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Role of Ascorbic Acid in Reducing the Harmful Effects of Sodium Chloride in *Triticum aestivum* L. and *Trigonella foenum-graecum* L. Plants

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THIS STUDY includes the role of ascorbic acid (ASA) in increasing the resistance of *Triticum aestivum* L. (wheat) and *Trigonella foenum-graecum* L. (fenugreek) plants to sodium chloride stress and its effect on improving growth compared to the control treatment. In this experiment, wheat and fenugreek plants were cultured in soil and irrigated with supplemented with sodium chloride salt at different concentrations (0.0,50,100 or150mM/L) and sprayed with ascorbic acid at three concentrations (0.0,100 or 200ppm/L). The highest concentration of sodium chloride (150mM/L) resulted in a significant decrease in plant height 34.8cm , leaf area 4.199cm^2 and photosynthetic pigments (chlorophyll a, b, total chlorophyll and carotene) contents 1.355, 0.846, 2.458 and 0.728mg/g fresh weight, respectively.

Significant increases in plant height 42.25cm, leaf area 6.058cm^2 and photosynthetic pigments (chlorophyll a, b, total chlorophyll and carotene) reaching 1.875, 1.569, 3.652 and 1.007mg/g fresh weight, respectively were observed when ascorbic acid was used at the highest concentration (200ppm/L) of the two plants.

Keywords: Ascorbic acid, Fenugreek, NaCl, Salinity, Wheat.

Introduction

Salinity is one of the important abiotic stresses that affects crop productivity and it is a complex phenomenon that affects plants in several ways, including water stress (osmotic), toxicity of ions, disturbances of metabolic processes, and decreased cell division and growth (Shanker & Venkateswarlu, 2011). Salt stress also causes ionic imbalance, leads to the generation and accumulation of reactive oxygen species (ROS) in plant cells that damage the lipid membranes, proteins and nucleic acids (Chawla et al., 2013).

Vitamins are a group of bio-regulator compounds that greatly affects plant growth, when it is in low concentrations (El-Quesni et al., 2009) and there is a lot of interest concentrated currently on the external addition of vitamins to improve plant growth and development. This is due to its many benefits and because it is anatural product. Among these vitamins is ascorbic acid (ASA) as it is made vital in higher plants and affects the growth and development of plants as it plays an important role as a catalyst in interaction enzymatic activity in the electron transport system and metabolism (El-Kobisy et al., 2005).

Ascorbic acid is a low molecular weight antioxidant, and acts as a component of non-enzymatic scavengers of reactive oxygen species (ROS) in plant growth and stress tolerance (Akram et al., 2017). The L-galactose pathway is the main pathway for ascorbic acid biosynthesis in plants, and most genes have been identified in this pathway (Bulley & Laing, 2016).

Ascorbic acid has an important role in plant growth and development, cell division, cell expansion, cell wall metabolism, photosynthesis, flowering regulation, senility in leaves, apical

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meristem formation of the stem and root development. It works an important role in detoxification and stress defense in addition to being a cofactor for enzyme activity (Xu et al., 2015).

Wheat (*Triticum aestivum* L.) is a major cereal crop in many parts of the world and is popular and known as the king of the grains. Wheat is considered as a crop strategy and plays a major role in economy, production, food and nutrition around the world (Jahan et al., 2019). It contributes to providing 20% of the human need for Food (El-Fouly et al., 2011). It represents the main food for more than 53% of population.(El-Lethy et al., 2013). It is one of the important conditions for feeding and classification. It is economical and grown in regions for production (Central Statistical Organization. Iraq, 2017).

Fenugreek (*Trigonella foenum-graecum* L.) is one of the important and popular plants used in medicine as it is a rich source of a group of food ingredients such as proteins, fats, carbohydrates, minerals and vitamins, and its seeds contain many medical and pharmaceutical compounds (Newal et al., 1998; Barnes et al., 2002).

The aim of the study is to know the effect of spraying with non-enzymatic antioxidant ascorbic acid (ASA) on some physiological and biochemical characteristics of wheat and fenugreek plants under conditions of salt stress.

