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EFFECT OF VITAMIN E AND SELENIUM ON SOME PHYSIOCHEMICAL COMPOSITIONS OF SOYBEAN PLANTS UNDER SALINITY CONDITIONS

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ABSTRACT: ***The present investigation aimed to study the interaction between salinity and antioxidants (vitamin E and selenium) on some physiological and chemical compositions in alleviating salinity of soybean plants (Glycine max L) Giza 111, growing under saline condition at different levels (1.5,3 and 6 EC) with and without antioxidants .Photosynthetic pigments ,total carbohydrates ,soluble sugars and some minerals (N.P and K) were significantly decreased by salinity treatments meanwhile enzymes activity increased in different organs of the plants and these values increased also by antioxidants application .The interaction between antioxidants and salinity led to an increase in the above mentioned values especially at rate of 3 EC salinity plus 50 mg./l selenium .Meanwhile the interaction between rate of 6 EC salinity decreased the above mentioned values except the rate of 50 mg./l selenium under the same level of salinity which increased these values . It could be recommended that antioxidants has a good effect for improving the uptake of some minerals in saline soils and increasing plant resistance to salt stress.***

Key words: ***Soybean ,salinity ,antioxidants , vitamin E ,N uptahe,selenium.***

INTRODUCTION

Soybean plants (Glycine max, L.) is one of the most important leguminous crops all over the world. Soybean seeds are used widely in human food and animal feed for big nutrition value. , and soybean plants are used for silage of green manuring .

Salinity is a wide spread environmental stress for crop plants and soil salinization is one of the most serious environmental threats for plant survival and crop yield. In aired and semi-aired region in particular soil development is characterized by high salt levels in the soil profile . Salinity exerts in undesirable effects through osmotic inhibition, ionic toxicity and induce physiological disorders eg. Na or Cl (Arunsiri,1983).

Soluble salt depresses the water uptake by plant roots (Gangwar and Varshney, 1986) and also lead to disturbing the uptake and translocation of nutritional ions (Misra and Dwivedi,2004).

Antioxidants (vitamin E and selenium) are substances which may delay or inhibit oxidative damage to a targe molecule . The antioxidants are chemicals that prevent the oxidation of other chemicals and protect chloroplast

membranes from photo-oxidation and help to provide an optimal environment for photosynthetic machinery . Oxidation produces highly reactive free radicals which react with other molecules . The antioxidants scavenged the damaging cells from these free radicals.

Therefore this study was carried out to detect the effect of some antioxidants (vitamin E and selenium) under salinity conditions (NaCl+CaCl2) on physiological& chemical composition.

MATERIALS AND METHODS

Two pot experiments were conducted at the experimental Farm of fac ulty of Agriculture at Shebin El-Kom, Minufiya University during two successive seasons of 2007 and 2008 to study the effect of some antioxidants under salinity conditions on some physiochemical aspects of soybean plants .

Plastic pots (30 cm, inner diameter and depth)were filled with 10 kg of nil clay soil.

The salinity levels were mainted by adding a mixture salt of NaCl + CaCl2 (1 : 1 w/w) to each pot to get artifical salinity levels 0f 1.5 as a control ,3 and 6 ds m- by the mixture of salts ten days befor sowing iducing chloride salinization according to Strogonov (1962).

Phosphorus (P2O2) in the form of calcium super phosphate was added to the soil befor sowing at the rate of 1-2 gm.per pot and nitrogen fertilizer in the form of ammonium nitrate at the rate of 1.58 gm.per pot at two portions , the first portion 21 days after sowing and the secound one at the begining of podding stage .

Seeds of soybean plants (Glycine max,L.) cv Giza 111 were obtained from the Ministry of Agriculture, Giza, Egypt. The seeds were sown in the pots on 15 March of the two seasons (2007 and 2008) at the rate of 10 seeds pre pot at equal distance and depth .

After sowing the pots were watered immediately and watered twowice every week at the field capacity during the growth period .

The seedlings were thinned ,after the appearance of the foliage leaf to four plants per pot .

Antioxidants treatments :

Vitamin E (Thechpherol) was applied at rate of 0 ,100 and 200 mg./l and selenium as sodium selenate was applied at rate of 0 ,50 ,100 mg./l and the two antioxidants were obtained from Sigma Chemical Company

The plants were sprayed three times , the first application was at 30 days from sowing and the second one at 45 days from sowing (vegetative growth) and the third one at 60 days from sowing (flowering stage) .

The treatments were designed in complete randomized block system with three replicates .

Physiological and Chemical constituents:

Two samples were taken at 45 and 60 days from sowing to determine photosynthetic pigments concentration the activity of some enzymes in fresh leaves ,total carbohydrates ,total soluble sugars , proline concentration , total phenols , and mineral compositions .

Photosynthetic pigments were estimated according to Wettstein (1957).

peroxidase activity was measured according to the method described by Ferhrman and Dimond (1967).

Catalase activity was determined as described by Bach and Oparin (1968) .

Determination of carbohydrates :

Total carbohydrates and total soluble sugars were determined according to the methods by Dubois *et al* (1956).

D-Mineral analysis :

a) Nitrogen:

Total nitrogen was determined colorimeterically in the acid digest according to the method described by Yeun and Pollard (1952)

b)Phosphorus :

Total phosphorus was determined colourimeterically by hydrogen method described by Snell and Snell (1954).

c)Potassium :

Potassium was estimated in the acid digest by Flame photometer according to the method described by A .O .A .C (1995)

Calcium :

Calcium content was determined by using versenate method as described by Jackson (1967) .

Sodium :

Sodium was determined by using the Flame photometer method as described by A .O .A .C . (1995) .

