Available online at http://bajas.edu.iq
https://doi.org/10.37077/25200860.2022.35.1.01
College of Agriculture, University of Basrah

Basrah Journal of Agricultural Sciences

ISSN 1814 – 5868 Basrah J. Agric. Sci., 35(1), 1-20, 2022 E-ISSN: 2520-0860

Study The Effect of Antioxidants on The Traits of the Fruits of Two Cultivars of Jujube (*Ziziphus mauritiana* Lamk.) Al-Tufahi and Alarmouti Cultivars

Bushra F. Ismael [1], Abdul Kareem M. Abd[1*] & Firas J. Jabbar[2]

[1]Department of Horticulture and Landscape Engineering, College of Agriculture, University of Basrah, Iraq

[2]Department of Pharmacy, Southern Technical University, Iraq

*Corresponding author email: abdulkareem.abd@uobasrah.edu.iq

Received 15th July 2021; Accepted 6th October 2021; Available online 23 February 2022

Abstract: This study was conducted in one of the private orchards in Al-Haritha region, Northern Basra city to study the effect of spraying antioxidants with three concentrations of (0, 3 and 6) ml.L^{-1} on two cultivars of jujube trees, Alarmouti and Altfahic. The physical traits of the stages of fruit growth were studied, starting from 50 days after flowering to the final maturity 120 days after of flowering. The results of the study recorded It is too complicated. The progress of the growth and development fruits for all the traits. The study revealed that the Alarmouti cultivar significantly excelled in most of the studied traits at all different growth stages, where the highest values were recorded in the traits of size, length, diameter, and fruit weight (11.07 cm3, 35.99 mm, 27.40 mm, and 21.97 g) respectively. It also excelled in chemical traits during growth stages. The study also showed that the antioxidant concentration of 6 ml.L^{-1} significantly excelled in most of the studied physical and chemical traits. The bi-interaction also had a significant effect on the studied traits, while the fresh weight of the seed was not significant different between cultivars, concentrations, and their -interaction.

Keywords: Jujube trees, Antioxidants, Physical traits, Chemical traits.

Introduction

Jujube plant *Ziziphus* spp., is a perennial and evergreen fruit tree, which growing in arid desert areas (Nasri-Ayachi & Nabli, 2008). Jujube trees belong to family Rhamnaceae, including many genera, estimated at approximately 58 genera. Its cultivation spreads in warm and hot areas, i.e. in tropical and semi-tropical areas, jujube fruits are used as the main food for the rural population; its leaves as fodder for animals and wood as fuel. The branches of the trees are used as fences as well as the use of its parts in the manufacture of medicine (Saied *et al*., 2008).

One of the problems facing cultivation of jujube is salinity, increasing of the concentration of salts (sodium chloride and others) at the root zone of the plant. Salinity can be considered one of the main obstacles facing agriculture sector in central and southern Iraq. For that reason, the salinity is considered a determining factor for the cultivation and success of many agricultural crops, including jujube that affects the health and productivity of trees (Al-Juburi & Maroff, 2007). Although jujube have antioxidants that are naturally present in the plant, they are sometimes not enough to resist salt stress, in order to overcome this problem, it was possible to use antioxidants of natural source extracted from seaweed (Shi *et al*., 2018). Thus, some plant growth regulators such as salicylic acid, puterescine can be used to reduce the salinity damage on the plants by regulating the osmotic pressure of cells and leads to the regulation and encouragement of growth under conditions of salt stress and improving productivity and fruiting traits (Al-Juburi & Maroff, 2007). The physical traits of the fruits are indicators of maturity represented by the size, phase of growth, diameter, and fruit weight (Hernández *et al*., 2006). Several studies were conducted to show to evaluate the physical traits of jujube trees. Al-Miahy & Abbas (2006) studied ten cultivars of jujube trees, and indicated that the fruits size ranged from 14.5-24.00 cm, while the diameter was about 3.09-4.60 cm. Obeed *et al*. (2008) evaluated the fruits of jujube trees Al-Tufahi cultivar; they found that the size of the fruits was about 35.5-35.63 cm, while their length was about 3.96-4.04 cm, and the diameter ranged from 4.00-4.01 cm. Artificial plant hormones (Growth regulators) work as antioxidants to improve the physical properties of jujube fruits. There are many growth regulators, like NAA, GA3, ethephon, ethylene and salicylic acid, which have an important role in improving the ripening of fruits and its quality (Mccellan & Chang, 2008). Growth regulators (H_3BO_3, NAA, GA3, 2.4-D, $ZnSo_4$) also work to deal with the abiotic problems and biological stress by spraying jujube trees (Majumder *et al*., 2017). Jujube trees CV. Al-Tufahi were sprayed by NAA and GA3 at concentrations (10 and 20 ppm) at 15 days before and after flowering; Spraying with GA3 increase the weight and size of the fruits. However, spraying by NAA led to a reduction in the weight of the fruits (Al-Miahy & Abbas, 2006). Due to the lack of studies on the knowledge of natural and non-synthetic antioxidants in the treatment of salt stress, the study aimed to:

i- Studying the role of natural antioxidants in the treatment of salt stress and the extent of its impact on improving the vegetative and fruitful growth of jujube trees.

ii- Studying the differentiation between cultivars in salt tolerance and productivity.

iii- Studying the interaction between the cultivar and the antioxidant.

Materials & Methods

This study was conducted during the growing season of 2020-2021 in a private orchards in Al-Haritha region, 30 km Northern Basra province. The effect of the antioxidant dealing with salt stress was studied and some chemical components (total acidity, total chlorophyll and carotene) were examined. The treatments were applied during the period starting from seven weeks after flowering (7, 10, 13, 16 and 17) weeks after flowering.

Jujube trees

Two types of jujube trees were selected: Al-Tufahi and Alarmouti, which are considered among the jujube cultivars desired by consumers and the most prevalent in Basra province. Nine trees were selected for each cultivar; these trees were similar in size and age as much as possible, as well as disease-free. The trees were identified by placing numbered signs on them according to the treatments.

Service operations

All agricultural service operations were conducted, consisting the hoeing the soil and fertilizing with chemical fertilizer in the amount of 300 kg for each tree, removing weeds, pruning trees by removing dry, infected, and intertwining branches during September.

Application of the treatments

Trees were treated with an antioxidant (natural ingredients and free of chemical compounds). The treatments were prepared in different concentrations to determine the extent of the trees' resistance when exposed to salt stress. The first treatment was prepared by dissolving 75 ml of the nutrient solution in 25 liters of water to obtain a concentration of 3% with the addition of a little diffuser Tween 20, while the second treatment was prepared by dissolving 150 ml of the nutrient solution in 25 liters of water to obtain a concentration of 6% with the addition of a little diffuser Tween 20. The trees were sprayed early morning to wetness using a hydraulic pump with a capacity of 15 m3. The first spray was conducted on 5/9/2020 before the beginning of the flowering, and the fruits were held on 5/11/2020; the spray continued during fruits growth March with an interval between sprays about six weeks. The control treatment was 0%, and it was prepared from distilled water only.

Jujube Fruits Traits

Samples were collected with a certain amount for each experimental unit from both Al-Tufahi and Alarmouti cultivars randomly. The physical and chemical traits were measured in order to know the changes occurring in the fruits from the beginning of growth after fruit set to the full maturity of the fruits.

