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Productivity of Olive Trees as Influenced by Spraying with Glucose, Phosphorus and Gibberellic Acid

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Abstract: This investigation was carried out through 2019 and 2020 seasons on 21 years old of Picual Olive trees grown in sandy soil, planted at 5.5 x 6 meter apart under drip irrigation system in a private orchard located at Fayed city, Ismailia governorate. The tested Picual trees were sprayed twice, at first and mid of December with glucose in two concentrations (1 and 1.5 %), Phosphorus as (Mono ammonium Phosphate) at (1 and 3 g/L) and gibberellic acid (GA_3) at (50 and 100 ppm). The investigation that tracked during two seasons aimed to study of their independent effects on vegetative growth, flowering, fruiting, yield, oil content and leaves carbohydrate content revealed that, the highest values of vegetative growth attained by foliar application with GA_3. In addition, foliar application with Phosphorus (MAP) enhanced the flowering density. Similarly, sprays tree with glucose improved total number of flowers, inflorescence, perfect flower percent, fruit weight, oil content % and give the highest fruit yield. Foliar application with each of glucose and GA_3 increased leaves carbohydrate content. The most effective treatment by spraying Picual Olive trees with Phosphorus at the rate of 1 g/l and glucose at 1.5%.

Key words: Olive · Gibberellic acid · Glucose · Phosphorus · Picual

INTRODUCTION

Olive tree (*Oleae uropeae* L.) considered one of the oldest known cultivated trees in the world. The Olive fruit has a great economic importance in the Mediterranean region [1]. Most of olive fruits are utilized as it yields to naturally ripe olive in brine, as a source of oil and dual purposes [2, 3].

In Egypt, olive agro sub-sector has seen unprecedented development, the total acreage reached to 247742 feddans in 2019 with total Production 882092 tons olive according to statistical of the Ministry of Agriculture. The majority of olive trees were cultivated under sandy soil conditions, but the yield was low especially in the newly reclaimed areas. Environmental conditions, amounts of nutrients, hormonal balance and photosynthesis capacity play an important role in effect of growth and productivity of olives [4, 5].

Picual is one of the foreign cultivars (Spain) that planted as a double purpose cultivar for table and oil extraction under Egypt conditions. In recent years, there has been a noticeable decrease on its productivity. So, it needs conduct experiments for improving the productivity and fruit quality.

There are two energy sources of fruit growth and oil formation in Olives: the main source is a sugar translocated in phloem from leaves or sites of storage. The secondary source is a sugar formed by photosynthesis in fruit themselves which remain green for a considerable period to retain active chlorophyll. Consequently, using spray of glucose and phosphorus as exogenous energy currency component and (GA_3) as growth regulators works on the hydrolysis of starch and sucrose into fructose and glucose, led to improve the growth, yield and fruit quality due to their role in the balance in the levels of endogenous hormones [6].

Glucose is a monosaccharide sugar product from photosynthesis. It helps for reducing the effects of climatic stresses [7]. Similarly, the plant is able to store glucose at the night or in winter through the process called cellular respiration, that stored glucose provide the energy which plant needs to flower. In addition, glucose

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molecules form cellulose, which builds or adds strength to cell walls. Glucose molecules also form carbohydrates and proteins that help in growth, form flowers and develop fruit and seeds [8].

Phosphorus is considered a key to all forms of life and one of the main yield limiting factors in many arid and semi-arid regions [9]. Olive tree requires Phosphorus to promote new growth, flower bud formation, many biochemical processes as cell division, photosynthesis linked carbon fixation from carbon dioxide, intermediary metabolism, breakdown the carbohydrates, the utilization of sugars and starch and transfer the energy within the plant and its role in nucleic acids and activity in biological energy change via adenosine triphosphates (ATP) [10, 11]. Mono ammonium phosphate one of types of phosphorus is commonly used in fertigation field practices and foliar application in many crops.

