J. Agric. Sci. Mansoura Univ., 34 (5): 5151 - 5163, 2009

EFFECT OF SOME APPLIED ANTIOXIDANTS ON PEPPER GROWTH AND YIELD UNDER SALINITY STRESS LEVELS

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ABSTRACT

Two pot experiments were performed at the Experimental Station Farm , Faculty of Agriculture Mansoura university during two successive summer seasons of 2007 and 2008. This work was conducted to study the role of some antioxidant materials in alleviation the harmful effect of different salinity stress levels on sweet pepper cv. California wonder.

Data show that high salinity stress levels decreased all growth parameters as well as fruit yield of pepper plant during the two growing seasons (2007/2008). 6000 mg/l salinity stress level was the most effective in this respect.

On the other hand, the data show that antioxidant materials such as HA (1000 mg/l), Salicylic acid (250 mg/l), Ascorbic acid (250 mg/l), Put.(1 mg/l) used as presoaking and foliar spray gave positive effect on growth parameters and yield of pepper plant . It could be show that applied antioxidant materials (ASA and SWE) were the most effective in increasing growth parameters of pepper plant during the two growing seasons. According to the effect of the interaction treatments of salinity stress levels (2000, 4000 or 6000 mg/l) with each of antioxidant treatment presoaking + foliar spray (HA, SA, ASA, Putrescince and SWE). It could be show that any of applied antioxidants increased all growth parameters under low salinity level (2000 mg/l). In this case, the applied antioxidants completely mitigated the harmful effect of 2000 mg/l salinity level on growth of pepper plant. It could be say that the applied antioxidants completely counteracted the harmful effect of low and moderate salinity levels (2000 and 4000 mg/l) and partially counteracted the harmful effect of salinity stress level (6000 mg/l) on pepper yield. Ascorbic and SWE were most effective in this respect.

INTRODUCTION

Pepper is an important agricultural crop, not only because of its economic importance, but also for the nutritional value of its fruits, mainly due to the fact that they are an excellent source of natural colours and antioxidant compounds. The intake of these compounds in food is an important health-protecting factor. They have been recognized as being beneficial for prevention of widespread human diseases, including cancer and cardiovascular diseases, when taken daily in adequate amounts (Bramley, 2000).

A wide spectrum of antioxidant compounds is present in pepper fruits such as Phenolic compounds which retard or inhibit lipid autoxidation by acting as radical scavengers , and consequently, are essential antioxidants that protect against propagation of the oxidative chain. It is also known that vitamin C, an important compound of pepper fruits, reacts with singlet oxygen and other free radicals, and suppresses peroxidation, reducing the risk of diseases. Carotenoids play an important role in fruit colouring and act as antioxidants, reacting with free radicals, mainly peroxide radicals and singlet molecular oxygen. Lycopene is a powerful natural antioxidant that acts as the most efficient singlet oxygen quencher in vitro among common carotenoids (Kaiser, & Sies, 1989).

Salinity decreases pepper growth and yield (Navarro *et al.,* 2002) .Adler and Wilcor, (1987) found that salinity adversely affected the vegetative growth of tomato, and other solanaceaus plants, it reduced plant length and dry weight. Salinity also reduced the fresh and dry shoot and root weight of tomato (Shannon, *et al.,* 1987). Increased salinity over 4000 ppm led to reduction in dry weight, leaf area, plant stem, and roots of tomatoes (Omar, *et al.,* 1982).

Sakr, (2007), indicated that salinity suppressed both cell division and cell enlargement proportionally in wheat plants. The reduction in plant growth under salinization may be also due to regulation between the endogenous Phytohormones present in the plants. (Ozdemir *et al.,* 2004).

Exogenous application of SA promoted growth and yield, and counteracted the salt stress-induced growth inhibition of salt tolerant . The improvement in growth and grain yield of wheat due to SA application was associated with improved photosynthetic capacity. Changes in photosynthetic rate due to SA application were not due to stomatal limitations, but were associated with metabolic factors, other than photosynthetic pigments and leaf carotenoids. (Kuznetsova and Shevyakova,1999).