Physical traits

Size, length, diameter, fresh and dry weight of jujube fruits

The fruit size was estimated using the method of the quantity of displaced water, by placing a known quantity of water inside a numbered cylinder of a liter capacity. The length and diameter were estimated using Electronic Vernia. The fresh weight was calculated using a sensitive electric balance Sartorius type. The total weight of the fruit was averaged, and then the seed was separated from the flesh of the fruit. The fresh weight was measured separately, and the dry weight was calculated for each of the above and that by drying the fruits and seeds by an electric oven at a temperature of 65 for two days; the fruits were weighed on the same scale for each of the fruit flesh and seeds.

Chemical traits

1- Total chlorophyll pigment of the fruit peels (mg.100gm^{-1})

The total chlorophyll in the peels of fresh fruits was determined according to Zaehringer *et al* described in Goodwin (1976), at a weight of 0.5 g of the flesh of the fresh fruits and crushed by a ceramic mortar with the addition of 80% acetone. Then the samples were placed in tubes and filtered by means of a centrifuge, then the optical absorbance was measured at the wavelengths 663 nm for chlorophyll a and 645 nm for chlorophyll b using a spectrophotometer type 1700-UV. Shimadzu, the total chlorophyll was estimated according to the following equation:

$$\text{Total chlorophyll (mg/L)} = 20.2 * (645)\,\text{O.D} + 8{,}02 * (663)\,\text{O.D}$$

where O.D is the spectrophotometer reading.

Carotene pigment content of the fruits

The carotene pigment was extracted from the peels of the fresh fruits in the same method as the above-mentioned chlorophyll pigment. The optical absorbance was measured at a wavelength of 480 nm. The carotene pigment was estimated according to the equation:

$$X = (E * Y/e * 100) * 1000$$

X is the number of milligrams of carotene in cm^3 of the solution.

The device reads at a wavelength of 480nm.

E The specific extinction coefficient of the total carotenoids is 2300.

Y represents the final solution after dilution with acetone.

The results were converted into units ($mg.100g^{-1}$).

Estimation of the total neutralizing acidity:

The total acidity was estimated at each sampling date using the method (A.O.A.C, 2016) by mashing 5 g of fresh fruit pulp with 100 ml of distilled water. Then the sample was filtered by gauze and 10 ml of filtered juice was taken and wiped with 0.1 N sodium hydroxide by two drops of phenolphthalein index until reaching the equilibrium point (the appearance of pink color).The percentage of total acidity was calculated through the following equation:

$$\text{Total acidity} = \text{base standard} * \text{its quantity} * 0.064 * \text{final volume of solution} / \text{volume of swab} * \text{weight of the sample} * 100$$

Statistical analyses

Randomized complete block design (R.C.B.D) was conducted with two factors, the first factor was cultivar (Alarmouti and Altfahi), and the second factor was an antioxidants (organic substances, amino acids and natural organic carbon) with three concentrations (0 and 5 and 8 $ml.L^{-1}$) using three replicates. The analysis was achieved by using SPSS ver. 24. For the comparison between the means, the Revised Least Significant Difference (R.L.S.D. was used at the probability level of 0.05 (Al-Rawi & Khalaf Allah, 2000).

Results

Table (1) showed that the jujube Alarmouti cultivar was excelled in size, length and diameter, recording (4.32 cm 3, 22.64 mm and 18.721 mm) after seven weeks of flowering.

The concentration of 6 $ml.L^{-1}$ antioxidant was excelled in the traits of size, length, and diameter, with the highest values. The bi-interaction also had a significant effect on all studied traits.

Table (2) showed the jujube Alarmouti cultivar in the traits: the highest values of the fresh weight for fruit, the weight of the fresh flesh of the fruit were 4.327 and 3.507 g, respectively. Non-significant differences were observed between the cultivars in the trait of the fresh weight of the seed. The concentration of 6 $ml.L^{-1}$ was significantly excelled in most of the studied traits, the fresh weight of fruit and the fresh weight of the fruit flesh; the same table showed significant differences for the bi-interaction between the cultivars and the concentration of the antioxidant used.

Table (1): Effect of cultivar and antioxidant on some physical traits after seven weeks of flowering.

		Size (cm^3)		length (mm)		Diameter (mm)
		Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti
0 ml.L^{-1}		2.07±0.26^{d}	2.63±0.73^{d}	18.67±0.89^{e}	20.14±0.31^{de}	15.377±0.41^{e}	16.630±0.31^{d}
3 ml.L^{-1}		4.14±0.37^{c}	4.69±0.12^{bc}	21.31±0.98^{cd}	22.37±0.70^{bc}	17.550±0.04^{c}	19.243±0.41^{b}
6 ml.L^{-1}		5.22±0.15^{ab}	5.63±0.35^{a}	23.29±0.51^{b}	25.40±0.22^{a}	18.147±0.31^{c}	20.290±0.14^{a}
cultivar average		3.81±1.28^{a}	4.32±1.39^{a}	21.09±2.30^{b}	22.64±1.94^{a}	17.024±1.56^{b}	18.721±1.23^{a}
concentration average	0 ml.L^{-1}	2.35±0.62^{c}		19.40±0.97^{c}		16.003±0.72^{c}	
	3 ml.L^{-1}	4.42±0.30^{b}		21.84±0.81^{b}		18.397±0.92^{b}	
	6 ml.L^{-1}	5.43±0.41^{a}		24.35±1.27^{a}		19.218±1.07^{a}	

Table (2): Effect of cultivar and antioxidant on some physical traits after seven weeks of flowering.

		The fresh weight for fruit(g)		The fresh weight of the fruit flesh (g)		Fresh seed weight (g)	
		Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti
0 ml.L^{-1}		2.100±0.286^{e}	2.667±0.081^{de}	1.100±0.290^{e}	1.847±0.081^{d}	1.00±0.086^{a}	0.820±0.141^{ab}
3 ml.L^{-1}		3.120±0.583^{d}	3.957±0.068^{c}	2.133±0.401^{d}	3.220±0.047^{c}	0.987±0.182^{ab}	0.737±0.047^{ab}
6 ml.L^{-1}		5.113±0.226^{b}	6.357±0.93^{a}	4.217±0.281^{b}	5.453±0.012^{a}	0.897±0.068^{ab}	0.903±0.086^{ab}
cultivar average		3.444±1.579^{b}	4.327±1.254^{a}	2.483±1.522^{b}	3.507±1.297^{a}	0.961±0.140^{a}	0.820±0.109^{a}
concentration average	0 ml.L^{-1}	2.383±0.353^{b}		1.473±0.429^{c}		0.910±0.147	
	3 ml.L^{-1}	3.538±0.452^{a}		2.677±0.579^{b}		0.862±0.138	
	6 ml.L^{-1}	2.383±0.749^{b}		4.835±0.680^{a}		0.900±0.142	

Table (3) showed jujube Alarmouti the dry weight of the fruit and dry weight of flesh (3.18 and 2.617) g, the dry weight of the seed, and the Al-Tufahi cultivar was excelled by recording the highest values of 0.751 g in comparison with the cultivar Alarmouti 0.559 g. The control treatment was significantly excelled on to the third concentration of antioxidant 6 $ml.L^{-1}$. The bi-interaction has a significant effect on the studied treatments. The results of table (4) after 10 weeks of flowering showed that the cultivar Alarmouti excelled in all the studied traits, the size, length and diameter, of the fruit (5.233 cm^3, 23.62 mm and 19.75 mm), respectively, As well as the concentration of 6 $ml.L^{-1}$ was significantly excelled in all traits, and there are significant differences for the bi-interactions of the studied traits. Table (5) showed Alarmouti cultivar excelled in all the studied traits: fresh weight for fruit, fresh fruit flesh weight, and fresh seed weight, as well as the concentration 6 $ml.L^{-1}$ excelled in all traits table (5). The Alarmouti cultivar with concentration 6 $ml.L^{-1}$ had the highest values for all traits. Table (6) showed the effect of the cultivar and the concentration of antioxidants and their interactions on the dry weight of flesh and dry weight of the seed (4.42, 2.92 and 1.50) g in which the Alarmouti cultivar excelled by 1.50 g. The table also showed that there were significant differences between the concentration of the antioxidant used, as well as the bi- interaction.

