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EFFECT OF SOIL SALINITY AND SOME ANTIOXIDANTS ON JEW'S MALLOW (*Corchorus olitorus* L.): 1-VEGETATIVE GROWTH AND QUALITY PARAMETERS.

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ABSTRACT

Two pot experiments were carried out in the farm of Fac. of Agric.; Mansoura university during the two successive summer seasons of 2008 and 2009, to investigate the effect of soil salinity levels and some antioxidants on plants growth, yield and quality parameters of Jew's mallow (*Corchorus olitorius* L.) cultivar "Balady". Four treatments of salinity in this study (control, 3000, 6000 and 9000 mg/l) and four antioxidants with three levels for each (ascorbic acid, salicylic acid, proline at; 100, 200 and 300 mg/l and yeast extract at; 1000, 2000 and 3000 mg/l) were used in the foliar way as well as the control treatment (tap water). The results obtained from this work could be summarized as follow:

a) All vegetative growth parameters under investigation were significantly decreased as the level of soil salinity was increased.
b) Foliar spraying of Jew's mallow plants with antioxidants significantly increased the mean values of the vegetative growth parameters as compared to the untreated treatment.
c) The highest level was most pronounced and associated with the highest mean values for all previously mentioned traits comparing with the first and second level of foliar amendments.
d) Foliar spraying of proline combined with the levels of soil salinity was superior for increasing the values of these parameters following by yeast extracts, ascorbic acid and finally salicylic acid treatment.
e) There was a significant decrease as the level of salinity was increased on No_2-N and No_3-N contents, while ascorbic acid was increased.
f) Both No_2-N and No_3-N were decreased significantly with antioxidant treatments.

Keywords: Jew's mallow, *Corchorus olitorius*, salt stress, soil salinity, vegetative growth, quality parameters, antioxidants treatments, growth stages, free NO_3.

INTRODUCTION

Jew's mallow (*Corchorus olitorus* L.) is a popular leafy vegetable crop in Egypt. It is consumed as a fresh vegetable soup; even though the dried leaves could be used as well. Leaves contain vitamin A that protect from cancer. It has medical properties in anti constipation, ulcers, jaundice, heart weakness, treating derma disorders and skins and Blagarr disease. Also, it contains Glycosides and Allinozeds and vitamin D which help in strong bones formation. Jew's mallow has a mucilage material that has medical effects for intestines ulcer (Ibrahim *et al*., 2006; Aboud, 2007).

Soil salinity is a serious environmental constraint to crop production in many parts of the world. Adverse effects of salinity on crop growth from two

characteristics:(1) The increased osmotic potential of the soil solution with salinity makes the water in the soil less available for plants (2) specific of some elements (Na, Cl, B, etc.) present in excess concentrations (Munns, 2005). Salt stress adversely affects plants at all stages of its life cycle. Salinity causes several specific structural changes that disturb plant water balance. The shape and size of plant organs and cells may be changed in response to salt stress. This includes increased leaf succulence, decreased leaf size and leaf number, reduced number of stomata, thickening of the leaf cuticle and deteriorated or undeveloped xylem .The negative effect of salinity on plants provoked osmotic potential by salt in the culture medium, so root cells can't obtain required water from the soil. Therefore in plants the uptake of some mineral nutrient dissolved in water are also districted. Thus, growth and development of plants are inhibited due to the occurring defect in metabolism. Pascale and Barbieri (1997) studied the effect of soil salinity (0%, 0.125%, 0.25%, 0.5% and 1% of commercial NaCl) on growth and yield of broad bean plant and found that within the range of electrical conductivity of the saturate soil extract between 2 dSm-1 and 6 dSm-1, soil salinity reduced plant height by 60%, leaf dry matter and specific leaf weight were positively related to salinity. Metwally (2009) showed that high soil salinity levels decreased all growth parameters of pepper plant such as plant height, number of leaves, leaf area, shoot fresh weight and dry weight.

Traditional methods for reclamation of saline soils, such as leaching; are not only difficult but also expensive and time consuming. Besides, it is uneconomic for a grower to keep his soil un-cropped for a long time. Thus judicious use of special management practices to minimize the adverse effect of soil salinity on plant growth by using ascorbic acid, salicylic acid, proline and yeast extract in foliar way represent an acceptable means in this study.

Yeast is a natural source of many growth substances such as sugars, proteins and amino acids as well as several vitamins and most of nutritional elements i.e. Na, Ca, Fe, Mg, P, K, Zn, Si and organic compounds which have a positive affect on plant growth. Farouk (2000) found that proline 200 mg/L counteracted the harmful effects of salinity on stem, main root lengths and number of leaves / plant as compared to untreated plant, also leaves area was increased gradually with application of proline “200 mg/L” under low and moderately NaCL levels. Yousif (2007) showed that the treatment with yeast extract either in foliar way or as seed soaking led to a significant increase in all the measured growth aspects of snap bean plant as compared with the untreated treatment. Metwally (2009) revealed that salicylic acid (250 mg/l) and ascorbic acid (250 mg/l) used as presoaking or foliar spray gave positive effect on growth parameters of pepper plant.

The aim of this study is evaluate the growth an quality characteristics of Jew’s mallow grown under different levels of salt soil and some antioxidant treatments.