Statistical analysis :

The obtained data were subjected to statistical analysis using program COSTAT 6.311 . The L.S.D test at 5 % level of propability was used to compare the means of treatments according to Costat Software (1985) .

RESULTS AND DISCUSSION:

Photosynthetic pigments:

Data illustrated in (Table 1) indicate that under salinity levels (EC 3 and EC 6) a significant decrease in chlorophyll a, b, a + b and carotenoids was obtained. This decrease was more pronounced with increasing salinity levels

and the maximum decrease in this respect was noticed at rate of EC 6 salinity if compared with the control plants.

These results are in accordance with those obtained by Borowski (2003) on soybean plants , Hamada and Ahmed (2004) 0n broad bean plants and El-Ghinbihi (2007) who found that , a high significant reduction in the concentration of photosynthetic pigments (chlorophyll a , b , a + b and carotenoids) were observed in response to salinity stress treatments pf pea plants .

All levels of vitamin E and selenium caused a significant increase in chlorophyll a , b , a + b and carotenoids concentrations in leaves of soybean plants . The level of 100 mg. /l vitamin E caused more increase than that of 200 mg. /l vitamin E, meanwhile 50 mg. /l selenium caused more increase than that of 100 mg. /l selenium and the two levels of vitamin E applications if compared with untreated plants.

These results are in harmony with those obtained by Yamani et al (2004) who recorded that, pre- treated plants with ascorbate which scavenged H2O2 effectively suppressed the reduction of chlorophyll content and the destruction of chloroplasts.

It was clear that the interaction between the different levels of antioxidants used under all salinity levels increased chlorophyll a , b , a + b and carotenoids , especially at rate of EC 3 salinity . The maximum increase was noticed at selenium treatments more than vitamin E application if compared with control plants. The increase in chlorophyll a, b, a + b and carotenoids at antioxidants combined with rate of EC 6 salinity was less than that of at rate of EC 3 salinity plus antioxidants and control plants, except the level of EC 6 salinity plus level of 50 mg. /l selenium which caused a slight increase in chlorophyll a, b, a + b and carotenoids compared to the control plants.

The obtained results are similar with those obtained by Yamani *et al* (2004) who revealed that salinity plus the application of antioxidants which scavenged H2O2 and OH2, effetely suppressed the reduction of chlorophyll content and the destruction of chloroplasts by NaCl. , and Munne (2005) indicated that, Tochepherol (vitamin E) is the major vitamin compound found in leaf chloroplasts where it is located in the chloroplast envelope, thylakoid membranes and plastoglbuli.

Table (1) Effect of salinity, antioxidants, and their interaction on photosynthetic pigments (mg/g D.W.) of soybean plants during growing seasons 2007 and 2008.

Characters / Treatments		45 days from sowing				60 days from sowing			
(season 2007)									
Salinity	Antioxidants Mg./1	Chl A	Chl B	Chl A+ B	Carotenoids	Chl A	Chl B	Chl A+B	Carotenoids
1.5		4.61	2.65	7.26	1.73	5.20	2.61	5.81	1.60
3		4.02	2.03	6.05	1.69	5.01	2.32	7.33	1.52
6		3.71	2.00	5.71	1.53	4.35	2.37	6.72	1.42
	000	3.13	1.69	4.82	1.41	4.23	2.53	6.76	1.26
	Vit 100	4.14	2.27	6.41	1.70	5.01	2.19	7.20	1.58
	Vit 200	4.08	2.34	6.42	1.60	4.65	2.34	6.99	1.45
	Se 50	4.55	2.38	6.93	1.85	5.25	2.66	7.81	1.64
	Se 100	4.56	2.39	6.95	1.71	5.08	2.44	7.52	1.44
1.5		4.05	1.87	5.92	1.49	4.81	2.65	7.46	1.39
	Vit 100	4.62	3.13	7.75	1.88	5.50	2.63	8.13	1.53
	Vit 200	4.55	2.87	7.42	1.64	5.05	2.42	7.47	1.50
	Se 50	5.58	2.99	8.57	1.93	5.60	2.90	8.50	1.58
	Se 100	5.36	2.84	8.20	1.81	5.26	2.53	7.79	1.54
3		2.88	1.81	4.69	1.44	4.64	2.30	6.94	1.35
	Vit 100	4.07	1.90	5.97	1.70	5.02	2.02	7.04	1.66
	Vit 200	4.01	2.05	6.06	1.66	4.95	2.66	7.61	1.44
	Se 50	4.14	1.95	6.09	1.93	5.11	2.19	7.30	1.68
	Se 100	4.28	2.16	6.44	1.73	5.21	2.39	7.60	1.55
6		2.46	1.41	3.87	1.31	3.25	2.64	5.89	1.05
	Vit 100	3.72	1.80	5.52	1.53	4.50	1.95	6.45	1.56
	Vit 200	3.68	2.11	5.79	1.50	3.95	1.94	5.89	1.48
	Se 50	3.94	2.19	6.13	1.69	5.04	2.89	7.93	1.66
	Se 100	4.04	2.17	2.21	1.59	4.76	2.41	7.17	1.49
L.S.D 5%	Sal.	0.001	0.001	0.0001	0.001	0.001	0.011	0.012	0.001
	Anti.	0.001	0.001	0.0001	0.011	0.014	0.012	0.014	0.012
	Iner.	0.341	0.211	0.219	0.015	0.223	0.190	0.233	0.016
(season 2008)									
Salinity EC(dSm	Antioxidants Mg./1	Chl A	Chl B	Chl A+ B	Carotenoids	Chl A	Chl B	Chl A+ B	Carotenoids
1.5		4.71	2.69	7.40	1.82	5.36	2.82	8.18	2.34
3		3.99	2.09	6.08	1.74	4.89	2.76	7.59	2.28
6		3.53	1.89	5.42	1.56	4.39	2.37	6.75	2.20
	000	3.03	1.74	4.77	1.63	4.05	2.44	6.44	1.99
	Vit 100	4.25	2.38	6.63	1.67	4.95	2.71	7.66	2.33
	Vit 200	4.01	2.22	6.23	1.66	4.71	2.64	7.35	2.22
	Se 50	4.59	2.43	7.02	1.86	5.63	2.71	8.34	2.43
	Se 100	4.46	2.31	6.77	1.77	5.00	2.61	7.61	2.39
1.5		3.93	2.05	5.98	1.76	4.89	2.75	7.64	2.04
	Vit 100	5.02	3.07	8.09	1.81	5.73	2.94	8.67	2.49
	Vit 200	4.46	2.81	7.27	1.79	5.13	2.79	7.92	2.37
	Se 50	5.60	3.00	8.60	1.82	5.94	2.95	8.89	2.50
	Se 100	5.41	2.88	8.29	1.81	5.80	2.80	8.60	2.45
3		2.78	1.80	4.58	1.69	3.74	2.38	6.12	2.02
	Vit 100	4.02	2.07	6.09	1.86	4.94	2.78	7.72	2.29
	Vit 200	4.06	2.05	6.11	1.88	4.96	2.86	7.82	2.20
	Se 50	4.22	2.09	6.31	1.94	5.13	2.58	7.71	2.41
	Se 100	4.07	2.06	6.13	1.78	5.07	2.82	7.89	2.39
6		2.38	1.38	3.76	1.42	3.53	2.19	5.72	1.91
	Vit 100	3.73	2.00	5.73	1.55	4.19	2.40	6.59	2.20
	Vit 200	3.50	1.79	5.29	1.50	4.04	2.28	6.32	2.10
	Se 50	3.96	2.21	6.17	1.82	5.83	2.59	8.42	2.40
	Se 100	3.91	2.01	5.93	1.73	4.14	2.22	6.36	2.35
L.S.D 5%	Sal.	0.011	0.001	0.012	0.001	0.013	0.002	0.014	0.011
	Anti.	0.016	0.018	0.015	0.016	0.017	0.019	0.016	0.017
	Iner.	0.235	0.112	0.299	0.123	0.199	0.132	0.289	0.131