Gibberellic acid (GA_3), is one of the growth regulators that promote flowering initiation and development, enhancing olive fruit growth, seed development and yield [12, 13]. In addition, GA_3 application works on the hydrolysis of starch and sucrose into fructose and glucose [14-16]. The gibberellic acid are involved in regulation of many physiological processes, including floral induction and growth regulation. The gibberellic acid produced in roots appears to influence flowering by inhibiting the reproductive buds development [17]. Thus, if the gibberellic acid is responsible for the flowering inhibition, then growth retardants that act by inhibiting the endogenous gibberellic acid synthesis may promote flowering [18].

Therefore, the objective of the present work was to study the independent effects of spraying glucose, Phosphorus and Gibberellic acid (GA_3) on productivity of olive trees.

MATERIALS AND METHODS

This investigation was under taken during two successive growing seasons (2019 and 2020) on twenty one Picual olive trees grown in sandy soil and planting distance of 5.5 x 6 meters a part with saline water (8627 ppm) under drip irrigation system in a private orchard located at Fayed city, Ismailia governorate situated (30°437'188") N latitude, 32°162'102") E longitude.

The selected trees were nearly uniform in their shape size and visually free from any disease symptoms. The trees received normal fertilization and cultural practices recommended in the orchard.

Water Analyses: Water chemical properties were determined by Soil, Water and Environmental Res. Inst. Agric. Res. Center, according to the methods as described by Jackson [19] and was summarized in Table (1).

The tested trees were sprayed twice, at first and mid-Decemberwith one of the following treatments:

- Control: (were sprayed with water)
- Foliar spray with glucose at the rate of 1%
- Foliar spray with glucose at the rate of 1.5%
- Foliar spray with Mono ammonium Phosphate (61% P and 12%N) at the rate of 1 g/L
- Foliar spray with Mono ammonium Phosphate (61% P and 12%N) at the rate of 3 g/L
- Foliar spray with gibberellic acid at 50 ppm
- Foliar spray with gibberellic acid at 100 ppm

Furthermore, Tween 20 was added at 0.1 % as a surfactant to all spray solutions including the control. Spraying process was carried out using a compression sprays (7 L. solution/tree).

- The treatments were arranged as a completely randomized block design with three replicates per treatment and one tree per each.

Vegetative Growth Measurements: At the end of each growing season (first of November) sixteen healthy one year old shoots/tree (4 in each tree direction) was selected randomly and the following parameters were recorded:

- Average shoots length (cm).
- Leaves density = number of leaves / shoot and calculated per meter.

Floral Characteristics: Flowering density was calculated according to the following equation:

Flowering density = No. of inflorescence x100/ shoot length.

Total number of flowers per inflorescence was counted according the IOC [20].

Number of perfect flowers per inflorescence was counted according to Hegazi and Stino [21] and Hejaz [22].

Yield and Fruits Physical Characteristics:

Yield: The average yield (kg/tree) was recorded at ripe stage (olive with superficial pigmentation on more that 50% of the skin) for each replicate tree in both seasons.

Table 1: Chemical characteristics of the tested water sample collected from the experimental area

		Soluble cations (me/L)				Soluble anions (me/ L)				
pH 2.5:1	E.C. ds/M (1:5)	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3-	HCO_3^-	Cl^-	SO_4^-	S.A.R
7.89	13.48	15.4	14.2	97.3	8.1	0.00	37.9	32.7	34.4	25.29

Fruits Physical Characteristics: Fifty fruits at ripe stage were randomly selected in both seasons from each replicate to study fruit length (cm), fruit diameter (cm) and fruit weight (g.).

Chemical Characteristics

Leaves Carbohydrate Content (%): It was estimated according to Smith *et al.* [23].

Fruits Oil Content (%): Oil content as a dry weight was extracted by soxelt apparatus from the dry fruit samples using petroleum ether (60-80%) as a solvent for 16 hours according to method described by A.O.A.C. [24].