MATERIALS AND METHODS

Two pot experiments were carried out in the farm of Fac. of Agric.; Mansoura University during the two successive summer seasons of 2008 and 2009, to investigate the effect of soil salinity levels and some antioxidants on plant growth, yield and quality parameters of Jew's mallow (*Corchorus olitorius* L.) cultivar "Balady"

Factorial experiment in a randomized complete block design was used with 4 replicates for each treatment. The experiment included 52 treatments: 4 treatments of soil salinity and 13 antioxidants treatments.

I. First factor (Soil salinity):

1- Control, 2172 mg/l.
2- 3000 mg/l.
3- 6000 mg/l.
4- 9000 mg/l.

II. Second factor (Antioxidants treatments):

1- Untreated
2- Ascorbic acid 100 mg/l.
3- Ascorbic acid 200 mg/l.
4- Ascorbic acid 300 mg/l.
5- Salicylic acid 100 mg/l.
6- Salicylic acid 200 mg/l.
7- Salicylic acid 300 mg/l.
8- Proline 100 mg/l.
9- Proline 200 mg/l.
10- Proline 300 mg/l.
11- Yeast extract 1000 mg/l.
12- Yeast extract 2000 mg/l.
13- Yeast extract 3000 mg/l.

Antioxidants treatments were used in the foliar way as well as the control treatment (tap water) applied twice; one after 15 days from sowing and the other after 15 days later. Thus, the total number of pots required for each season was 208 pots.

Preparation of pots:

The potted non-saline soil were artificially salinized by dissolving a calculated amount of the salt crust in a volume of tap water equivalent to the soil field capacity to obtain the desiderated level of salinity. The initial salinity of the experimental soil of (2336 and 2008 mg/l in the first and second seasons, respectively) was put in consideration; thus the treatments of salinity were 3000, 6000 and 9000 mg/l as well as the control treatment.208 polyethylene pots; 30 cm in diameter and 40 cm height were used in each season. Each pot was filled with 10 kg air dried clay soil taken from the surface layer of Agric. Exp. Station, Mansoura University Some physical and chemical properties of the used soil are shown in Table 1. Raw salt crust was obtained from El-Max Saline Co.; Alexandria pulverized and analyzed for chemical and salt composition as shown in Table 2.

Table 1: Physical and chemical analysis of the experimental soil during 2008 and 2009 seasons.

Seasons	OM %	$CaCO_3$ %	Coarse sand%	Fine Sand%	Silt %	Clay %	Texture class	EC** dS/m	pH*
2008	1.36	2.05	1.89	21.34	26.15	47.21	Clay	0.73	8.16
2009	1.84	2.07	1.12	21.91	26.12	46.94	Clay	0.69	7.98

Table 1: continue

S. p	Available (ppm)					meq/100g soil			
%	N	P	K	Ca^{++}	Mg^{++}	Na^{+}	Cl^{-}	SO_4^{--}	HCO_3^{--}
68	48	3.75	325	0.92	0.53	2.22	1.12	1.59	1.03
66	53	4.16	412	0.96	0.57	1.91	0.71	1.66	1.16

Soil suspension (1:2.5)** * Soil extraction (1:5)**

Table 2: Chemical analysis of salt crust in g/100g salt (oven dry basis).

NaCl	Na_2SO_4	$MgSO_4$	K_2SO_4	$CaSO_4$	$Ca(HCO_3)_2$	Impurities
84.05	8.46	1.33	0.18	0.81	0.41	4.76

Method of planting:

Twenty seeds/pot were sown on 28th April (2008 and 2009) at equal distance and depth. After 14 days from sowing (4 true leaves) the plants were thinned to the most eight uniform plants per pot. Throughout the experiment; soil moisture was kept at 60% of water holding capacity till the end of the growing season.

Ascorbic acid, salicylic acid and proline were obtained from El-Gamhoria Co.; Mansoura, Egypt, and foliarly applied at the rates of 100, 200 and 300 mg/l for each. The control treatment was sprayed with tap water the treatments of antioxidants were foliarly applied at two stages; one after 20 days from sowing and the first cut and the other 15 days later. Yeast extract: Backer's yeast mixed with sugar at ratio of 1:1 and left for 3 hours at room temperature. Then it was frozen for disruption of yeast tissue and releasing their content. Preparation of yeast extract was done according to El Ghamriny *et al.* (1999).

Sampling date:

After 45 days from the sowing and the first cut; 8 plants were randomly taken from each treatment to determine the following parameters:

I- Vegetative groth characteristics:

- Plant height cm.
- Number of leaves per plant.
- Plant fresh yield g/plant.
- Plant dry yield g/plant.
- Leaf area /plant cm^2: It was determined according to the method mentioned by (Koller, 1972).

II- Quality parameters:

- Nitrate and Nitrite: Which were determined by using methods of Singh (1988).
- Ascorbic acid (Vitamin C): It was determined using the indophenols method (2, 6-dichlorophenolindophenol) as described by Ranganna (1979).

Statistical analysis:

Obtained data were subjected to statistical analysis as factorial experiment in a randomized complete block design with four replicates in the both growing seasons. All data were statistically analyzed according to the procedure outlined by Snedecor and Cochran (1967). The treatment means were compared using LSD according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

1- Effect of soil salinity:

Concerning the effect of soil salinity levels on vegetative growth parameters, data in Table 3 reveal that all these parameters under investigation in the first and second cut were significantly decreased as the level of soil salinity was increased in the first season; the highest values; 44.13, 46.92, 496.53, 14.19 and 3.42 for plant height, number of leaves, leaf area, plant fresh yield and plant dry yield respectively were realized for the control treatment in the first cut. While highest values in the second cut; 46.98, 51.69, 710.35, 17.57 and 4.17 for plant height, number of leaves, leaf area, plant fresh yield and plant dry yield respectively were realized for 3000 ppm treatment. While, the lowest one 28.10, 19.10, 167.65, 7.35 and 1.33 were obtained from the plants grown under salinity level of 9000 ppm in the first cut. Also, the lowest one in the second cut 39.44, 30.63, 551.00, 12.67 and 3.22 were obtained from the plants grown under salinity level of 9000 ppm. The same trend was happened during the second season of the experiment.