Enzymes activity :

It was obvious from data presented in Table (2) that, salinity levels were significantly effective in increasing peroxidase activity as the salinity levels increased, the increase in peroxidase activity at level of EC 6 salinity was more than that at rate of EC 3 salinity if compared with un-treated plants . The activity of catalase enzyme was also significantly increased at the different levels of salinity.

These results are in line with those obtained by Gharbanli *et al* (2004) on soybean plants and Telesinki *et al* (2008) on bean plants , who indicated that salinity levels increased the activities of peroxidase and catalse enzymes in leaves .

It is observed from the same Table and that antioxidants application increased the activities of peroxidase and catalase enzymes in leaves of soybean plants at all levels of antioxidants compared to the control plants. The highest increase was observed at rate of 50 mg. /l selenium if compared with other treatments and control plants, while the lowest one was obtained at rate of 100 mg. /l vitamin E application.

These results are in harmony with those obtained by Bandeoglu *et al* (2004) on lentil and Djanaguiraman et al (2005) who mentioned that selenium positively promoted and increased super-peroxidase and glutathione peroxidase enzyme activities in soybean plants

The interaction between salinity levels and antioxidants application caused s significant increase in the activities of peroxidase and catalase enzymes under all levels of salinity plus antioxidants.

The highest increase in this respect was recorded at rat of 1000 mg./l salinity plus 50 mg./l selenium application if compared with the control plants.

The antioxidants may be work against the toxicity of salinity and may lead to increasing of enzyme activities. These findings are confirmed with those of Gharbanli *et al* (2004) on soybean plants and Djanaguiraman *et al* (2005) who indicated that, selenium promoted the activity of enzymes in soybean plants. The high level of salinity plus antioxidants increased the activities of peroxidase and catalase more than that at the low level of salinity plus antioxidants. Furthermore the interaction between salinity and selenium led to more increase the activity of peroxidase and catalase than that salinity plus vitamin E application in the leaves of the plant.

Proline:

Results recorded in Table (2) indicate that the salinity treatments caused a significant increase in the concentration of praline in leaves of soybean plants. The highest praline concentration was obtained at rate of 2000 mg./l salinity if compared to the control plants .The accumulation of proline seem to correlate with greater tolerance against salt stress . In a more general

context, it could say that the formation of complete osmolytes such as proline and betane, capable of stabilizing membranes and proteins, is responsible for the increase in tolerance against saline stress.

These results are confirmed by those recorded by Ismail and Azooz (2000) on faba bean, Fahad on pea and bean plants, and Cick and Cakilar (2008) who stated that salinity treatments increased proline concentration in leaves of soybean plants.

Data in the same Table indicate that, all levels of both vitamin E and selenium significantly increased proline concentration in leaves of soybean plants and the increase by selenium application was pronounced more than that by vitamin E treatments. The highest increase of proline concentration was recorded at level of 50 mg. /l selenium application.

These findings are in agreement with results obtained by Djanaguiraman *et al* (2005) and Fahad (2007) who reported that, vitamin E as antioxidant increased proline concentration in leaves of pea seedlings.

It was observed from the obtained results in the same Table that, the interaction between salinity levels and antioxidants application caused a significant increase in proline concentration in leaves of soybean plants.