Statistical Analysis: All data parameters studied were analyzed as Randomized Complete Blocks Design in factorial arrangement with three replications. All data were subjected to statistical analysis as described by Snedecor and Cochran [25]. Mean separation were carried out using Duncan's multiple range test [26].

RESULTS AND DISCUSSIONS

Vegetative Growth Measurements

Shoot Length (cm): As regard to the presented data in Table (2), it was clearly that, all treatments under study achieved the highest value comparing with control. Similarly, spraying trees with gibberellic acid was superiority and gave the best results of shoot length (22.71 & 26.60) in both seasons respectively, partnership with control in the first one. Meantime, data revealed that high concentration gave the best values in the first season, while no significant difference was observed in second one. Concerning the interaction effect between spraying treatments and their levels, it was noticed the superiority of gibberellic acid under low concentration in both seasons shared with phosphorus in a high concentration in the first season.

Average Number of Leaves/Shoot: Data presented in Table (3) exhibit a mark variation among spraying treatments in two seasons under study. The maximum number of leaves/shoot cleared significantly by spraying with gibberellic acid (61.33 & 67.17) in both 2019 and 2020 seasons, as well as treatment with glucose gave the highest value (59.33) in the second season as spraying with gibberellic acid. With respect to the effect of spraying levels, the high concentration was superior in the number of leaves/shoot.

Concerning the interaction effect between spraying treatments and their levels there were a convergence among glucose, phosphorus and gibberellic acid under high concentration in two studied seasons.

These results are probably due to the stimulating effect of gibberellic acid for increasing the cell elongation and intermodal distance. Additionally, gibberellic acid improves the rate of photosynthesis and encourages transport of nutrients which leads to increase in dry matter of plant and significant improvement in growth rate.

The obtained results of vegetative growth are in close conformity with Diego and Ercan [27]. Who reported that, spraying olive trees at the first of December with 75 ppm of GA_3 illustrated the highest number of leaves. These results are matched with those of Abd El-Naby *et al.* [28] and Ullah *et al.* [16] on olive, Mostafa and Saleh [29] on apple and Al-Rawi *et al.* [30] on peach.

Flowering Behavior

Flowering Density: The tabulated data in Table (4) demonstrate that, all spraying treatments were superiority on the flowering density than control treatment that achieved the least one. The highest value of flowering density was concomitant to the treatment of Phosphorus (77.37 & 76.48) in both studied seasons shared with treatments of glucose (69.43) in the first season and GA_3 (81.03) in the second season.

Furthermore, there were no statistical difference between high and low concentrations, this was truthful at the two seasons of study. According to the interaction between treatments and levels of spraying, the spraying treatments with GA_3 gave the highest results in the first and second seasons.

These results were agreement with Erel *et al.* [9] they found that, Phosphorus us nutritional level was positively related to rate of density of flowers in olives. Moreover, Shereen [31] found that, foliar spraying of olive with MAP (1%) at the mid of January recorded the highest flowering density.

Table 2: Effect of spraying glucose, phosphorus and gibberellic acid on shoot length (cm) of Picual cultivar during 2019 and 2020 seasons

	2019						2020					
Treatments	Low concentration		High concentration		Mean		Low concentration		High concentration		Mean	
Control	21.95	B	21.95	b	21.95	A	22.10	bc	22.10	bc	22.10	B
Glucose	21.67	B	19.07	c	20.37	B	22.90	b	18.23	cd	20.57	BC
Phosphorus	15.30	D	23.90	a	19.60	B	15.23	d	21.33	bc	18.28	C
GA_3	24.37	A	21.05	b	22.71	A	29.43	a	23.77	b	26.60	A
Mean	20.82	B	21.49	A			22.42	A	21.36	A		

Values have the same letter are not significantly different at 5% using Duncan's Test.

Table 3: Effect of spraying glucose, phosphorus and gibberellic acid on number of leaves/shoot of Picual cultivar during 2019 and 2020 seasons.