The results of table (7), showed the cultivar Alarmouti excelled in all the studied traits after 10 weeks of flowering of size, length and, diameter of the fruit, which were recorded (7.663 cm^3, 30.74 mm and 24.08 mm), respectively, and the concentration 6 ml. L^{-1} was significantly excelled in the studied traits. The results also showed the effect of the bi-interaction significantly on the studied traits, and it showed the Alarmouti cultivar treatment and the antioxidant concentration of 6 $ml.L^{-1}$ clear significant difference in all traits. Whereas jujube Alarmouti cultivar was significantly excelled on the studied traits, where the table (8) indicates that there was no significance for the fresh weight of the seed among the cultivars. The table gave similar results in terms of the concentration used of the antioxidant 6 ml. L^{-1} was excelled on the other treatments of the studied trait, except for the soft seed weight, which was recorded as non-significant. Also, table (9) recorded significant differences between the cultivars and the concentrations used of the antioxidant, as well as the significant bi-interaction.

The results of the current study showed in Table (10), after 16 weeks of flowering, Alarmouti cultivar was significantly excelled in the traits of size, length and diameter, of the fresh fruit (9.073 cm^3, 33.84 mm and, 26.30mm), respectively, and the concentration 6 ml. L^{-1} has recorded the highest values significantly for the studied traits. The table also showed the effect of interaction in the traits and it was significant. Table (11) showed similar results to table (10) in terms of the Alarmouti cultivar and the concentration of 6 ml. L^{-1} excelled in most traits except for fresh weight of flesh.The Al-Tufahi cultivar in seed dry weight (table 12) and the absence of significant differences between the concentrations used for the antioxidant. As well as for the bi-interaction between the cultivar and the concentration of the antioxidant.

Table (3): Effect of cultivar and antioxidant on some physical traits after seven weeks of flowering.

	The dry weight of the fruit (g)		Dry weight of flesh (g)		The dry weight of seed (g)	
	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti
0 ml.L^{-1}	1.03±0.377^{e}	1.73±0.047^{de}	0.210±0.290^{e}	0.957±0.081^{d}	0.823±0.89^{ab}	0.777±0.047^{ab}
3 ml.L^{-1}	2.08±0.478^{cd}	2.92±0.030^{c}	1.243±0.401^{d}	2.330±0.030^{c}	0.840±0.153^{a}	0.587±0.077^{ab}
6 ml.L^{-1}	3.92±0.635^{b}	4.88±0.340^{a}	3.327±0.281^{b}	4.563±0.340^{a}	0.590±0.357^{ab}	0.313±0.328^{b}
cultivar average	2.34±1.392^{b}	3.18±1.208^{a}	1.593±1.522^{b}	2.617±1.297^{a}	0.751±0.299^{a}	0.559±0.227^{a}
concentration average	0 ml.L^{-1}	1.38±0.441^{c}	0.583±0.429^{c}		0.800±0.080^{a}	
	3 ml.L^{-1}	2.50±0.613^{b}	1.787±0.579^{b}		0.713±0.287^{a}	
	6 ml.L^{-1}	4.40±0.634^{a}	3.945±0.680^{a}		0.452±0.291^{a}	

Table (4): Effect of cultivar and antioxidant on some physical traits after 10 weeks of flowering.

	Size (cm^{3})		length (mm)		Diameter (mm)	
	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti
0 ml.L^{-1}	3.400±0.368^{c}	3.967±0.432^{c}	20.27±0.830^{d}	21.73±0.679^{bc}	18.14±1.009^{bc}	18.20±1.468^{bc}
3 ml.L^{-1}	5.047±0.355^{b}	5.500±0.041^{ab}	21.04±0.520^{cd}	23.08±0.818^{b}	17.67±0.589^{c}	19.50±0.801^{b}
6 ml.L^{-1}	5.667±0.205^{ab}	6.233±0.339^{a}	25.60±0.433^{a}	26.05±0.276^{a}	19.40±0.416^{b}	21.56±0.694^{a}
cultivar average	4.704±0.966^{b}	5.233±1.008^{a}	22.15±1.907^{b}	23.62±2.240^{a}	19.75±1.557^{b}	18.40±1.276^{a}
concentration average	0 ml.L^{-1}	3.683±0.491^{c}	21.00±1.052^{c}		18.17±1.260^{b}	
	3 ml.L^{-1}	5.273±0.339^{b}	22.06±1.229^{b}		18.59±1.151^{b}	
	6 ml.L^{-1}	5.950±0.398^{a}	25.60±0.573^{a}		20.48±1.219^{a}	

Table (5): Effect of cultivar and antioxidant on some physical traits after 10 weeks of flowering.

	The fresh weight for fruit(g)		The fresh weight of the fruit flesh (g)		Fresh seed weight (g)	
	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti
0 ml.L^{-1}	3.84±0.781^{d}	4.69±0.915^{cd}	2.66±0.576^{c}	3.81±0.208^{bc}	1.18±0.595^{ab}	0.87±0.478^{b}
3 ml.L^{-1}	5.64±0.385^{bc}	6.26±0.311^{ab}	3.49±0.160^{c}	4.93±0.688ab	2.15±0.678^{a}	1.33±0.239^{ab}
6 ml.L^{-1}	6.43±0.148^{ab}	7.19±0.408^{a}	5.08±0.349^{ab}	5.67±0.217^{a}	1.34±0.327^{ab}	1.53±0.705^{ab}
cultivar average	5.30±1.139^{b}	6.05±1.241^{a}	3.74±0.484^{b}	4.80±0.605^{a}	1.56±1.178^{a}	1.24±0.874^{a}
concentration average	0 ml.L^{-1}	4.26±0.926^{c}	3.23±0.459^{b}		1.03±0.629^{a}	
	3 ml.L^{-1}	5.95±0.468^{b}	4.21±0.644^{b}		1.74±0.977^{a}	
	6 ml.L^{-1}	6.81±0.491^{a}	5.37±0.304^{a}		1.43±0.868^{a}	

Table (6): Effect of cultivar and antioxidant on some physical traits after 10 weeks of flowering.