The increase by application salinity at rate of 1000 mg. /l plus vitamin E was closed to the increase by selenium levels. The lower increase in proline concentration was recorded at rate of 1000 mg. /l salinity plus 100 mg. /l selenium, meanwhile the highest increase was observed at rate of 1000 mg. /l salinity plus 50 mg. /l selenium . Such increase in protective osmolyte (proline) was insufficient to protect seedling against damage. Tocehpherol (vitamin E) belong to compounds that can play different roles in plant metabolism, and can play also important roles in amelioration of biotic and a biotic stresses.

Djanaguiraman *et al* (2005) on soybean plants and Hussein *et al* (2007) recorded that, Tochepherol (vitamin E) as a antioxidant which defense against free radical damage of cowpea plants .

Carbohydrates:

The obtained results presented in Table (3) indicate that all salinity levels reduced the concentration of total carbohydrates and soluble sugars in roots, stems and leaves of soybean plants. This reduction was higher in leaves than that in roots and stems at the high level of salinity (EC 6).

The obtained results are in accordance with those obtained by Cho- Jin Woong *et al* (2002) who found that , salinity decreased sugars and starch contents of soybean plants . In addition Hamada and Ahmed (2004) on broad bean plants and Namich *et al* (2008) revealed that, salinity treatments reduced total soluble sugars in leaf of cotton plants.

Table (2): Effect of salinity, antioxidants, and their interaction on proline and enzymes activity of soybean leaves during the growing seasons 2007 and 2008.

(season 2007)

Characters / Treatments		45 days from sowing			60 days from sowing		
Salinity EC (dSm)	Antioxidants Mg./1	Proline Leucine/gD	Peroxidas O.D/g fwt.	Catalase O.D/g fwt.	Proline leucine/gD	Peroxidas O.D/g fwt.	Catalase O.D/g fwt.
1.5		799.17	1.30	10.77	805.55	1.55	11.18
3		800.81	1.48	11.69	864.10	1.77	12.99
6		861.26	1.59	12.17	865.07	1.83	14.23
	000	820.03	1.25	9.47	824.30	1.48	10.93
	Vit 100	829.03	1.40	11.20	832.22	1.75	12.73
	Vit 200	827.28	1.34	10.66	828.76	1.70	11.93
	Se 50	860.23	1.66	13.56	867.58	1.83	14.33
	Se 100	858.68	1.62	12.80	860.18	1.82	14.07
1.5		748.93	1.17	8.00	758.01	1.36	9.00
	Vit 100	760.15	1.20	10.30	764.21	1.59	10.70
	Vit 200	758.20	10.19	10.10	759.96	1.58	10.30
	Se 50	853.42	1.48	12.90	858.50	1.60	12.40
	Se 100	850.92	1.43	11.80	861.19	1.59	12.30
3		855.48	1.24	9.90	859.22	1.47	11.10
	Vit 100	864.56	1.40	11.30	863.71	1.82	13.20
	Vit 200	861.29	1.37	10.90	858.90	1.76	12.30
	Se 50	865.11	1.67	13.80	869.52	1.90	14.70
	Se 100	860.84	1.64	12.90	847.29	1.88	14.30
6		855.89	1.35	10.50	855.68	1.61	12.70
	Vit 100	862.48	1.51	12.00	868.71	1.83	14.30
	Vit 200	861.37	1.46	11.10	867.40	1.78	13.20
	Se 50	864.59	1.83	14.10	874.32	1.97	15.90
	Se 100	863.01	1.78	13.70	872.40	1.96	15.60
L.S.D 5%	Sal.	20.001	0.010	1.01	20.001	0.001	0.011
	Anti.	20.072	0.010	1.02	21.001	0.011	0.101
	Iner.	20.100	0.224	1.50	20.030	0.502	48
(season 2008)							
Salinity EC(dSm)	Antioxidants Mg./1	Proline Leucine/gD	Peroxidas O.D/g fwt.	Catalase O.D/g fwt.	Proline Leucine/gD	Peroxidas O.D/g fwt.	Catalase O.D/g fwt.
1.5		800.00	1.31	10.72	807.88	1.57	10.69
3		863.73	1.44	11.84	866.39	1.75	13.24
6		856.83	1.59	12.48	870.47	1.81	14.07
	000	825.44	1.25	9.87	830.44	1.46	11.07
	Vit 100	830.30	1.37	11.30	230.79	1.72	12.63
	Vit 200	817.07	1.35	10.73	830.13	1.71	11.87
	Se 50	858.50	1.66	13.70	876.38	1.84	14.30
	Se 100	862.67	1.58	12.80	866.38	1.81	13.73
1.5		754.63	1.17	8.65	759.00	1.34	8.70
	Vit 100	759.71	1.21	10.20	763.15	1.61	10.40
	Vit 200	752.43	1.20	9.70	758.08	1.59	10.70
	Se 50	857.02	1.50	12.70	878.47	1.64	12.70
	Se 100	858.28	1.44	11.30	858.90	1.63	12.10
3		263.30	1.25	10.00	867.40	1.47	11.76
	Vit 100	862.88	1.39	11.40	856.57	1.83	13.40
	Vit 200	859.53	1.37	10.80	865.16	1.76	12.70
	Se 50	868.38	1.64	14.10	872.27	1.89	14.90
	Se 100	864.00	1.56	13.70	870.39	1.85	14.20
6		858.37	1.35	10.90	864.80	1.58	12.80
	Vit 100	868.29	1.52	12.30	872.86	1.72	14.10
	Vit 200	839.26	1.47	11.70	867.18	1.78	12.90
	Se 50	850.10	1.83	14.30	875.44	1.98	15.30
	Se 100	865.75	1.74	13.40	871.68	1.96	14.90
L.S.D 5%	Sal.	21.01	0.01	1.01	20.21	1.01	1.03
	Anti.	20.59	0.11	1.12	20.19	1.13	1.11
	Iner.	21.24	0.13	1.23	21.28	1.64	1.45

Table (3): Effect of salinity, antioxidants, and their interaction on total carbohydrates and soluble sugars (mg/g D.W.) during growing 2007. (45 day from sowing) .

