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Influence of ascorbic acid and tocopherol on the vegetative, physiological and chemical traits of dates palm tissue, Barhi cultivar, irrigated from the Shatt Al-Arab water

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Abstract

This study was conducted in one of the private orchards in Al-Dair district, north of Basra Governorate during the 2019 AD growing season, with the aim of studying the effect of foliar spray with antioxidants, Asc and Toc on some physiological and biochemical traits of tissue dates palm offshots, Al-Barhi cultivar which was irrigated from Shatt Al-Arab water. The experiment included seven treatments with antioxidants using the concentrations 125, 250 and 375 mg L^{-1} for each in addition to the control treatment (with distilled water only). The offshoots were sprayed four times. The results of the study showed the following: 1) The treatment of spraying with Toc at a concentration of 375 mg.L^{-1} recorded a significant difference in the increase of the height of the offshoot, and in the leaf content of the soluble protein f.w. The treatment also recorded the highest amount of P and K that reach 1.60 and 4.23 mg.g^{-1} d.w, respectively, and led to a decrease in the amount of Cl^{-}, as it reached 11.17 mg g^{-1} d.w. It also increased the activity of the Po enzyme, which reached 81.88 units g^{-1} d.w. 2) The results of the study showed that spraying with Asc with a concentration of 375 mg L^{-1} reported significantly higher increase in the number of leaves and the leaf area and % for the water content of the leaves. It also led to an increase in the pigment of total Chl, total soluble carbohydrates and vitamin C, whose concentrations in the leaves reached 6.92, 49.39 and 34.77 mg g^{-1} f.w. The same concentration of ascorbic acid reduced the proline and Na concentration in the leaves to 13.26 mg g^{-1} dry weight and 0.18 mg g^{-1} dry weight respectively. In addition, the treatment increased the concentration of N in the leaves that amounted to 21.33 mg.gm^{-1} d.w, as well as an increase in the K:Na to 22.50. It also led to lowering ABA to 41.83 µg g^{-1} f. w.

Keywords: ascorbic acid, Tocopherol, Date Palm Tissue, Peroxidase, ABA

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INTRODUCTION

The date palm tree *Phoenix dactylifera* L. belongs to the Arecaceae palm tree. It is believed that its native origin is southern Iraq and the Arab Gulf region, and is of great economic and social importance for many countries in the world (Zaid & De wet, 2002). Although date palm trees can grow in a wide range of environmental conditions, productivity is greatly affected by many environmental stress factors, especially saline stress, as salinity (soil salinity or irrigation water salinity) is one of the most important problems facing agriculture at Global scale, especially in arid and semi-arid regions (Munns & Tester 2008). Salinity affects more than 20% of irrigated land in the world, and Iraq is at the forefront of Arab and Asian countries in terms of the total area affected by salinity which the problem of salinity in Iraq has been aggravated in recent years due to water shortage, water resources, deteriorating water quality and poor management, and high levels of ground water, which led to soil salinization in the irrigated areas in central and southern Iraq (Quraishi & Al-Falahi, 2013). The harmful effects of salinity on plant growth are due to ionic poisoning, especially S, Cl and Na ions, as well as osmotic tension and deficiency of essential elements, oxidative stress, and ionic imbalance (Chinnusamy et al., 2005; Oyediranet al, 2017).

Plants have two defensive systems, the enzyme antioxidant system which includes non-oxidizing

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enzymes and non-enzyme antioxidants like Asc and Toc. Asc is one of the most powerful non-enzymatic antioxidants, and has an effect in protecting the plant from different environmental stresses (Ozturk et al., 2003). The treatment by Asc reduced the harmful effects of drought by improving the plant content of carbohydrates, protein, Chl pigment, soluble sugars, carotenoids, N elements, P and K (Hussein & Khursheed, 2014). The study conducted by Aati (2016) showed that spraying date palm trees, Alhillawi cultivar, by Asc for three times using the concentrations of 500, 1000 mg L^{-1} and resulted in a significant increase than the control treatment in the leaf content of chlorophyll and carotene and the concentration of proline and Asc and increased the effectiveness of the POE. The study by Al-Atrushy and Abdul-Hadar (2016) indicated that the addition of Asc to olive trees resulted in a significant increase in the leaf area, plant height and leaf content of total Chl. Saleh explained (2019) that spraying date palm offshoots in a saline environment with Asc with a concentration of 300 mg L^{-1} recorded a significant difference in the increase in the number of leaves and leaf area for the first season, while the treatment of spraying with Asc at a concentration of 450 mg L^{-1} showed significant superiority in the concentration of plant pigments Chl a and b, total Chl, carotenoids, total soluble carbohydrates, soluble protein, vitamin C, N concentration and IAA concentration in the leaves for the first and second seasons respectively, and significantly increased the height of the offshoot, number of formed leaves, leaf area and the concentration of K and K:Na ratio for the second season only. The same treatment was significant at recording the highest number of stomata on the lower surface of the leaf skin. The spray treatment with Asc at 450 mg L^{-1} recorded a significant decrease in the concentration of free amino acids and ABA in the leaves for the two seasons, the first and second, and a decrease in Na concentration for the second season only.

