to the Duncan's multiple range tests.

Table (7). Effect of Chitosan and amino acids on fruit quality of Aggizi olive treesin 2019 and 2020 seasons.

Treatments	Fruit weight (g)		Flesh weight (g)		Flesh (%)		Seed weight (g)	
	2019	2020	2019	2020	2019	2020	2019	2020
T1: Control.	7.01D	7.23C	5.81D	6.01G	82.88C	83.13D	1.202A	1.215
T2: Chitosan 0.5 %.	7.16CD	7.29C	5.98CD	6.10G	83.52C	83.68CD	1.181A	1.188A
T3: Chitosan 1.0 %.	7.30CD	7.49C	6.12CD	6.31F	83.84BC	84.25CD	1.175A	1.180A
T4: Amino acids 1 %.	7.15CD	7.28C	5.96CD	6.09G	83.36C	83.65CD	1.191A	1.188A
T5: Amino acids 2 %.	7.60B-D	7.74BC	6.42BCD	6.56E	84.47BC	84.75B-D	1.183A	1.181A
T6: Chitosan 0.5 % + amino acids 1%.	7.72BC	7.97BC	6.55BC	6.81D	84.85ABC	85.45B-D	1.165A	1.162A
T7: Chitosan 0.5 % + amino acids 2%.	8.08AB	8.37BC	6.92AB	7.22C	85.64ABC	86.26BC	1.161A	1.153A
T8: Chitosan 1.0 % + amino acids 1%.	8.42A	9.11AB	7.32A	7.54B	86.94AB	87.37AB	1.095A	1.090A
T9: Chitosan 1.0 % + amino acids 2%.	8.71A	9.95A	7.66A	8.92A	87.94A	89.65A	1.052A	1.033A

Values within each column followed by different letters are significantly different at $p < 0.05$ according to the Duncan's multiple range tests.

4- Fruit moisture content and oil (%).

Table (8) indicated the effect of foliar application of chitosan and amino acid on

fruit moisture % and fruit oil % of Aggizi olive trees during the two studied seasons. Results showed that treatment with chitosan 1 % + amino acids 2 % gave the lowest significant value of fruit moisture % (62.82 and 63.88 %) and had the highest values of fruit oil % (10.87 and 11.56 %) in both seasons, respectively. Meanwhile, the control treatment gave the highest values of fruit moisture % (68.37 and 67.92 %) and had the lowest fruit oil content (7.47 and 8.01 %) in both seasons respectively. Also, it is obvious from the results that there are no significant differences between T 7, T 8 and T 9 on fruit oil content in both seasons.

Table (8). Effect of Chitosan and amino acids on fruit moisture content % and olive oil % in dry weight of Aggizi olive treesin 2019 and 2020 seasons.

Treatments	Fruit moisture content %		Oil % in dry weight %	
	2019	2020	2019	2020
T1: Control.	68.37A	67.92 A	7.47 B	8.00 C
T2: Chitosan 0.5 %.	67.32A	66.29 A-D	8.22 B	8.52 BC
T3: Chitosan 1.0 %.	65.92AB	66.22 AB	8.11 B	9.27 BC
T4: Amino acids 1 %.	66.39AB	67.31 AB	8.45 B	8.81 BC
T5: Amino acids 2 %.	65.88 AB	66.85 A-C	8.09 B	7.96 C
T6: Chitosan 0.5 % + amino acids 1%.	65.94 AB	64.19 B-E	8.77 B	8.82 BC
T7: Chitosan 0.5 % + amino acids 2%.	64.27 BC	63.54 DE	10.22A	9.98A-C
T8: Chitosan 1.0 % + amino acids 1%.	63.47 BC	62.89 E	10.74A	10.69 AB
T9: Chitosan 1.0 % + amino acids 2%.	62.82 C	63.88 C-E	10.87A	11.56 A

Values within each column followed by different letters are significantly different at $p < 0.05$ according to the Duncan's multiple range tests.

