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EFFECT OF DIFFERENT IRRIGATION INTERVALS,APPLIED ANTIOXIDANTS AS WELL AS THEIR INTERACTIONS ON GROWTH AND YIELD OF MAIZE PLANT.

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ABSTRACT

Increasing irrigation intervals (every 14, 16, 18 or 20 days), decreased growth parameters as well as yield and its components of maize plants throughout the hole experimental periods during the two growing seasons (2007& 2008).

Irrigation every 20 days was the most effective treatment in decreasing growth , yield and its component of maize plants.

According to antioxidants, the the results show that applied antioxidants Citric acid, Ascorbic acid or Sea weed extract increased all growth parameters , yield and its components of maize plants.Sea weed extract was the most effective in this respect.

The interaction effect between irrigation intervals and antioxidants substances show that the applied antioxidants enhanced all growth parameter as well as yield and its component of maize under drought stress.

It could be concluded that applied antioxidants could partially counteract the harmful effect of drought stress (irrigation every 16, 18, 20 days) on growth as well as yield and its component of maize plant .

INTRODUCTION

The quantity and quality of plant growth depend on cell devision, enlargement, and differentiation, and all of these events are affected by water stress **(**Mckersie, *et al.,* 1996).

It could be concluded that the sequence of events in the plant tissue subjected to drought stress as follow : (1-) plant cells accumulate solutes to prevent water loss and to reestablish cell turgor. (2-) Water stress can induce ABA accumulation and oxidative stress in plant cells (Zeevart and Creelman.1988.,Bowler et al., 1992. (3-) increased level of lipid peroxidation and a decrease in the concentration of total soluble protein and thiols was observed in stressed seedlings(Sharma and Dubey (2005). (4-) The activities on superoxide dismutases (SODs) as well as ascorbate peroxidase (APX). (5-) The quantity and quality of plant growth depend on cell devision, enlargement, and differentiation, and all of these events are affected by water stress (Mckersie, *et al.,* 1996). Hsiao (1973), concluded that water stress inhibits cell enlargement more than cell devision. (6-)A loss of turgor may cause a change in the spatial position of transport channels, membrane enzymes, and decrease membrane thickness (Nelson and Orcutt, 1996). (7-) Water stress greatly suppresses cell expansion and plant growth due to the low turgor pressure (Mckersie and Leshem, 1994). (8-) Reactive oxygen species, will be produced and accumulated in the cell (Walker, 1992). (9-)

Water stress resulted in a significant increases in antioxidant _-tocopherol which is a lipid-soluble antioxidant and concentrated in the chloroplasts, especially the thylakoid membranes

Exposure of maize to drought during vegetative phase inhibits shoot growth and endangers the development of reproductive organs. Inaddition, there is a negative response of number of grains/ear,100-grain weight and yield as drought occurred, during grain filling period **(**During vegetative stage, early drought inhibits the growth of leaves and stems, consequently decreases the florets development, while drought during reproductive periods (late drought) adversely affected fertility, formation and number of spikelets followed by decreased in ear grain number and grain yield/fed of maize plant.

According to Sallah, *et al.,* (2006) drought stress is a major factor limiting the productivity of maize. In the stress environment, grain yields of the varieties ranged from 2.21 to 3.12 t ha^{-1}, while in the favourable environment yields ranged from 4.17 to 5.96 t ha^{-1}.

Zhang and Schmidt, (2000),found that natural products, seaweed extract (SWE) are common sources of plant growth regulators (PGRs) that exhibit multiple functions. These sources of PGRs could not only regulate plant growth and development but also increase plant resistance to various environmental stresses, such as drought, salinity, and low temperature. Seaweed extracts, which possess cytokinin-like and auxin-like properties, can stimulate endogenous cytokinin activities of plants (Crouch, 1990).

Seaweed extracts contain not only most of the major and minor nutrients, amino acids, and vitamins B_1, B_2, C, E, but also cytokinins, auxin, GAs, and ABA-like growth substances (Abetz, 1980). Low rates of seaweed extract could also promote plant growth significantly (Crouch, 1990).