Toc is one of the important compounds of the plant and is an antioxidant (Hess, 1983) for its role in increasing the stability of membranes and getting rid of free radicals (ROS) and scavenging them. It, together with other fat oxidation, reduce which the free radicals in choroplast membranes whici in turn limits the oxidization of fats by limitting the lipid peroxyl root (Munne Bosch, 2005). Toc have many physiological roles, including plant protection from low temperatures (Maeda et al., 2006; 2008), drought (Cela et al., 2011) and heavy elements (Collin et al., 2008) and have a role in seed dormancy and germination (Sattler et al., 2006) and cell signaling (Cela et al, 2011). Saleh's study (2019) showed that the treatment by 300 mg L^{-1} of Toc spray on offshoots of Al-Barhi palm grown in a saline environment recorded a significant increase in the number of leaves formed for the first season and the concentration of P for the first and second season. The same treatment recorded a significant decrease in the concentration of Na for the first season only. The results also indicated a significant superiority of the treatment of spraying Toc at a concentration of 450 mg L^{-1} in the increase of plant height for the first season and in the effectiveness of the POE and the concentration of GA3 for the first and second season. The same treatment recorded a significant decrease in the concentration of the amino acid, proline and Cl in the leaves for the first and second seasons respectively.

In view of the exacerbation of the problem of soil salinity and water irrigation in recent years in southern Iraq, especially in Basra Governorate, and the lack of studies under the current water irrigation conditions in Shatt al-Arab on the effect of antioxidants on date palm trees, the current study was conducted on palm tree dates, cultivars of Barhi, which are irrigated from Shatt Al Arab water to study some of the physiological and chemical aspects and the effectiveness of the peroxidase enzyme on the leaves of the offshoots under study.

MATERIALS AND METHODS

The current study was conducted in one of the private orchards of Al-Dair district, Al-Zwain region during the 2019 AD growing season. It selected 21 offshoots of date palm, Al-Barhi cultivar, produced from tissue culture, consistent in growth and at the age of five years, planted on lines with dimensions of 7 × 7 m and irrigated from Zawin river branching from Shatt al-Arab and received the same service operations. After that, the concentrations of spraying agents Asc and Tco were distributed randomly, as three concentrations were used for each of them (125, 250 and 375) mg L^{-1} In addition to the comparison concentration, where distilled water was used only. Further, soil analysis and water irrigation we`re performed. Soil analysis was carried out by examinning random samples from different sites from the orchards land after removing the surface layer. The samples were collected from depths ranging from 0 - 60 cm. After that, the samples were mixed with each other and air dried for a period of 72 hours and were milled and sifted with sieve of 2 mm in diameter. Then soil and water samples were analyzed at the Center for Marine Sciences at Basra University. **Table 1** demonstrates the physical and chemical properties of the soil. **Table 2** shows the chemical properties of water irrigation for the growing season 2019 AD.

Preparation of solutions

Asc solutions were prepared in three concentrations 125, 250 and 375 mg L^{-1}. Each concentration was dissolved in a little distilled water and completed the volume to a liter with distilled water. As for the antioxidant of Toc, the solution was prepared by using the available Toc in the form of a capsule produced by the Indian pharmaceuticals (MVC) company. The

Table 1. Some physical and chemical properties of orchard soil at a depth of (0 - 60) cm

Properties	Valuable
E. C. Des m^{-1}	17.80
pH soil	8.65
Ready N mg g^{-1}	199.00
Ready P mg g^{-1}	26.33
Ready K mg g^{-1}	125.70¹
Organic matter%	0.43
% Soil separation	%
Clay	ا58.5
Sand	16.9
Silt	24.6
Soil tissue	Light clay

Table 2. Some chemical properties of irrigation water for the growing seasons 2019 AD

Characteristic	January	April	July	ا October
E.C Dec.m^{-1}	8.25	7.84	4.70	5.18
pH water	7.50	7.36	7.28	7.16
K mg L^{-1}	16.49	14.40	14.10	15.88¹
Na mg L^{-1}	418.75	290.63	271.00	279.22
Ca mg L^{-1}	23.55	18.68	17.39	17.92
Cl mg L^{-1}	206.84	130.90	128.70	169.21

solution was prepared in three concentrations:125, 250, 375 mg L^{-1}, the required concentrations were dissolved in a small amount of hexane and completed the volume to a liter with distilled water. A few drops of the substance Tween 20 were added to the prepared solutions in order to reduce surface tension and increase the adhesion of the substance on the leaves. The control treatment was prepared by from only distilled water and Tween 20. The spray process was applied in the early morning on the vegetative until complete wetness, using a 20 liter manual sprinkler.

