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IMPROVING GROWTH AND YIELD OF WHEAT (*Triticum aestivum* L.) PLANT GROWING IN SALINE SOIL BY USING SOME OSMOREGULATORS.

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ABSTRACT

Na Cl salinity at 2500 and 500 ppm decreased wheat plant growth expressed by plant height, number of fertile tillers, dry weight of shoot system (g) and flag leaf area (Cm) as well as photosynthetic pigment concentrations in flag leaf in both seasons. Accumulation of both Na^+ and Cl^- ions in the shoot system was increased with increasing NaCl levels, while K^+ concentration was decreased. Yield and its components represented by number of spikes per plant, spike length (cm); number of spikelets per spike, grains weight per spike and 1000-grain weight as well as carbohydrate, protein, N, P and K percentages in the grains were decreased compared with control.

Anatomically, salinity decreased root diameter, cortex thickness, vascular cylinder diameter and metaxylem vessel diameter as well as flag leaf thickness in the keel region, mesophyll tissue thickness, main vascular bundle dimension, xylem and phloem tissues thickness and metaxylem vessel diameter. Treatment with either trehalose or glycinebetaine at 100 ppm and their interactions with salinity increased all the above mentioned parameters in both non-salinized and salinized plants. Trehalose was the most effective in this respect.

Treatments with either trehalose or glycinebetaine are recommended not only for improving plant growth and yield of wheat plant but also for recovery the adverse effects of salinity.

INTRODUCTION

Soil salinity is one of the most important factors limiting plant growth and yield. The deleterious effects of salinity result from water deficit, ion toxicities, ion imbalance or a combination of these factors (Kurth *et al.*, 1986).

Wheat is one of the major and wide spread crops in the world. It is exposed to salinity due to irrigation or saline subsoil and is considered to be a crop moderately to salinity (Richards 1954). There is evidence that high salt concentration caused an imbalance of in the cellular ions resulting in ion toxicity and osmotic stress leading to reduction in plant growth and yield (Muthukumarasamy and Panneerelvam, 1997). It also reduced the photosynthetic pigments and the rate of photosynthesis in the plant leaves (El-kheir *et al.*, 2001); led to a reduction in the content of other nutrients and inhibited protein synthesis (Santos *et al.*, 2001). Salt stress also induced anatomical changes in plant organs, including both lignification process and root aerenchyma formation (Reinhardt and Rost 1995b and Garcia *et al.*, 1997). These changes as well as osmotic adjustment are a fundamental adaptive response of plant cell to salinity, being necessary for their survival and growth under saline conditions (Binzel *et al.*, 1987 and Serrato-, *et al.*, 1996).

The osmoregulators play a central role in adaptation to saline stress. Exogenous application of glycinebetaine and trehalose has been shown to increase the tolerance to various stresses of several plant species (Agboma *et al.*, 1997a; Garcia *et al.*, 1997; Holmstrom *et al.*, 2000 and Rahman *et al.*, 2002).

The objective of this investigation was to study the effects of salinity on growth, photosynthetic pigments; mineral uptake as well as yield and its components of wheat plant. The anatomical structure of both root and flag leaf was also studied. In addition, the use of glycinebetaine and trehalose to alleviate the adverse effects of salinity on wheat plant growth and yield was also studied.

MATERIALS AND METHODS

Plant material and experimental conditions:

Two pot experiments were carried out during the two successive seasons of 2002/2003 and 2003/2004 in the Experimental Farm and Laboratories of Agric., Botany Dept., Fac.; of Agric. Mansoura Univ., Mansoura, Egypt. Each pot (30 cm diameter) was filled with 6 kg clay/ sandy soil (1:1 v/v). The pots were divided into three groups; each group contains 18 pots. Wheat grains Cv. 168 were obtained from Agric. Research Center, Giza, Egypt. Five uniform wheat grains were sown on 10th of November in the two growing seasons. Tap water was used for irrigation till complete seedling stage (15 days from sowing), then the plants were thinned to leave three uniform plants per pot.

After 21 days from sowing, the plants were subjected to two levels of salt concentrations till harvest by using NaCl solution. Such levels were 2500 and 5000 ppm in addition to tap water as control.

The plants were irrigated with tap water or saline water to reach 65% of field capacity. The plants were irrigated with tap water at three weeks intervals to prevent any accumulation of NaCl.