Asada et al., (1994) reported that ascorbate has important functions in photosynthesis, such as in protection of photosynthetic apparatus against the oxygen radicals and H_2O_2 that formed during photosynthetic activity, and against photo inactivation since it is a cofactor of carotenoid de-epoxidation (Siefermam and Yamanoto, 1994). Moreover ascorbate enhances ATP synthesis coupled to electron transport in plants grown under salinity stress condition. (Forti and Ehrenheim, 1993). Ascorbate may also be involved in regulation of the cell cycle (Kerk and Feldman 1995). Shalata and Neumann, (2001), found that ascorbic acid acts directly to neutralize superoxide radicals, singlet oxygen or superoxide and as a secondary anti-oxidant during reductive recycling of the oxidized form of α-tocopherol, (Noctor and Foyer, 1998).

MATERIALS AND METHODS

Two field experiments were carried out at Tag-El- Ezz research station in Dakahlia Governorate, Agric.Res.Center, Ministry of Agric during 2007 and 2008 seasons to investigate the role of selected antioxidants in alleviating the harmful effect of drought stress condition on maize plant.

Maize grains(hybrid ,310) kindly supplied by plant breeding section, Field agric.Res. Center, Ministry of Agric .Giza, Egypt) were used in this

expermints. Uniform maize grains were sown in May 10th in the two growing seasons of2007 and 2008 . The expermintal unit was 3.5x3.3 =10.5m2
All the normal cultural practices of the growing maize were applied .

Five irrigaton intervals were applied of each maize plants as follow:
Irrigation every 12 days (control), 14 , 16 , 18 or 20 days.

Maize plants were sprayed with some antioxidants at 30 , 45 , and 60 days from sowing. Automatic atomizers were used for spraying the applied antioxidants after adding tween 20 as a wetting agent" (0.05 %).
Antioxidant materials used were: Tap water (control)., Citric acid (300 mg/l)., Ascorbic acid (ASA,300 mg/l).,Sea weed extract(SWE,1000 mg/l)
Three samples were taken at 3 different physiological stages (45, 60 and 75 day from sowing) to study the growth characters. At harvesting stage yield and components of maize (ear length, grain yield / plant, weight of 100 grains, oil content in the grains).

Each treatment replicated 3 times and arranged in a complete randomized block design. The data of 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 presented in tables (1 – 4) show the effect of irrigation intervals and applied antioxidants as well as their interactions on vegetative growth parameters (stem dry weight, leaves dry weight, leaf area, leaves number/plant,) of maize plants throughout the experimental periods (three experimental dates) during the two growing seasons.

Data show that increasing irrigation intervals (every 14, 16, 18, 20 days), decreased growth parameters of maize plants throughout the hole experimental periods during the two growing seasons . Irrigation every 20 days treatment was the most effective in decreasing growth of maize plants.

Data in tables (1 – 4) show that applied antioxidants Citric, ASA or SWE increased all growth parameters of maize plants throughout the experimental periods during the two growing seasons. It could be shown that Sea weed extract was the most effective in this respect.

The interaction treatments of irrigation intervals with antioxidants materials show that the applied antioxidants enhanced all growth parameter of maize under drought stress (irrigation every 16, 18, 20 days) compared with drought stress treatments but these increasing stell less than control.

It could be concluded that applied antioxidants could partially counteract the harmful effect of drought stress on growth of maize plant.

Table (1): Effect of water irrigation intervals and plant antioxidant materials as well as their interactions on stem dry weight (gm) of maize plant during the two growing seasons 2007 and 2008.