Materials and Methods

The study was conducted in the greenhouse and laboratories of the Department of biology, College of Education for Pure Sciences, University of Mosul in the season, 2019-2020. Soil taken from the agricultural fields of the College of Agriculture and Forestry at a depth of 0-30cm was used . The soil was dried and passed through 2mM diameter sieve. Each pot was filled with 4kg of the soil with added sodium chloride salt in four concentrations 0,50,100 or 150mM/L. Seeds of wheat and fenugreek plants were obtained from the examination and certification of seeds/ Nineveh and were planted on 30/1/2019 and after two weeks from seed germination, seedlings were reduced to five per pot. After 40 days of planting, the plants were sprayed with ascorbic acid in three concentrations 0, 100 or 200ppm/L. After 52 days from the date of spraying, three replicates were used for each treatment to study some physiological and chemical assays. The factorial experiment was used in Completely Randomized Design (C.R.D) with four factors in six replicates. The results were analyzed using SAS program.

The following measurements were taken:

1. Plant height (Cm).

2. Leaf area that was measured according to Fang et al. (2006).

3.Chlorophyll and carotenoid content of leaves that were measured spectrophotometrically according to Saied (1990). The following equations were used to calculate the amount of chlorophyll:

Chlorophyll a(mg/mL)= (12.7)* (A.663)-(2.69)* (A.645) × V/ (1000×W).

Chlorophyll b(mg/mL)= (22.9) * (A.645) - (4.68)* (A.663) × V/ (1000×W).

Total chlorophyll (mg/mL)= (20.2)* (A.645)+ (8.02)* (A.663) × V/ (1000×W).

Carotene was measured according to a method of Abdul Jaleel et al. (2009), and the following equation was used:

Carotene (mg/mL)= A.480+ (0.114 × A.663- 0.638 × A.645)

A.663 =Absorbance at a wave length (663nm).

A.645 = Absorbance at a wave length (645nm).

A480 = Absorbance at a wave length (480nm).

Results

Plant height (cm)

Results in Table 1 showed that soil treatment with different concentrations of sodium chloride 0, 50, 100 or 150mM/L led to a decrease in the height of wheat and fenugreek plants, and the significant limits were reached at two concentrations 100 and 150mM/L. They reached 37.7 and 34.8cm, respectively compared to the control. Ascorbic acid 100 and 200ppm was ameliorated the vegetative growth of the two plants, where the lengths of fenugreek and wheat shoots reached 36, 43 and 42, 45cm, respectively.

TABLE 1. The effect of different concentrations of ascorbic acid on the height of wheat and fenugreek plants (Cm) under different levels of salinity

Plant type	Concentrations ASA (ppm)	NaCl (mmol/ L)				Plant type × concentrations ASA	Effect of plant type	Effect of ASA concentratios
		0.0	50	100	150			
Wheat	0.0	39d-g	37e-h	33hij	29jk	34.5c		32.125c
	100	42bcd	40c-f	43a-d	41b-e	41.5b	40.3a	38.125b
	200	45ab	44abc	47a	43a-d	44.8a		42.25a
Fenugreek	0.0	32ij	32ij	29jk	26k	29.8d		
	100	36f-i	35ghi	35ghi	33hij	34.8c	34.8b	
	200	43a-d	41b-e	39d-g	36f-i	39.8b		
Plant type × salinity	Wheat	42a	40.333a	41a	37.7b			
	fenugreek	37 b	36bc	34c	31.7d			
ASA concentrations × salinity	0.0	35.5cd	34.5d	31e	27.5f			
	100	39b	38bc	39b	37bcd			
	200	44a	42.5a	43a	40b			
The effect of salinity		39.5a	38.3a	37.7b	34.8c			

Similar litters refer to nonsignificant differences found between treatments at 5% probability according to Duncans test.

As for the result of the interaction between ascorbic acid and salinity, it is shown from Table 1 that spraying the growing plants in soil treated with sodium chloride salt at concentration 100mM/L with ascorbic acid at concentration 200ppm/L led to a significant superiority in the height of wheat plants and the fenugreek reached 43cm.