		Total carbohydrates (mg/g D.wt.)			Soluble sugars (mg/g D.wt.)		
Salinity EC(dSm)	Antioxidants Mg./1	Roots	Stems	Leaves	Roots	Stems	Leaves
1.5		103.95	126.46	119.06	51.50	61.13	58.85
3		98.96	121.67	112.60	50.24	58.64	56.41
6		91.34	116.35	106.77	64.20	49.63	53.46
	000	83.87	113.19	101.39	42.97	50.17	49.91
	Vit 100	99.82	124.31	114.41	50.26	57.90	57.29
	Vit 200	97.39	119.28	110.94	49.48	57.09	56.64
	Se 50	106.42	127.26	121.87	52.25	59.20	59.38
	Se 100	102.95	123.61	115.45	51.71	57.98	57.97
1.5		96.88	120.31	110.94	48.43	57.82	55.47
	Vit 100	106.25	129.69	118.75	52.34	62.50	59.38
	Vit 200	103.13	123.44	115.63	51.56	61.72	58.59
	Se 50	110.94	131.25	126.56	53.91	64.06	60.94
	Se 100	107.81	126.56	123.44	53.13	63.28	60.16
3		81.25	114.06	98.44	42.97	48.44	48.44
	Vit 100	101.56	123.44	114.06	50.78	60.94	57.81
	Vit 200	98.44	118.75	112.50	50.00	60.16	57.03
	Se 50	106.25	126.56	120.31	52.34	61.72	59.38
	Se 100	104.69	125.00	117.19	51.56	66.94	58.86
6		68.75	106.25	95.31	37.50	43.75	44.53
	Vit 100	93.75	117.19	109.38	47.65	50.00	54.60
	Vit 200	90.63	114.06	104.69	46.88	49.21	54.58
	Se 50	100.0	123.44	118.75	50.00	51.56	57.81
	Se 100	95.31	118.75	106.25	47.92	50.78	54.69
L.S.D 5%	Sal.	2.121	2.013	2.001	1.220	1.002	1.110
	Anti.	2.110	2.111	2.212	1.210	1.170	1.330
	Iner.	2.213	2.330	2.874	1.350	1.450	1.480
(60 days from sowing)							
Salinity EC(dSm)	Antioxidants Mg./1	Roots	Stems	Leaves	Roots	Stems	Leaves
1.5		116.11	134.37	124.88	52.91	66.30	63.04
3		112.60	130.42	121.25	51.30	64.79	60.36
6		103.12	124.06	115.83	48.07	59.89	57.86
	000	97.57	116.49	107.46	45.40	58.33	53.47
	Vit 100	112.33	132.29	122.92	51.12	63.97	60.94
	Vit 200	110.42	128.30	119.79	50.60	62.58	60.92
	Se 50	117.82	138.89	129.69	54.25	67.70	64.50
	Se 100	114.93	132.12	123.96	52.60	65.71	62.67
1.5		109.38	123.44	118.75	50.00	61.72	60.16
	Vit 100	115.63	134.38	126.56	53.13	65.63	62.50
	Vit 200	114.06	131.25	121.88	52.34	64.84	60.72
	Se 50	121.88	142.19	132.81	55.47	70.31	65.63
	Se 100	118.75	139.06	129.69	54.69	69.53	64.84
3		98.44	115.63	104.69	54.31	59.37	51.56
	Vit 100	114.06	132.81	123.44	51.56	64.84	60.94
	Vit 200	112.50	129.69	120.31	50.78	63.28	60.90
	Se 50	120.31	137.50	131.25	53.91	67.19	64.06
	Se 100	117.19	134.38	125.00	53.12	66.41	63.28
6		84.38	109.38	98.44	39.84	53.13	48.43
	Vit 100	106.25	128.13	117.19	48.44	60.94	59.38
	Vit 200	104.69	123.44	115.63	47.66	58.59	58.59
	Se 50	110.94	134.38	128.13	52.34	64.84	63.28
	Se 100	107.81	121.88	117.19	49.22	60.94	59.38
L.S.D 5%	Sal.	2.330	1.999	2.132	1.010	1.102	1.111
	Anti.	2.121	2.111	2.122	1.100	1.105	1.123
	Iner.	2.543	2.441	2.542	1.443	1.451	1.551

Data in the same Table indicate that, the concentration of total carbohydrates and soluble sugars significantly increased by application of all levels of antioxidants . The increase by the two levels of vitamin E application was less than that of the two levels of selenium in roots stems and leaves of soybean plants if compared to the control plants. The highest increase in total carbohydrates and soluble sugars was recorded at rate of 50 mg. /l selenium, whereas the lowest one was recorded at rate of 200 mg. /l vitamin E if compared with the control plants.

These results are in agreement with those obtained by Ismail and Azooz (2002) who revealed that, application of antioxidants (vitamin pyroxene) on Vicia faba enhanced the production of carbohydrates.

It can be noticed that , the concentration of total carbohydrates and soluble sugars was significantly increased in different organs of soybean plants treated with antioxidants under low level of salinity (EC 3) if compared with the control plants and soluble sugars was less than that those obtained at rate of 100 mg./l vitamin E if compared to the control .