Shalata and Neumann, (2001), showed that the additional of ascorbic acid increased the percentage of tomato seedlings able to survive the toxic effects of 9 h exposure to NaCl, from 0% to 50%. Alternative organic carbon sources without direct anti-oxidant activity, such as glucose, glycine-betaine, leucine or proline, did not provide equivalent protection. The remarkable protective effect of exogenous ascorbic acid therefore appeared to be specifically related to its anti-oxidant activity, rather than its possible utility as an organic substrate for respiratory energy metabolism.

Broetto *et al.* (1999), suggested that polyamines play an important role in the growth and development of the cells. They also concluded that polyamine metabolism appear to be an important biochemical marker of tolerance to salinity in several plant species. Among the early markers, polyamines have an essential role in the control of cell division and elongation, cell differentiation and morphogenesis(Cvikrova, *et al.*, 1999).

It could be concluded that biostimulants(SWE) and HA can alleviate the harmfull effect of salinity or drought stress Clapp et al (2002) Studied the effects of humic sbstances (HS) on plants consistently show stimulation of plant growth. Both increase in root length and evelopment of secondary roots have been observed for HS in nutrient solutions. Some researchers attributed the stimulative effects of HS to higher uptake of nutrients. Others, however, suggested that hormone activity of HS promotes plant growth. A small fraction of lower molecular weight components of HS can be taken up by plants and are considered to increase cell membrane permeability and to exhibit hormone-like activity.

MATERIALS AND METHODS

Two pot experiments were performed at the Experimental Station Farm , Faculty of Agriculture Mansoura university during two successive summer seasons of 2007 and 2008. This work was conducted to study the role of some antioxidant materials in alleviation the harmful effect of different salinity stress levels on sweet pepper cv. California wonder.

Seed of sweet pepper (*Capsicum annum* L.) cv. California wonder were sown on 15 th February in both 2007 and 2008 seasons. Seedling were transplanted at the age 45days (6.7 leaves) on the 1 st of April in pots (50 cm inner diameter) containing 8 kg of air dried loamy soil at the rate of two plants/ pot. Each pot was supplied limit amounts of 20.5 % N in form ammonium sulphate at the rate (2.5 kg), 15.5 % P_2O_5 in the form calcium superphosphate at the rate (1.5 kg) and 48 % K2O in the form potassium sulphate at the rate (1 kg) before planting and added 1.5 kg ammonium sulphate 30, 60 and 120 days after transplanting.

Four levels of artificial sea water used by dissolving known weight of natural salt crust, in tap water. The natural salt crust was brought directly from the salterns of Rashid, El- Beheira Governorate, Egypt where the Mediterranean sea water is evaporated, air dried, thoroughly crushed using porcelain mortar and pestle .The four salinity levels used:

1)- Tap water (320 mg/l). ,2)- 2000 mg/l. ,3)- 4000 mg/l. ,4)- 6000 mg/l..

The amount of salt for each salinity level was calculated, dissolved in the proper amount of tap water and used for experimental investigation.

Applied antioxidants treatments were: 1)- Tap water.,2)- Humic acid (1000 mg/L)., 3)- salicylic acid (250 mg/L)., 4)- Ascorbic acid (250 mg/L).,5)- Putrescince (1 mg/L).,6)- Seaweed extract (1000 mg/L).

The seeds were presoaking in any of applied antioxidants for 8 hours before sowing and the plants were foliar sprayed with any of each applied antioxidants at 30,60,80,120 and 150 days after transplanting under salinity stress levels.

Data recorded in three plants which were randomly taken from each pot at 105 days after transplanting to estimate plant vegetative growth as follow: number of branches/plant, shoot dry weight (g).,Leaf area (cm^2/plant).

Total yield calculated by summation of two pickings. Six plant from each treatment were taken to recored number of fruit/ plant and fresh weight of fruit/plant (g).

The data of all experiments were statistically analyzed as technique of the analysis of variance (ANOVA) according to Gomez and Gomez(1984). The treatment means were compared using the least significant differences (LSD).