Leaf area (cm^2)

It was noted from the results in Table 2 that the treatment of soil with different concentrations of sodium chloride 0, 50, 100 or 150mM/L led to a decrease in the leaf area of the wheat and fenugreek plants and reached the significant limits at the two concentrations 100 and 150mM/L, reaching 4,365 and 4,199cm² respectively. Also, there was a significant increase in the leaf area of the wheat and fenugreek plants 4.671 and 6.058cm², respectively when the vegetative group of the two plants was sprayed with ascorbic acid at concentrations 100 and 200ppm/L. Table 2 shows that ASA at concentration of 200ppm/L ameliorated significantly the effect of NaCl at concentration of 50mM/L on leaf area of the wheat and fenugreek which reached 6.423cm^2.

TABLE 2. The effect of different concentrations of ascorbic acid on the leaf area (cm^2) of wheat and fenugreek plants under different levels of salinity

Plant Type	Concentrations ASA (ppm)	NaCl (mmol/ L)				Plant type × concentrations ASA	Effect of plant type	Effect of ASA concentratios
		0.0	50	100	150			
Wheat	0.0	6.534c	6.486c	5.883c	5.43c	6.083c		3.777c
	100	8.145b	8.7b	5.542c	5.43c	6.954b	7.519a	4.671b
	200	10.862a	10.257a	8.522b	8.447b	9.522a		6.058a
Fenugreek	0.0	1.81de	1.509de	1.358de	1.207e	1.471e		
	100	2.564d	2.564d	2.312de	2.112de	2.388d	2.151b	
	200	2.651d	2.589d	2.569d	2.564d	2.593d		
Plant type × salinity	Wheat	8.514a	8.481a	6.649b	6.436b			
	fenugreek	2.342c	2.221c	2.08c	1.961c			
ASA concentrations × salinity	0.0	4.172c	3.998c	3.621c	3.319c			
	100	5.355b	5.632b	3.927c	3.771c			
	200	6.756a	6.423a	5.546b	5.506b			
The effect of salinity		5.427a	5.351a	4.365b	4.199b			

Similar litters refer to nonsignificant differences found between treatments at 5% probability according to Duncans test.

Pigments content

The results of Tables 3, 4 and 5 showed that treating the soil with increased concentrations of sodium chloride salt 0, 50, 100 or 150mM/L led to a decrease in the content of photosynthetic pigments, showed Table 3 a significant decrease in the chlorophyll a content occurred In the leaf tissues of wheat and fenugreek plants, reaching the significant limits at the three concentrations as 1.884, 1.7 and 1.355mg/g fresh weight, respectively, compared treatment. We also note that there was a significant increase in the chlorophyll content a in the leaf tissues of the wheat and fenugreek plants, and it reached when the vegetative group of the two plants was sprayed with ascorbic acid at a concentration of 200 ppm/L reaching 1.875mg/g fresh weight.

A result of the interaction between ascorbic acid and salinity, that spraying the growing plants with soil treated with sodium chloride salt at conncentration 50mM/L and ascorbic acid at concentration 200ppm/L led to a superiority in the chlorophyll content a. In the leaf tissues of the wheat and fenugreek plants and reached 1.929mg/g fresh weight compared to the comparison treatment.

TABLE 3.The effect of different concentrations of ascorbic acid in chlorophyll a mg/g fresh weight of wheat and fenugreek plants under different levels of salinity

Plant Type	Concentrations ASA (ppm)	NaCl (mmol/ L)				Plant type × concentrations ASA	Effect of plant type	Effect of ASA concentratios
		0.0	50	100	150			
Wheat	0.0	1.916a-d	1.839b-e	1.719cde	1.235g	1.677bc	1.83a	1.63b
	100	2.151ab	1.928a-d	1.788b-e	1.635def	1.876a		1.754b
	200	2.323a	1.934a-d	1.794b-e	1.699de	1.938a		1.875a
Fenugreek	0.0	1.948a-d	1.765b-e	1.49efg	1.123g	1.582c	1.675b	
	100	1.979a-d	1.912bcd	1.492efg	1.145g	1.632bc		
	200	2.118abc	1.924a-d	1.916a-d	1.291g	1.812ab		
Plant type × salinity	Wheat	2.13a	1.9bc	1.767cd	1.523e			
	fenugreek	2.015ab	1.867bc	1.633de	1.186f			
ASA concentrations× salinity	0.0	1.932b	1.802bc	1.605cd	1.179e			
	100	2.065ab	1.92b	1.64cd	1.39de			
	200	2.221a	1.929b	1.855bc	1.495d			
The effect of salinity		2.073a	1.884b	1.7c	1.355d			

Similar litters refer to nonsignificant differences found between treatments at 5% probability according to Duncans test.