At 42 days from sowing, the pots of each treatment were divided to three groups. The first one of each treatment left to study the effect of salinity. The second group was sprayed with 100 ppm of trehalose or glycinebetaine till dripping. The pots were arranged in a complete randomized design with three replications to form the following treatments. Control, 100 ppm trehalose, 100 ppm glycinebetaie salinity at 2500 and 5000 ppm; salinity at 2500 ppm + 100 ppm trehalose, salinity at 2500 + 100 ppm glycinebetaine,, salinity at 5000 ppm+ 100 ppm trehalose and salinity at 5000 ppm + 100 ppm glycinbetaine.

At flowering stage (65 days from sowing), the following parameters were recorded: plant height, number of fertile tillers, and dry weigh of shoot (g) as well as flag leaf area (cm^2) calculated according to Quarrie and Jones (1979). In addition photosynthetic pigments were determined in the flag leaf blade (Mackinney, 1941). Concentrations of Na^+ and K^+ in the shoot system were also determined (Chaudhary *et al*, 1996)

For anatomical studies samples were taken at flowering stages (65 days from sowing) from the basal part of an adventitious root formed on the first basal node on the main stem as well as the flag leaf taken from the middle part of the blade.

Samples were killed and fixed in FAA, dehydrated in alcohol series followed by xylene and embedded in paraffin wax (52-54 C.m.p.). Cross sections 15-20 µm thick were prepared by a rotary microtome, stained in saffranin-light green combination,cleared in clove oil and mounted in Canada balsam (Gerlach, 1977). The sections were examined microscopically.

Yield and its components

At harvesting stage (150 days from sowing) number of spikes/plant spike length (cm) number of spikelets/spike grain weight/spike (g) and 1000 grain weight (g) were recorded.

Moreover, total soluble carbohydrate percentage in the grains (Sadasivam and Manickam, 1996) and percentages of nitrogen and phosphorus (Jackson, 1967) as well as potassium (Peterburgski, 1968) were determined. Moreover, protein percentage was calculated by multiplying the N percentage by 5.7.

All the chemical analyses except photosynthetic pigments were determined during the second season only.

Data were subjected to statistical analysis of variance (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Growth parameters:

Data presented in Table (1) show that salinity at two concentrations (2500 and 5000 ppm) caused a significant reduction in wheat growth expressed by plant height, number of fertile tillers, flag leaf area (cm^2) and dry weight of shoot system. The great reduction in these parameters was observed under high salinity level (5000 ppm).

Table (1): Effects of salinity and some osmoregulators and their interactions on certain growth parameters during the two growing seasons 2002/2003 and 2003/2004.

Treatments	Plant height (cm)		No. of fertile tillers		Flag leaf area (cm^2)		Dry weight of shoot system	
	2003	2004	2003	2004	2003	2004	2003	2004
Control	56.5	56.9	3.2	3.8	17.9	18.7	7.7	8.9
2500 ppm NaCl	50.4	51.8	2.8	3.0	14.4	15.3	6.1	6.7
5000 ppm NaCl	46.4	45.1	1.7	2.3	11.3	13.4	5.5	6.3
Trehalose	74.5	76.9	7.1	7.7	27.8	28.4	13.5	14.9
Glycinebetaine	70.5	65.2	6.1	6.7	24.6	25.7	12.3	13.0
Tri + 2500 ppm NaCl	65.0	67.0	4.5	5.7	21.2	22.0	11.7	12.3
Tri + 5000 ppm NaCl	67.4	69.3	3.5	3.8	16.3	18.4	8.5	9.2
GB. + 2500 ppm NaCl	65.0	65.5	3.4	5.0	19.5	20.0	10.0	11.4
GB. + 5000 ppm NaCl	59.5	61.5	3.1	4.7	14.4	14.9	9.1	9.6
L.S.D. at 5%	3.7	3.9	0.3	0.4	1.4	1.7	1.5	1.8

Tr. : Trehalose **GB: Glycinebetaine**

Data in the same Table reveal that exogenous application of osmoregulators alone or in combination with different salinity levels not only increased growth parameters but also counteracted the harmful effects of salinity. Treatment with trehalose was most effective in this respect.