Table 3: Effect of soil salinity on vegetative growth parameters:

Characters / Treatments	Plant height (cm)		No. of leaves /plant		Leaf area (cm^2)		Plant fresh weight (g)		Plant dry weight (g)	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
First cut										
A:Salinity levels (ppm)										
Control	44.13	37.90	46.92	26.43	496.53	701.74	14.19	21.49	3.42	4.19
3000 mg/l	37.97	30.75	35.60	20.22	375.65	290.72	12.19	13.85	2.52	2.50
6000 mg/l	35.12	26.12	28.44	18.24	293.39	257.30	10.70	10.82	1.93	1.65
9000 mg/l	28.10	20.35	19.10	15.47	167.65	206.75	7.35	6.19	1.33	1.11
LSD at 5 %	0.2	0.1	3.6	1.4	47.8	62.5	0.9	1.0	0.3	0.3
Second cut										
Control	44.14	43.62	46.08	28.61	649.00	524.23	16.10	18.35	3.84	3.72
3000 mg/l	46.98	47.35	51.69	31.08	710.35	656.94	17.57	25.71	4.17	5.56
6000 mg/l	42.09	38.60	33.89	27.22	611.25	551.19	14.61	14.90	3.53	2.83
9000 mg/l	39.44	34.22	30.63	25.29	551.00	488.09	12.67	13.18	3.22	2.61
LSD at 5 %	1.21	0.32	1.91	0.11	26.54	7.16	0.85	0.29	0.11	0.07

Concerning the effect of salinity levels on some quality parameters, data in Table 4 indicate that, there was a significant decrease as the level of

salinity was increased. The lowest values (4.09 and 352.5) in the first season and (4.58 and 393.2) in the second season were obtained from the plant grown in 9000 ppm for No_2-N and No_3-N, respectively. While, there were general trends of higher ascorbic acid (vitamin C) concentrations at all salinity levels increased. The highest values of ascorbic acid were obtained from the plants grown in 9000 ppm.

Table 4: Effect of soil salinity on quality parameters:

Characters / Treatments	Vitamin C (mg/100gFW)		No_2-N (ppm)		No_3-N (ppm)	
	2008	**2009**	**2008**	**2009**	**2008**	**2009**
A:Salinity levels (ppm)						
Control	1.06	1.06	6.43	7.76	589.7	702.9
3000 mg/l	2.00	2.03	5.45	6.42	487.2	575.4
6000 mg/l	2.86	2.89	4.67	5.34	405.3	465.0
9000 mg/l	3.96	4.00	4.09	4.58	352.5	393.2
LSD at 5%	0.11	0.11	0.06	0.28	5.53	337.4

It could be concluded that, the decreases in vegetative growth parameters due to increasing the level of soil salinity may be attributed to the decrease in number and length of internodes/plant due to increasing osmotic pressure of soil solution which decreases water absorption by root system. This may exert its effects on the elongation of cells during their formation. This was accompanied with a reduction in nutrient uptake, metabolic processes, merestimatic activity and/or cell elongation leading to a decrease in all parameters of plant growth.

Obtained results are similar to those reported by Eraslan *et al*. (2007) on lettuce, In addition; El-Mansi *et al*. (2004) on tomato, Gaballah and Gomaa (2004) on faba bean, Shabana (2004) on tomato and Yousif (2007) on snap bean revealed that all vegetative growth parameters were significantly decreased as the level of salinity was increased.

2- Effect of antioxidants:

Data in Table 5 indicated that; foliar spraying of Jew's mallow plants with ascorbic acid, salicylic acid, proline and yeast extract significantly increased the mean values of the vegetative growth parameters as compared to the untreated treatment. For all antioxidants under study; the third level was most pronounced and associated with the highest mean values for all previously mentioned traits comparing with the first and second level of foliar amendments. Additionally, the differences between the mean values of growth parameters for the three levels growth parameters were significant during both seasons in the first and second cut.

Table 5: Effect of antioxidants on vegetative growth parameters:

Characters / Treatments	Plant height (cm)		No. of leaves/plant		Leaf area (cm^2)		Plant fresh weight (g)		Plant dry weight (g)	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
first cut										
B : Antioxidant treatments (mg/l)										
Untreated	31.28	25.83	16.63	16.90	237.25	209.90	8.93	9.23	1.78	1.58
Ascorbic100	34.05	26.78	28.70	19.05	291.45	234.25	10.30	10.90	1.99	1.92
Ascorbic200	36.80	28.88	30.78	20.55	321.40	284.80	11.20	12.38	2.28	2.27
Ascorbic200	38.35	30.53	36.05	21.60	367.93	356.38	12.00	14.50	2.57	2.87
Salicylic100	32.85	26.29	26.40	17.90	274.23	207.25	9.78	10.33	1.77	1.79
Salicylic 200	35.68	28.45	28.48	18.55	299.28	255.85	9.98	11.55	2.06	2.16
Salicylic 300	37.95	29.78	33.80	20.45	339.13	316.23	11.60	13.05	2.37	2.34
Proline 100	35.40	27.83	32.15	19.43	323.33	276.45	10.75	12.18	2.28	2.28
Proline 200	37.51	29.63	36.20	19.78	373.33	330.10	11.91	15.30	2.57	2.69
Proline 300	41.78	32.30	41.20	25.55	433.93	402.90	13.53	19.48	3.07	3.52
Yeast 1000	35.09	27.25	29.73	19.15	298.18	252.65	10.55	11.88	2.09	1.99
Yeast 2000	36.45	29.25	34.46	19.68	345.23	295.93	11.48	13.80	2.40	2.36
Yeast 3000	39.11	31.18	38.28	22.60	428.38	365.33	12.43	15.53	2.68	2.93
LSD at 5 %	0.3	0.2	6.4	2.7	86.2	112.7	1.6	1.8	0.6	0.5
Second cut										
Untreated	31.43	33.58	25.18	22.48	358.78	331.83	10.64	11.89	2.25	2.24
Ascorbic100	38.43	36.43	32.53	23.87	490.56	432.48	12.37	13.92	2.74	2.81
Ascorbic200	42.98	41.03	38.63	27.05	627.78	555.00	15.50	16.71	3.39	3.59
Ascorbic200	47.68	44.80	49.50	31.65	799.51	725.35	17.69	22.89	4.74	4.43
Salicylic100	36.40	35.08	29.25	23.55	410.98	358.15	11.79	12.99	2.45	2.62
Salicylic 200	42.50	40.50	36.75	26.08	563.76	507.48	15.32	16.99	3.35	3.47
Salicylic 300	46.05	43.53	46.85	29.03	758.58	675.83	16.90	19.62	4.16	4.09
Proline 100	41.18	39.25	35.35	25.20	539.03	485.60	13.29	15.80	3.20	3.38
Proline 200	45.33	42.50	43.58	28.75	722.65	651.88	16.28	19.38	4.13	3.97
Proline 300	54.73	49.43	58.93	39.23	912.44	840.00	20.28	27.23	5.62	5.47
Yeast 1000	40.00	37.75	34.73	24.80	519.40	457.28	12.51	14.20	2.92	2.97
Yeast 2000	44.55	41.88	42.83	27.90	676.90	637.95	16.32	19.08	3.75	3.70
Yeast 3000	49.88	46.58	53.38	35.0	814.45	752.68	19.22	23.77	5.25	5.12
LSD at 5 %	1.14	0.28	2.65	0.15	40.72	8.52	0.85	0.16	0.12	0.05

With regard to the effect of antioxidants treatments under investigation on No_2-N, No_3-N and ascorbic acid (vitamin C) contents in Jew's mallow plants, data at Table 6 also reveal a significant effect for antioxidants on ascorbic acid and No_2-N contents in the two seasons of the experiment, while there was a significant effect on No_3-N in the first season, but there was not significant effect on No_3-N in the second season of the experiment.

Table 6: Effect of antioxidants on quality parameters:

Characters / Treatments	Vitamin C (mg/100gFW)		No_2-N (ppm)		No_3-N (ppm)	
	2008	**2009**	**2008**	**2009**	**2008**	**2009**
B: Antioxidant treatments (mg/l)						
Untreated	2.92	2.96	5.56	6.49	491.5	525.0
Ascorbic 100	2.85	2.88	5.34	6.07	472.8	549.5
Ascorbic 200	2.48	2.51	5.10	6.06	458.0	529.8
Ascorbic 300	2.24	2.27	4.90	5.76	439.3	512.0
Salicylic 100	2.77	2.80	5.31	5.76	439.3	537.0
Salicylic 200	2.56	2.59	4.87	5.98	450.3	516.0
Salicylic 300	2.15	2.18	4.66	5.74	427.5	511.0
Proline 100	2.63	2.66	5.49	6.38	484.5	566.0
Proline 200	2.31	2.34	5.27	6.15	467.8	555.5
Proline 300	1.99	2.01	5.07	5.90	447.8	524.5
Yeast 1000	2.72	2.74	5.40	6.21	475.5	554.0
Yeast 2000	2.46	2.41	5.18	6.02	465.0	542.0
Yeast 3000	2.07	2.10	4.15	5.79	443.8	520.8
LSD at 5%	0.01	0.01	0.03	0.01	1.48	Ns

The favourable role of antioxidants on stimulation vegetative growth parameters of Jew's mallow plants may refer to the role played by these components on plant bioactivities. Obtained results are similar to those reported by Talaat (2003), Irfan-Afzal *et al.* (2006), Maggio *et al*. (2007), Eraslan *et al*. (2008) and Metwally (2009) who showed that antioxidant materials such as salicylic acid (250 mg/l) and ascorbic acid (250 mg/l) used as presoaking or foliar spray gave positive effect on growth parameters of pepper plant.

The effect of proline for improving the vegetative growth parameters of the plants under saline condition may refer to the function of proline as source of solute for intercellular osmotic adjustment. An effect of exogenous application of proline on the maintenance of turgidity in stressed leaves of wheat and barely has also been stated (Sinha and Rajogopal, 1980).