The highest increase in this respect was observed at rate of EC 3 salinity plus 50 mg. /l selenium more in stems and leaves than roots of the plants if compared with the control plants.

From the same Table . it can be noticed that, the interaction between rate of EC 6 salinity and all levels of antioxidants (vitamin E and selenium) caused a decrease in total carbohydrates and soluble sugars in roots, stems and leaves of soybean plants except rate of EC 6 salinity plus 50 mg. /l selenium which caused a slight increase in these values in different organs of the plants if compared to the control plants.

The increase in total carbohydrates and soluble sugars were recorded under salinity conditions and antioxidants i. e. vitamin pyroxine B6 of vicia faba plants was recorded by many authors among them Ismail and Azooz (2002), Hussein *et al* (2007) who found that, the interaction between vitamin E and salinity increased photosynthetic pigments which lead to an increase in photosynthetic rate and consequently accumulation of carbohydrates of cowpea plants.

Mineral analysis:

a-Nitrogen (N):

The concentration of Nitrogen in different plant organs of soybean plants was obtained in (Table 4) showed a significant decrease at all treatments of salinity.

The two levels (EC 3 and EC 6) decreased the content of nitrogen in roots, stems and leaves of soybean plants. Salinity at the level of EC 6

gave the highest decrease of nitrogen concentration in different organs of the plants as compared with the control plants.

Table (4) Effect of salinity, antioxidants, and their interaction on mineral composition (%) of soybean plants at 45 days during growing seanson 2007.

Treatments \ Char.		N %			P %			K %			Na %			Ca %		
Sal.EC (dSm)	Anti. Mg./1	Ro.	St.	Le.	Ro.	St.	Le.	Ro.	St.	Le.	Ro.	St.	Le.	Ro.	St.	Le.
1.5		1.66	1.77	2.47	0.27	0.37	0.57	1.49	2.35	3.07	0.51	0.40	0.44	1.50	1.45	
3		1.46	1.64	2.21	0.25	0.34	0.53	1.25	1.88	2.79	0.72	0.68	0.63	1.55	1.51	1.51
6		1.18	1.39	1.74	0.20	0.31	0.46	1.09	1.67	2.07	0.80	0.69	0.74	1.55	1.54	1.61
												0				1.66
	000	0.97	1.17	1.44	0.01	0.27	0.40	1.15	1.86	2.56	0.74	0.65	0.68	1.45	1.44	1.49
	Vit 100	1.46	1.63	2.20	8		0.51	1.27	2.00	2.60	0.67	0.59	0.60	1.56	1.50	1.61
	Vit 200	1.35	1.57	2.08	0.25	.35	0.48	1.22	1.93	2.67	0.69	0.61	0.63	1.54	1.48	1.59
	Se 50	1.75	1.86	2.54	0.23	0.34	0.62	1.44	2.13	2.80	0.61	0.51	0.54	1.58	1.55	1.65
	Se 100	1.57	1.66	2.36	0.28	0.37	0.56	1.36	2.06	2.72	0.64	0.54	0.58	1.55	1.53	1.64
					0.26	0.35										
1.5		1.26	1.40	1.57	0.23	0.32	0.48	1.34	2.25	3.12	0.52	0.43	0.49	1.40	1.40	1.42
	Vit 100	1.61	1.82	2.52	0.30	0.38	0.55	1.48	2.40	3.07	0.46	0.37	0.43	1.50	1.45	1.50
	Vit 200	1.54	1.75	2.38	0.27	0.36	0.52	1.42	2.33	3.01	0.49	0.40	0.46	1.51	1.43	1.46
	Se 50	1.89	1.96	2.66	0.32	0.40	0.69	1.68	2.59	3.29	0.43	0.34	0.40	1.59	1.50	1.60
	Se 100	1.82	1.89	2.59	0.29	0.39	0.64	1.61	2.50	3.17	0.46	0.37	0.43	1.55	1.46	1.59
3		0.91	1.26	1.47	0.19	0.28	0.39	1.12	1.79	2.65	0.78	0.75	0.71	1.45	1.43	1.49
	Vit 100	1.47	1.68	2.31	0.26	0.35	0.52	1.26	1.88	2.67	0.71	0.68	0.64	1.58	1.52	1.65
	Vit 200	1.40	1.61	2.17	0.24	0.34	0.50	1.20	1.82	2.80	0.75	0.71	0.68	1.55	1.50	1.63
	Se 50	1.75	1.82	2.52	0.30	0.38	0.64	1.39	1.98	2.96	0.68	0.61	0.58	1.59	1.57	1.66
	Se 100	1.68	1.75	2.45	0.28	0.35	0.56	1.32	1.93	2.89	0.75	0.64	0.61	1.57	1.55	1.65
6		0.70	0.84	0.98	0.12	0.26	0.34	0.98	1.52	1.92	0.92	0.78	0.81	1.50	1.49	1.55
	Vit 100	1.19	1.33	1.68	0.20	0.32	0.46	1.06	1.69	2.05	0.81	0.71	0.75	1.60	1.55	1.69
	Vit 200	1.05	1.26	1.61	0.19	0.31	0.43	1.04	1.64	2.20	0.85	0.75	0.78	1.58	1.50	1.67
	Se 50	1.54	1.68	2.31	0.23	0.34	0.54	1.24	1.82	2.15	0.71	0.59	0.68	1.57	1.59	1.70
	Se 100	1.12	1.33	1.68	0.22	0.32	0.49	1.16	1.73	2.10	0.75	0.61	0.71	1.54	1.57	1.69

These results are similar with those obtained by Essa (2002) and Redendo *et al* (2007) who revealed that salinity in the range of 0-700 mol/m NaCl decreased nitrogen concentrations with increasing salinity in Atriplex portulacoids plants .