The depressing effect of salinity on plant growth may be a result of an inhibition of cell division and cell elongation (Kurth *et al.*, 1986) and internal hormonal imbalance (Younis *et al.*, 2003). Moreover, the retardation in plant growth caused by salinity may be attributed mainly to the osmotic stress, which reduced availability and uptake of water and essential nutrients (Neumann, 1997) as well as the excessive accumulation of both toxic ions, *i.e*, Na^+ and intermediate compounds such as reactive oxygen species (Rodriguez *et al.*, 2004) which cause oxidative damage to DNA, lipids and proteins and consequently a decrease in plant growth.

The stimulating effect of both osmoregulators on plant growth may be attributed to an increase in the availability and uptake of water and essential nutrients through adjusting osmotic pressure in plant cells (Tao and Mei 2003) and reducing the accumulation of harmful Na^+ and Cl^- in plant tissues (Garcia *et al.*, 1997 and Rahman *et al.*, 2002). Moreover, it alleviates oxidative stress caused by salinity through its effect on increasing the antioxidant enzyme activities (Tao and Mei, 2003). In addition the stimulating effect of osmoregulator on number of tillers may be attributed to its effect on a reduction in apical dominance (Romero *et al.*, 1997)

Photosynthetic pigments:

Data in Table (2) show that all salinity levels significantly decreased chlorophyll a, b and carotenoids in flag leaf of wheat plants compared with the non-salinized (control) plants, while, treatment with osmoregulators to both salinized and non-salinized plants increased the photosynthetic pigments as compared to the untreated (control) plants.

Table (2): Effects of salinity and some osmoregulators and their interactions on photosynthetic pigment concentrations (mg/g F.W) during the two growing seasons 2002/2003 and 2003/2004.

Treatments	Seasons					
	2002/2003			2002/2003		
	Chl.A	Chl. B	Total carot.	Chl.A	Chl. B	Total carot.
Control	1.70	1.30	0.65	1.7	1.40	0.67
2500 ppm NaCl	1.30	0.80	0.50	1.4	0.90	0.52
5000 ppm NaCl	0.70	0.60	0.38	1.0	0.80	0.42
Trehalose	2.80	2.10	0.72	3.0	2.50	0.78
Glycinebetaine	2.50	1.80	0.68	2.9	2.90	0.73
Tri + 2500 ppm NaCl	2.10	2.10	0.54	2.4	2.00	0.57
Tri + 5000 ppm NaCl	2.00	1.30	0.48	2.1	1.50	0.51
GB. + 2500 ppm NaCl	2.60	1.60	0.63	2.3	2.00	0.66
GB. + 5000 ppm NaCl	1.80	11.20	0.60	1.9	1.40	0.62
L.S.D. at 5%	0.40	0.40	0.70	0.30	0.40	0.60

Tr. : Trehalose **GB: Glycinebetaine**

The results in the same Table indicate that treatments with both osmoregulators overcame the depressing effect of salinity stress on photosynthetic pigments. Trehalose treatment was more effective in this concern.

The decrease in photosynthetic pigments under salinity stress may be due to one or more of the following processes: The inhibitory effect of chloride on the activity of Fe containing enzymes cytochrome oxidase which, ,in turn, may decrease the rate of chlorophyll biosynthesis and increase chlorophyll degradation (Sants *et al.*, 2001) and cause disruption of chloroplasts by oxidative stress which cause a decrease in chlorophyll content (Rahman *et al.*, 2000). Moreover, high salinity level and osmotic stress not only caused destruction of photosynthetic apparatus but also decreased the photosynthetic reactions (Lutts *et al.*, 1996 b and Rahman *et al.*, 2000).

The stimulating effect of osmoregulators on photosynthetic pigments may be due to, stabilizing active site of enzyme and photosynthetic reactions (Mamedov *et al.*, 1991 and Hare *et al.*, 1998). Moreover, both osmoregulators enhanced exclusion of toxic ions such as Na^+ (Rahman *et al.*, 2002). Qifang *et al.*, (2004) noted that the exogenous application of glycinbetaine not only alleviated oxidative stress by salinity but also inhibited the degradation of chlorophyll and proteins caused by salinity and protected the integrity and stability membranes under salt stress.