Treatment / Irrigation intervals	Tap water	Critic	ASA	SWE	Mean	Tap water	Critic	ASA	SWE	Mean
	Season 2007					Season 2008				
	1st sample									
12 days(cont.)	156	184	192	198	182	١٥٧	١٨٥	١٩٣	١٩٩	١٨٣
14 days	132	141	148	154	143	١٣٣	١٤٢	١٥٠	١٥٦	١٤٥
16 days	90	94	97	104	96	٩١	٩٥	٩٨	١٠٥	9
18 days	84	87	92	95	89	٨٥	٨٨	٩٣	٩٦	٩٠
20 days	68	72	77	86	75	٦٩	٧٣	٧٨	٨٧	٧٦
Mean	106	115	121	127		١٠٧	١١٦	١٢٢	١٢٨	
LSD at 5%	Antioxidant: 1.25 Irrigation: 1.97 Interaction:2.98					Antioxidant: 1.25 Irrigation: 0.88 Interaction: 2.97				
	2nd sample									
12 days(cont.)	195	200	225	260	220	١٩٦	٢٠١	٢٢٦	٢٦١	٢٢١
14 days	155	157	165	185	165	١٥٦	١٥٨	١٦٧	١٨٦	١٦٦
16 days	105	122	145	150	130	١٠٦	١٢٣	١٤٦	١٥١	١٣١
18 days	95	97	98	103	98	٩٧	٩٨	٩٩	١٠٤	٩٩
20 days	78	82	89	95	86	٧٩	٨٣	91	٩٦	٨٧
Mean	125	131	144	158		١٢٦	١٣٢	١٤٥	١٥٩	
LSD at 5%	Antioxidant:0.17 Irrigation: 0.47 Interaction: 1.1					Antioxidant: 0.17 Irrigation: 0.47 Interaction: 1.0				
	3rd sample									
12 days(cont.)	290	310	340	345	321	٢٩١	311	٣٤١	٣٤٦	322
14 days	220	229	245	280	243	٢٢١	٢٣٠	246	281	244
16 days	180	200	205	212	199	١٨١	201	٢٠٦	213	200
18 days	150	158	175	178	165	١٥١	١٦٠	١٧٦	١٧٩	166
20 days	80	109	129	143	115	٨١	١١٠	١٣٠	١٤٤	116
Mean	184	201	218	231		١٨٥	٢٠٢	٢٢٠	٢٣٢	
LSD at 5%	Antioxidant: 0.30 Irrigation: 0.32 Interaction: 0.72					Antioxidant: 0.3 Irrigation: 0.31 Interaction: 0.71				

Table (2): Effect of water irrigation intervals and plant antioxidant materials as well as their interactions on leaves dry weight (gm) of maize plant during the two growing seasons 2007 and 2008.

Treatment / Irrigation intervals	Tap water	Critic	ASA	SWE	Mean	Tap water	Critic	ASA	SWE	Mean
	Season 2007					Season 2008				
	1st sample									
12 days(cont.)	115	116	120	137	122	١١٦	١١٧	١٢١	١٣٨	123
14 days	96	102	103	105	101	٩٧	١٠٣	١٠٤	١٠٦	١٠٢
16 days	86	90	93	94	91	٨٧	٩١	٩٤	٩٥	91
18 days	80	81	83	86	82	٨١	٨٢	٨٤	٨٧	٨٣
20 days	59	63	69	75	66	٦٠	٦٤	٧٠	٧٦	٦٧
Mean	87	90	93	99		٨٨	٩١	٩٤	١٠٠	
LSD at 5%	Antioxidant: 0.71 Irrigation: 0.81 Interaction: 1.8					Antioxidant: 0.7 Irrigation: 0.81 Interaction: 1.8				
	2nd sample									
12 days(cont.)	138	140	145	162	146	١٣٩	١٤١	١٤٦	١٦٣	١٤٧
14 days	117	124	127	128	124	١١٨	١٢٥	١٢٨	١٢٩	١٢٥
16 days	101	104	105	110	105	١٠٢	١٠٥	١٠٦	١١١	١٠٦
18 days	90	92	94	97	93	٩١	٩٢	٩٥	٩٨	٩٤
20 days	76	79	84	89	82	٧٧	٨٠	٨٥	٩٠	٨٣
Mean	104	107	111	117		١٠٥	١٠٨	١١٢	١١٨	
LSD at 5%	Antioxidant: 0.22 Irrigation: 0.45 Interaction:1.0					Antioxidant: 0.25 Irrigation:0.45 Interaction: 1.1				
	3rd sample									
12 days(cont.)	221	258	272	282	258	٢٢٢	٢٥٩	٢٧٣	٢٨٣	٢٥٩
14 days	182	203	211	216	203	١٨٣	٢٠٤	٢١١	٢١٧	٢٠٣
16 days	148	154	165	173	160	١٤٩	١٥٥	١٦٦	١٧٤	١٦١
18 days	129	132	142	146	137	١٣٠,٥	١٣٣	١٤٣	١٤٧	١٣٨
20 days	84	97	115	116	103	٨٥	٩٨	١١٦	١١٧	١٠٤
Mean	152	168	181	186		١٥٣	١69	١٨١	١٨٧	
LSD at 5%	Antioxidant: 0.31 Irrigation: 0.23 Interaction: 1.51					Antioxidant: 0.31 Irrigation: 0.32 Interaction: 1.52				