TABLE 4. The effect of different concentrations of ascorbic acid in chlorophyll b mg/g fresh weight of wheat and fenugreek plants under different levels of salinity

Plant type	Concentrations ASA (ppm)	NaCl (mmol/ L)				Plant type × concentrations ASA	Effect of plant type	Effect of ASA concentratios
		0.0	50	100	150			
Wheat	0.0	1.162 b-e	0.837 de	0.804 de	0.583 e	0.847de	1.257a	0.739c
	100	1.465 abc	1.461 abc	1.306a-d	0.816de	1.262bc		1.17b
	200	1.795ab	1.792ab	1.535abc	1.533abc	1.664a		1.569a
Fenugreek	0.0	0.731de	0.621e	0.608e	0.561e	0.63e	1.061b	
	100	1.617ab	1.358a-d	0.656e	0.679e	1.078c		
	200	1.865a	1.773ab	1.354a-d	0.902cde	1.474ab		
Plant type × salinity	Wheat	1.474a	1.363a	1.215ab	0.977bc			
	fenugreek	1.404a	1.251ab	0.873c	0.714c			
ASA concentrations× salinity	0.0	0.947cd	0.729d	0.706d	0.572d			
	100	1.541ab	1.41ab	0.981cd	0.748d			
	200	1.83a	1.783a	1.445ab	1.218bc			
The effect of salinity		1.439a	1.307a	1.044b	0.846b			

Similar litters refer to nonsignificant differences found between treatments at 5% probability according to Duncans test.

TABLE 5. Effect of different concentrations of ascorbic acid on total chlorophyll mg/g fresh weight of wheat and fenugreek plants under different levels of salinity

Plant Type	Concentrations ASA (ppm)	NaCl (mmol/ L)				Plant type× concentrations ASA	Effect of plant type	Effect of ASA concentratios
		0.0	50	100	150			
Wheat	0.0	2.999 a-f	2.855 a-h	2.427 c-h	1.818 h	2.525b	2.916a	2.199c
	100	3.053 a-e	2.999 a-f	2.625 b-h	2.427 c-h	2.776b		2.721b
	200	3.848 a	3.46 abc	3.377 abc	3.099 a-d	3.446a		3.652a
Fenugreek	0.0	1.912 fgh	1.867 gh	1.856 gh	1.853 gh	1.872c	2.799a	
	100	3.687 ab	2.847 a-h	2.174 d-h	1.957 e-h	2.666b		
	200	3.955 a-g	3.947 a	3.934 a	3.594 ab	3.858a		
Plant type × salinity	Wheat	3.3a	3.105ab	2.81abc	2.448c			
	fenugreek	3.185ab	2.887abc	2.655bc	2.468c			
ASA concentrations× salinity	0.0	2.456cd	2.361cd	2.142d	1.836d			
	100	3.37ab	2.923bc	2.4cd	2.192cd			
	200	3.902a	3.704a	3.656ab	3.347ab			
The effect of salinity		3.243a	2.996a	2.733ab	2.458b			

Similar litters refer to nonsignificant differences found between treatments at 5% probability according to Duncans test.