3-Ion contents:

Data in (Fig.1) shows that salinity at all levels (2500 and 5000 ppm) increased gradually Na^+ and Cl^- concentrations. This increase was accompanied by a corresponding decline in K^+ concentration. On the other hand, application of both osmoregulators and their interactions with salinity show a reverse effect in this concern. Stressed plants and treated with osmoregulators showed accumulated less Na^+ and more K^+. The most effective treatment in this respect was trehalose at 100 ppm.

Excessive amount of Na^+ and Cl^- under saline conditions resulted in high Na^+/K^+ ratio which impair the selectivity of the root membrane and resulted in the passive accumulation of Na^+ in the root and shoot systems (Khan *et al.*, 1997).

The reduction in internal potassium concentration could be related to: The antagonism between K^+ and Na^+ cations, which increased considerably as salinity increased (Rahman *et al.*, 2002). This antagonism may be due to the direct competition between sodium and potassium on the absorption sites of root (Epstein, 1986); an increase in potassium efflux into the root media due to a disrupt in membrane integrity and an interference with its uptake or its transport caused by Na^+ accumulation (Cramer *et al.*, 1985 and Lynch and lauchli, 1985).

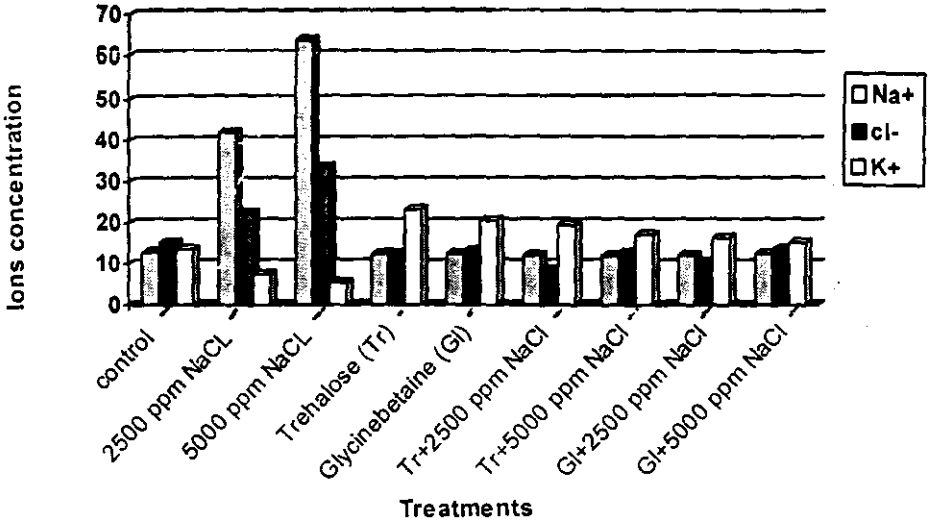

Fig. (1): Effects of salinity and some osmoregulators and their interactions on Na^+, Cl^- and K^+ concentration (mg/g D.W).

Overcoming the adverse effect of salinity on Na^+ and K^+ concentrations in the shoots may be attributed to their role on enhancing exclusion of Na^+ and increased absorption of K^+ to maintain an appropriate Na^+/K^+ balance in the shoot (Rahman *et al.*, 2002). They added that glycinebetaine might reduce the translocation of Na^+ from the root to the shoot and accumulate Na^+ in the root tip or root cap region through its effect on enhancing the formation of many vacuoles in root cells which may act to store Na^+ and decrease its accumulation in the shoot. Moreover, these osmoregulators not only protected the integrity and stability of membranes (Qifang *et al.*, 2004) but also increased production of ATP due to an increase in number and size of mitochondria (Rahman *et al.*, 2002), which, supply additional energy for osmotic adaptation and for selective uptake and transport processes (Koyro *et al.*, 1993 and Rahman *et al.*, 2002).

Anatomical structure:

A: Root structure

Root growth reduction in response to salinity associated with changes in root function which are often reflected by modifications in root structure

Data in Table (3) and (Fig. 2) indicate that salinity decreased root diameter as a result of decreasing cortex tissue thickness and vascular Cylinder dimension. Metaxylem vessels diameter was also decreased. On the other hand, treatments with osmoregulators to non–stressed and stressed plants increased the above mentioned parameters. Trehalose was most effective in this respect.

The results indicate also formation of an exodermis, internal air spaces (aerenchyma) and or vacuoles in the cortex tissue (Fig. 2C, E and F) and developed an endodermis are among the most striking structural responses to salinity and osmoregulators treatment.