V. Leaf mineral contents:

As presented in Table (9) there are significant differences in leaf mineral composition in both seasons. The treatment of spraying with chitosan 1 % + amino acids 2 % gave the highest leaf mineral contents of N (1.86 & 1.79 %), P (0.345 & 0.366 %), K (1.84 & 1.88 %) and this treatment achieved significantly increase compared with the other treatments in both seasons, respectively. whereas, the lowest mineral contents of N (1.37 & 1.42 %), P (0.214 & 0.221 %), K (1.15 & 1.08 %) were recorded with untreated Aggizi olive trees in 2019 and 2020 seasons, respectively, The leaves of other treatments had intermediate values of N, P and K% in both seasons.

Table (9). Effect of Chitosan and amino acids on leaf mineral contents % of Aggizi olive treesin 2019 and 2020 seasons.

Treatments	Leaf N content (%)		Leaf P content (%)		Leaf K content (%)	
	2019	2020	2019	2020	2019	2020
T1: Control.	1.37F	1.42C	0.214C	0.221C	1.15D	1.08E
T2: Chitosan 0.5 %.	1.45EF	1.48BC	0.219C	0.230C	1.34CD	1.42D
T3: Chitosan 1.0 %.	1.51DE	1.55A-C	0.228BC	0.241C	1.50BC	1.56CD
T4: Amino acids 1 %.	1.63CD	1.67A-C	0.234BC	0.255BC	1.61A-C	1.54CD
T5: Amino acids 2 %.	1.71BC	1.76AB	0.266A-C	0.283BC	1.68AB	1.61C
T6: Chitosan 0.5 % +amino acids 1%.	1.72A-C	1.74AB	0.286ABC	0.312AB	1.69AB	1.64BC
T7: Chitosan 0.5 % +amino acids 2%.	1.80AB	1.76AB	0.311AB	0.355A	1.70AB	1.72A-C
T8: Chitosan 1.0 % + amino acids 1%.	1.80AB	1.75AB	0.338A	0.357A	1.78AB	1.79AB
T9: Chitosan 1.0 % + amino acids 2%.	1.86A	1.79A	0.345A	0.366A	1.84A	1.88A

Values within each column followed by different letters are significantly different at $p < 0.05$ according to the Duncan's multiple range tests.

VI. General evaluation of the tested treatments:

The numerally assessment of studied treatments, Tables (10 & 11) cleared that, sprayingChitosan 1.0 % + amino acids 2% (T_9) or spraying Chitosan 1.0 % + amino acids 1% (T_8) register the highest units as it attained the highest score units (100 & 96) followed byChitosan 0.5 % + amino acids 2% (T_7) which occupied the third ranked (92).

The total score (40 units) for fruit quality and leaf nitrogen content in dry weight of Aggizi olive fruits (fruit weight, flesh weight, fruit oil content and leaf nitrogen content) was significantly varied according to use chitosan and amino acids. Using Chitosan 1.0 % + amino acids 2% (T_9) gave the highest values comparing with other treatments based on total score (40) units.

In general view, it find that foliar application of Aggizi olive trees with chitosan at 0.5 and 1 % plus amino acids at 1 and 2 % had to mitigate the environmental stress specially heat stress during fruit growth cycle compared with the control treatment, these treatments increased the yield by 4.5, 11.0, 5.4, 10.1, 13.8, 17.6, 21.1, 29.4 as average the two studied seasons according to the treatments ; T2, T3, T4, T5, T6, T7, T8, T9 over the control sprayed with water, respectively.

Discussion:

The positive effect of chitosan on growth, nutritional status, flowering, yield and fruit quality characteristics of olive trees are due to the effect of glucosamine polymer on the molecularbiology and biochemistry of the plant cell. The plasma membrane and nuclear chromatin are among the targets of cell causing changes in cell membrane, chromatin, DNA, Ca, MAP Kinase, oxidative burst and reactive oxygen species (ROS) (**Wogdyla, 2001; Barka*et al*, 2004** and **Feng *et al*., 2007**). Chitosan has shown great importance in improving the physiological mechanisms of fruit trees against biotic and abiotic stress. In addition, chitosan plays a role in regulating gene expression and inducing molecular defense systems in plants (**Zhang *et al*., 2017**). It is used as an environmentally friendly biocide that enhances the immune ability of plants to defend themselves against adverse environmental conditions (**Borkowski and Kowalczyk, 1999;Sharif, *et al*., 2018**).Application of chitosan increased key enzymes activities of nitrogen metabolism (nitrate reductase, glutamine synthetase and protease) and improved the transportation of nitrogen (N) in the functional leaves which enhanced plant growth and development and increase the yield **(Monda*et al*., 2013)**.