The applications of all levels of antioxidants significantly increased the concentrations of nitrogen in roots, stems and leaves of soybean plants. The selenium application recorded more increase than that of vitamin E treatments. On the other hand, the highest increase in nitrogen concentrations was observed at level of 50 mg/l selenium.

It is clear that the interaction between salinity and antioxidants increased nitrogen concentrations in roots, stems and leaves of soybean plants. This increment was more pronounced at rate of EC 3 salinity plus antioxidants than that at rate of EC 6 plus 50mg/l selenium in leaves more than that in roots and stems of the plant.

Treating plants with high levels of salinity plus all levels of vitamin E and selenium decreased the concentrations of nitrogen in all organs of the plants except rate of EC 6 salinity plus 50 mg/l selenium which lead to increasing it.

The increase of nitrogen may be due to the application of antioxidants which reduce the injurious effect of salts.

b-Phosphorus (P):

Results obtained in Table (4) recorded that all salinity levels significantly decreased phosphorus concentrations sharply in roots then that in stems and leaves of soybean plants at all samples dates when compared to the control plants .

The reduction of phosphorus concentrations at high level of salinity was more than that at low level of salinity. This reduction of phosphorus concentrations in the organ of the plant may be due to toxicity of salts and raising the soil osmotic pressure or to increasing soil – PH which lowered the ability of phosphorus concentration (Russell, 1973) additionally (Daw, 1982) and El-Ghinbihi (2007) who found that salinity levels (60 and 120 mM of NaCl) in root media decreased phosphorus concentrations in pea leaves compared with control plants.

The levels of selenium increased phosphorus concentrations than that vitamin E application and the highest increase occurred at 50 mg/l selenium in all organs of the plants if compared to all treatments or control plants. The lowest increase in phosphorus concentration was observed at the level of 200 mg /l vitamin E compared to all treatments and control plants.

It can be noticed that the combination between salinity and all antioxidant levels increased phosphorus concentration in roots, stems and leaves of soybean plants and this increase was clear at rate of 1000 mg/l salinity in combination with all level of antioxidants. Meanwhile the high level of salinity (EC 6) plus all antioxidant levels decreased phosphorus concentrations except the level of 50 mg/l selenium caused a slight increase in all organs of the plant, and the best increase in phosphorus concentration was recorded at rate of 50 mg/l selenium under EC 3 salinity.

These results are in agreement with recorded by El-Ghanam (2004) who revealed that, selenium application resulted in a significant increase in phosphorus concentration of soybean plants. In addition Sakr et al (2008) indicated that salinity stress at levels of (4000 and 6000 mg/l decreased phosphorus concentration of wheat plants.

c-Potassium (K):

Data presented in Table (4) show that, there was a remarkable reduction in potassium concentration in roots, stems and leaves of soybean plants with increasing salinity levels. In this respect the highest decrease was observed at rate of EC 6 salinity in all sample dates compared to the control plants. This reduction in potassium concentration may be due to the high osmotic pressure in soil solution which may decrease the absorption of potassium.

These results are in agreement with those obtained Essa (2002) on three soybean cultivars, El-Ghinbihi (2007) and Redondo (2007) who revealed that, salinity in range of 0-700 mol/m NaCl caused a sharply decreased in potassium concentration of Atriblex portulacoides plants.

Potassium concentrations in roots, stems and leaves of soybean plants tended to increase when antioxidants applied at all levels as compared with a control plant. Selenium application cause more increase in potassium concentration than that of vitamin E application.

The highest increase in this respect was observed at 50 mg/l selenium application and the lowest one recorded at rate of 200 mg/l vitamin E if compared with control plants.

The interaction between the low level of salinity (EC 3) combined with all antioxidants had a positive effect on potassium concentration. The increase in potassium concentration was more pronounced at selenium application than that in vitamin E treatments. The highest increase was observed at EC 3 salinity plus 50 selenium if compared with the control.

The increase in potassium concentration due to the antioxidants application may be due to that antioxidants may decrease or prevent the toxicity of salinity on the uptake of potassium.

These findings are similar with those obtained by Essa (2002) on soybean plants.

Furthermore sodium uptake causes plasma membrane depolarization leading to activation of outward rectifying potassium channels and consequent potassium loss (Shabala *et al* , 2003) and (Shabala *et al* 2005).

d-Sodium (Na):

Data recorded in Table (4) indicate that sodium concentration was increased with increasing salinity levels in roots than stems and leaves of soybean plant. The highest increase was recorded at the level of EC 6 salinity in all sample dates if compared with the control plants. This increase in sodium concentration may be due to the rising of osmotic pressure of root cell causing more absorption of minerals.

These results are in harmony with those obtained by Essa (2002) on soybean, Dabuxliatu and Ikede (2004) on soybean plants and Redondo et al (2007) who stated that salinity in the range of 0-700 mol/m NaCl increased accumulation of sodium concentrations in Atriplex portulacoides plants.

It can be concluded that, all levels of antioxidants decreased sodium concentration in roots, stems and leaves of soybean plants. This decrease was more pronounced at rate of 50 mg/l selenium then 100 mg/l selenium and 100 mg/l vitamin E. The highest decrease was observed at rate of 50 mg/l selenium if compared with all antioxidants treatments. This decrease in sodium concentrations may be due to that antioxidants may prevent more absorption of sodium.

The interaction between EC 3 salinity with all antioxidants level increased sodium concentration in roots, stems and leaves of soybean plants and this increase was more at vitamin E application than that of selenium treatments.