The spraying process started from the first day of February to the first of April with a period of 20 days between one sprinkle and another. The first sprinkling was in 1/2, the second in 20/2, the third in 12/3, and the fourth in1/4. Measurements were taken on 20/9 for each season, by taking the leaflets from the fronds in the third line after the growing peak leaves, as the ringworm reaches the maximum activity at this stage (Al-Ani, 1998). The following characteristics have been studied:

1- The increase in the height of the offshoot (cm).

The height of the offshoot under study was measured from the base area to the top (the longest leaf) by means of a tape measure and the increase in the offshoots height was calculated according to the following formula:

Increase in offshoot height = height of offshoot after treatment - the height of offshoot before treatment.

2- The increase in the leaf area (m^2)

The area of the leaf was calculated by taking four leaflets taken from four leaves from the second row to the bottom of the directions all around the offshoot, as the average length of the leaflet and their width for each leaf were calculated, then the area of the leaf was extracted according to the following equation based on (Ahmed & Morsy, 1999) .

0.37 (leaflet length x width) + 10.29 x No. of leaflet = $\frac{leaf area}{1000}$

The leaf area was of the offshoot was calculated by multiplying the leaf area by the number of leaves of the offshoot.

3- The increase in the number of leaves.

The number of new formed leaves of the offshoots was calculated according to the following formula:

Number of new formed leaves = number of leaves per offshoot after treatment - number of leaves per offshoot before treatment.

4- Chemical and physiological characteristics.

4-1 Water content (%) in leaves

The weight (10 g) of fresh leaflets was dried by an oven at a temperature of 70 ° C. for a period of 72 hours. After cooling and measuring their weight, the leaflets were again returned to the oven for two hours at the same temperature, then cooled and then having their their weight measured. The water content of the sheets was estimated as follows:

$$water\ content\ \% = \frac{sample\ f.w - sample\ d.w}{sample\ f.w} \times 100$$

4-2 Concentration of plant pigment in the leaves.

The concentration of the total chlorophyll(Chl) and carotenoids in the leaves was estimated based on the Holden method described by (porra, 2002).

4-3- The Concentration of total soluble carbohydrates in the leaves

The concentration of total soluble carbohydrates in the leaves is determined according to the phenolic sulfuric acid method based on Dobois et al. , (1956).

4-4 Soluble protein.

The soluble protein in the leaves is estimated according to the previously described method. (Herbert et al., 1971)

4-5 Asc.

Asc estimated in the leaves According to the method described in A.O.A.C. (1970).

4-6 The concentration of the proline amino acid in the leaves.

The concentration of the proline amino acid in the leaves was estimated according to the method described in (Troll and Lindesly, 1955).

4-7 The Concentration of mineral elements in the leaves.

The process of digesting plant samples was carried out according to the following steps, in line with the method of Cresser and Parsons (1979):

1- N component.

N is estimated as described in Page et al. (1982) using the Micro Kjeldal device.

2- P component.

P was estimated according to the Murphy and Riley method (1962).

3– K and Na.

Both components are estimated, according to Page et al., (1982), using the flame device

Table 3. The effect of Asc and Toc on increasing the height of the offshoot (cm) and the number of leaves formed in it and its leaf area m^2 and % of the water content of the leaves in it

Conc. of treat. mg L $^{-1}$	height cm	N0. of leaves	Leafy area m^2	%Water content of leaves
control	30.3	4.66	1.2	58.62
125 Asc.	48.65	5.9	1.35	64.15
250 Asc.	59.77	7.66	1.56	65.70
375 Asc.	63.29	9.33	1.63	68.49
125 Toc.	47.2	5.66	1.28	63.83
250 Toc.	60.66	7.99	1.47	64.75
375 Toc.	68.4	8.33	1.6	65.38
L.S.D.(0.05)	1.15	0.62	0.07	0.82

4- K:Na ratio.

The ratio was estimated by dividing the K results by the Na results.

5 –Cl.

Cl is determined by the method in (Kalra, 1998).

5- Determination of the effectiveness of the POE.

The effectiveness of the POE was estimated depending on the method in (Whitaker and Bernhard, 1972).

6- Measuring ABA.

The amount of ABA was estimated by (Horgen, 1981).

7- Experimental design and statistical analysis

The experiment included six treatments, which are anti-oxidant concentrations, in addition to the control treatment as follows:

1- Asc at 125 mg L^{-1}

2- Asc at a concentration of 250 mg.L^{-1}

3- Asc at 375 mg L^{-1}

4- Tocl at a concentration of 125 mg L^{-L}

5- Toc at a concentration of 250 mg L^{-1}

6- Toc at 375 mg L^{-1}

7- Control treatment (spraying with distilled water)

The study is implemented as a simple experiment, according to Randomized Complete Design R.C.D, as three methods were randomly selected for each trial transaction, and each offshoot represents a recurrence. The results were analyzed using the Genstat program and the averages were compared using the Least Significant Difference Test L.S.D at the 0.05 probability level (Al-Rawi & Khalaf Allah, 2000).