	2019						2020					
Treatments	Low concentration		High concentration		Mean		Low concentration		High concentration		Mean	
Control	43.67	d	43.67	D	43.67	D	49.67	c	49.67	c	49.67	B
Glucose	50.67	cd	60.00	A	55.33	B	54.67	bc	64.00	ab	59.33	A
Phosphorus	30.00	e	67.00	A	48.50	C	26.33	d	59.00	a-c	42.67	B
GA_3	55.67	bc	67.00	A	61.33	A	66.00	ab	68.33	a	67.17	A
Mean	45.00	B	59.42	A			49.17	B	60.25	A		

Values have the same letter are not significantly different at 5% using Duncan's Test.

Table 4: Effect of spraying glucose, phosphorus and gibberellic acid on flowering density of Picual cultivar during 2019 and 2020 seasons.

	2019						2020					
Treatments	Low concentration		High concentration		Mean		Low concentration		High concentration		Mean	
Control	56.80	f	56.80	f	56.80	C	54.30	g	54.30	g	54.30	D
Glucose	57.70	f	81.17	c	69.43	A	60.54	f	66.03	e	63.29	B
Phosphorus	83.87	b	70.87	d	77.37	A	68.63	d	84.33	b	76.48	A
GA_3	88.37	a	65.14	e	76.75	B	89.53	a	72.53	c	81.03	A
Mean	71.68	A	68.49	A			6.25	A	69.30	A		

Values have the same letter are not significantly different at 5% using Duncan's Test.

Total Number of Flowers per Inflorescence: Data in Table (5) illustrated that, the greatest number of total flowers/ inflorescence were detected by spraying of glucose in each of first (16.83) and second (14.83) season. While, the reverse was true with each of control and phosphorus which acquired the least value in both seasons of the study. Similarly, each of low and high concentration of spraying treatments recorded the highest number of total flowers/inflorescence in both seasons. Moreover, glucose in both concentrations was superiority as the effect of interaction.

Number of Perfect Flowers per Inflorescence: Table (6) displays obviously that, the highest number of perfect flowers/ inflorescence was statistically detected by spraying of glucose during 2019 & 2020 experimental seasons. Anyhow, the least one was significantly in concomitant to control and GA_3 treatments. Additionally, the highest number of perfect flowers paralleled with increase in spraying concentration in the first season, whereas, there was no apparent effect in the second one. The interaction between tested treatments and its concentrations recorded the highest values by treatment with glucose in both seasons of the study.

The abovementioned results of flowers are in accordance with the findings of Ulger *et al.* [32], whose indicate that, the main reason of spraying sugar as a supplementation before blooming is to boost carbohydrates, which are the main energy source and increase the carbon availability for developing olive flowers and fruitlets. Moreover, Rogers and Potter [33] observed that, sucrose application significantly improved apple flower production and bud sized. Furthermore, Cho *et al.* [34] show that, addition of exogenous glucose led to increase concentration of sugars during different floral stage and promotes the flowering.

Meantime, Jutamanee and Phavphuyanon [35], found that sprayed Jasmine trees with glucose at1% mixed with GA_3 at 1% increased the number of flowers. The number of male flowers in lychee was increased quadratically by GA_3 both years [36].

Table 5: Effect of spraying glucose, phosphorus and gibberellic acid on the total number of flowers per inflorescence of Picual cultivar during 2019 and 2020 seasons

	2019						2020					
Treatments	Low concentration		High concentration		Mean		Low concentration		High concentration		Mean	
Control	13.33	c	13.33	c	13.33	C	10.67	cd	10.67	cd	10.67	C
Glucose	15.67	b	18.00	a	16.83	A	15.33	a	14.33	ab	14.83	A
Phosphorus	13.00	c	15.67	b	14.33	BC	9.66	d	11.67	c	10.66	C
GA_3	14.00	c	16.00	b	15.00	B	13.33	b	11.33	c	12.33	B
Mean	14.00	A	15.75	A			12.25	A	12.00	A		

Values have the same letter are not significantly different at 5% using Duncan's Test.