It has been suggested by other authors (Reinhardt and Rost 1995 a, Garica *et al.*, 1997) that formation of aerenchyma is an adaptive response that contributes to protect the cytoplasm from toxic ion levels by storing them in the vacuoles. This vacuolation facilitates osmotic adjustment and the compartmentation of toxic ions, *.i.e.*, Na^+ and Cl^-, thereby mitigating adverse effects of high salt concentrations in the root medium (Reinhardt and Rost 1995 b). In addition, plant may have been trying to form aerenchyma during NaCl stress to compensate for a reduction in metabolic activity due to salinity (Schwarz *et al.*, 1991). Moreover, an exodermis differentiation due to salinity and osmoregulators may play a role in protecting the root from water loss and/or leakage of solutes needed for osmotic adjustment (Reinhardt and Rost 1995 b). They added that the endodermis suberized cell walls affect the main root function of water and ion uptake and transport. Melchior and Steudle (1993) noted that the suberized walls in the endodermis are known as the major barriers to radial ion and water movement in plant roots.

Table (3): Measurement of some anatomical characters (µm) in wheat radventitious oots as affected by salinity some osmoregulators and their interactions.

Treatments	Root thickness	Cortex thickness	Vascular cylinder thickness	Pith thickness	Metaxylem vessel diameter
Control	680	240	300	150	56
2500 ppm NaCl	600	180	250	138	48
5000 ppm NaCl	520	150	220	110	44
Trehalose	980	320	380	230	88
Glycinebetaine	900	300	355	215	80
Tri + 2500 ppm NaCl	870	280	330	190	80
Tri + 5000 ppm NaCl	760	255	310	184	72
GB. + 2500 ppm NaCl	730	270	315	200	68
GB. + 5000 ppm NaCl	700	245	308	170	60
L.S.D. at 5%	18.8	4.3	6.2	5.7	3.1

Tr. : Trehalose **GB: Glycinebetaine**

The effects of salinity on adventitious root structure may be attributed to its effect on inhibition cell division and cell size (Aspinall 1986).

Formation of aerenchyma in the roots by treatment with osmoregulators under salt \stress may be attributed mainly to an increase in ethylene production (Sharp and lenoble 2002). Ethylene enhances cell wall degradation by promoting the activity of cellulase and polyglactouronase (Hung *et al.*, 1997). Formation of aerenchym in the roots under other stresses facilitates the movement of oxygen from the aerial shoots to roots and rhizosphere as well as oxidizes any toxic soil constituents at root surface (Jakson and Drew 1984).