RESULTS AND DISCUSSION

Effect of Asc and Toc on height of offshoots, number of leaves, leaf area and water content of leaves

The results of **Table 3** showed that the treatment of spraying with antioxidants Asc and Toc significantly affected the amount of increase in the characteristics under study compared to the control treatment.The treatment of spraying with Toc concentration of 375 mg L^{-1} is more significant than all treatments by recording the highest increase in the height of the offshoot which reaches 68.4 cm, followed by the effect of the treatment of spraying with Asc 375 mg.L^{-1} and which reported more leaf numbers, more laef area of the offshoot,and more water content (30.3cm, 4.66 leaves, and 58.62 %) sequentially. The reason behind the superiority of spray treatment by Asc is the increase in the plant height, while the increase in the number of leaves and laef area may be due to the physiological roles of the acid in the split of cells, increase of their sizes, photosynthesis, provision of nutrients, and the necessary energy for growth and construction and their roles in increasing the efficiency of the plant to photosynthasize and manipulate the outcomes to this process. All these lead to increase the characteristics in question (Robinson, 1973). In addition, the Asc is considered as a co-enzyme in the enzyme interactions of metabolysim of carbohydrates and protiens (Smirnoff & Wheeler, 2000). These results are in line with Al-Mayahi's (2016b) study on the date palm plantlets Alnersy cultivar.

The reason of the significant increase of spraying by Toc can be attributed to the roles of toctopheroles that are considered as the former of the chloroplasts membranes and protector against any oxidative stress by forming soluable antioxidant fats, as well as a reducer of the harm that results from the increase of salts because of scaving the free roots that accumulate because of salt stress and the increase of gene and hormone balance and its role in developing the transmit cell walls in and consequently resulting in increasing growth and characteristics (Fryer, 1992 and Munne-Bosch & Aleger, 2002).

The results shown in **Table 3** also indicate a significant superiority of treatment factors for spraying with Asc and Toc in the number of leaves formed compared to the control treatment (spraying with distilled water) and excellence of treatment with spraying with Asc at a concentration of 375 mg L-1 at the highest increase in the number of leaves formed In Al-Faseela, it reached 9.33 leaves, with a significant difference from all treatments, followed by the effect of treatment of Toc in a concentration of 375 mg L^{-1} which did not differ significantly from the treatment of Toc in a concentration of 250 mg L^{-1} liter, also, no significant differences were recorded between Toc and Asc in the concentration of 250 mg.L^{-1} each in a count Securities, which amounted to two 8.33 and 7.99 and 7.66 leaves for the offshoot respectively, No significant differences were recorded in the treatment of Asc and Toc treatments with a concentration of 125 mg L^{-1} per one, as the number of papers in them reached 5.90 and 5.66 leaves respectively, while the control treatment recorded the smallest increase in the number of leaves amounted to 4.66.

The results of **Table 3** indicate a significant effect of the treatment of spraying with antioxidants Asc and Toc in the leafy area of the offshoot compared to the control treatment, as the spray treatment with Asc was superior

Table 4. Effect of Asc and Toc on leaf content of Chl, carotene, total soluble carbohydrates, soluble protein, vitamin C (mg. g^{-1} fresh weight) and protein (mg.g^{-1} fresh weight)

Conc. of treat. mg L^{-1}	Chl.Conc.	Carotin con.	Carbohydrat con.	Prolin con.	Prolin Conc.	Vitt. C
Controlr	2.44	0.003	30.19	1.96	25.80	20.66
Asc. 125	5.23	0.007	40.66	3.21	19.37	29.33
Asc. 250	5.66	0.010	42.24	3.50	16.58	30.19
Asc.375	6.92	0.013	49.39	4.15	13.26	34.77
Toc.125	4.50	0.008	29.69	2.99	21.08	27.85
Toc.250	5.31	0.021	42.18	3.88	19.66	29.70
Toc.375	5.90	0.020	48.25	4.33	15.34	30.83
L.S.D 0.05	0.05	0.002	1.08	0.12	2.00	1.87

to a concentration of 375 mg L^{-1} was significant over all treatments by recording the highest increase in the leafy area of the offshoot amounted to 1.63 m^2 , while the control treatment recorded the lowest leaf area of 1.2 m^2.