Table 6: Effect of spraying glucose, phosphorus and gibberellic acid on number of perfect flower per inflorescence of Picual cultivar during 2019 and 2020 seasons

	2019						2020					
Treatments	Low concentration		High concentration		Mean		Low concentration		High concentration		Mean	
Control	7.67	d	7.67	d	7.67	C	4.33	d	4.33	d	4.33	C
Glucose	12.00	a	13.00	a	12.50	A	10.33	a	9.00	ab	9.67	A
Phosphorus	9.00	c	10.67	b	9.83	B	6.67	b-d	8.33	a-c	7.50	B
GA_3	7.67	d	7.00	d	7.33	C	5.67	cd	4.67	d	5.17	C
Mean	9.08	B	9.58	A			6.75	A	6.58	A		

Values have the same letter are not significantly different at 5% using Duncan's Test.

Table 7: Effect of spraying glucose, phosphorus and gibberellic acid on yield (kg/tree) of Picual cultivar during 2019 and 2020 seasons

	2019						2020					
Treatments	Low concentration		High concentration		Mean		Low concentration		High concentration		Mean	
Control	9.00	d	9.00	d	9.00	C	6.63	c	6.63	c	6.63	B
Glucose	13.33	a	11.75	bc	12.54	A	10.00	b	13.63	a	11.82	A
Phosphorus	10.77	c	12.00	b	11.39	AB	11.20	b	11.00	b	11.10	A
GA_3	9.50	d	11.75	bc	10.63	B	9.63	b	10.37	b	10.00	A
Mean	10.65	A	11.13	A			9.37	A	10.41	A		

Values have the same letter are not significantly different at 5% using Duncan's Test

Table 8: Effect of spraying glucose, phosphorus and gibberellic acid on fruit length (cm) of Picual cultivar during 2019 and 2020 seasons

	2019						2020					
Treatments	Low concentration		High concentration		Mean		Low concentration		High concentration		Mean	
Control	2.433	f	2.433	f	2.433	B	2.533	c	2.533	c	2.533	C
Glucose	3.10	a	2.777	e	2.938	A	2.930	a	2.943	a	2.937	A
Phosphorus	2.847	d	2.983	b	2.915	A	2.747	b	2.780	b	2.763	B
GA_3	2.917	c	2.927	c	2.922	A	2.717	b	2.723	b	2.720	B
Mean	2.824	A	2.780	A			2.732	A	2.745	A		

Values have the same letter are not significantly different at 5% using Duncan's Test

Yield (kg/tree): Displayed data in Table (7) cleared that, all spraying treatments was superiority and enhanced the yield than control treatment which achieved the least one, that may be due to the water salinity levels which had a negative effect on olive productivity reached to decrease it more than a third. A narrow variation was observed among the treatments of glucose, phosphorus and gibberellic acid in the first season, whereas no statically difference was observed among them in the second one. Moreover, no difference was appeared between the levels of spraying in both seasons. Otherwise, in the interaction between them, treatment with glucose in low concentration was superior in the first season, while glucose in the high concentration was superior in the second one. Superiority of exogenous foliar applications in enhancing the yield may be due their role in increasing the plants tolerance to the biotic stress which was exerted by saline irrigation water, by mitigation the negative effect of salt stress to solve the disruption of the endo hormones and lake of available nutrients under salt stress

Sami *et al.* [37]. Several studies elucidated the role of sugars in enhancing plant growth and yield. Sanaa and Abd El Megeed [38], summarized that, spraying Mango trees with sucrose at high concentration (10%) once at full bloom was very effective in improving the yield. Otherwise, each of Ackerson [39]; Ma *et al.* [40] and Zahid *et al.* [7], found that, spraying glucose at lower concentrations in the blooming stage significantly improves yield by activating glucose for some physiological functions.