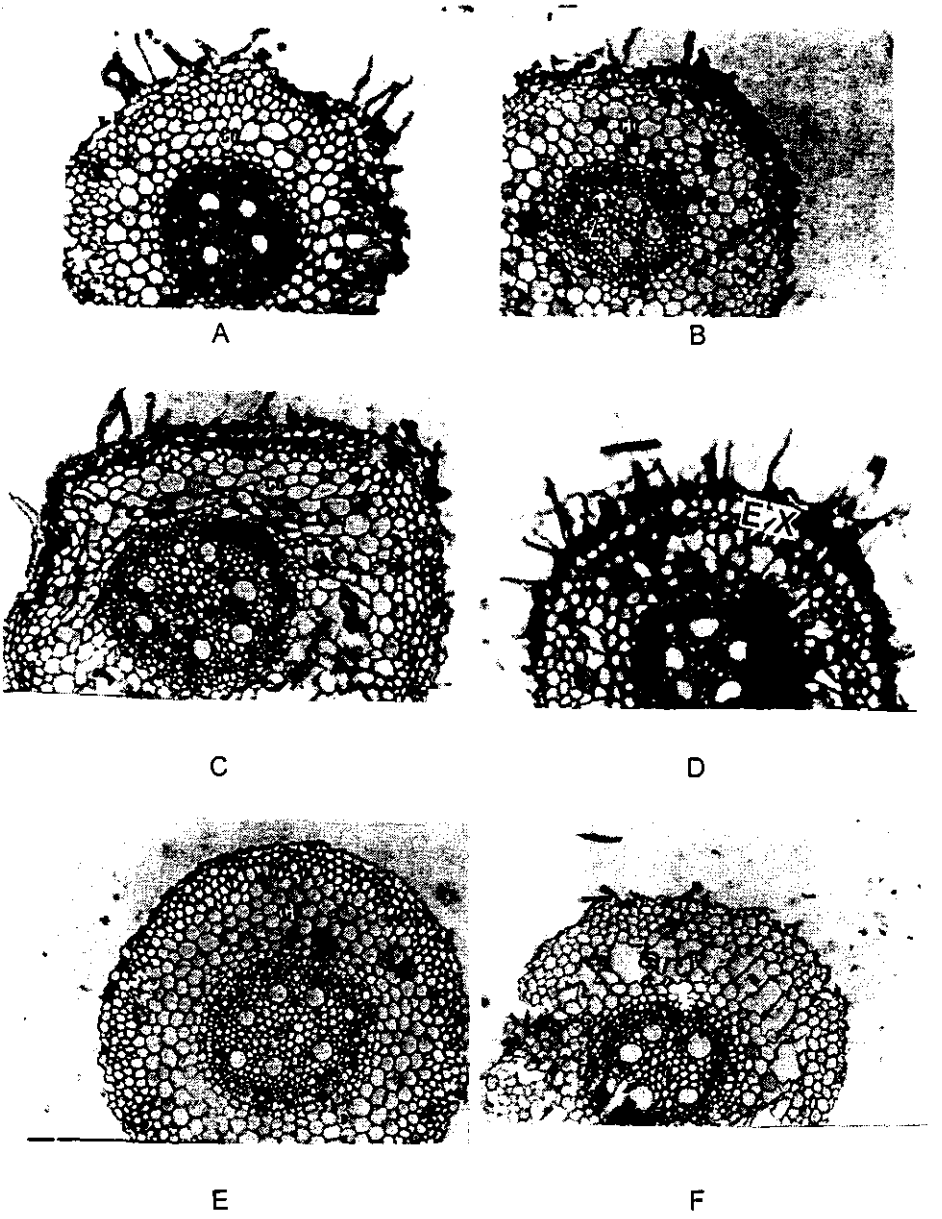

Fig.(2): Cross sections of the adventitious roots affected by salinity, trehalose and glycinebetaine as well as their interactions (obj x 10x Oc. x10).

A: control **B: salinity 5000 ppm** **C:Trehalose**
D:Tr.+ 5000 ppm **E: glycinebetaine** **F: GB+ 5000 ppm**
Co: cortex **ar: aerenchyma**