Table 3 also shows the significant effect of the treatment of spray Asc and Toc in the water content of the leaves compared to the control treatment and the superiority of the treatment of Asc in the concentration of 375 mg L^{-1} and the significant differences between the treatment of Toc in the two concentrations of 250 and 375 mg $L^{-1}$the percentage of the water content of the leaves reached 64.75 and 65.38 respectively, while the control treatment recorded the lowest water content of the leaves at 55.72%. The increase in water content of the leaves when treated with Asc and Toc may be due to the physiological roles of the antioxidants in increasing the absorption of water and the nutrients K, Ca and Mg (Farouk, 2011), and that the results obtained agreed with Abdel Wahid et al. (2012) on the seedlings of local orange.

Effect of Asc and Toc on leaf content of total Chl pigments, carotene, soluble total carbohydrates, soluble protein, proline and vitamin C

The results of **Table 4** showed the significant effect of spraying with Asc and Toc on the concentration of the total Chl pigment in the leaves compared to the control treatment. The treatment of spraying with Asc at a concentration of 375 mg L^{-1} is significantly difference from all treatments by recording the highest concentration of total Chl in the leaves as it reached 6.92 mg g^{-1} fresh weight. The control treatment recorded the lowest concentration of total Chl at 2.44 mg g^{-1} f.w. Spray treatments with Toc were recorded at concentrations of 125, 250 and 375 mg L^{-1} 4.50, 5.31 and 5.9 mg g^{-1} fresh weight of total Chl with significant differences between them. The two concentrations 125 and 250 mg L^{-1} of Asc and 5.23, 5.66 mg g^{-1} weight of fresh total Chl recorded a significant difference.

The results of **Table 4** refer to the significant effect of spraying with Asc and Toc on the concentration of carotene pigment compared to the control treatment, and also showed the superiority of the two concentrations 250 and 375 mg L^{-1} of the leaves content of carotene pigment and a significant difference from other concentrations of the studied parameters, and recorded 0.21 and 0.20 mg g^{-1} f.w respectively, followed by the effect of Asc treatment on the concentrations 375 and 250 mg L^{-1} as it recorded 0.013 and 0.010 mg g^{-1} f.w. On the other hand, the control treatment recorded the lowest amount of carotene pigment of 0.003 mg g^{-1} f.w, the increase of the concentrations of the two pigments, Chl and carotene, in the leaves when sprayed with Asc and Toc may be due to the antioxidants as they protect chloroplast from oxidative damage resulting from stress (El-Bassiouny, 2005). Farouk (2011) states that the antioxidants work to protect chloroplast which prevents Chl from breaking down in the ROS (Bowler et al., 1992). As for the reason for the low accumulation of Chl in the leaves of trees in the control treatment can be due to the increase of salts in irrigation water (**Table 2**), the increased concentration of salts caused an increase in the activity of the Chlorophylas enzyme that destroys Chl, as well as an increase in the level of the plant hormone ABA, which accelerates the decomposition of Chl (Noreen & Ashraf, 2009). This increase was positively reflected as a result of spraying the leaves by anioxidants becasue the Asc is one of the non-enzyme antioxidants that remove the reactive oxygen compounds ROS which reduce the breakdown of the Chl pigment under stress conditions, while increasing the accumulation of Chl when spraying with Toc vitamin which is considered as an anti-oxidant, as it works to protect chloroplast from oxidative damage resulting from stresses (El-Bassiouny, 2005).

The results of the table also indicate significant effects of spraying with Asc and Toc in the leaf content of total soluble carbohydrates compared to the control treatment, and the treatment of Asc was superior to a concentration of 375 mg L^{-1}, with a significant difference from all spray treatments and recorded 49.39 mg g^{-1} f.w, followed by the effect of the treatment 375 mg L^{-1} tocopherol, which recorded 48.25 mg g^{-1} f.w, and no significant differences were observed between the treatment of Asc and tocopherol at a concentration of 250 mg L^{-1} and between the control treatments and Toc in a concentration of 125 mg L^{-1} as the total amount of soluble carbohydrates in them reached 42.24, 42.18, 30.19 and 29.70 mg g^{-1} f.w in them, respectively. The increase in the total soluble carbohydrate concentration in the leaves when spraying with Asc and Toc may be due to the role of these two compounds in increasing the efficiency of photosynthesis and increase in the leaf area exposed to light, which led to an increase in the amount

Table 5. Effect of Asc and Toc on leaves content of N, P, K, Na and Cl (mg g^{-1} d.w) and k:Na ratio