Table (3): Effect of water irrigation intervals and plant antioxidant materials as well as their interactions on leaf area of maize plant during the two growing seasons 2007 and 2008.

Treatment / Irrigation Intervals	Tap water	Critic	ASA	SWE	Mean	Tap water	Critic	ASA	SWE	Mean
	Season 2007					Season 2008				
	1st sample									
12 days(cont.)	592	610	624	672	624	٥٩٥	٦١٥	٦٣٠	٦٧٥	٦٢٨
14 days	412	522	528	604	516	٤١٥	٥٢٦	٥٣٢	٦٠٧	٥٢٠
16 days	386	462	500	516	466	٣٩٢	٤٦٥	٥٠٥	٥٢٠	٤٧٠
18 days	354	402	462	482	425	٣٦٠	٤٠٦	٤٦٥	٤٨٥	٤٢٩
20 days	302	386	476	482	411	٣٠٨	٣٩٠	٤٧٦	٤٨٥	٤١٤
Mean	409	476	518	551		٤١٤	٤٨٠	٥٢١	٥٥٤	
LSD at 5%	Antioxidant:3.4 Irrigation: 3.0 Interaction: 6.7					Antioxidant: 3.4 Irrigation: 3.0 Interaction: 6.7				
	2nd sample									
12 days(cont.)	626	618	694	703	660	٦٣٠	٦٢٢	٦٩٦	٧٠٦	٦٦٣
14 days	478	545	562	643	557	٤٨٠	٥٥٠	٥٦٥	٦٤٧	٥٦٠
16 days	412	504	550	617	520	٤١٥	٥١٠	٥٥٦	٦٢٠	٥٢٥
18 days	396	425	550	577	487	٤٠٠	٤٣٠	٥٥٤	٥٨٢	٤٩١
20 days	384	419	432	502	434	٣٩٢	٤٢٢	٤٣٥	٥١٠	٤٣٩
Mean	459	502	557	608		٤٦٣	٥٠٦	٥٦١	٦١٣	
LSD at 5%	Antioxidant: 2.8 Irrigation:3.5 Interaction: 7.8					Antioxidant: 2.8 Irrigation: 3.5 Interaction: 7.8				
	3rd sample									
12 days(cont.)	682	695	710	742	707	٦٩٠	٧٠٠	٧١٥	٧٤٦	٧١٢
14 days	516	572	585	687	590	٥٢٠	٥٧٦	٥٩٥	٦٩٢	٥٩٥
16 days	474	546	562	642	556	٤٨٠	٥٥٠	٥٧٠	٦٤٨	٥٦٢
18 days	412	494	555	601	515	٤١٥	٥٠٠	٥٦٢	٦٠٦	٥٢٠
20 days	385	432	500	532	462	٣٩٠	٤٣٦	٥٠٨	٥٣٦	467
Mean	493	547	582	640		٤٩٩	٥٥٢	٥٩٠	٦٤٥	
LSD at 5%	Antioxidant: 3.8 Irrigation: 3.5 Interaction: 8.0					Antioxidant: 3.8 Irrigation3.5 Interaction: 8.0				

Table (4): Effect of water irrigation intervals and plant antioxidant materials as well as their interactions on leaves number of maize plant during the two growing seasons 2007 and 2008.