RESULTS

Growth:

Data in tables (1 – 3)show that high salinity stress levels decreased all growth parameters of pepper plant such as number of branches, leaf area, shoot dry weight during the two growing seasons (2007/2008). 6000 mg/l salinity stress level was the most effective in this respect.

On the other hand, the data in tables (1 – 3) show that antioxidant materials such as HA (1000 mg/l), Salicylic acid (250 mg/l), Ascorbic acid (250 mg/l), Put.(1 mg/l) used as presoaking and foliar spray gave positive effect on growth parameters of pepper plant during the two growing seasons. It could be show that applied antioxidant materials (ASA and SWE) were the most effective in this respect. According to the effect of the interaction treatments of salinity stress levels (2000, 4000 or 6000 mg/l) with each of antioxidant treatment presoaking or foliar spray (HA, SA, ASA, Putrescince and SWE). It could be show in tables (1–3) that any of applied antioxidants increased the all growth parameters under low salinity level (2000 mg/l). In this case, the applied antioxidants completely mitigated the harmful effect of 2000 mg/l salinity level on growth of pepper plant.

Table (1)Effect of salinity stress levels and antioxidants (presoaking and foliar spray) as well as their interactions on No. of branches/ plant during the two growing seasons (2007 & 2008).

Treatment / Antioxidant (mg/l)	Salinity levels (mg/L)									
	0.00	2000	4000	6000	Mean	0.00	2000	4000	6000	Mean
	Season 2007					Season 2008				
Tap water	3.6	3.3	2.2	2.0	2.7	3.0	2.8	2.2	2.0	2.5
HA (1000)	5.0	4.3	2.2	2.0	3.3	4.5	3.5	2.6	2.0	3.1
SA (250)	5.6	3.6	2.5	2.3	3.5	4.3	3.0	2.7	2.0	3.0
ASA (250)	5.0	3.7	2.8	2.4	3.4	4.0	4.0	2.3	2.0	3.0
Put. (1)	4.6	3.9	2.9	2.3	3.4	4.0	2.7	3.0	2.0	2.9
SWE (1000)	4.0	3.3	2.0	2.0	2.8	4.2	2.8	3.0	2.0	3.0
Mean	4.6	3.7	2.8	2.1		4.4	3.0	2.5	2.0	
LSD at 5%	Antioxidant: 0.35 Salinity:0.66 Interaction:0.69					Antioxidant:0..34 Salinity: 0.6 Interaction: 0.8				

HA : humic acid, SA : Salicylic acid, ASA : Ascorbic acid, Put : Putrescine, SWE : seaweeds extract

Table (2): Effect of salinity stress levels and antioxidants (presoaking and foliar spray) as well as their interactions on Leaf area (cm2) during the two growing seasons (2007 & 2008).

Treatment / Antioxidant (mg/l)	Salinity levels (mg/L)									
	0.00	2000	4000	6000	Mean	0.00	2000	4000	6000	Mean
	Season 2007					Season 2008				
Tap water	2443	1850	1357	617	1567	2862	1951	1667	874	1839
HA (1000)	4054	2392	1637	895	2245	4095	3689	2138	1053	2744
SA (250)	3986	2893	1758	974	2403	4024	3344	2260	1049	2669
ASA (250)	4254	3305	2134	1290	2746	4391	3804	2422	1300	2979
Put. (1)	3527	3424	1986	842	2445	4319	3804	2230	1245	2900
SWE (1000)	٢٧٨٨	3500	2100	1079	2617	3983	3689	2260	1290	2806
Mean	3695	2981	1830	933		3995	3390	2162	1147	
LSD at 5%	Antioxidant: 3.35 Salinity: 5.16 Interaction:9.6					Antioxidant:3.34 Salinity: 6.16 Interaction: 12.6				

HA : humic acid, SA : Salicylic acid, ASA : Ascorbic acid, Put : Putrescine, SWE : seaweeds extract

Table (3): Effect of salinity stress levels and antioxidants (presoaking and foliar spray) as well as their interactions on Shoot Dry weight (g) during the two growing seasons (2007 & 2008).