Conc. of treat. mg L^{-1}	N conc.	P conc.	K conc.	Na conc.	Cl conc.	K:Na
Control	10.48	0.28	2.94	0.90	16.63	3.27
125 Asc.	14.90	0.82	3.68	0.48	14.22	7.66
250 Asc.	17.66	1.33	3.82	0.30	13.04	12.73
375 Asc.	21.33	1.20	4.23	0.18	12.75	23.5
125 Toc.	15.26	0.90	3.53	0.41	14.00	8.61
250 Toc.	17.72	0.81	4.16	0.27	13.40	15.41
375 Toc.	19.11	1.60	4.37	0.33	11.17	13.24
L.S.D.(0.05)	0.99	0.26	0.13	0.06	0.52	1.16

of carbohydrates in the leaves (Shu and Liu , 2001).The decrease in the total soluble carbohydrate concentration in the control treatment may be due to the effects of salinity in irrigation water in reducing the leaf area of the plant and the total Chl content of the leaves as well as their effect on the activity of enzymes responsible for reducing carbon dioxide, especially the RuBP Carboxylase Rubisco (Kahrizi et al., 2012). But, the decrease in the total amount of soluble carbohydrates in the treatment of Toc at a concentration of 125 mg L^{-1} may be due to a lack of the concentration that did not activate the enzymes responsible for reducing carbon dioxide.

The results of **Table 4** show the significant effect of spraying with Asc and Toc in the leaf content of the soluble protein compared to the control treatment. The treatment of Toc at a concentration of 375 mg L^{-1} showed a significant difference from all spray treatments and recorded 4.33 mg g^{-1} f.w, followed by the effect of the treatment 375 mg L^{-1} of Asc which recorded 4.15 mg g^{-1} f.w. The control treatment recorded a significant decrease compared to all spray treatments in the leaf content of the soluble protein amounted to 1.96 mg.g^{-1} fresh weight. The increase in soluble protine concentration in the leaves during the treatment with the antioxidants may be due to their roles in increasing the activities of the plant including the absorption of the nutrients in the soil, N is one of them, then increasing its concentration in the leaves. The reason behing the lack of soluble protein in the control treatment may be due to the shortage of the construction of protine or the increase in its decomposition under saline stress conditions resulting from the salinity of irrigation water (Azooz, 2004). Also, the decrease in the concentration of protine under salinity stress conditions can be explained by the shortage of water or to activate the activity of the protase that causes protein analysis (Reddy & Vora, 1985).

The results of **Table 4** indicated the significant effect of spraying with Asc and Toc in the leaf content of the amino acid proline in comparison to the control treatment and the treatment of the concentration of 375 mg L^{-1} Asc recorded a significant decrease than all spray treatments and recorded 13.26 mg g^{-1} f.w followed by the effect of the treatment with 375 mg L^{-1} Toc which recorded 15.34 mg.g^{-1} fresh weight, while the control treatment recorded the highest amount of proline which reached 25.80 mg g^{1} f.wt. The treatment with Asc and Toc resulted in a decrease in the concentration of proline in the leaves and this can be attributed to their role in reducing salt stress on plants (Moussa, 2006 ; Hanafy et al., 2008 ; Ellouzi et al., 2013), whereas the reason for the increase in the concentration of proline in the control treatment may be due to a decrease in the activity of the Proline Oxidase enzyme and consequently the accumulation of proline in plant tissue (Girija et al., 2002), or to the increase in protein degradation because of salinity as a result of an increase in the effectiveness of the protease under conditions of saline tension to release the acid free amino, including proline, to be stored, transported, or used in the osmotic modification (Azooz, 2004). The results of Table (4) showed the significant effect of spraying with Asc and Toc in the leaf content of a vitamin C compared to the control treatment. The treatment effect with 375 mg.L^{-1} Asc recorded a significant increase than all spray treatment including the control treatment which recorded 34.77 mg g^{-1} f.w followed by the effect of the treatment 375 mg L^{-1} Toc which recorded 15.34 mg g^{-1} f.w. The control treatment recorded the least amount of vitamin C as it reached 20.66 mg g^{-1} fresh weight. The increased accumulation of avitamin C in the leaves may be attributed to the antioxidants that scaving the free radicals produced in the blastids causing an increase in the activity of photosynthesis, and as a result, an increase in the accumulation of soluble sugars and N content in plant tissues under stress conditions, and may reduce the harmful effects of salinity through curbing and preventing protein oxidation, and as a result, an increased concentration of amino acids, including Asc (Dolatabadian et al., 2010 and Khan et al. , 2011), the results were agree with Aati (2016) on date palm cultivars, Halawi and Saleh (2019) on date palm cultivars, Al-Barhi.

Effect of Asc and Toc on leaf content of N, P, k, Na, Cl and a ratio between K:Na

Table 5 shows the significant effect of the treatment of spray with Asc and Toc in the concentration of N in the leaves compared to the control treatment, as the spray treatment with 375 mg L^{-1} As was superior by recording the highest values of 21.33 mg g^{-1} d.w with a significant difference from all the treatments followed by the effect of the treatment of 375 mg L^{-1} Toc spray which recorded 19.11 mg g^{-1} d.w. It is clear in the table that no significant differences occurred between the two treatments of Asc and Toc in the concentration of 250 mg L^{-1} as they recorded 17.66 and 17.72 mg g^{-1} d.w, respectively, also, there were no significant differences between the two treatments of spraying with Asc and Toc with a concentration of 125 mg L^{-1} as the concentration of N in them reached 14.90 and 15.26 mg g^{-1} d.w.