These results are in agreement with those reported by **Jiang and Li, (2001); Chien and Chou, (2006); Gornil*et al*., (2008); Amborabe*et al*., (2008); Ali *et al*., (2011); El-Miniawy*et al*., (2013); Hadwiger, (2013); Malerbe and Cerana, (2016);Ahmed, *et al*. (2016); Saied and Radwan, (2017)** and **Nabil *et al*., (2021).**

The physiological activities of plant growth and development are affected directly or indirectly by application of amino acids. They are considered as precursors components of proteins and are important to stimulate cell growth. Moreover, the foliar applications of amino acids have been to modulate vegetative growth, yield and fruit quality **(Rai, 2002; Shiraishi*et al*., 2010** and **Khan *et al*., 2012).** Amino acids are important in promoting growth and olive tree nutritional status, as well as its positive effect on stimulating the physiological activities certainly reflected on the promotion of the growth, flowering and fruit quality. These results are in line with those found by **Ahmed and Abd El-Hameed (2003), Shahin*et al*., (2015); El-Alakmy*et al*., (2017)** and **El-Salhy*et al*., (2021).**

Conclusion:

Under the resembling conditions and the current results, it could be concluded that foliar application of chitosan 1 % + amino acids 2% is useful in the improvement of

nutritional status olive trees and produced a high yield with good fruit quality under the Qena Governorate conditions.

Table (10): General evaluation of Chitosan and amino acids effects on some vegetative growth, flowering density, final fruit set and yield kg/tree of Aggizi olive trees as average of two studied season.

Characters	Parameters													
	Shoot length	**No. of shoots/twig**	**Leaf area**	**Total**	**Flowering density**	**Fruit set**	**Yield**	**Total**	**Fruit weight**	**Flesh weight**	**Fruit oil content**	**Leaf nitrogen content**	**Total**	**G. Total**
Score	**10**	**10**	**10**	**30**	**10**	**10**	**10**	**30**	**10**	**10**	**10**	**10**	**40**	**100**
T1: Control.	6.20	4.00	8.00	18.20	6.30	6.30	7.80	20.40	7.60	7.10	6.90	7.60	29.20	67.80
T2: Chitosan 0.5 %.	7.40	4.10	8.30	19.80	7.90	7.90	8.10	23.90	7.70	7.30	7.50	8.00	30.50	74.20
T3: Chitosan 1.0 %.	9.00	4.70	8.60	22.30	7.50	7.60	8.60	23.70	7.90	7.50	7.70	8.30	31.40	77.40
T4: Amino acids 1 %.	7.50	3.90	8.60	20.00	7.00	7.10	8.20	22.30	7.70	7.30	7.70	9.00	31.70	74.00
T5: Amino acids 2 %.	8.10	4.10	8.80	21.00	8.20	8.20	8.50	24.90	8.20	7.80	7.20	9.50	32.70	78.60
T6: Chitosan 0.5 % + amino acids 1%.	9.30	8.60	9.40	27.30	9.30	9.30	8.80	27.40	8.40	8.10	7.80	9.50	33.80	88.50
T7: Chitosan 0.5 % + amino acids 2%.	9.60	8.80	9.60	28.00	9.40	9.40	9.10	27.90	8.80	8.50	9.00	9.80	36.10	92.00
T8: Chitosan 1.0 % + amino acids 1%.	9.90	9.70	9.70	29.30	9.80	9.80	9.40	29.00	9.40	9.00	9.60	9.70	37.70	96.00
T9: Chitosan 1.0 % + amino acids 2%.	10.00	10.00	10.00	30.00	10.00	10.00	10.00	30.00	10.00	10.00	10.00	10.00	40.00	100.00

REFERENCES

A.O.A.C. (1995). Official Methods of Analysis.15th ed. Association of Official Analytical Chemists. Washington, D.C., USA.