Treatment / Antioxidant (mg/l)	Salinity levels (mg/L)									
	0.00	2000	4000	6000	Mean	0.00	2000	4000	6000	Mean
	Season 2007					Season 2008				
Tap water	16.8	12.0	10.5	5.6	11.2	21.0	16.0	13.7	10.7	15.3
HA (1000)	28.2	22.9	14.5	9.2	18.7	37.2	28.0	17.0	12.5	23.6
SA (250)	27.9	24.0	12.9	7.2	18.0	36.2	27.5	18..9	14.0	19.4
ASA (250)	28.5	25.5	16.0	13.5	20.8	43.0	35.0	20.0	15.0	28.2
Put. (1)	27.3	24.6	17.6	14.7	21.0	43.0	35.2	20.0	15.0	28.3
SWE (1000)	28.0	21.7	18.7	14.5	20.7	42.0	35.0	21.0	15.2	28.3
Mean	26.1	21.4	15.7	11.0		38.8	30.6	16.7	13.6	
LSD at 5%	Antioxidant: 1.35 Salinity: 2.16 Interaction: 2.6					Antioxidant: 1.34 Salinity:2.16 Interaction: 2.6				

HA :humic acid, SA : Salicylic acid, ASA : Ascorbic acid, Put : Putrescine, SWE : seaweeds extract

On the other hand, it could be show that any of each applied antioxidants could be partially counteracted the harmful effect of high salinity levels (4000 and 6000 mg/l) which enhanced all growth parameters under high salinity levels. This increasing effect of antioxidant on growth parameters comparing with the effect of salinity stress levels only without applied antioxidants but this increase nearly but less control.

Yield and yield components:

Number of fruits/plant:

The data(4,5) show that salinity stress levels decreased total fruit yield of pepper plant. This decreasing effect was increased with increasing salinity level. On the other hand, all applied antioxidants (presoaking and foliar spray) increased total pepper fruit yield during the two growing seasons.

Table (4): Effect of salinity stress levels and antioxidants (presoaking and foliar spray) as well as their interactions on No. of Fruit/ plant during the two growing seasons (2007 & 2008).

Treatment / Antioxidant (mg/l)	Salinity levels (mg/L)									
	0.00	2000	4000	6000	Mean	0.00	2000	4000	6000	Mean
	Season 2007					Season 2008				
Tap water	9.0	5.2	4.0	2.6	5.2	6.2	5.0	3.8	2.7	4.4
HA (1000)	11.0	8.9	8.0	4.0	7.9	8.0	7.0	6.	4.0	6.2
SA (250)	9.7	10.0	7.0	3.0	7.4	9.7	7.7	5.7	3.0	6.5
ASA (250)	10.3	9.0	7.6	5.3	8.0	8.3	7.3	7.4	4.0	6.7
Put. (1)	8.3	9.0	7.0	4.5	7.2	11.0	9.7	6.6	4.0	7.8
SWE (1000)	10.3	9.	7.3	3.7	7.5	9.0	10.0	6.7	4.3	7.5
Mean	9.8	8.0	6.9	3.7		9.1	8.1	6.0	3.6	
LSD at 5%	Antioxidant: 1.35 Salinity: 1.16 Interaction: 2.6					Antioxidant: 1.34 Salinity: 1.16 Interaction: 2.6				

HA : humic acid. SA : Salicylic acid. ASA : Ascorbic acid. Put : Putrescine. SWE : seaweeds extract

Table (5): Effect of salinity stress levels and antioxidants (presoaking and foliar spray) as well as their interactions on Fresh weight Fruit/ plant (g) during the two growing seasons (2007 & 2008).

Treatment / Antioxidant (mg/l)	Salinity levels (mg/L)									
	0.00	2000	4000	6000	Mean	0.00	2000	4000	6000	Mean
	Season 2007					Season 2008				
Tap water	286	208	156	62	178	313	215	134	94	189
HA (1000)	573	334	278	115	325	529	402	198	121	312.5
SA (250)	549	455	331	99	358.5	630	402	221	117	342.5
ASA (250)	714	505	٣٣٣	115	416.8	585	441	255	161	360.5
Put. (1)	590	498	308	128	381	582	427	252	142	350.8
SWE (1000)	595	520	315	140	392.5	599	418	274	131	355.5
Mean	565.3	388.6	285.0	106.3		522.1	376.7	218.8	125.2	
LSD at 5%	Antioxidant:7.35 Salinity:9.16 Interaction: 12.6					Antioxidant:7.34 Salinity: 9.16 Interaction: 12.6				