The results of **Table 5** show the significant effect of spray treatment with Asc and Toc in the concentration of P and K in the leaves compared to the control treatment, as the treatment of spray with 375 mg L^{-1} Toc was superior as it recorded the highest concentration of P and K in the leaves which reached 1.60 and 4.37 mg g^{-1} d.w and a significant difference than all spray treatments under study. The control treatment recorded the least concentration of P and K in the leaves which reached 0.28 and 2.94 mg g^{-1} d.w.The increased concentration of N, P and K when treating Asc and Toc may be due to the role of these antioxidants in the activity of plant biological processes, increasing plant growth and encouraging root growth (Sadak et al. 2010). Antioxidants have an important role in protecting the plant from oxidative damage and this leads to the protection of photosynthesis and their role in increasing plant hormones within the plant, including auxins, which have an important role in the origins and development of the roots and cytokinins that help the transfer of nutrients from the roots to the vegetative system and thus their accumulation in the leaves (Muhammad and Yunus, 1991 and Overvoorde et al., 2010), it also works to protect the cell membrane against the active oxygen species during stress, which in turn increases the absorption of nutrients. Or perhaps due to their role in improving the permeability of membranes as well as increasing the accumulation of protein that protects cell membranes and membranes associated with membranes (Farouk, 2011). The results obtained when treated with Asc and Tocl are consistent with Masoud and EL- Aharawy (2012) on orange trees.

The results of **Table 5** indicate a significant effect of the treatment of spraying with Asc and Toc in reducing the Na concentration in the leaves compared to the control treatment. The results show that the treatment of spraying with 375 mg L^{-1} Asc significantly decreased the concentration of Na in the leaves which reached 0.18 mg g^{-1} d.w, than all spray treatments under study. The two spray treatments with 125 and 250 mg L^{-1} Asc and spray treatment with 125, 250, and 375 mg L^{-1} Toc recorded 0.48, 0.30, 0.33, 0.27, and 0.41 mg g^{-1} of Na with a significant difference between them. The control treatment recorded the highest sodium concentration 0.90 mg g^{-1} dry weight in the leaves.

The results of **Table 5** indicate the significant effect of the treatment of spraying with Asc and Toc in reducing the concentration of Cl element in the leaves compared to the control treatment, and the treatment of Toc at a concentration of 375 mg L^{-1} was recorded. Concentration: 11.17 mg g^{-1} d.w, the coefficients of Asc spray and Toc were recorded at a concentration of 125 mg L^{-1} 14.22 and 14.00 mg g^{-1} d.w with no significant difference between them, and we also note that no significant differences were recorded between the two treatments of Asc and Toc in the concentration of 250 mg L^{-1}. The concentration of Cl was 13.04 and 13.4 mg g^{-1} d.w, respectively. The spray treatment with 375 mg L^{-1} Asc was 12.75 mg g^{-1} d.w which did not differ significantly from the same treatment with Asc at the concentration 250 mg L^{-1}, while the control treatment recorded the highest concentration of Cl in the leaves, 16.63 mg g^{-1} d.wt. The results of **Table 5** show that the treatment of spraying with Asc and Toc recorded a significant superiority in the ratio of K:Na in the leaves compared to the control treatment, and the treatment of Asc at a concentration of 375 mg L^{-1} was significant in all spray treatments at a rate of 23.50 mg g^{-1} d.w. The ratios of the treatment with Asc and Toc at the concentration of 250 mg L^{-1} and Toc at the concentration 375 mg L^{-1} were 12.73 and 15.41 and 13.24 mg g^{-1} d.w in sequentially, but no significant differences were recorded between the treatments of Asc and Toc at the concentration 125 mg L^{-1}, as the ratio was 7.66 and 8.61 mg g^{-1} d.w Sequentially, while the control treatment recorded the lowest proportions and reached 3.27 mg g^{-1} d.w. The increase in the concentration of Na and Cl under the influence of irrigation water may be attributed to the increase in the concentration of Na and Cl in the water, which occurred by being absorbed by the plant and the increase in their concentration in the leaves (tawban and others, 2004). The low concentration of K^+ in the leaves of plants under the conditions of salinity of water may be due to the increase in the concentration of Na^+, which manipulates all the proteins that transport the K ion, and then decreases its concentration since K is active in more than 60 enzymes, in addition to being an essential element in building protein and important in tRNA binding with ribosomes (Blaha et al., 2000 and Saleh, 2019). And that the anti-oxidant spraying treatments led to a decrease in the concentration of Na and Cl in the leaves and this may be due to the role of Asc and Toc in improving the ionic balance in the leaves (Ellouzi et al., 2013). Thus, the improvement of the relationship between K and Na indicates the role of antioxidants in controlling the Na^+ ratio: K^+ under the conditions of salt stress.