	The dry weight of the fruit (g)		Dry weight of flesh (g)		The dry weight of seed(g)	
	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti
0 ml.L^{-1}	2.34±0.690^{d}	2.98±1.102^{cd}	1.11±0.167^{d}	2.01±0.887^{cd}	1.23±0.735^{a}	0.98±0.505^{a}
3 ml.L^{-1}	3.18±0.230^{cd}	4.85±0.393^{ab}	2.16±0.171^{bc}	2.99±0.379^{ab}	1.03±0.507^{a}	1.87±0.617^{a}
6 ml.L^{-1}	4.07±0.301^{bc}	5.42±0.192^{a}	3.02±0.086^{ab}	3.76±0.208^{a}	1.06±0.294^{a}	1.66±0.511^{a}
cultivar average	3.20±0.887^{b}	4.42±1.217^{a}	2.09±0.732^{b}	2.92±0.967^{a}	1.10±0.662^{a}	1.50±0.554^{a}
concentration average	0 ml.L^{-1}	2.66±1.086^{b}	1.56±0.781^{c}		1.10±0.643^{a}	
	3 ml.L^{-1}	4.02±0.787^{a}	2.57±0.508^{b}		1.45±0.704^{a}	
	6 ml.L^{-1}	4.75±0.386^{a}	3.39±0.404^{a}		1.36±0.514^{a}	

Table (7): Effect of cultivar and antioxidant on some physical traits after 13 weeks of flowering

	Size (cm^3)		length (mm)		Diameter (mm)	
	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti
0 $ml.L^{-1}$	5.800±0.432^{e}	6.367±0.368^{d}	27.39±0.679^{d}	28.85±0.830^{c}	22.47±1.468^{bc}	22.53±1.009^{bc}
3 $ml.L^{-1}$	7.447±0.041^{c}	7.900±0.355^{bc}	28.16±0.818^{cd}	3020±0.520^{b}	22.00± 0.801^{c}	23.83±0.589^{b}
6 $ml.L^{-1}$	8.067±0.339^{b}	8.633±0.205^{a}	32.28±0.276^{a}	33.17±0.433^{a}	23.73±0.694 ^{b}	25.89±0.416^{a}
cultivar average	7.104±0.996^{b}	7.663±1.008^{a}	29.27±1.907^{b}	30.74±2.240^{a}	22.73±1.557^{b}	24.08±1.276^{a}
concentration average	0 $ml.L^{-1}$	6.083±2.198^{c}	28.12±1.052^{c}		22.50±1.260^{a}	
	3 $ml.L^{-1}$	7.673±0.339^{b}	29.18±1.229^{b}		22.91±1.151^{b}	
	6 $ml.L^{-1}$	8.350±0.398^{a}	32.72±0.573^{a}		24.81±1.219^{a}	

Table (8): Effect of cultivar and antioxidant on some physical traits after 13 weeks of flowering.

	The fresh weight for fruit (g)		The fresh weight of the fruit flesh (g)		Fresh seed weight (g)	
	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti
0 $ml.L^{-1}$	7.96±0.915^{d}	8.81±0.718^{cd}	3.79±0.208^{c}	4.94±0.576^{bc}	4.17±1.120^{ab}	3.86±0.690^{b}
3 $ml.L^{-1}$	9.76±0.311^{bc}	10.38±0.385^{ab}	4.62± 0.688^{c}	6.06± 0.160^{ab}	5.14±0.393^{a}	4.32±0.230^{ab}
6 $ml.L^{-1}$	10.55±0.408^{ab}	11.31±0.148^{a}	6.21± 0.217^{ab}	6.80± 0.349^{a}	4.33±0.192^{ab}	4.52±0.301^{ab}
cultivar average	9.42±1.241^{b}	10.17±1.139^{a}	4.87±0.605^{b}	5.93±0.484^{a}	4.55±1.217^{a}	4.23±0.887^{a}
concentration average	0 $ml.L^{-1}$	8.38±0.926^{c}	4.37±0.459^{c}		4.02±0.781^{b}	
	3 $ml.L^{-1}$	10.07±0.468^{b}	5.34±0.644^{b}		4.73±0.509^{a}	
	6 $ml.L^{-1}$	10.95±0.491^{a}	6.50±0.304^{a}		4.42±0.404^{ab}	

Table (9): Effect of cultivar and antioxidant on some physical traits after 13 weeks of flowering.

	The dry weight of the fruit (g)		Dry weight of flesh (g)		The dry weight of seed (g)	
	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti
0 $ml.L^{-1}$	4.20±1.102c	4.84±0.690^{c}	2.53±0.915^{c}	3.43±0.718^{b}	1.67±0.887^{a}	1.42±0.167^{a}
3 $ml.L^{-1}$	5.04±0.393 ^{bc}	6.71±0.301^{ab}	3.58±0.311^{b}	4.41±0.385^{ab}	1.47±0.379^{a}	2.31±0.171^{a}
6 $ml.L^{-1}$	5.93±0.192^{b}	7.28±0.327^{a}	4.44±0.408^{ab}	5.18±0.148^{a}	1.50±0.208^{a}	2.10±0.086^{a}
cultivar average	5.06±1.217^{b}	.628±0.887^{a}	3.51±0.74^{b}	4.34±1.178^{a}	1.55±0.605^{a}	1.94±0.484^{a}
concentration average	0 $ml.L^{-1}$	4.52±1.086^{b}	2.98±0.629^{c}		1.55±0.782^{a}	
	3 $ml.L^{-1}$	5.88±0.787^{a}	3.99±0.977^{b}		1.89±0.506^{a}	
	6 $ml.L^{-1}$	6.60±0.386^{a}	4.81±0.868^{a}		1.80±0.407^{a}	

Table (10): Effect of cultivar and antioxidant on some physical traits after 16 weeks of flowering.

	Size (cm^3)		length (mm)		Diameter (mm)	
	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti
0 $ml.L^{-1}$	7.240±0.432^{e}	7.807±0.368^{d}	30.49±0.679^{d}	31.95±0.830^{c}	24.69±1.468^{cd}	24.75±1.009^{bcd}
3 $ml.L^{-1}$	8.887±0.041^{c}	9.340±0.355^{bc}	31.26±0.818^{cd}	33.30±0.520^{b}	24.22±0.801^{d}	26.05±0.589^{b}
6 $ml.L^{-1}$	9.507±0.339^{b}	10.073±0.205^{a}	35.38±0.276^{a}	36.27±0.433^{a}	25.95±0.694^{bc}	28.11±0.416^{a}
cultivar average	8.544±1.008^{b}	9.073±0.996^{a}	32.37±2.240^{b}	33.84±1.907^{a}	24.95±1.276^{b}	26.30±1.557^{a}
concentration average	0 $ml.L^{-1}$	7.523±0.491^{c}	31.22±1.052^{c}		24.72±1.260^{b}	
	3 $ml.L^{-1}$	9.113±0.339^{b}	32.28±0.229^{b}		25.14±1.151^{b}	
	6 $ml.L^{-1}$	9.790±0.398^{a}	35.82±0.573^{a}		27.03±1.219^{a}	

Table (11): Effect of cultivar and antioxidant on some physical traits after 16 weeks of flowering.

	The fresh weight for fruit (g)		The fresh weight of the fruit flesh (g)		Fresh seed weight (g)	
	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti
0 $ml.L^{-1}$	10.77±0.915[c]	11.70±0.718[bc]	5.96±1.102[d]	6.23±0.690[d]	.482±0.787[a]	5.47±0.887[a]
3 $ml.L^{-1}$	.1164±0.311[bc]	12.34±0.230[b]	7.29±0.339[c]	8.51±0.230[ab]	.435±0.564[a]	3.83±0.379[a]
6 $ml.L^{-1}$	13.58±0.408[a]	13.96±0.148[a]	8.14±0.192[bc]	9.31±0.301[a]	5.44±0.823[a]	.465±0.802[a]
cultivar average	12.00±1.241[b]	12.66±1.139[a]	7.13±1.217[b]	8.01±0.887[a]	.487±0.967[a]	.456±0.732[a]
concentration average	0 $ml.L^{-1}$	.1124±0.926[b]	6.09±1.086[c]		5.14±0.781	
	3 $ml.L^{-1}$	11.99±0.468[b]	7.90±0.787[b]		.409±0.509[a]	
	6 $ml.L^{-1}$	.1377±0.491[a]	8.73±0.386[a]		5.05±0.404[a]	

Table (12): Effect of cultivar and antioxidant on some physical traits after 16 weeks of flowering.