Farouk (2000) on canola plant found that exogenous application of proline 200 mg/l counteracted the harmful effects of salinity on stem, main root lengths and number of leaves/plant as compared to untreated plant. Also, He indicated that proline at two applied; 100 and 200 mg/l levels increased leaves area as compared to nonsalinized control plant under high salinity levels. In addition; El-Mansi *et al*. (2004), Gaballah and Gomaa (2004), Shabana (2004) and Yousif (2007) showed that the treatment with yeast extract either in foliar way or as seed soaking led to a significant increase in all investigated growth parameters.

3- Effect of The interaction:

The interaction effects between soil salinity levels and rates of foliar amendments on Jew's mallow plants during the two seasons of the experiment were presented at Tables 7 and 8. It was obvious that; foliar spaying of ascorbic acid, salicylic acid, proline and yeast extract at any rate under study has been corrected the bad effect of salinity levels on the mean

values of all growth parameters under investigation in the first and second cuts. In this respect, foliar spraying of proline combined with the levels of soil salinity was superior for increasing the values of these parameters following by yeast extract, ascorbic acid and finally salicylic acid treatment. Also, a remarkable influence was exerted for the third level of all growth regulators than the second and first levels of foliar spraying under all the studied levels of soil salinity. The higher magnitudes of plant height, number of leaves, leaf area, plant fresh and plant dry yield were realized for the plants grown under salinity level of ; 3000 and 6000 ppm combined with the third level of proline in foliar way. Such effect was the same during both seasons of 2008 and 2009.

As show from the data presented in Table 9 the interaction effect between salinity levels and antioxidants treatments had a significant effect on No_3-N No_2-N and ascorbic acid.

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The effect of proline for improving the vegetative growth parameters of the plants under saline conditions may refer to the function of proline as source of solute for intercellular osmotic adjustment. An effect of exogenous application of proline on the maintenance of turgidity in stressed leaves of wheat and barley has also been stated (Sinha and Rajogopal, 1980).

Farouk (2000) on canola plant found that exogenous application of proline 200 mg/l counteracted the harmful effects of salinity on stem, main root lengths and number of leaves/plant as compared to untreated plant. Also, He indicated that proline at two applied; 100 and 200 mg/l levels increased leaves area as compared to nonsalinized control plant under high salinity levels. In addition; El-Mansi *et al*., (2004), Gaballah and Gomaa (2004), Shabana (2004) and Yousif (2007) showed that the treatment with yeast extract either in foliar way or as seed soaking led to a significant increase in all investigated growth parameters.

These results were in agreement with those obtained by Farouk (2005), Yousif (2007), Eraslan *et al.* (2008), Metwally (2009) and Hamail *et al.* (2009) who found that nitrite and nitrate concentrations in celery tissues were significantly decreased by irrigation with saline water at any level of seawater dilutions as compared to the plants received Nile water (control treatment). The highest values of No_2-N and No_3-N were obtained from the plants irrigated with saline water at rate of 25% seawater dilution. Also, Tarraf *et al*., (1999), Singh *et al*. (2001), Farouk (2005), *Dar et al.* (2007) and Metwally (2009) who revealed that applied ascorbic acid (250 mg/l) and salicylic acid (250 mg/l) as foliar spray and/or presoaking caused an increased in Vit. C content in the shoot of pepper plants throughout the two growing seasons.

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Table 9: Interaction effect between soil salinity and antioxidant applications on quality parameters in the second cut of jew's mallow plants during 2008 and 2009 seasons.

Characters	Vitamin C (mg/100gFW)				No_2-N (ppm)				No_3-N (ppm)			
Treatments mg/l	First season											
	control	3000	6000	9000	control	3000	6000	9000	control	3000	6000	9000
untreated	1.52	2.38	3.28	4.50	7.02	5.81	5.03	4.38	631	531	426	378
Ascorbic100	1.43	2.33	3.20	4.42	6.62	5.69	4.83	4.21	610	499	420	362
Ascorbic200	1.06	2.01	2.87	3.96	6.32	5.45	4.59	4.05	598	485	398	351
Ascorbic300	0.78	1.81	2.67	3.71	6.19	5.19	4.40	3.82	572	466	387	332
Salicylic 100	1.34	2.26	3.15	4.33	6.62	5.66	4.77	4.18	493	492	415	357
Salicylic 200	1.13	2.09	2.94	4.07	5.45	5.45	4.57	4.00	581	481	395	344
Salicylic 300	0.69	1.73	2.59	3.59	6.18	4.32	4.33	3.81	570	425	385	330
Proline 100	1.20	2.17	2.99	4.15	6.89	5.81	4.88	4.37	619	516	426	377
Proline 200	0.87	1.86	2.72	3.78	6.58	5.60	4.75	4.16	612	492	412	355
Proline 300	0.55	1.58	2.45	3.39	6.30	5.41	4.62	3.95	580	480	392	339
Yeast 1000	1.32	2.23	3.08	4.24	6.75	5.75	4.85	4.23	612	506	420	364
Yeast 2000	1.27	1.92	2.78	3.86	6.50	5.49	4.61	4.12	609	488	408	355
Yeast 3000	0.62	1.65	2.52	3.50	6.22	5.21	4.42	3.94	579	473	385	338
LSD at 5 %	0.01				0.05				2.96			
Second season												
untreated	1.56	2.42	3.31	4.55	8.24	6.84	5.97	4.90	625	542	511	422
Ascorbic100	1.47	2.37	3.23	4.46	7.91	6.10	5.54	4.71	732	580	482	404
Ascorbic200	1.09	2.04	2.90	4.00	7.77	6.69	5.25	4.53	700	570	457	392
Ascorbic300	0.80	1.84	2.70	3.75	7.40	6.41	4.97	4.27	671	564	442	371
Salicylic 100	1.37	2.29	3.18	4.37	7.87	5.08	5.48	4.60	730	548	473	397
Salicylic 200	1.16	2.12	2.97	4.11	7.91	6.41	5.13	4.47	682	566	441	375
Salicylic 300	0.71	1.76	2.62	3.63	7.56	6.20	4.92	4.26	684	559	432	369
Proline 100	1.23	2.20	3.02	4.19	8.31	6.66	5.68	4.88	748	607	489	421
Proline 200	0.89	1.89	2.75	3.82	7.76	6.84	5.34	4.67	729	618	476	399
Proline 300	0.56	1.60	2.47	3.42	7.43	6.59	5.18	4.41	695	574	450	379
Yeast 1000	1.30	2.26	3.11	4.28	8.07	6.46	5.60	4.73	732	595	482	407
Yeast 2000	0.99	1.95	2.81	3.90	7.40	6.73	5.29	4.65	716	587	468	397
Yeast 3000	0.64	1.67	2.55	3.54	7.27	6.41	5.07	4.40	693	570	442	378
LSD at 5 %	0.01				0.02				Ns			