Treatment / Irrigation intervals	Tap water	Critic	ASA	SWE	Mean	Tap water	Critic	ASA	SWE	Mean
	Season 2007					Season 2008				
	1st sample									
12 days(cont.)	14	14	15	15	14.5	١٥	١٥	١٦	١٦	١٥,٥
14 days	14	15	14	15	14.5	١٥	١٦	١٥	١٦	١٥,٥
16 days	12	13	12	14	12.7	١٣	١٣	١٢	١٥	١٣,2
18 days	10	10	12	12	11.0	١١	١١	١٢	١٣	١1.7
20 days	10	10	11	12	10.7	١١	١٠	١١	١٢	١١,٠
Mean	12	12.4	12.8	13.6		١٣	١٣	١٣,٢	١٤,٤	
LSD at 5%	Antioxidant: 0.67 Irrigation: 0.54 Interaction: 1.21					Antioxidant: 0.65 Irrigation: 0.54 Interaction: 1.21				
	2nd sample									
12 days(cont.)	17	17	17	18	17.2	١٨	١٨	١٨	١٩	١٨,٢
14 days	17	17	17	17	17.0	١٨	١٨	١٨	١٨	١٨,٠
16 days	16	17	18	18	17.2	١٧	١٨	١٩	١٩	١٨,٢
18 days	17	18	17	18	17.5	١٧	١٨	١٨	١٨	١٧,٧
20 days	16	16	17	17	16.5	١٦	١٧	١٧	١٧	١٦,٧
Mean	16.6	17.0	17.2	17.6		١٧,٢	١٧,٨	١٨.0	١٨,٢	
LSD at 5%	Antioxidant:0.53 Irrigation: 0.62 Interaction: 1.38					Antioxidant:0.3 Irrigation: 0.621 Interaction: 1.38				
	3rd sample									
12 days(cont.)	17	17	18	18	17.5	١٨	١٨	١٩	١٩	١٨,٥
14 days	16	17	17	17	16.7	١٧	١٨	١٨	١٨	١٧,٧
16 days	17	17	18	18	17.5	١٨	١٨	١٨	١٩	١٨,٢
18 days	16	17	17	17	16.7	١٧	١٨	١٨	١٨	١٧,٧
20 days	16	16	16	17	16.2	١٧	١٧	١٧	١٧	١٧.0
Mean	16.4	16.8	17.2	17.4		١٧,٤	١٧,٨	١٨.0	١٨,٢	
LSD at 5%	Antioxidant: 0.59 Irrigation:0.62 Interaction: 0.60					Antioxidant: 0.59 Irrigation: 0.62 Interaction: 0.60				

Yield and its components:

Data presented in tables (5– 8) show the effect of drought stress levels (irrigation every 14, 16, 18, 20 days) and applied antioxidants (Citric, ASA, SWE) as well as their interactions on the yield and yield components of maize (ear length, grain yield **/** plant, weight of 100 grains, oil content in the grains) during the two growing seasons 2007 and 2008.

Data show that drought stress the yield and its component of maize plants during the two growing seasons. The highest drought stress level (irrigation every 20 days) was the most effective in decreasing the yield of plants.

Applied antioxidants increased yield and its components of maize plants during the two growing seasons. SWE was found to be the most effective in this respect.

As for the interactions treatments, the data show that each of applied antioxidants enhanced the yield and its components of maiz plants as compared with the drought stress treatments but the values were nearly or still less than unstressed plants. SWE combined with irrigation every 14 days was the most effective treatment in this respect.

It could be concluded that antioxidants could counteract the harmful effect of drought stress levels on the yield of maize during the two growing seasons. Moreover, SWE was found to be the most effective antioxidant in this respect.

Table(5): Effect of water irrigation intervals and plant antioxidant materials as well as their interactions on ear length (cm) of maize plant during the two growing seasons 2007 and 2008.