Effect of Asc and Toc on the activity of POE:

Fig. 1 indicates the significant effect of spraying with the Asc and Toc in the activity of the POE in the leaves, as it is observed in the table that the treatment of Toc spray is superior at the concentration 375 mg L^{-1} and with a significant difference, from all spray treatments studied, in the enzyme activity which amounted to 81.88 units.g^{-1} f.w, whereas POE was less effective in the control treatment that was 47.93 units.g^{-1} f.w. The increased effectiveness of the POE as a result of

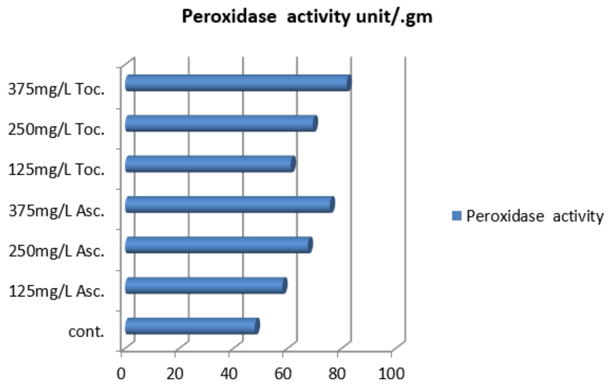

Fig. 1. Effect of Asc and Toc on the activity of POE unit g^{-1} f.w

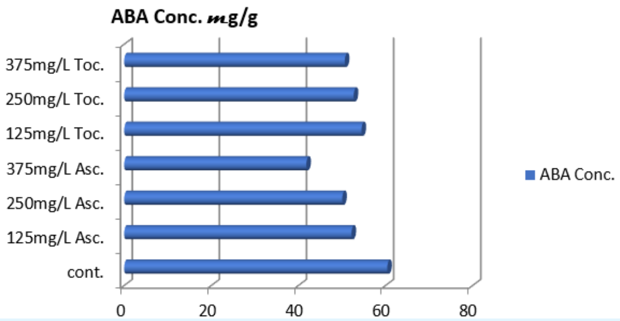

Fig. 2. Effect of Asc acid and Toc on ABA µg g^{-1}

spraying with antioxidants vitamin Toc and Asc may be due to the role of antioxidants in increasing plant resistance to stress conditions (Palaniswamy et al., 2003). Perhaps the increase in the effectiveness of the POE is due to the physiological functions of these compounds in increasing the plant's ability to with stand environmental stress by increasing the enzymatic activity inside the plant as a response to curbing the harmful effect of stress and as one of the biochemical mechanics to resist environmental stresses, and increasing the efficiency of photosynthesis. Increasing the effectiveness of POE under the conditions of saline stress works to remove free roots by accelerating the proton oxidation and forming compounds associated with hydrogen peroxide, which leads to its destruction and converting it into water and oxygen, as well as its role in increasing the stability of the cell membrane and Chl pigment (Chinnusamy et al., 2005; Hossain et al., 2013). The results of the research agree with the findings of Aati (2016) when treating date palm trees, cultivar hillawi, with Asc.

Effect of Asc and Toc on the leaves content of ABA

It is evident in **Fig. 2** that the effect of spray treatment with Asco and Toc is significant in the leaf content of ABA. The results show a significant decrease in the concentration of ABA in the leaves compared to the control treatment as the treatment of spraying with Asc at a concentration of 375 mg L^{-1} recorded a significant reduction by recording the lowest concentration of ABA in the leaves, which amounted to 41.83 µg g^{-1}, while the control treatment recorded the highest concentration of ABA in the leaves 60.42 µg g^{-1}. The reason for the increase in the concentration of ABA the leaves is probably the result of an increase in the concentration of salts in irrigation water, **Table 1**, as the salt tension causes the imbalance in hormone that leads to a decrease in the levels of plant hormones that encourage growth such as auxins, cytokinins, and gebrlins in plant tissues and levels of plant growth hormones (growth inhibitors) increase, like ABA, which is one of the components of signal transduction leading to gene Induction, and this leads to the formation of proteins necessary to protect the plant from the conditions of stress (Munns, 2002, 2005).

In this study, we conclude that spraying date palm leaves with 375 mg L^{-1} Asc resulted in a significant increase in the number of leaves, leaf area and water content of the leaves, as well as increased the leaf content of Chl, total soluble carbohydrates , N, K:Na ratio and vitamin C, and also led to reducing the amount of proline, Na ion, and ABA in the leaves. The same concentration of Toc led to an increase in the offshoot height and increase the leaf content of soluble protein and P and K elements, reducing the concentration of Cl ion and increasing the POE activity. Therefore, the study recommends spraying date palm offshoots, Barhi cultivar, with Asc and Toc, and conducting further studies on other cultivars.

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