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تأثير ملوحة التربة وبعض مضادات الأكسدة على نبات الملوخية:-
١- مقاييس النمو الخضرى والجودة

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نفذت تجربتى أصص فى مزرعة كلية الزراعة- جامعة المنصورة- خلال موسمى الزراعة ٢٠٠٨-٢٠٠٩ لدراسة تأثير مستويات مختلفة من ملوحة التربة وبعض مضادات الأكسدة على نمو ومحصول نبات الملوخية . إستخدم فى هذه الدراسة نظام التصميم العاملى فى قطاعات كاملة العشوائية مشتملا على أربع معاملات ملوحة (كنترول - ٣٠٠٠- ٦٠٠٠ - ٩٠٠٠ جزء/مليون) و أربع معاملات علاجية كل منها بثلاث تركيزات وهم حمض الإسكوربيك، وحمض السالسليك، والبرولين بتركيزات (١٠٠ – ٢٠٠ – ٣٠٠ جزء/مليون) وكذلك مستخلص الخميرة بتركيزات (١٠٠٠ – ٢٠٠٠ – ٣٠٠٠ جزء/مليون) بالإضافة إلى معاملة الكنترول (الرش بماء الصنبور) ، وتم أخذ العينات لدراسة صفات النمو الخضرى ، بالإضافة إلى صفات الجودة.

- و يمكن تلخيص النتائج المتحصل عليها من هذه الدراسة كالتالى :

أ – سجلت متوسطات القيم لصفات النمو الخضرى إنخفاضا معنويا بزيادة مستويات ملوحة التربة.
ب- سجلت متوسطات القيم لصفات النمو الخضرى زيادة معنوية عند إستخدام مضادات الأكسدة.
ج- كانت أفضل النتائج لمضادات الأكسدة فى هذه الدراسة عند الرش بالتركيز الثالث مقارنة بالتركيزات الأقل.
د- كانت أفضل معاملة علاجية تحت مستويات الملوحة المختلفة كانت للبرولين ثم مستخلص الخميرة يليها حمض الأسكوربيك وحمض السالسليك.
و- إزداد محتوى الأوراق من فيتامين ج عند زيادة مستويات ملوحة التربة.
ك- إنخفاض محتوى الأوراق من النيتريت و النترات بزيادة مستويات ملوحة التربة و إنخفاضها مع الرش بمضادات الأكسدة.

Table 8: Interaction effect between soil salinity and antioxidant applications on vegetative growth parameters of jew's mallow plants in first and second cut during 2009 season.