HA : humic acid. SA : Salicylic acid. ASA : Ascorbic acid. Put : Putrescine. SWE : seaweeds extract

According to the interaction treatments, it could be show that applied antioxidants (presoaking + foliar spray) increased total fruit yield under (2000 and 4000 mg/l) while enhanced total pepper yield under high salinity level (6000 mg/l).

It could be recorded that applied antioxidants as (presoaking + foliar spray) could completely counteract the harmful effect of salinity stress levels (2000 and 4000 mg/l) and partially contract this harmful effect under the highest salinity stress level (6000 mg/l).

Fresh weights of fruits:

The data in table (5) show that salinity stress levels decreased fresh weight of pepper fruits.

On the other hand, applied antioxidant(presoaking + foliarspray)increased fresh weight of pepper fruits during the two growing seasons.

According to the interaction treatments, it cold be show that applied antioxidants increased fresh weight of pepper fruits under (2000,4000mg/l) salinity level .

It could be say that the applied antioxidants completely counteracted the harmful effect of low and moderate salinity levels (2000 and 4000 mg/l) and partially counteracted stress level (6000 mg/l). Ascorbic and SWE were most effective in this respect.

DISCUSSION

Effect of salinity stress on:

Growth

The inhibitory effect of salinity on growth of pepper plant in our reaults may be due to decrease in water absorption, metabolic processes, merestematic activity and/or cell enlargement (Khadr, *et al.*, 1994).

In this study, the severity of salinity antagonism to the normal growth of the plant, as indicated by FW and DW measurements, was higher in the pepper plant, indicating that NaCl has a negative influence on the growth of pepper plants.

Saied, *et al.*, (2005), reported that, salinity can reduce the plant growth or damage the plants through: (1) osmotic effect (causing water deficit), (2) toxic effects of ions, and (3) imbalance of the uptake of essential nutrients.

yield and its components:

The reduction in yield is largely due to (1) a reduction in fruit set which attribute to a decrease in the viability of pollen and/or in the receptivity of the stigmatic surface. The reduction in pollen viability has been related to decreased calcium mobilization from plant leaves treated with sodium chloride, which is important in pollen germination and pollen tube growth. (2) also, the significance reduction in fruit number due to substantial abscission of flowers or young fruit due to ethylene induction by salinity. Factor affecting cell division and cell expansion, such as tissue water status and the concentration of certain plant hormones, i.e. ABA are involved in the regulation fruit of set under stress. (3) moreover, revealed that increasing salinity levels decreased significantly yield due to the decreasing production pollen grain, mean number of perfect flowers, and fruit set. (4) the depression effect of salinity on fruit yield may be due to decreasing the leaf area and number per plant, resulting reduction in the supply of carbon assimilate due to decreasing the net photosynthetic rate and biomass accumulation. (5) it can be proposed that the several detrimental effects attributed to salinity stress on most of the studies growth characters and yield might be partially due tc decreases in nitrogen concentration.

According the data recorded in this investigation , it could be, show that salinity stress decreased many parameters such as: branches numbers, leaf area , accumulation of dry matter, photosynthetic pigments, nitrogen and phosphorus as well as potassium uptake, carbohydrates and sugars content. This may be reflect on decreasing pepper yield and its components(Sakr,et.al,2007.,Grattal,et.al.,2002).

Role of antioxidant salicylic acid on alleviating the harmful effects of salinity stress:

The increased water potential values in SA pre-treated pepper plants under osmotic stress suggest that accumulation of inorganic or organic osmolytes makes the surplus of water uptake possible as it can also be seen from the increased relative water contents of tissues (Szepesi, *et al.*, 2005).

SA decreased the Na^+/K^+ ratio in the roots and increased it significantly in the leaves. Na^+, accumulated in the leaf tissues, functioned as an inorganic osmolyte, and resulted in an increased water potential and water content.