As for the content of chlorophyll b, the results of Table 4 showed that the treatment of soil with increased concentrations of sodium chloride salt 0, 50, 100 or 150 mM/L led to a decrease in the content of chlorophyll b in the leaf tissues of the wheat and fenugreek plants. reaching the significant limits at two concentrations 100 and 150mM/L. as they reached 1.044 and 0.846mg/g fresh weight, respectively, compared to the comparison treatment. We also note that there was asignificant increase in the chlorophyll content b in the leaf tissues of the wheat and fenugreek plants, reaching when the vegetative group of the two plants was sprayed with ascorbic acid at concentrations 100 and 200ppm/L and reached 1.17 and 1.569mg/g fresh weight, respectively. As for the effect of the plant type, we noticed a significant superiority in the chlorophyll content b in the leaf tissue of the wheat plant compared to the fenugreek plant, reaching 1.257mg/g fresh weight.

As for the result of the interaction between ascorbic acid and salinity, it was observed that spraying the growing plants with soil treated with sodium chloride salt at a concentration 50mmol/L. and ascorbic acid at a concentration 200ppm/L led to a significant superiority in the chlorophyll content b in the leaf tissues of the wheat and fenugreek plants it reached 1.783mg/g fresh weight compared to the comparison treatment.

As for the total chlorophyll content, the results of Table 5 showed that the treatment of soil with increased concentrations of sodium chloride salt 0, 50, 100 or 150mM/L The significant limits were reached at the concentration 150mM/L reaching 2.458 mg/g fresh weight compared to the comparison treatment. We also note that there was a significant increase in the total chlorophyll content in the leaf tissues of the wheat and fenugreek plants, and it reached, when the vegetative groups of the two plants were sprayed with ascorbic acid at concentrations 100 and 200ppm/L and reached to 2.721 and 3.652mg/g fresh weight, respectively. As for the effect of the plant type, we note that the total chlorophyll content in the leaf tissue of the wheat plant was superior to the fenugreek plant, reaching 2,916mg/g fresh weight.

We note from Table 5 as a result of the interaction between ascorbic acid and salinity that spraying the growing plants with soil treated with sodium chloride salt at concentration 50mM/L and ascorbic acid at concentration 200ppm/L led to a significant superiority in the total chlorophyll content in the leaf tissue of the wheat and fenugreek plants reached 3.704mg/g fresh weight compared to the comparison treatment.

Carotene mg/g fresh weight

The results of Table 6 showed that the treatment of soil with increased concentrations of sodium chloride salt 0, 50, 100, 150mM/L led to a decrease in the carotene content in the leaf tissues of the wheat and fenugreek plants, and the significant limits were reached at the three concentrations, as it reached 0.859, 0.8 and 0.728mg/g fresh weight respectively, compared to the comparison treatment. We also note that there was a significant increase in the content of carotenoids in the leaf tissues of the wheat and fenugreek plants, and it reached, when the vegetative group of the two plants was sprayed with ascorbic acid at a concentration of 200ppm/L and reached 1.007mg/g fresh weight. As for the effect of the plant type, we notice a significant superiority in the content of carotenoids in the leaf tissue of the wheat plant compared to the fenugreek plant, reaching 0.937mg/g fresh weight.

We note from Table 6 as a result of the interaction between ascorbic acid and salinity that spraying the growing plants with soil treated with sodium chloride salt at concentration 50mM/L and ascorbic acid at concentration 200ppm/L led to a significant superiority in the carotene content in leaves Wheat and fenugreek plants and reached 1.055mg/g fresh weight compared to the comparison treatment.

Discussion

It was observed from the results of Tables 1, 2, 3, 4, 5, 6 that there was a decrease in growth indicators such as plant height, leaf area and photosynthetic pigments (chlorophyll a, b, total chlorophyll and carotene) and the decrease in the height of wheat and fenugreek plants may be due to inhibition of photosynthesis due to the increased osmotic potential and the decrease in the amount of water absorbed. This leads to a decrease in the amount of absorbed nutrients and growth hormones transported from the roots to the other parts of the plant, and thus a decrease in cell elongation and a decrease in plant height (Al-Taie, 2013). This decrease may be due to the presence of salts in the soil solution, which work to raise the osmosis potential of the soil solution decreases the plant's ability to absorb water or its readiness for absorption due to salinity, so the growth rate decreases (Chen et al., 2009). This result is in agreement with Puvanitha & Mahendran (2017), Dadrwal et al. (2018), Khattab et al. (2019) and El-Far et al. (2020). As for the decrease in the leaf area, this decrease can be attributed to the fact that the increase in salts has a detrimental effect on the leaf area through inhibition of the photosynthesis process, which may be due to the osmotic effect to lack the amount of water entering the plant, as well as the lack of transport of nutrients and growth hormones from the roots to the other parts of the plant due to the small amount of water absorbed (Tuteja, 2005).