Ahmed, A. H. and Abd El-Hameed, H.M. (2003). Growth, uptake of some nutrients and productivity of Red Roomy vines as affected by spraying of some amino acids, magnesium and boron, Minia J. of Agric. Res. Develop., 23(4): 649- 666.

Ahmed, A.H.H.; Nesiem, M.R.A.; Allam, H.A. and Amira F. El-Wakil (**2016)**. Effect of pre-harvest chitosan foliar application on growth, yield and chemical composition of Washington navel orange trees grown in two different regions. African Journal of Biochemistry Research, Vol. 10 (7), pp. 59-69.

Ahmed, F.F.; and Morsy, M.H. (1999). A new method for measuring leaf area in different fruit species. Minia J. of Agric. & Develop. (19):97-105.

Ahmed-Zienab F.R. (2019). Flowering, Fruiting of Two Table Olive Cultivars "Oleaeuropaea L." Grown in Southern Egypt. Egypt. J. Hort. **Vol. 46,** No.1, pp. 145-153.

Ahmed-Zienab. F.R., Eman M.A. Taha, Naglaa, A.A. Abd-Elkarim (2019). Floral Behavior, Fruit Characteristics and Oil Quality of Some Olive Cultivars "*Oleaeuropaea* L.". Egypt. J. Hort. Vol. 46, No.1, pp. 155 -168.

Ali, A., Muhammad, M.T.M., Sijam, K. and Siddiqui, Y., (2011). Effect of chitosan coatings on the physicochemical characteristics of Eksotika II papaya (*Carica papaya* L.) fruit during cold storage. Food Chemistry, 124 (2): 620-626.

Amborabé, B.E., Bonmort, J., Fleurat-Lessard, P. and Roblin, G., (2008): Early events induced by chitosan on plant cells. J. Exp. Bot., 59 (9).2317-2324.

Baldoni, L. and Belaj, A. (2009) Olive. In: Vollmann J., Rajcan I. (Eds), Oil Crops. Handbook of Plant Breeding. Volume 4, Springer, New York, NY, pp 397-421.

Barka, E.A., Eullaffroy, P., Clément, C., and Vernet, G. (2004). Chitosan improves development, and protects *Vitisvinifera* L. against Botrytis cinerea. Plant Cel Rep., 22(8), 608-614.

Bautista-Baños, S., Hernāndez-López, M., Bosquez-Molina, E., Wilson C.L. (2003). Effect of chitosan and plant extracts on growth of Colletrichumgloeasporioides, anthracnose levels and quality of papaya fruit. Crop Prot. 22:1087-1092.

Beppu, K. and Kataoka, I. (2011). Studies on pistil doubling and fruit set of sweet cherry in warm climate. J. Jpn. Soc. Hort. Sci., (80): 1-13.

Black, C.A., D.D. Evans, L.E. Evsminger, J.L. White and F.E. Clark (1965). Methods of soil analysis. Ame. Soc. Agron., Inc., Publ. Madison, Wisconsin, USAP, 1162 – 1168.

Borkowski, J. and Kowalczyk, W. (1999). Influence of tytanit and chitosan sprays and other treatments on the tomato plant growth and the development of powdery mildew (*Oidiumlycopersicum*). Bull. Polish Acad. Sci. Biology Sci., 47 (2-4): 129-132.

Brown, J. D. and Lilleland, D. (1946). Rapid determination of potassium and sodium in plant material and soil extract by flame photometer. Proc. Amer. Soc. Hort. Sci Vol. (48) P. 341.

Chapman, H.D. and Pratt, P.F. (1978). Methods of analysis for soil, plant and water. Agric. Sci. Dept., Univ. California, USA 309.Chem.36: 345-347.