	The dry weight of the fruit (g)		Dry weight of flesh (g)		The dry weight of seed(g	
	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti
0 $ml.L^{-1}$	6.658±0.208[f]	7.305±0.576[e]	5.450±0.478[d]	6.100±0.595[c]	1.208± 0.505[a]	1.206±0.735[a]
3 $ml.L^{-1}$	7.466±0.688[d]	.9746±0.160[a]	6.230±0.239[c]	8.550±0.678[a]	1.236±0.617[a]	1.196±0.507[a]
6 $ml.L^{-1}$	8.313±0.217[c]	.9216±0.349[b]	7.110±0.705[b]	8.343±0.327[a]	1.204±0.511[a]	1.873±0.294[a]
cultivar average	7.479±0.605[b]	8.755±0.487[a]	6.263±0.662[b]	7.664±1.178[a]	1.216±0.554[a]	1.091±0.662[a]
concentration average	0 $ml.L^{-1}$	6.981±0.459[c]	5.775±0.629[c]		1.207±0.643[a]	
	3 $ml.L^{-1}$	8.606±0.644[b]	7.390±0.977[b]		1.216±0.704[a]	
	6 $ml.L^{-1}$	8.764±0.304[a]	7.727±0.868[a]		1.031±0.514[a]	

It is noticed from the table after 17 weeks of flowering (13) that the results of the previous tables were similar to the results of the current table, with the Alarmouti cultivar in most of the physical traits, as well as the concentration of 6 $ml.L^{-1}$. The Alarmouti cultivar was recorded with a concentration of 6 ml. L^{-1} had the highest values of bi-interaction in most traits. As for the table, it is noted that (14) of seed fresh weight, which was significant between the cultivars, the concentrations used and the bi-interaction. All factors of table (15), were significant in terms of the effect of cultivar, concentration and bi-interaction. The chemical traits after seven weeks of flowering (Table 16) showed the Alarmouti cultivar in both total chlorophyll and carotene and non-significant acidity. The concentration of 6 ml. L^{-1} of the antioxidant recorded the highest numbers and significantly for both total chlorophyll and carotene. The significant effect of the bi-interaction of the two traits (chlorophyll and carotene) and the non-significance of the acidity trait.

The results of table (17) indicated that the concentration 6 $ml.L^{-1}$ was significantly excelled in acidity, and the bi-interaction was also significant, where the cultivar Alarmouti and the concentration were 6 $ml.L^{-1}$ antioxidant, the highest values for this trait reached 2.305 $mg.L^{-1}$.

Table (18) showed the Alarmouti cultivate excelled in total chlorophyll, carotene, and acidity (1.837, 0.690, and 0.744) mg. L^{-1}. The concentration recorded a significant difference for the studied traits. Also the bi-interaction had a significant difference.

It is noticed from table (19), 16 weeks after flowering that there were no differences between the cultivars for acidity with significant differences for the other two traits, as the concentration was recorded at 3 ml. L^{-1} has the highest values for acidity and 6 ml. L^{-1} for total chlorophyll and carotene. The table showed that there was a significant effect of the bi-interaction for the studied traits.

Table (20) revealed that there were no significant differences between total chlorophyll and acidity of the studied cultivars, however, there was a significant differences for caroten, also, the concentration of 6 $ml.L^{-1}$ recorded the highest values for chlorophyll and carotene, and the highest values for the concentration of 3 ml. L^{-1} for acidity. The results of the table also recorded significant bi-interactions for all trait.

Table (13): Effect of cultivar and antioxidant on some physical traits after 17 weeks of flowering.

	Size (cm^3)		length (mm)		Diameter (mm)	
	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti
0 $ml.L^{-1}$	11.41±0.664^{a}	9.81±0.659^{b}	32.64±0.679^{d}	34.10±0.830^{c}	25.79±1.468^{c}	25.85±1.009^{c}
3 $ml.L^{-1}$	11.89±0.367^{a}	11.17±0.974^{a}	33.41±0.818^{d}	35.45±0.520^{b}	25.32±0.801^{c}	27.15±0.589^{b}
6 $ml.L^{-1}$	12.51±0.956^{a}	12.24±0.294^{a}	37.53±0.276^{a}	38.42±0.433^{a}	27.05±0.694^{b}	29.21±0.416^{a}
cultivar average	11.93±0.836^{a}	11.07±1.217^{a}	34.52±2.240^{b}	35.99±1.907^{a}	26.05±1.279^{b}	27.40±1.557^{a}
concentration average	0 $ml.L^{-1}$	10.61±1.038^{b}	33.37±1.052^{c}		25.82±1.260^{b}	
	3 $ml.L^{-1}$	11.53±0.818^{ab}	34.43±1.229^{b}		26.23±1.151^{b}	
	6 $ml.L^{-1}$	12.37±0.720^{a}	37.97±0.573^{a}		28.13±1.219^{a}	

Table (14): Effect of cultivar and antioxidant on some physical traits after 17 weeks of flowering.

	The fresh weight for fruit (g)		The fresh weight of the fruit flesh (g)		Fresh seed weight (g)	
	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti
0 $ml.L^{-1}$	13.77±1.468^{bc}	14.20±0.687^{bc}	9.24±o.732^{bc}	9.59±0.735^{bc}	4.530±0.887^{a}	4.610±0.216^{a}
3 $ml.L^{-1}$	13.30±0.803^{c}	15.13±0.589^{b}	8.51±0.346^{c}	10.49±0.364^{b}	4.797±0.379^{a}	4.640±0.161^{a}
6 $ml.L^{-1}$	15.03±0.696^{b}	17.19±0.328^{a}	10.15±0.612^{bc}	12.52±0.321^{a}	4.887±0.207^{a}	4.667±0.668^{a}
cultivar average	14.03±1.276^{b}	15.50±1.367^{a}	9.30±0.766^{b}	10.86±0.707^{a}	4.738±0.961^{a}	4.639±0.732^{a}
concentration average	0 $ml.L^{-1}$	13.98±1.153^{b}	9.41±0.354^{b}		4.570±0.781^{a}	
	3 $ml.L^{-1}$	14.22±1.158^{b}	9.50±0.445^{b}		4.718±0.509^{a}	
	6 $ml.L^{-1}$	16.11±1.220^{a}	11.33±0.103^{a}		4.777±0.404^{a}	

Table (15): Effect of cultivar and antioxidant on some physical traits after 17 weeks of flowering.

	The dry weight of the fruit (g)		Dry weight of flesh (g)		The dry weight of seed(g)	
	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti
0 ml.L^{-1}	9.22±1.102[bc]	9.65±0.168[bc]	7.81±0.478[bc]	8.16±0.471[bc]	1.410±0.505[a]	1.490±0.741[a]
3 ml.L^{-1}	8.75±0.394[c]	10.58±0.230[b]	7.08±0.236[c]	9.06±0.678[b]	1.677±0.617[a]	1.520±0.507[a]
6 ml.L^{-1}	10.48±0.194[b]	12.64±0.086[a]	8.72±0.705[bc]	11.09±0.302[a]	1.767±0.511[a]	1.547±0.293[a]
cultivar average	9.48±1.217[b]	10.95±1.026[a]	7.87±0.874[b]	9.43±1.178[a]	1.618±0.554[a]	1.519±0.663[a]
concentration average	0 ml.L^{-1}	9.43±0.921[b]	7.98±0.629[b]		1.450±0.643[a]	
	3 ml.L^{-1}	9.67±0.510[b]	8.07±0.977[b]		1.598±0.704[a]	
	6 ml.L^{-1}	11.56±0.389[a]	9.90±0.868[a]		1.657±0.514[a]	

Table (16): Effect of the cultivar and antioxidant on some chemical traits after seven weeks of flowering.