Treatment / Irrigation Intervals	Tap water	Critic	ASA	SWE	Mean	Tap water	Critic	ASA	SWE	Mean
	2007					2008				
12 days(cont.)	22	22	22	23	22	٢٣	٢٣	٢٣	٢٣	٢٣
14 days	19	21	21	21	20	٢٠	٢٢	٢٢	٢٢	٢٢
16 days	19	21	20	21	20	٢٠	٢١	٢١	٢١	٢١
18 days	19	20	20	20	20	١٩	٢١	٢٠	٢١	٢٠
20 days	17	19	18	19	18	١٧	٢٠	١٨	٢٠	١٩
Mean	19	20	20	21		٢٠	٢١	٢١	٢١	
LSD at 5%	Antioxidant: 0.42 Irrigation: 0.25 Interaction: 0.56					Antioxidant:0.73 Irrigation: 0.34 Interaction: 0.77				

Table (6): Effect of water irrigation intervals and plant antioxidant materials as well as their interactions on grain yield (gm)/plant of maize plant during the two growing seasons 2007 and 2008.

Treatment / Irrigation intervals	Tap water	Critic	ASA	SWE	Mean	Tap water	Critic	ASA	SWE	Mean
	2007					2008				
12 days(cont.)	88	95	97	99	94.7	85	92	95	97	92.2
14 days	83	90	92	94	89.7	80	88	90	92	87.5
16 days	75	82	84	86	81.7	71	79	82	84	79.0
18 days	66	72	74	76	72.0	62	69	72	75	69.5
20 days	55	62	64	66	61.7	51	60	63	65	59.7
Mean	73.4	80.2	82.2	84.2		69.8	77.6	80.4	82.6	
LSD at 5%	Antioxidant:2.13 Irrigation:1.45 Interaction: 3.24					Antioxidant: 0.80 Irrigation: 0.47 Interaction: 1.05				

Table (7): Effect of water irrigation intervals and plant antioxidant materials as well as their interactions on weight of 100 grain (gm) of maize plant during the two growing seasons 2007 and 2008.

Treatment / Irrigation intervals	Tap water	Critic	ASA	SWE	Mean	Tap water	Critic	ASA	SWE	Mean
	2007					2008				
12 days(cont.)	21	24	26	28	24.7	22	24	26	28	25.0
14 days	20	21	22	23	21.5	21	22	23	25	22.7
16 days	16	17	19	21	18.2	17	18	20	22	19.2
18 days	16	16	16	18	16.5	16	17	17	19	17.2
20 days	12	14	14	14	13.5	12	15	15	15	14.2
Mean	17.0	18.4	19.4	20.8		17.6	19.2	20.2	21.8	
LSD at 5%	Antioxidant: 0.39Irrigation: 0.28 Interaction: 0.63					Antioxidant:1.179Irrigation: 0.12 Interaction: 0.28				

Table (8): Effect of water irrigation intervals and plant antioxidant materials as well as their interactions on seeds oil content (gm/100 gm grains) of maize plant during the two growing seasons 2007 and 2008.

Treatment / Irrigation intervals	Tap water	Critic	ASA	SWE	Mean	Tap water	Critic	ASA	SWE	Mean
	2007					2008				
12 days(cont.)	2.67	2.67	2.78	2.87	2.70	2.78	2.77	2.87	2.92	2.83
14 days	2.66	2.64	2.65	2.67	2.65	2.75	2.76	2.75	2.84	2.77
16 days	2.63	2.62	2.65	2.66	2.64	2.68	2.67	2.68	2.68	2.67
18 days	2.61	2.53	2.62	2.63	2.59	2.65	2.65	2.67	2.67	2.66
20 days	2.49	2.62	2.58	2.60	2.57	2.52	2.64	2.65	2.65	2.61
Mean	2.61	2.62	2.65	2.68		2.67		2.72	2.75	
LSD at 5%	Antioxidant:0.3 Irrigation:0.3 Interaction: 0.5					Antioxidant:0.3 Irrigation:0.3 Interaction: 0.6				