Characters / Treatments (mg/l)	Plant height (cm)				No. of leaves/plant				Leaf area/plant (cm^2)				Plant fresh weight (g)				Plant dry weight (g)			
	First cut in the second season																			
	control	3000	6000	9000	control	3000	6000	9000	control	3000	6000	9000	control	3000	6000	9000	control	3000	6000	9000
untreated	34.9	28.7	23.9	15.7	19.9	19.2	17.3	11.2	251.0	226.2	189.2	173.2	15.4	10.1	8.7	2.7	2.60	1.51	1.22	1.00
Ascorbic100	35.5	29.1	24.5	18.0	23.3	18.7	17.7	16.5	332.7	252.4	191.6	160.3	17.4	11.7	10.1	4.4	3.19	2.13	1.34	1.02
Ascorbic200	37.8	30.4	26.1	21.2	28.2	19.5	17.9	16.6	420.3	295.5	241.7	181.7	19.5	12.7	10.7	6.6	3.92	2.56	1.52	1.07
Ascorbic300	39.7	32.3	27.7	22.4	29.9	20.6	18.9	17.0	540.9	311.9	297.3	275.4	22.3	15.6	11.9	8.2	5.25	2.89	2.08	1.27
Salicylic100	35.3	28.9	24.2	16.8	20.9	18.9	18.3	13.5	274.0	237.3	190.5	127.2	17.3	11.4	8.8	3.8	2.90	1.99	1.26	1.01
Salicylic200	37.6	29.9	25.6	20.7	24.6	19.1	15.8	14.7	337.5	284.9	231.3	169.7	18.3	12.1	9.8	6.0	3.83	2.32	1.45	1.03
Salicylic300	38.7	32.0	27.3	21.9	27.9	20.5	17.2	16.2	471.4	302.6	296.3	194.6	20.10	15.0	9.9	7.2	4.52	2.17	1.63	1.04
Proline 100	36.8	29.6	25.1	19.8	24.9	20.6	18.4	13.8	391.1	276.9	247.8	190.0	19.5	13.6	10.6	5.0	3.73	2.65	1.69	1.05
Proline 200	38.2	31.7	26.9	21.7	25.6	20.8	17.4	15.3	452.1	302.0	330.2	236.1	25.3	16.1	12.1	7.7	4.92	3.00	1.73	1.10
Proline 300	43.1	33.9	28.5	23.7	38.1	24.7	22.0	17.4	542.7	416.6	328.0	324.3	37.9	17.3	13.8	8.9	6.93	3.37	2.40	1.38
Yeast 1000	36.3	29.4	24.8	18.5	23.6	18.4	17.5	17.1	342.2	262.7	241.8	163.9	19.1	13.3	10.3	4.8	3.26	2.23	1.42	1.04
Yeast 2000	37.9	31.1	26.6	21.4	24.2	20.2	19.7	14.6	448.1	297.0	248.4	190.2	21.8	15.2	11.5	6.7	4.06	2.77	1.53	1.06
Yeast 3000	40.9	32.7	28.3	22.8	32.5	21.7	19.0	17.2	535.9	313.4	310.8	301.2	25.4	15.9	12.4	8.4	5.33	2.91	2.17	1.29
LSD at 5 %	0.5				0.53				22.55				0.36				1.1			
Second cut in the second season																				
untreated	36.3	40.4	29.3	28.3	22.7	24.5	21.4	21.3	327.3	494.9	261.3	243.8	15.59	15.7	8.67	7.61	2.28	3.48	1.70	1.49
Ascorbic100	37.7	42.3	34.0	31.7	23.5	26.3	22.5	23.2	414.9	541.4	411.7	361.9	13.88	20.6	12.1	9.09	2.77	4.48	2.17	1.82
Ascorbic200	42.3	48.5	39.3	34.0	28.4	29.7	25.8	24.3	586.5	633.2	501.7	498.5	15.86	24.7	14	12.26	3.99	5.03	2.77	2.57
Ascorbic300	49.7	49.7	43.3	36.5	31.3	35.3	31.6	28.4	774.5	813.5	708.3	605.1	22.6	32.6	19.1	17.27	4.54	6.16	3.57	3.46
Salicylic100	37.3	42.0	31.7	29.3	23.6	25.8	22.7	22.1	393.6	406.3	371.0	261.7	13.68	20.3	9.15	8.83	2.74	4.39	1.75	1.58
Salicylic200	42.0	47.3	39.0	33.7	25.4	28.9	25.3	24.7	480.5	605.8	473.5	470.1	15.93	23.2	15.4	13.41	3.61	5.02	2.77	2.49
Salicylic300	47.3	49.7	41.4	35.7	31.9	32.4	25.9	25.9	681.8	745.5	675.8	600.2	21.08	25.8	17.2	14.38	4.16	5.96	3.36	2.89
Proline 100	40.7	47.0	36.3	33.0	24.7	28.6	24.4	23.1	470.6	564.5	461.9	445.4	15.28	23.1	12.6	12.21	3.56	4.89	2.68	2.39
Proline 200	45.3	49.0	40.0	35.7	29.1	30.7	29.8	25.4	672.6	700.1	664.6	570.2	20.55	25.6	16.7	14.65	4.09	5.84	3.12	2.83
Proline 300	52.7	55.0	49.7	40.3	40.8	45.3	38.9	31.9	859.3	959.6	840.4	700.6	25.41	43.0	20.7	19.82	5.00	8.64	4.11	4.1
Yeast 1000	39.7	45.0	34.0	32.3	24.0	27.4	24.4	23.4	442.3	548.4	420.5	417.9	14.33	20.8	11.8	9.86	2.96	4.56	2.28	2.07
Yeast 2000	44.0	49.0	39.5	35.0	28.7	30.7	26.9	25.3	664.3	680.5	647.9	559.1	20.47	25.5	15.9	14.44	4.02	5.24	2.86	2.67
Yeast 3000	52.0	50.7	44.3	39.3	37.9	38.4	34.3	29.8	826.8	846.5	726.8	610.6	23.92	33.3	20.4	17.45	4.7	8.63	3.61	3.55
LSD at 5 %	0.56				0.29				17.03				0.33				0.09			

Table 7: Interaction effect between soil salinity and antioxidant applications on vegetative growth parameters of jew's mallow plants in first and second cut during 2008 season.