	Chlorophyll mg.100 g		Carotene mg. 100 g		Acidity mg.L^{-1}	
	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti
0 ml.L^{-1}	1.944±0.129[c]	1.861±0.046[c]	0.525±0.001[d]	0.532±0.006[d]	1.263±0.209[a]	1.377±0.205[a]
3 ml.L^{-1}	1.893±0.048[c]	2.134±0.004[b]	0.585±0.049[c]	0.703±0.046[b]	1.294±0.084[a]	1.409±0.023[a]
6 ml.L^{-1}	1.996±0.685[c]	2.507±0.325[a]	0.708±0.018[b]	0.786±0.040[a]	1.489±0.104[a]	1.611±0.064[a]
cultivar average	1.944±0.538[b]	2.167±0.261[a]	0.606±0.075[b]	0.674±0.120[a]	1.349±0.312[a]	1.466±0.275[a]
concentration average	0 ml.L^{-1}	1.903±0.126[b]	0.529±0.004[c]		1.320±0.219[a]	
	3 ml.L^{-1}	2.014±0.095[b]	0.644±0.067[b]		1.352±0,081[a]	
	6 ml.L^{-1}	2.251±0.544[a]	0.747±0.052[a]		1.550±0.097[a]	

Table (17): Effect of cultivar and antioxidant on some chemical traits after 10 weeks of flowering.

	Chlorophyll mg.100 g		Carotene mg. 100 g		Acidity mg.L^{-1}	
	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti
0 ml.L^{-1}	1.834±0.110^{bc}	1.751±0.138^{c}	0.394±0.043^{bc}	0.311±0.028^{c}	1.542±0.110^{d}	1.687±0.138^{cd}
3 ml.L^{-1}	1.783±0.109^{c}	2.024±0.150^{b}	0.343± 0.076c	0.584±0.183^{b}	1.977±0.109^{bc}	2.088±0.150^{bc}
6 ml.L^{-1}	1.886±0.067^{bc}	2.397±0.057^{a}	0.446±0.017^{bc}	0.957±0.248^{a}	2.214±0.067^{ab}	2.305±0.057^{a}
cultivar average	1.834±0.106^{b}	2.057±0.291^{a}	0.394±0.109^{b}	0.617±0.234^{a}	1.911±0.106^{a}	2.027±0.291^{a}
concentration average	0 ml.L^{-1}	1.793±0.138^{b}	0.353±0.084^{b}		1.614±0.131^{c}	
	3 ml.L^{-1}	1.904±0.178^{b}	0.464±0.262^{b}		2.033±0.178^{b}	
	6 ml.L^{-1}	2.141±0.263^{a}	0.701±0.230^{a}		2.260±0.263^{a}	
RLSD interaction						

Table (18): Effect of the cultivar and antioxidant on some chemical traits after 13 weeks of flowering.

	Chlorophyll mg.100 g		Carotene mg. 100 g		Acidity mg.L^{-1}	
	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti
0 ml.L^{-1}	1.614±0.474^{bc}	1.531±0.698^{c}	0.521±0.007^{d}	0.518±0.030^{d}	1.139±0.242^{a}	1.172±0.324^{a}
3 ml.L^{-1}	1.563±0.048^{c}	1.804±0.120^{b}	0.612±0.065^{c}	0.729±0.043^{b}	0.301±0.159^{c}	0.640±0.363^{abc}
6 ml.L^{-1}	1.666±0.781^{bc}	2.177±0.334^{a}	0.747±0.018^{ab}	0.822±0.035^{a}	0.377±0.249^{c}	0.421±0.157^{bc}
cultivar average	1.614±0.705^{b}	1.837±0.635^{a}	0.627±0.1007^{b}	0.690±0.123^{a}	0.606±0.438^{a}	0.744±0.432^{a}
concentration average	0 ml.L^{-1}	1.573±0.632^{b}	0.519±0.021^{c}		1.156±0.287^{a}	
	3 ml.L^{-1}	1.684±0.782^{b}	0.671±0.080^{b}		0.471±0.327^{b}	
	6 ml.L^{-1}	1.921±0.562^{a}	0.784±0.046^{a}		0.399±0.210^{b}	

Table (19): Effect of the cultivar and antioxidant on some chemical traits after 16 weeks of flowering.

Fourth chemical	Chlorophyll mg.100 g		Carotene mg. 100 g		Acidity mg.L^{-1}	
	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti
0 ml.L^{-1}	1.484±0.489^{bcd}	1.401±0.702^{d}	0.587±0.007^{d}	0.584±0.030^{d}	0.999±0.242^{a}	1.032±0.324^{a}
3 ml.L^{-1}	1.433±0.042^{cd}	1.674±0.197^{b}	0.678±0.065^{c}	0.795±0.043^{b}	0.161±0.159^{d}	0.500±0.363^{bcd}
6 ml.L^{-1}	1.536±0.260^{bcd}	3.047±0.362^{a}	0.813±0.018^{ab}	0.888±0.035^{a}	0.237±0.249^{cd}	0.281±0.157^{bcd}
cultivar average	1.484±0.687^{b}	1.707±0.649^{a}	0.693±0.100^{b}	0.756±0.123^{a}	0.466±0.438^{a}	0.604±0.432^{a}
concentration average	0 ml.L^{-1}	1.443±0.638^{b}	0.585±0.021^{c}		1.016±0.287^{a}	
	3 ml.L^{-1}	1.554±0.808^{b}	0.737±0.080^{b}		0.331±0.309^{b}	
	6 ml.L^{-1}	1.791±0.332^{a}	0.850±0.046^{a}		0.259±0.210^{b}	

Table (20): Effect of the cultivar and antioxidant on some chemical traits after 17 weeks of flowering.

	Chlorophyll mg.100 g		Carotene mg. 100 g		Acidity mg.L^{-1}	
	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti	Al-Tfahi	Alarmouti
0 ml.L^{-1}	0.218±0.042^{f}	0.268±0.104^{cde}	0.596±0.004^{c}	0.603±0.036^{c}	0.877±0.268^{a}	0.880±0.271^{a}
3 ml.L^{-1}	0.232±0.026^{ef}	0.289±0.191^{bcde}	0.699±0.070^{b}	0.817±0.033^{a}	0.195±0.112^{d}	0.474±0.339^{abcd}
6 ml.L^{-1}	0.494±0.177^{cde}	0.636±0.095^{a}	0.828±0.030^{a}	0.903±0.032^{a}	0.226±0.237^{cd}	0.278±0.160^{bcd}
cultivar average	0.315±0.166^{a}	0.398±0.217^{a}	0.708±0.104^{b}	0.775±0.130^{a}	0.432±0.382^{b}	0.544±0.366^{a}
concentration average	0 ml.L^{-1}	0.243±0.083^{b}	0.599±0,026^{c}		0.879±0.270^{a}	
	3 ml.L^{-1}	0.260±0.139^{b}	0.758±0.08^{b}		0.335±0.289^{b}	
	6 ml.L^{-1}	0.565±0.159^{a}	0.866±0.048^{a}		0.252±0.204^{b}	