Cheung, R.C.F., Ng, T.B., Wong, J.H. and Chan, W.Y. (2015). Chitosan: An Update on Potential Biomedical and Pharmaceutical Applications. Mar. Drugs, 13(8), 5156-5186.

Chien, P. J., and Chou, C. C. (2006). Antifungal activity of chitosan and its application to control post-harvest quality and fungal rotting of Tankan citrus fruit (*Citrus tankan Hayata*). J. of the Sci. of Food and Agric., 86(12), 1964-1969.

Dag, A., Tugendhaft, Y., Yogev, U., Shatzkin, N. and Priel, N. (2008). Commercial cultivation of olive (*Oleaeuropaea* l.) with saline water under extreme desert conditions. ActaHortic., (791): 279-284.

Davies, D. D. 1982. Physiological aspects of protein turnover. Encycl. Plant Physiol. New Series, 14 A (Nucleic acids and proteins: structure, biochemistry and physiology of proteins, Eds., Boulter, D. and B Partier, Springer Verlag, Berlin, Heidelberg & New York, pp: 190-228.

Du, J., H. Gemma and S. Wahori, (1997). Effects of chitosan coating on the storage of Peach Japanese Pear and Kiwi fruit. J. Jpn. Soc. Hortic. Sci., 66(1): 15-22.

Duncan, D.B. (1955). Multiple Range and Multiple F tests. Biometrics, 11: 1-24.

Dzung, N.A., Khanh, V.T.P. and Dzung, T.T. (2011). Research on impact of chitosan oligomers on biophysical characteristics, growth, development and drought resistance of coffee. Carbohydr. Polym., 84, 751–755.

El-Alakmy, H.A. and Darin M.R. El-Bolok (**2017)**. Effect of foliar application of some plant extracts and amino Acids on "Picual" olive production and oil quality. J. Plant Production, Mansoura Univ., Vol. 8 (11): 1229 - 1239.

El-Miniawy, S., Ragab, M., Youssef, S. and Metwally, A. (2013). Response of strawberry plants to foliar spraying of chitosan. Res. J. Agric. Biol. Sci, 9 (6): 366-372.

El-Salhy, A.M.1; M. Kamal; A.Y. Haleem and Radwan, E.M.A. (2021). Effect of Some Treatments on Heat Stress Tolerance of Flame Seedless Vineyards. Assiut J. Agric. Sci., 52 (4): 85-97.

Esraa, M. E. Hussein (**2017)**. Behavior of Prime seedless grapevines grown under sandy soil conditions to foliar application of chitosan. J. Product. & Dev., 22 (3): 683-696.

Feng, T., Du, Y., Li, J., Wei, Y. and Yao, P. (2007). Antioxidant activity of half N-acetylated water-soluble chitosan in vitro. Eur Food Res Technol, 225 (1): 133-138.

Fernandez, E.R. and G.V. Gomez (1985). Cross pollination in GordalSevillano olives. Hortscience, (202): 191–192.

Górnil, K., Grzesik, M. and Romanowska-Duda, B. (2008). The effect of chitosan on rooting of grapevine cuttings and on subsequent plant growth under drought and temperature stress. J. of Fruit and Ornamental Plant Res. (16): 333-343.

Gowda, A.M.; A.A. El- Taweel and K.B. Eassa (2011). Studies on reducing the harmful effect of saline water irrigation on Picual olive trees. Minufiya J. Agric. Res. Vol. 36 No. (3): 623 – 645.

Guerfel, M., Baccouri, O., Boujnah, D., Chaïbi, W. and Zarrouk, M. (2009). Impacts of water stress on gas exchange, water relations, chlorophyll content and leaf structure in the two main Tunisian olive (*Oleaeuropaea* L.) cultivars. Sci. Hortic., 119 (3): 257-263.

Hadwiger, L.A. (2013). Plant science review: Multiple effects of chitosan on plant systems: Solid Science or Hype. Plant Sci., (208): 42-49.

Hashimoto, T. and Y. Yamada (1994). Alkaloid biogenesis: Molecular Aspects. Ann. Rev. Plant Physiol. Plant Mol. Biol., pp: 245-257.