Zheng et al. (2009) explained that the decrease in the leaf area of the wheat plant which was stressed by salinity may be due to the osmotic effect of salinity which led to a decrease in the amount of water entering the plant which caused a decrease in the swelling pressure of the leaf cells and a decrease in their elongation and this leads to a decrease in their area. This result is consistent with Salem (2017), Zahra et al. (2020) who indicated that higher salinity concentrations lead to a decrease in the leaf area compared to the control treatment.

TABLE 6. The effect of different concentrations of ascorbic acid in carotene content mg/g fresh weight of wheat and fenugreek plants under different levels of salinity

Plant type	Concentrations ASA (ppm)	NaCl (mmol/ L)				Plant type × concentrations ASA	Effect of plant type	Effect of ASA concentratios
		0.0	50	100	150			
Wheat	0.0	1.0780 a-d	0.853 cdef	0.797 efg	0.767 efg	0.874b		0.74b
	100	1.15 a	0.957 a-e	0.823 d-g	0.777 efg	0.927ab	0.937a	0.802b
	200	1.152 a	1.135 ab	0.877 b-f	0.871 b-f	1.009a		1.007a
Fenugreek	0.0	0.731 efg	0.575 g	0.567 g	0.547 g	0.605c		
	100	0.786	0.658 fg	0.635 fg	0.623 fg	0.676c	0.762b	
	200	1.157 efg	0.974 a-e	1.102 abc	0.785 efg	1.005a		
Plant type × salinity	Wheat	1.127a	0.982b	0.832cd	0.805cd			
	fenugreek	0.891bc	0.736de	0.768cde	0.652e			
ASA concentrations× salinity	0.0	0.905bcd	0.714e	0.682e	0.657e			
	100	0.968bc	0.808cde	0.729de	0.7e			
	200	1.155a	1.055ab	0.989abc	0.828cde			
The effect of salinity		1.009a	0.859b	0.8bc	0.728c			

Similar litters refer to nonsignificant differences found between treatments at 5% probability according to Duncans test.

Also, the decrease in the chlorophyll content in the leaf tissues can be attributed to the fact that high salinity concentrations have a negative effect on the photosynthesis process, as photosynthesis activity is considered one of the main factors that control plant growth (Siddiqui et al., 2018; Abdelhameed et al., 2021). Salinity indirectly slows down photosynthesis in plants and photosynthesis is directly related to stomatal conduction, chlorophyll contents, transpiration and water stress. Leaf photosynthesis can be lowered by reducing stomatal conductance due to water imbalance under salt stress (Chandrasekaran et al., 2019). Eraslan et al. (2008) also indicated that salinity breaks down photosynthetic systems such as photosynthesis pigments (chlorophylls and carotenoids) and the synthesis of grana membranes in chloroplasts and disrupted electron transport chain due to excessive production of oxygen active species ROS.

The decrease in the carotene content under conditions of salt stress may be attributed to the fact that many of the biosynthesis of some compounds in the cell are negatively affected when exposed to salt stress and one of these compounds is the carotenoids, as their formation decreases upon exposure to salt stress leading to reducing the efficiency of the photosynthesis (Lu et al., 2010). It may be due to the increase in salinity that leads to the destruction of the photosynthetic pigments such as chlorophyll and carotenoids, and especially to a reduction in the carotene content of the leaves, ultimately causing a decrease in efficiency photosynthesis (Navarro et al., 2006). This finding is in agreement with Gateh (2015) and Ayyal & Karim (2017).