Discussion

The results of this study indicated that the cultivar and the concentration of antioxidants had a significant effect on the physical and chemical traits. The Armouti cultivar was excelled in most of the physical and chemical traits of the fruits, while the Al-Tufahi cultivar was excelled in the (the fresh weight of the seed). Perhaps the reason for the difference between the cultivars in the above-studied traits is due to the nature of the genetic structure of the cultivar and its ability to reduce the permeability of toxic ions in the root zone, including the sodium ion, and thus increase the availability to absorb mineral elements in the root zone and their transmission to the leaves and improve the osmotic pressure of cells and reach a state of equilibrium hormonal and nutritional support by maintaining a high ratio of potassium ions to sodium, which is one of the important factors for salinity resistance (Davarpanah *et al*,. 2016), which reflected positively on the physical and chemical traits by increasing the efficiency of physiological and biochemical processes such as photosynthesis, carbohydrate accumulation, protein synthesis and fat metabolism in plants under conditions of salt stress.

The results agreed with Soliman *et al*. (2015) on the palm trees (Zuhdi, Khastawi, Maktoum and Barben) cultivar were irrigated with salt water. The cultivars differed in the extent to which they were affected by salts, as the Maktum cultivar was affected more than other cultivars in the decrease of yield and other physical traits of the fruits and the content of the leaves of mineral elements, while the Zuhdi cultivar was the least affected (Al-abdoulhadi *et al*, 2012). The high salinity affected the photosynthesis process and the chlorophyll content of the leaves, and the Akhilas cultivar was more tolerant than the Majhul and al-Barhi cultivar. It was concluded that although the date palm is one of the trees that tolerate relatively high degrees of salinity, the growth of the palm and the yield of the fruits are greatly affected at high salinity and that the cultivars differ in the degree of their tolerance to salinity (Al-Hasnawi *et al*., 2016; Altemimy *et al*., 2019). The results also showed that spraying with different concentrations of the antioxidant had an effect on improving the physical and chemical traits under the conditions of salt stress, where the micro mineral elements (Fe, Zn, Cu, B, Mn and Mo) that the antioxidant contains play an important role in resisting the conditions of salinity. salinity and increase growth and production by filling the plant's need of the necessary micro- elements and in sufficient quantities, Some antioxidants controlling the absorption of sodium and other toxic ions through its role in protecting the structure of the plasma membrane of cells and inhibiting the action of the enzyme NADPH oxidase associated with the plasma membrane, which is responsible for activating free oxygen radicals in the cell (Pinton *et al*, 1994). Zinc also stimulates the formation of the amino acid tryptophan, which is the initiating compound for the synthesis of IAA. Auxin is known to increase water absorption and protein synthesis and increases the elasticity and elasticity of cell walls, and this leads to stimulating the process of cell division and elongation (Jain, 2017).

The increase in the weight of flesh, the weight of the seed, the length and diameter of the fruit when using different concentrations of antioxidants, may be due to the role of the microelements contained in the compound (zinc, iron, copper and manganese) in increasing the activity of photosynthesis enzymes and increasing the concentration of chlorophyll and thus increasing the efficiency of Photosynthesis and accumulation of manufactured materials (Jain, 2017). Another reason may be due to the role of iron in the activity of enzymes that participate in the photosynthesis process, as it enters the formation of ferredoxin, which contributes to the processes of oxidation and reduction, by transferring electrons in the process of photosynthesis, and the mineral flavoprotein complex that enters the composition of the antioxidant enzymes Catalase and Peroxidase. In addition to the important role of manganese in the process of photosynthesis and the formation of the chlorophyll molecule, amino acids, and proteins, and its participation with K, Zn, B and Ca in regulating the osmotic effort of cells, which increases the resistance of plants to salt stress conditions (Kamiab & Bahramabadi, 2016; Abd *et al*., 2020) and this activity leads to a greater accumulation of food Such as sugars, proteins, acids and water in the dilated cells and consequently an increase in the weight of the seed and the flesh and the length and diameter of the fruit, which was positively reflected in the increase in the weight and size of the fruit. These results were in agree with what was reached by Davarpanah *et al*. (2016) on pomegranate trees, which caused a significant increase in the length and diameter of the fruit and the weight and size of the fruit.

Zagzog & Gad (2017) found on mango trees recorded the highest average in the length and diameter of the fruit and the size of the fruit and the weight of the fruit. As for the reason for the increase in the leaves' content of total chlorophyll, carotene, and acidity with the use of antioxidants, it may be attributed to the role of micro elements in reducing the effect of salt stress on the plant and protecting the chlorophyll molecule from demolition and prolonging its life. Zinc contributes indirectly to the formation of chlorophyll through its role in activating the enzyme carbonic anhydrase, which acts as a buffer regulator for the pH inside the chloroplasts to protect proteins from losing their vital nature in addition to its active role as an antioxidant cofactor (Sabir *et al*., 2014).

Conclusions

The results of this study concluded that it is possible to use the antioxidant at a concentration of 6 ml. L^{-1}. In order to obtain the best results for all the studied traits. The cultivar, Armouti significantly excelled compared to the Altfahi cultivar. It is also possible to use the bi-interaction of the armature with a concentration of 6 ml.L^{-1} for best results.

Acknowledgements

The authors thanks to Prof. Dr. Sabah Al-Shatti, Department of Food Science, for providing some references, and Miss Esra A. Yousef, Basrah Journal for Agricultural Sciences for the technical support.

Conflicts of Interest: The authors declare no conflicts of interest.

Orcid

A.M. Abd https://orcid.org/0000-0002-2695-9485

References

Abd, A. M., Altemimy, I. H. H., & Altemimy. H. M. A. (2020) Evaluation of the effect of nano-fertilization and disper osmotic in treating the salinity of irrigation water on the chemical and mineral properties of date palm (*Phoenix dactylifera* L. *Basrah Journal of Agricultural Sciences, 33*(1), 68-88. https://doi.org/10.37077/25200860.2020.33.1.06

A.O.A.C. (2016). *Official Methods of Analysis of AOAC* International. 20th Edition, Washington D.C., 3172pp. https://www.techstreet.com/standards/official-methods-of-analysis-of-aoac-international-20th-edition-2016?product_id=1937367#jumps

Al-Abdoulhadi, I. A., Dinar, H. A., Ebert, G., & Buuml, C. (2012). Influence of salinity stress on photosynthesis and chlorophyll content in date palm (*Phoenix dactylifera* L.) cultivars. *African Journal of Agricultural Research*, *7*(22), 3314-3319. https://academicjournals.org/journal/AJAR/article-abstract/AA1574438996

Al-Juburi, H. J., & Maroff, A. (2007). The growth and mineral composition of hatamy date palm seedlings as affected by sea water and growth regulators. *Acta Horticulturae*, *736*(1), 161-176. https://doi.org/10.17660/ActaHortic.2007.736.13

Al-Hasnawi, A. N., Cheradziahi, C. M. Z., Kadhimi, Isahak, A. A., A., Mohamad, A., & Yusoff, W. M. W. (2016). Enhancement of antioxidant enzyme activities in rice callus by ascorbic acid under salinity stress. *Biologia Plantarum*, *60*(4), 783-787. https://doi.org/10.1007/s10535-016-0603-9

Al-Miahy, M. Z. S., & Abbas, M. F. (2006). Effect of $CaCl_2$ by Spraying on some chemical and physiological characters of jujube fruits cv.zaitoni and bambawi. *Basrah Journal of Agricultural Sciences*, *19*(2), 12-23. https://www.iasj.net/iasj/article/57304

Al-Rawi, K. M., & Khalaf Allah, A.M. (2000). *Design and Analysis of Agricultural Experiments.* Dar Al Kutub Printing & Publishing Est. 2nd ed. University of Mosul, Iraq, 488pp. (In Arabic).