Jabeen, N. and Ahmad, R. (2013). The activity of antioxidant enzymes in response to salt stress in safflower (*Carthamustinctorius* L.) and sunflower (*Helianthus annuus* L.) seedlings raised from seed treated with chitosan. J. Sci. Food Agric. 93 (7):1699-1705.

Jiang, Y. and Li, Y. (2001). Effects of chitosan coating on postharvest life and quality of longan fruit. Food Chem., 73 (2): 139-143.

Katiyar, D., Hemantaranjan, A. and Singh, B. (2015). Chitosan as a promising natural compound to enhance potential physiological responses in plant: a review. Ind. J. Plant Physiol., 20 (1): 1–9.

Khan, A.S., B. Ahmad, Muhammad J. Jaskani, Rashid Ahmad and Aman U. Malik (2012). Foliar Application of Mixture of Amino Acids and Seaweed (*Ascophylumnodosum*) Extract Improve Growth and Physicochemical Properties of Grapes. Int. J. Agric. Biol., (14): 383–388.

Limpanavech P., Chaiyasuta S., Vongpromek R., Pichyangkura R., Khunwasi C., Chadchawan S., Lotrakul P., Bunjongrat R., Chaidee A., Bangyeek-hun T. (2008). Chitosan effects on floral production, gene expression, and anatomical changes in the Dendrobium orchid. Sci. Hortic., 116 (1): 65-72.

Lizarraga-Paulín, E.G., Torres-Pacheco, I., Moreno-Martínez, E., Miranda-Castro, S.P. (2011). Chitosan application in maize (*Zea mays*) to counteract the effects of abiotic stress at seedling level. Afr. J. Biotechnol. 10(34):6439-6446.

Lombardo, N., Marone, E., Alessandrino, M., Giodino, G., Madeo, A., and Fiorino, P. (2008). Influence of growing season temperatures on the fatty acids (FAs) of triacylglycerols (TAGs) composition in Italian cultivars of *Oleaeuropaea*. Adv. Hort. Sci., (22): 49-53.

Malerbe, M., and Cerana, R. (2016). Chitosan Effects on Plant Systems. Inter. J. Mol. Sci., 17 (7): 996.

Ministry of Agriculture and Land Reclamation (2021). Agricultural statistics, pp: 335.

Mondal, M.M.A., M.A. Malek, A.B. Puteh and M.R. Ismail (2013). Foliar application of chitosan on growth and yield attributes of mungbean (*Vignaradiata*(L.) Wilczek). Bangladesh J. Bot., 42 (1): 179-183.

Nabil G.S., Safaa A.A. Nomier, M.M. Ibrahim and M.M. Gad (2021). Effect of spraying nano-chitosan and nano-silicon on physicochemical fruit quality and leaf mineral content of florida prince peach trees. Zagazig J. Agric. Res., Vol. 48 No. (5): 1215-1226.

Nguyen, Van S., Dinh Minh H. and Nguyen Anh, D. (2013). Study on chitosan nanoparticles on biophysical characteristics and

growth of Robusta coffee in green house. Biocatal. Agric. Biotechnol., 2 (4): 289-294.

O'Brien, J.A. and Benková E. (2013). Cytokinin cross-talking during biotic and abiotic stress responses. Cytokinin cross-talking during biotic and abiotic stress responses. Frontiers in Plant Science 4:451.

Park, P.J., Je, J.Y. and Kim, S. K. (2004). Free radical scavenging activities of differently deacetylatedchitosans using an ESR spectrometer. Carbohydrate Polymers, 55(1): 17-22.

Piper, C.S. (1950) Soil and plant analysis. Int. Sci. Publ., New York, P. 368.

Pope, K.S. (2012). Climate change adaptation: temperate perennial crops. Presented at the California Department of Food and Agriculture Climate Change Adaptation Consortium, November 28, Modesto, CA.

Rai, V.K. (2002). Role of amino acids in plant responses to stresses. Biol. Plant, 45, 481–487.