As for the effect of ascorbic acid on the height of wheat and fenugreek plants, the results showed an increase in the height of the two plants due to the fact that ascorbic acid increases the content of IAA, which stimulates cell division and increases the size of cells and thus improves plant growth ,ascorbic acid increases nutrient absorption and metabolism (Abd-El Hamid, 2009). It also has a role in cell division and expansion and activation of the process of carbonate representation and the resulting substances used in increasing growth, including plant height (Smirnoff, 1996). This is consistent with all of Mejbel (2019) and Authafa (2018). From that spraying with ascorbic acid led to a significant increase in plant height compared with the control treatment.

As for the leaf area, the results of Table 2 show an increase and the reason for this increase may be due to the fact that ascorbic acid is a powerful antioxidant, and works to expand the cell wall and division, stimulate the total leaf area, enhance photosynthesis pigments and improve plant tolerance against multiple stresses by cleaning ROS (Hameed et al., 2015; Dey et al., 2016). Or the role of ascorbic acid in encouraging the action of antioxidant enzymes, and this is consistent with El-Hawary & Nashed (2019) who found that increasing ascorbic acid that leads to an increase in leaf area.

As for the results in Tables 3, 4 and 5, an increase in the chlorophyll content in the leaf tissues of the wheat and fenugreek plants is due to the role of ascorbic acid in increasing the photosynthetic pigments, which in turn will lead to an increase in the energy obtained from this process and increase its efficiency, which leads to the accumulation of carbohydrates in plant tissue (El-Hifny & El-Sayed, 2011). These results are in agreement with Ahmad et al. (2018) and Pirasteh-Anosheh & Emam (2018). It was clearly demonstrated that the protective role of external antioxidants in protecting against oxidative stress by stimulating the ability of antioxidants may increase photosynthesis and reduce the toxic effects of salinity stress on corn plants and these results are consistent with Mejbel (2019).

It was also found that spraying plants with ascorbic acid led to a significant increase in the content of leaf tissue from carotene, and that the increase in carotene may be due to the positive effect of ascorbic acid because it performs basic metabolic functions in plant life such as protecting plants from oxidative damage and maintaining the continuation of photosynthesis and also delaying early leaf demolition, protects chlorophyll, stimulates mRNA synthesis, participates in flowering, promotes lateral bud growth and increases cell expansion and elongation (Azzedine, 2011).

Conclusion

It was conclude from this study that spraying with ascorbic acid has an effective role in reducing the negative effects of salt stress on plants as a result of preserving some physiological and biochemical characteristics of wheat and fenugreek plants.

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دور حامض الاسكوربيك في تقليل الآثار الضارة لكلوريد الصوديوم في نباتي *Triticum aestivum* L. و *Trigonella foenum-graecum* L.

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تتضمن هذه الدراسة دور حمض الأسكوربيك (ASA) في زيادة مقاومة نبات الحنطة *Triticum aestivum* L. ونبات الحلبة *Trigonella foenum-graecum* L. لإجهاد كلوريد الصوديوم وتأثيره في تحسين النمو مقارنة بمعاملة المقارنة. في هذه التجربة تمت زراعة نباتات الحنطة والحلبة في التربة وتم ريها بمكملات ملح كلوريد الصوديوم بتركيزات مختلفة (0،0، 50، 100و150ملي مول/ لتر) ورشها بحامض الاسكوربيك بثلاث تركيزات (100،0،0و 200 جزء في المليون/ لتر). أدى أعلى تركيز من كلوريد الصوديوم (150 ملي مول/ لتر) إلى انخفاض معنوي في ارتفاع النبات (34.8 سم)، ومساحة الورقة (4.199 سم^2) و محتوى صبغات البناء الضوئي (الكلوروفيل a ، b ، الكلوروفيل الكلي والكاروتين) اذ بلغت (1.355، 0.846، 2.458 و 0.728 ملغم/غم وزن طري ، على التوالي.

لوحظت زيادة معنوية في ارتفاع النبات (42.25 سم) ، ومساحة الورقة (6.058 سم^2) وصبغات البناء الضوئي (الكلوروفيل a، b، الكلوروفيل الكلي والكاروتين) اذ بلغت (1.875، 1.569، 3.652 و1.007 ملغم/ غم وزن طري، على التوالى عند استخدام حامض الاسكوربيك بأعلى تركيز (200 جزء في المليون/ لتر) للنباتين.