Since SA improved the photosynthetic performance of plants under stress conditions (Ananieva, *et al.*, 2002), and chlorophyll a fluorescence could give insight into the ability of a plant to tolerate environmental stresses, .these results suggests that SA-pre-treatment may improve the gross rate of carbon assimilation during osmotic stress.

Role of antioxidant ascorbic on alleviating the harmful effects of salinity stress:

Ascorbic can alleviate the harmfull effect of ROS which produced by salinity stress may be through several ways such as :
(1) inhibits the lipid photoperoxidation (Michalski and Kaniuga, 1981). (2) is involved in both electron transport of PS II and antioxidizing system of chloroplasts. (McKersie, 1996). (3) as membrane stabilisers and multifaceted antioxidants, that scavenge oxygen free radicals, lipid peroxy radicals, and singlet oxygen (Diplock, *et al.*, 1989). (4) can react with peroxyl radicals formed in the bilayer as they diffuse to the aqueous phase. (Hess, 1993). (5) . It scavenges cytotoxic H_2O_2, and reacts non-enzymatically with other ROS, singlet oxygen, superoxide radical and hydroxyl radical (Larson, 1988). (6) regenerate another powerful water-soluble antioxidant, ascorbic acid, via the ascorbate–glutathione cycle. (Blokhina, *et al.*, 2002). (7) stabilize membrane structures (Blokhina, 2002). (8) modulates membrane fluidity in a similar manner to cholesterol, and also membrane permeability to small ions and molecules (Fryer, 1992). (9) to decrease the permeability of digalactosyldiacylglycerol vesicles for glucose and protons (Berglund, *et al.*, 1999).

Role of antioxidant polyamine on alleviating the harmful effects of salinity stress:

The alleviating effect of polyamines on plants grown under salinity stress may be due to one or more of the following factors:(1)Through activating antioxidative defense system (chatto paydhay, *et al.,* 2002) . (2)Suppressed the level of superoxide and H_2O_2 in leaf stressed plants (Hernandes, *et al.,* 1993). (3)Suppress H_2O_2 level and thereby membrane damage is being evaluated in terms of antioxidative system (Dionisio –Sese and Tobita ,1988). (4)Caused reduction in ROS through quenching of singlet oxygen and excited chlorophyll by elevating level of CAR thereby maintained chloroplastic membrane (Velikova, *et al.,* 2000).(5)Reduce membrane leakage and lipid peroxidation and decreased MDA contents in sugarcane leaves (Zhang, *et al.*, 1996). (6) Stabilization of membrane damage may be due to its polycationic nature (Tiburcio, *et al.*(1994). (7)Increasing APX and GR activity as well as CAR and GSH at all salinity levels (Tiburcio, *etal.*, 1994) . (8)Stimulation of chlorophylls synthesis and prevent chlorophyll degradation (Krishnamurthy,1991). (9) Increasing all organic concentrations ,that may be attributed to that polyamines are involved in important biological processes , e. g. ionic balance and DNA , RNA and protein synthesis .

Role of antioxidant Sea Weed Extract (SWE)on alleviating the harmful effects of salinity stress:

Bostimulants (SWE) and HA can alleviate the harmfull effect of salinity or drought stress through: I)- activate root cells at the same time stimulate biosynthesis of endogenous Cytokinins from roots (Schmidt, 2005). II)- enhancing leaf water status, some plant nutrients uptake, shoot growth and root pull strength (Demir, *et al.,* 2004). III)-altering hormonal balances and favor Cytokinins and auxins production (Schmidt, 2005). IV)- enhancement of antioxidant enzymes (SOD,GR,ASP) for protection against adverse environmental conditions (Schmidt, 2005). V)- stimulation the biosynthesis of Tocopherol, ascorbic acid and carotenoids in chloroplast which protectphotosynthetic apparatus of PSII (Zhang and Schmidt, 2000).VI)-