Fruit Physical Characteristics

Fruit Length (cm): Data in Table (8) showed that, all spraying treatments gave the highest record of fruit length than control which attained the least record in 2019 and 2020 seasons. Similarly, there were no clear differences among spraying treatments towards the highest record in the first season, whereas glucose treatment exhibited the maximum ones during the second season. Moreover, the general mean of the concentrations failed to show any significant differences in both seasons. With respect to the interaction effect, it was noticed that glucose in low level have more effective in first seasons.

Fruit Width (cm): Data in Table (9) clarify that, the superiority of glucose, phosphorus and gibberellic acid treatments than control treatment, but, there was no clear indication among these treatments and their spraying levels on the fruit width. As for the interaction effects, between treatments and spraying levels, each of glucose with low level and gibberellic acid in high level gave the highest fruit width in the first season, while there were a convergence among spraying treatments in the second one.

Fruit Weight (g): Data in Table (10) illustrated that, a significant difference was observed according to fruit weight. The highest fruit weight value was obtained with foliar application with glucose (7.292 and 7.285 g) in both seasons respectively, shared with gibberellic acid (6.935 g) in the first season. Otherwise, the control treatment acquired the lowest value during two studied seasons. Furthermore, there was no clear indication of the effect of levels of spraying on the fruit weight. Similarly, sprayed Picual trees with glucose at low level (1%) as the result of interact between cultivars had a significant heaviest weight (8.362 and 7.624 g) in both seasons respectively.

In general, glucose improved fruit characteristics. These results are in line with those reported by Sanaa and Abd El Megeed [38] on mango trees, Soliman and Al-obeed [41] on date palm and Zahid *et al.* [7] on wheat, whose showed that, the incorporation of sugars spray on fruit characteristics.

Chemical Characteristics

Total Carbohydrates %: Data in Table (11) revealed that, foliar applications with glucose, phosphorus and gibberellic acid were adequate to give high values of the studied total carbohydrates inside the leaves of Picual cultivar comparing with control treatment which comprised the lowest value in two studied seasons. Moreover, each of glucose and gibberellic acid treatments acquired the highest carbohydrates content in both seasons. On the other side, data analysis did not record any significant difference due to levels of spraying in the first and second seasons. With respect to interaction between spraying treatments and its levels, the highest values mostly appeared with glucose treatment in low level (24.55 and 22.70%) in both seasons respectively. The aforementioned results agree with Amnon *et al.* [42], they reported that, exogenous applications of glucose, phosphorus and GA_3 increased the level of carbohydrate in leaves (starch, sucrose, glucose, fructose and sorbitol), which play an important role in new growth. Leaves are regard as a source and fruit growth depends largely on the carbohydrates synthesized by leaves in the same branches that bear fruits. Sugar metabolism in leaves is very fast, dynamic and complex and it can strongly alter leaf carbohydrate profile.

Fruits Oil Content (%): Table (12) demonstrates that, the oil content (dry weight) of Picual cultivar was affected by all spraying treatments than control. As the effect of treatments, foliar application with glucose enhanced the oil formation and gave the highest oil content (29.50 %) in the first season and (33.60 %) in the second one. The general mean of the concentrations of spraying treatments tend to be the high concentration was surpassed (26.65 & 30.62) in first and second seasons shared with the low concentration (25.47) in the first one. As for the combined effect of different treatments and concentrations, the highest values of oil content (%) was recorded by using of glucose at high concentration (30.10 and 35.30 %) in both seasons.

Zahid *et al.* [7] illustrated that, gas exchange and photosynthesis rates in leaves were raised by glucose treatments. This may be the reason for the higher statistical values of total carbohydrates (%) and oil content (%) in olive fruits.