Altemimy, H. M. A, Altemimy, I. H. H., & Abd, A. M. (2019). Evaluation the efficacy of nano-fertilization and Disper osmotic in treating salinity of irrigation water in quality and productivity properties of date palm *Phoenix dactylifera* L. IOP Conf. Series: *Earth and Environmental Science, 388*. https://doi:10.1088/1755-1315/388/1/012072

Davarpanaha, S., Tehranifar, A., Davaryneijad, Gh., Abadía, J., & Khorasani. R. (2016). Effects of foliar applications of zinc and boron nano-fertilizers onpomegranate (*Punica granatum* cv. Ardestani) fruit yield and quality. *Scientia Horticulturae, 210*, 57-64. https://doi.org/10.1016/j.scienta.2016.07.003

Goodwin, T. W. (1976). *Chemistry and Biochemistry of Plant Pigment*. 2nd ed. Academic Press, New York., 373pp. https://agris.fao.org/agris-search/search.do?recordID=US201300526331

Hernández-Muñoz, P., Almenar, E., Ocio, M. J., & Gavara, R. (2006). Effect of calcium dips and chitosan coatings on postharvest life of strawberries (*Fragaria x ananassa*). *Postharvest Biology and Technology*, *39*, 247-253. https://doi.org/10.1016/j.postharvbio.2005.11.006

Jain, V. K. (2017). *Fundamentals of Plant Physiology*. 19th ed. S. Chand and Company Ltd, Rom Nagar, 736pp. https://www.schandpublishing.com/books/higher-education/biology/fundamentals-plant-physiology/9789352533343/#.YPkfg8gzZdg

Kamiab, F., & Bahramabadi, E. Z. (2016). The effect of foliar application of nano-chelate super plus zfm on fruit set and some quantitative and qualitative traits of almond commercial cultivars. *Journal of Nuts*, *7*(1), 9-20. https://www.sid.ir/en/journal/ViewPaper.aspx?ID=506436

Majumder, I., Sau, S., Ghosh, B., Kundu, S., Roy, D., & Sarkar, S. (2017). Response of growth regulators and micronutrients on yield and physico-chemical quality of Ber (*Zizyphus mauritiana* Lamk) cv. BAU Kul-1. *Journal of Applied and Natural Science*, *9*(4), 2404-2409. http://dx.doi.org/10.31018/jans.v9i4.1545

McClellan, C. A., & Chang, C. (2008). The role of protein turnover in ethylene biosynthesis and response. *Plant Science*, *175*(1-2), 24-31. http://dx.doi.org/10.1016/j.plantsci.2008.01.004

Nasri-Ayachi, M. B., & Nabli, M. A. (2008). Floral biology study of *Ziziphus lotus* L. *In International Jujube Symposium*, *840*, 337-342. https://doi.org/10.17660/ActaHortic.2009.840.46

Obeed, R. S., Harhash, M. M., & Abdel-Mawgood, A. L. (2008). Fruit properties and genetic diversity of five ber (*Ziziphus mauritiana* Lamk*)* cultivars*. Pakistan Journal of Biological Sciences, 11*(6), 888-893. https://dx.doi.org/10.3923/pjbs.2008.888.893

Pinton, R., Cakmak, I., & Marschner, H. (1994). Zinc deficiency enhanced NAD (P) H-dependent superoxider radical production in plasma membrane vesicles isolated from roots of bean plants. *Journal of Experimental Botany*, *45*(1), 45-50. https://doi.org/10.1093/jxb/45.1.45

Sabir, S., Arshad, M., & Chaudhari, S. K. (2014). Zinc oxide nanoparticles for revolutionizing agriculture: Synthesis and applications. *Scientific*

World Journal Pakistan. 2014, Article ID 925494. https://doi.org/10.1155/2014/9254

Saied, A. S., Gebauer, J., Hammer, K., & Buerkert, A. (2008). *Ziziphus spina-christi* (L.) Willd.: A multipurpose fruit tree. *Genetic Resources and Crop Evolution*, *55*(7), 929-937. https://doi.org/10.1007/s10722-007-9299-1

Shi, Q., Zhang, Z., Su, J., Zhou, J., & Li, X. (2018). Comparative analysis of pigments, phenolics, and antioxidant activity of Chinese jujube (*Ziziphus jujuba* Mill.) during fruit development. *Molecules, 23*(8).1917. https://doi.org/10.3390/molecules23081917

Soliman, A. Sh., El-fek, S. A., & Darwish, E. (2015) Alleviation of salt stress on (*Moringa peregrine*) using foliar application of nanofertilizers. *Journal of Horticulture and Forestry*, 7(2), 36-47. https://doi.org/10.5897/JHF2014.0379

Zagzog, O. A., & Gad, M. M. (2017). Improving growth, flowering, fruiting and resistance of malformation of mango trees using nano-zinc. *Middle East Journal of Agricultural Research*, *6*(3), 673-681

دراسة اثر مضاد الاكسدة في صفات ثمار صنفين من السدر *Ziziphus mauritiana* Lamk. البمباوي والتفاحي

بشرى فاضل اسماعيل[1] وعبدالكريم محمد عبد[1] وفراس جميل جبار[2]

[1]قسم البستنة وهندسة الحدائق- كلية الزراعة- جامعة البصرة، العراق

[2]قسم الصيدلة، الجامعة التقنية الجنوبية، العراق

المستخلص : اجريت هذه الدراسة في احد البساتين الاهلية في منطقة الهارثة شمال مدينة البصرة . لدراسة تاثير رش مضاد الاكسدة بثلاث تراكيز هي (0 و3 و6) مل. لتر$^{-1}$ لصنفين من اصناف اشجار السدر وهما العرموطي والتفاحي. تم دراسة الصفات الفيزيائية لمراحل من نمو الثمرة ابتداءا من 50 يوم بعد الازهار الى النضج النهائي بعد 120 يوم من الازهار، حيث سجلت نتائج الدراسة تقدم الثمار بالنمو والتطور لكل الصفات المدروسة . كما سجلت الدراسة تفوق الصنف العرموطي معنويا في معظم الصفات المدروسة لمراحل النمو المختلفة حيث سجلت في مرحلة النضج النهائي اعلى القيم في الصفات الحجم والطول والقطر ووزن الثمرة لصنف العرموطي (11.07 سم^{3} و35.99ملم و27.40 ملم و21.97 غم) على التوالي. كما تفوق ايضا في الصفات الكيميائية وخلال مراحل النمو. كما بينت الدراسة تفوق تركيز مضاد الاكسدة 6 مل. لتر$^{-1}$ معنويا في معظم الصفات المدروسة الفيزيائية والكيميائية . كان التداخل الثنائي ايضا له الاثر المعنوي الواضح في الصفات المدروسة ، اما الوزن الطري للبذرة كانت غير معنوي بين الاصناف والتراكيز وكذلك التداخل الثنائي.

كلمات مفتاحية : اشجار السدر-مضاد الاكسدة-الصفات الفيزيائية-الصفات الكيميائية.