The best increase was observed at rate of EC 3 salinity plus 200 mg/l vitamin E if compared with the control plants. Also high level of salinity (EC 6) plus all antioxidants level lead to more increase in sodium concentration in roots, stems and leaves. The highest increase was observed at EC 6 salinity plus 200 mg/l vitamin E.

Tavori *et al* (2004) indicated that salinity levels increased sodium concentrations more in stems than in leaves of broad bean plants.

The significant increase in sodium concentration in soybean plants may be a result of salt toxicity leading to cell hydration and membrane disfunction. Such disturbances in ionic and osmotic balance would inhibit essential metabolic pathway leading to reducing plant growth (Sumithra *et al,* 2006).

It is clear that antioxidants may be reducing the injurious effect of salts (EC 3 and EC 6) and consequently decrease the absorption of sodium (Sheteawi, 2007) on soybean plants.

e-Calcium (Ca):

As for the effect of salinity , it is evident from the results obtained in Table (4) that the calcium concentration was significantly at all salinity levels in the different organs of the plant and the increase was more in leaves than in roots and stems of soybean plants. In this respect the highest increase was recorded at rate of EC 6 salinity at all sample dates compared with the control plants.

These findings are similar to those obtained by Hammad (2000) who indicated that salinity levels increased calcium concentration in shoots of sweet basal plants and Dabuxilata and Ikeda (2004) who recorded that salinity (NaCl + CaCl2) levels increased calcium concentration in soybean plants.

There was a remarkable increase in calcium concentration of roots, stems and leaves of soybean plants at all antioxidants (vitamin E and selenium) levels. This increase was more at selenium than that in vitamin E application.

The highest increase in this respect was recorded at rate of 50 mg/l selenium. These increments due to the antioxidants application which may be scavenge or prevent the free radicals which destroy the cell walls.

Vitamin E is considered as major antioxidants in biomembranes and protects lipids membrane from photo-oxidation (Michal *et al,* 2005) on Arabidobsis thaliana.

As for the effect of interaction between salinity and antioxidants, it is clear from the data recorded in the same Table and figure that, antioxidants had a marked effect on calcium concentration in roots, stems and leaves of soybean plants. In this concern all levels of antioxidants under salinity

resulted in increasing calcium concentration in the different organs of the plant at all level of salinity plus antioxidants.

The increase of calcium concentration at selenium application was more pronounced than that of vitamin E treatments. The highest increase in this respect was at rate of EC 6 salinity in addition to 50 mg/l selenium in the different organs of the plant if compared with the control.

These results are in line of those obtained by Hartikainen et al (2000) demonstrated that low concentrations of selenium acts as an antioxidants and can stimulate the plant growth also Hussein et al (2007) indicated that vitamin E (Tochephrol) as antioxidants and the most prominent of which is protection of polyunsaturated fatty acids of lipid peroxidation by quenching and scavenging a various reactive oxygen radicals and reduced the effect of salinity stress.

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تأثير السيلينيوم وفيتامين هـ على بعض الصفات الفسيولوجية والكيميائية لنباتات فول الصويا تحت مستويات من الملوحة

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الملخص العربي

تم إجراء تجارب أصص لدراسة تأثير السيلينيوم فيتامين هـ على تخفيف الآثار الضارة الناتجة من تأثير الملوحة بمستويات ١,٥,٣,٦ dS عن طريق دراسة بعض الصفات الفسيولوجية والكيميائية لنباتات فول الصويا وتم أخذ عينات بعد ٦٠,٤٥ يوم من الزراعة وتوصلت الدراسة إلى النتائج التالية:

أدت مستويات الملوحة إلى نقص في كلوروفيل أ، ب والكارتينيدات وأدى المستوى الملحي العالي إلى نقص كبير في هذه الصفات.

أدت المعاملة بالسيلينيوم إلى زيادة واضحة في الصفات السابقة عن الزيادة عند معاملة النباتات بفيتامين هـ .

وكانت اكبر زيادة في الكلوروفيل عند سيلينيوم ٥٠ مجم/لتر.

ظهر زيادة واضحة في نشاط إنزيمات البيروكيديز والكتاليز وكذلك محتوى النبات من البرولين بمعاملة النباتات بالملوحة وكذلك بمضادات الأكسدة.

أدت المعاملة بالملوحة إلى نقص واضح في الكربوهيدرات الكلية وكذلك السكريات الذائبة بينما أدت المعاملة بالسيلينيوم وفيتامين هـ إلى زيادة كبيرة في الصفات السابقة عن الزيادة الناتجة من المعاملة بفيتامين هـ.

أظهرت المعاملة بمضادات الأكسدة زيادة في تركيز النيتروجين والفسفور والبوتاسيوم بينما أدت المعاملة بالملوحة إلى نقص في العناصر السابقة وزيادة في عنصر الصوديوم والكالسيوم.

أدت المعاملة بالملوحة ومضادات الأكسدة معا إلى زيادة في الصفات النباتية ونشاط الإنزيمات وتركيز البرولين والكربوهيدرات الكلية والسكريات الذائبة وكذلك عناصر النيتروجين والفسفور والبوتاسيوم.

أدت المعاملة بالسيلينيوم ٥٠ مجم/لتر إلى اكبر زيادة في جميع الصفات السابقة وذلك لتغلبها على الآثار الضارة للملوحة.

يمكن التوجيه باستعمال السيلينيوم تركيز ٥٠ مجم/لتر وفيتامين هـ بتركيز ١٠٠ مجم/لتر للنباتات النامية في الأراضى المستصلحة أو الأراضى الملحية.