protection of plant cells from lipid peroxidation and inactivation of enzymes that occur under stress (Smirnoff, 1995). VII)- stimulation stem elongation and exhibits auxin-like activity. (Crouch and VanStaden,1993). VIII)- reduced uptake of NaCl (Nabati, *et al.*,1994) while increased K and Ca content in the leaves (Dimir, *et al.*, 2004). IX)- stimulation of chlorophyls biosynthesis (Garbay and Churin,1996) and regulation cell membrane components under drought stress. (Yan and Schmidt,1993). X)- inhibits activity of free radical groups which are major elements for chlorophyll degradation (Fletcher, *et al.*,1988). XI)- stimulation the uptake of N,P,K,Mg,Ca,Zn,Fe and Cu by the plants that alleviate the inhibitory effect of Na toxicity and restored growth (Van Staden,(1984). XII)- promoted the accumulation of reducing sugars which increased wilting resistance through enhancing osmotic pressure inside plant..Inaddition nucleic acids metabolism were stimulated (O,Donnell,1973). XIII)- Stimulation of chloroplast development and enhancing phloem loading and delay senescenc (Dimir, *et al.*,2004).

Role of antioxidants Humic acid (HA)on alleviating the harmful effects of salinity stress:

The enhancing effect of Humic acid on alleviation salinity or drought stress may be through (1). Stimulates plant growth by accelerating cell division, increasing the rate of development in root systems, and increasing the yield of dry matter (Clapp, *et al.*,2002). (2). Increases germination of seed and viability (Clapp, *et al.*, (2006) . (3). Increases vitamin content of plants(Ferrini and Nicese, 2002).(4). Increases the permeability of plant membranes; promoting the uptake of nutrients N,P,K,Ca and Mg (Mackowiak, *et al.*,2001). (5). Stimulates root growth, especially lengthwise (Tan and Nopamornbod, 2005). (6). Increases root respiration and formation (Hopkins and Stark, 2003). (7). Stimulates growth and proliferation of desirable soil icroorganisms as well as algae andyeast (Neri et al, 2006). (8). Aids in photosynthesis.(9). Stimulates plant enzymes.(10). Acts as an organic catalyst.(11) One reason is that humic acids permanently tie up the sodium ion. This helps plants tolerate the higher sodium oncentrations, avoiding toxicity and osmotic related problems. (12)Chelates Nutrients (Super-Grow, (2006). (13) Enhances Root Development (Vaughan and. Macdonald, 2005) . (14) Improves Plant Vigor and Appearance (Obatol, 2006). (15) Promotes Thatch Decomposition (Ozdoba, 2006). (16)Reduces Chemical Fertilizer Use (Vladimir Vaslenko, 2002).

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تأثير بعض مضادات الأكسدة على نمو و محصول نبات الفلفل تحت ظروف الإجهاد الملحى

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أجريت تجربتى أصص فى مزرعة محطة البحوث بكلية الزراعة -جامعة المنصورة فى الموسم الصيفى لعامى ٢٠٠٧& ٢٠٠٨ بغرض دراسة دور بعض مضادات الأكسدة فى التغلب على الأثار الضارة لمستويات الإجهاد الملحى على نمو و محصول نبات الفلفل صنف كاليفورنيا .

أظهرت النتائج أن مستويات الإجهاد الملحى المرتفعة أدت إلى نقص بعض صفات النمو والمحصول لنبات الفلفل وكان المستوى المرتفع ٦٠٠٠ مج/لتر هو الأكثر تأثيرا فى هذا الشأن.

على العكس من ذلك تماما أدت المعاملة بأى من مضادات الأكسدة مثل السالسيليك – الاسكوربيك – البتروسين – الهيوميك – مستخلص أعشاب البحر أدت إلى الحصول نتائج جيدة وايجابية على النمو والمحصول وكان الاسكوربيك و مستخلص أعشاب البحر هما الأكثر تأثيرا وفاعلية فى هذا الشأن

كما أدت المعاملة بأى من مضادات الأكسدة إلى التغلب كليا على الأثر الناجم عن المستوى ٢٠٠٠ مج/لتر على النمو والمحصول

كما أن تأثير مضادات الأكسدة كان جزئيا فى التغلب على الأثر الضار الناجم عن المستوى المرتفع ٦٠٠٠ مج/لتر من الإجهاد الملحى .