Saied, H.M.H. and Radwan, E.M.A. (2017). Insight in to the effect of chitosan on growth and fruiting of Succary mango trees. J. Product. & Dev., 22 (3): 781- 793.

Shahin M.F.M., E. A.-E. Genaidy and Laila F. Haggag (**2015)**. Impact of Amino Acids, Vinasse and Humic Acid as Soil Application on Fruit Quality and Quantity of "Kalamata" Olive Trees. International Journal of ChemTech Research, Vol.8, No. (11): 75-84.

Sharif, R., Mujtaba M., Mati Ur Rahman, Shalmani A., Ahmad, H., Anwar, T., Tianchan D., and Wang X. (2018). The Multifunctional Role of Chitosan in Horticultural Crops; A Review. Molecules. 2018 Apr; 23(4): 872.

Shehata, S.A., Fawzy, Z.F. and El-Ramady, H.R. (2012). Response of cucumber plants to foliar application of chitosan and yeast under greenhouse conditions. Aust. J. Basic Appl. Sci. 6 (4):63-71.

Shiraishi, M., H. Hiroyuki Fujishima and H. Hiroyuki Chijiwa (2010). Evaluation of table grape genetic resources for sugar, organic acid, and amino acid composition of berries. Euphytica, (174): 1–13.

Snedecor, G.A. and W.G. Cochran (1967). Statistical Methods. 7 Edition. The Iowa State Univ. Press, Ames. Iowa, USA. pp: 365- 372.

Waller, G.R. and E.K. Nowaki, (1978). Alkaliod, Biology and Metabolism in Plants. Plenum Press, New York, pp: 85-247.

Wojdyla, A. T. (2001). Chitosan in the control of rose disease-6-year-trials. Bull. Polish Academy. Sci. Biolog. Sci., 49 (3) 233-252.

Zhang J., Tan W., Zhang Z., Song Y., Li Q., Dong F. and Guo Z. Synthesis, (2017). Characterization, and the antifungal activity of chitosan derivatives containing urea groups. Int. J. Biol. Macromol; (109):1061–1067.

تأثير الرش الورقي بالشيتوزان والأحماض الأمينية علي النمو والإزهار والمحصول وجودة ثمار أشجار الزيتون صنف العجيزي تحت ظروف محافظة قنا

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أجريت هذه الدراسة على أشجار زيتون صنف العجيزي عمرها 10 سنوات نامية في بستان خاص بوادي قنا بمحافظة قنا ، وكان الهدف منها هو دراسة تأثير الرش الورقي بالشيتوزان والأحماض الأمينية على النمو والمحتوي المعدني للأوراق والمحصول وجودة الثمار خلال موسمي 2019 و 2020. حيث تم دراسة التأثيرات المفيدة لرش الشيتوزان والأحماض الأمينية على نمو وإنتاجية أشجار الزيتون العجيزي في ظل المناخ الشتوي الدافئ والصيف الحار في محافظة قنا ، وقد تم تصميم هذه التجربة في تصميم قطاعات كاملة العشوائية بأربعة مكررات لكل معاملة ، شجرة واحدة لكل منها وقد أشارت النتائج إلى أن جميع المعاملات كانت فعالة في زيادة النمو الخضري ومحتوى الأوراق من العناصر المعدنية وتحسين محصول وجودة ثمار أشجار الزيتون مقارنة بمعاملة الكنترول. وكانت المعاملة الأفضل فيما يتعلق بتحسين النمو الخضري ومحتوي الأوراق من النيتروجين والفوسفور والبوتاسيوم والإزهار والمحصول (كجم / شجرة) وجودة الثمار برش الشيتوزان 1٪ + الأحماض الأمينية 2٪ في كلا الموسمين.

يمكن الاستنتاج أن الرش الورقي للشيتوزان 1٪ + الأحماض الأمينية 2٪ مفيد في تحسين النمو الخضري ومحتوي الاوراق من العناصر لأشجار زيتون العجيزي مع إنتاج محصول عالي وثمار ذات جودة عالية تحت ظروف محافظة قنا.