DISCUSSION

water stress reduces plant growth through inhibition of various physiological and biochemical precesses, such as photosynthesis, respiration, translocation, ion uptake, carbohydrates, nutrient metabolism, and hormones (Kramer,1983). As a result, plant size, leaf area, extensive root systems and productivity are reduced. Cell growth (expansion) is one of the most drought sensitive physiological processes due to the reduction of turgor pressure. Water stress inhibits cell enlargement more than cell devision so water stress greatly suppresses cell expansion and plant growth due to the low turgor pressure

In accordance with the results of the present investigation,drought stress reduces yield of maize (*Zea mays* L.) and other grain crops by (i) reducing canopy absorption of incident photosynthetically active radiation (PAR), (ii) reducing radiation use efficiency (RUE), and (iii) reducing harvest index Earl and Davis, ((2003).

According to Kazemi, *et al.,* (2001). droughe reduced grain filling period and, thus yield of maize decreases significantly.

Role of antioxidants on alleviating the harmful effect of drought stress:

Ascorbic and citric acid can alleviate the harmfull effect of ROS which generated by drought stress levels 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 et al, 1996). (3)), as membrane stabilisers and multifaceted antioxidants, that scavenge oxygen free radicals, lipid peroxy radicals, and singlet oxygen (Diplock, *et al*., 1989). (4) react with peroxyl radicals formed in the bilayer as they diffuse to the aqueous phase. (Hess, 1993). (5) . scavenge cytotoxic H_2O_2, and reacts non-enzymatically with other ROS: singlet oxygen, superoxide radical and hydroxyl radical (Larson, 1988). (6) stabilize membrane structures (Blokhina, 2002). (7) modulates membrane fluidity in a similar manner to cholesterol, and also membrane permeability to small ions and molecules (Fryer, 1992). (8) to decrease the permeability of digalactosyldiacylglycerol vesicles for glucose and protons (Berglund*, et al*., 1999).

The enzymes ascorbate peroxidase, glutathione reductase, superoxide dismutase and monodehydroascrbate reductase, among others, are involved in the regeneration of glutathione and ascorbate that are important in detoxification of ROS (Foyer and Mullineaux, 1994). Ascorbate ,reduced gluthione (GSH), APX,GR,SOD and MDHAR are involved in several contexts in antioxidant regeneration throughout the the plant cell Ascorbate also acts as a reductant in the regeneration of *a* –tochopherol and in zeaxanthin cycle (Foyer, 1993).

Seaweed extract may enhance hydrophobic and hydrophilic antioxidant activity and thus promote growth and leaf water status. It may be concluded that antioxidant status could be manipulated with exogenous application of plant growth biostimulants (SWE) (Schmidt, 2005).

Bostimulants (SWE) can alleviate the harmfull effect of 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 ,(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 protect photosynthetic 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 (Demir, *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 and stimulate nucleic acids. (O,Donnell,1973). XIII)- Stimulation of chloroplast development and enhancing phloem loading and delay senescenc (Demir, *et al.,*2004).

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تـأثير فتـرات الـرى وبعض مضـادات الأكسـدة وكـذلك معـاملات التفاعل بيـنـهم علـى النمو و المحصول لنبات الذرة

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أدت معاملات التعطيش إلى نقص صفات النمو و المحصول لنبات الذرة وكانت المعاملة الرى بعد ٢٠ يوم هى الأكثر تأثيرا فى هذا الشأن. بينما أدت معاملات مضادات الأكسدة الى زيادة النمو و المحصول وكان SWE هو الأكثر فاعلية.

معاملات التداخل أدت الى تحسين صفات النمو و المحصول إذا ماقورنت بمعاملات التعطيش ولكن هذه الزيادة ظلت أقل من الكنترول.

يمكن ملاحظة أن مضادات الأكسدة المستخدمة أدت الى التغلب جزئيا على الأثار الضارة على النمو والمحصول والناجمة عن التعطيش.

قام بتحكيم البحث

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