Table 9: Effect of spraying glucose, phosphorus and gibberellic acid on fruit width (cm) of Picual cultivar during 2019 and 2020 seasons

	2019						2020					
Treatments	Low concentration		High concentration		Mean		Low concentration		High concentration		Mean	
Control	1.900	e	1.900	e	1.900	B	1.967	c	1.967	c	1.967	B
Glucose	2.287	a	2.100	c	2.193	A	2.190	a	2.180	a	2.185	A
Phosphorus	2.010	d	2.177	bc	2.093	A	2.113	ab	2.127	ab	2.120	AB
GA_3	2.127	c	2.217	ab	2.172	A	2.020	bc	2.027	bc	2.023	AB
Mean	2.081	A	2.098	A			2.073	A	2.075	A		

Values have the same letter are not significantly different at 5% using Duncan's Test.

Table 10: Effect of spraying glucose, phosphorus and gibberellic acid on fruit weight (g) of Picual cultivar during 2019 and 2020 seasons

	2019						2020					
Treatments	Low concentration		High concentration		Mean		Low concentration		High concentration		Mean	
Control	5.033	E	5.033	e	5.033	C	5.000	d	5.000	d	5.000	D
Glucose	8.362	A	6.221	d	7.292	A	7.624	a	6.946	b	7.285	A
Phosphorus	6.199	D	7.295	b	6.747	B	5.924	c	6.929	b	6.426	B
GA3	6.729	C	7.141	b	6.935	AB	5.682	c	5.587	c	5.635	C
Mean	6.581	A	6.422	A			6.058	A	6.116	A		

Values have the same letter are not significantly different at 5% using Duncan's Test.

Table 11: Effect of spraying glucose, phosphorus and gibberellic acid on total carbohydrates (%) of Picual cultivar during 2019 and 2020 seasons

	2019						2020					
Treatments	Low concentration		High concentration		Mean		Low concentration		High concentration		Mean	
Control	15.55	e	15.55	e	15.55	C	14.00	e	14.00	e	14.00	C
Glucose	24.55	a	18.00	d	21.28	A	22.70	a	18.40	d	20.55	A
Phosphorus	18.16	d	18.58	d	18.37	B	16.45	d	17.00	d	16.73	B
GA_3	21.34	b	20.42	c	20.88	A	20.34	b	19.85	c	20.10	A
Mean	19.90	A	18.14	A			18.37	A	17.31	A		

Values have the same letter are not significantly different at 5% using Duncan's Test.

Table 12: Effect of spraying glucose, phosphorus and gibberellic acid on oil content (as dry weight) of Picual cultivar during 2019 and 2020 seasons

	2019						2020					
Treatments	Low concentration		High concentration		Mean		Low concentration		High concentration		Mean	
Control	22.30	f	22.30	f	22.30	D	25.50	d	25.50	d	25.50	D
Glucose	28.90	b	30.10	a	29.50	A	31.90	b	35.30	a	33.60	A
Phosphorus	24.40	e	28.80	b	26.60	B	31.00	b	29.90	c	30.45	B
GA_3	26.30	c	25.40	d	25.85	C	22.30	e	31.80	b	27.05	C
Mean	25.47	A	26.65	A			27.67	B	30.62	A		

Values have the same letter are not significantly different at 5% using Duncan's Test

CONCLUSION

Exogenous foliar applications with glucose, phosphorus and gibberellic acid gave the positive effect in improving vegetative growth, flowering, fruit characteristic, yield, carbohydrates and fruit oil content of olive Picual cultivar under high concentration of saline water. In addition, the overall better performance was obtained by glucose treatment at 1 % than the other treatments in the majority of traits, because glucose is considered as a fast source of carbohydrates and endogenous hormone that preferable for helping to compensate the depletion of mineral nutrient and serves as osmolytes to alleviate the negative effect of salt stress that led to enhances tree fruiting, yield and fruit quality. Spraying Picual olive trees with each of glucose treatments at 1.5% and phosphorus (MAP) treatment at 1 g/l considered a good performance in increasing olive yield.

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