Characters / Treatments (mg/l)	Plant height (cm)				No. of leaves/plant				Leaf area/plant (cm^2)				Plant fresh weight (g)				Plant dry weight (g)			
	First cut in the First season																			
	control	3000	6000	9000	control	3000	6000	9000	control	3000	6000	9000	control	3000	6000	9000	control	3000	6000	9000
untreated	39.9	36.2	33.7	15.3	4 0.6	27.7	21.0	10.2	343.9	294.7	196.7	113.7	11.8	11.6	8.7	3.6	2.85	1.96	1.30	1.00
Ascorbic 100	40.3	36.7	34.3	24.9	41.7	33.2	23.3	16.6	434.0	339.5	250.3	142.0	13.1	11.5	9.8	6.8	2.81	2.32	1.77	1.04
Ascorbic 200	44.4	37.9	35.1	29.8	45.9	33.4	26.3	17.5	472.0	387.0	279.3	147.3	14.2	11.9	10.9	7.8	3.47	2.57	1.92	1.15
Ascorbic 300	46.7	39.3	35.8	31.6	49.6	36.1	36.2	22.3	546.5	405.3	340.5	179.4	14.6	13.0	11.5	8.9	3.80	2.67	2.20	1.60
Salicylic 100	40.1	36.4	34.2	20.7	40.7	31.3	21.1	12.5	413.1	318.3	233.3	132.2	11.9	11.0	9.5	6.7	2.60	2.10	1.34	1.04
Salicylic 200	41.1	37.7	35.0	28.9	42.9	32.2	25.3	13.5	463.4	340.2	250.8	142.7	13.7	11.7	10.0	4.5	3.12	2.19	1.82	1.10
Salicylic 300	45.6	39.1	35.7	31.4	46.8	35.9	31.9	20.6	509.1	343.9	329.4	174.1	14.3	12.7	11.4	8.0	3.59	2.41	1.99	1.48
Proline 100	41.1	37.2	34.9	28.4	43.9	36.9	26.1	21.7	474.7	375.6	272.8	170.2	13.3	11.9	10.5	7.3	3.39	2.49	2.05	1.20
Proline 200	44.9	38.7	35.5	30.9	51.5	39.0	31.7	22.6	608.1	416.4	294.2	174.6	16.1	12.1	11.2	8.2	3.98	2.69	2.04	1.56
Proline 300	58.1	39.8	36.2	33.1	56.3	44.0	36.2	28.3	646.3	443.9	384.6	260.9	17.4	14.1	12.8	9.8	4.49	3.24	2.59	1.97
Yeast 1000	40.9	36.9	34.8	27.8	42.0	36.2	23.8	16.9	402.2	370.9	272.4	147.2	13.2	11.6	10.4	7.0	2.92	2.46	1.84	1.13
Yeast 2000	42.0	38.1	35.4	30.3	49.7	37.3	30.4	20.5	522.9	408.8	287.2	162.0	15.4	12.0	10.6	7.9	3.60	2.66	1.96	1.39
Yeast 3000	48.6	39.6	36.0	32.2	52.0	39.6	36.4	25.1	618.7	439.0	422.6	233.2	15.5	13.3	11.8	9.1	3.83	3.00	2.24	1.63
LSD at 5 %	0.5				12.9				17.25				3.2				1.1			
Second cut in First season																				
untreated	35.3	40.0	28.7	21.7	30.2	32.4	20.4	17.7	385.07	444.7	319.16	286.20	10.95	14.1	10.9	6.6	2.44	2.89	2.3	1.38
Ascorbic 100	38.6	42.5	36.3	36.3	40.5	41.3	26.5	21.8	469.48	605.8	467.20	419.76	13.35	15.0	13.0	8.12	3.03	3.19	2.52	2.23
Ascorbic 200	43.1	44.7	43.1	41.0	42	53.1	30	29.4	657.20	703.5	577.97	572.40	15.69	17.4	14.6	14.3	3.61	3.63	3.11	3.21
Ascorbic 300	48.3	50.7	46.7	45.0	53.6	63	42.1	39.3	845.17	871.3	784.59	696.97	18.36	19.7	17.2	15.5	5.04	5.19	4.42	4.32
Salicylic 100	37.3	41.7	34.6	32.0	35.7	39.2	23.4	18.7	427.28	464.3	441.67	310.66	13.35	14.3	11.5	8.0	2.74	2.92	2.51	1.61
Salicylic 200	43.0	44.0	42.7	40.3	42.4	49.8	29.6	25.2	541.39	644	538.29	531.35	15.98	16.7	14.7	13.9	3.46	3.51	3.37	3.04
Salicylic 300	47.3	48.2	46.0	42.7	53.7	59.7	38.3	35.7	781.64	816.2	755.25	681.23	17.6	18.8	15.7	15.5	4.42	4.8	3.35	4.08
Proline 100	42.6	42.7	40.7	38.7	42.3	45	29.4	24.7	534.24	620.9	511.98	489.01	14.15	15.5	12.5	11.0	3.33	3.47	3.04	2.95
Proline 200	46.3	47.0	45.3	42.7	47.1	57.7	36.7	32.8	752.07	760.8	728.22	649.52	16.43	18.3	15.3	15.1	3.98	4.8	3.93	3.79
Proline 300	53.3	65.0	52.3	48.3	59.9	68.4	55.8	51.6	931.29	1039	929.97	749.50	20.61	23.5	19.2	17.8	5.54	6.92	5.27	4.74
Yeast 1000	41.1	42.7	39.7	36.5	41.7	44.3	28.7	24.2	500.13	619	481.45	477.00	13.62	15.7	11.8	8.9	3.09	3.17	2.90	2.50
Yeast 2000	46.0	46.0	44.0	42.2	55.1	55.4	30.9	29.9	727.43	734.9	622.64	622.64	17.78	17.8	15.4	14.3	3.78	3.83	3.78	3.61
Yeast 3000	51.7	55.5	47.0	45.3	54.8	62.7	48.8	47.2	884.62	910.2	787.85	676.73	21.48	21.6	18.1	15.7	5.41	5.85	5.33	4.42
LSD at 5 %	0.56				0.29				17.03				0.33				0.09			