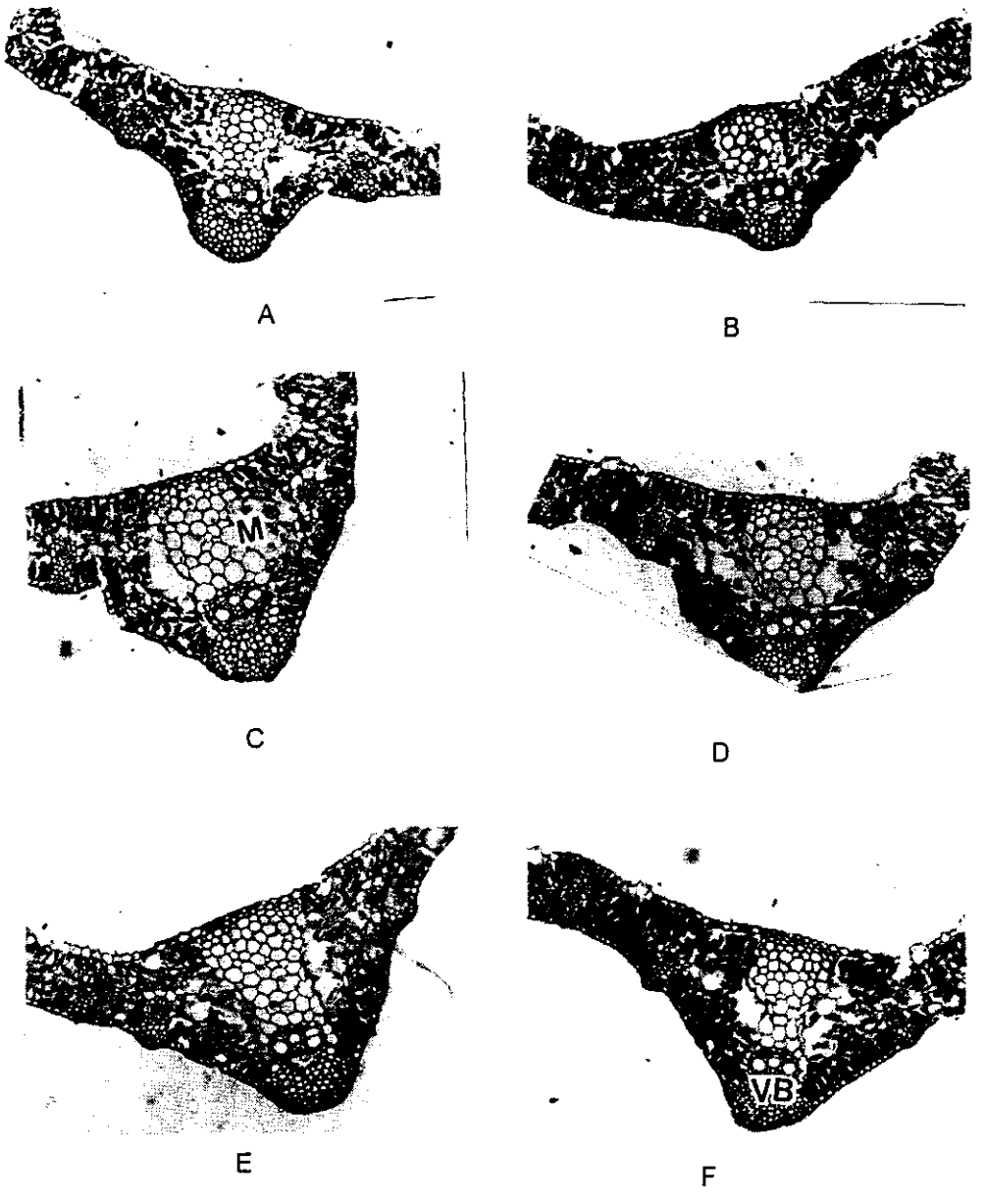

Fig.(3): Cross sections of the flag leaf of wheat plants as affected by salinity, trehalose and glycinebetaine as well as their interactions (obj x 10x Oc. x10).

A: control **B: salinity 5000 ppm** **C:Trehalose**
D:Tr.+ 5000 ppm **E: glycinebetaine** **F: GB+ 5000 ppm**
M: mesophyll tissue

B- Flag leaf structure.

Data presented in Table (4) and illustrated in (Fig 4) indicate that salinity decreased leaf thickness in the keel region, mesophyll tissue thickness, main vascular bundle dimension, xylem and phloem tissues thickness and metaxylem vessel diameter. The data in the same table indicate that either trehalose or glycinebetaine alone or in combination with different salinity levels increased all these parameters. Trehalose was the most effective in this respect.

Table (4): Measurements of some anatomical characters (μm) in wheat flag leaf as affected by salinity, some osmoregulators and their interactions.

Treatments	Leaf thicknss in the keel region	Mesophyll tissue thickness	Large V.B. dimension		Xylem tissue thickness	Phloem tissue thickness	Metaxylem vessel diameter
			Length	Width			
Control	350	320	140	88	76	64	30
2500ppm NaCl	318	296	118	128	70	48	28
5000 ppm NaCl	300	270	106	122	64	42	24
Trehalose	580	544	176	180	96	80	52
Glycinebetaine	450	364	162	156	84	78	38
Tri + 2500 ppm NaCl	460	512	156	168	84	72	40
Tri. 5000 ppm NaCl	430	414	154	164	82	72	36
GB. + 2500 ppm NaCl	416	354	164	154	82	82	34
GB. + 5000 ppm NaCl	380	346	158	110	78	70	32
L.S.D. at 5%	7.8	7.5	4.6	3.2	4.1	3.5	1.8

Tr. Trehalose **GB: Glycinebetaine**

The inhibiting effects of salinity in leaf structure may be correlated with an inhibition of the procambial activity which form, primary vascular tissues as well as with a decrease in the number and size of mesophyll cells.

Overcoming the adverse effects of salinity by application of Osmoregulators may be attributed to its role to alleviate oxidative stress caused by salinity (Qifang *et al.*, 2004). Moreover, Trehalose preserving the internal structure of leaf blade from oxidative stress caused by salinity not only by enhancing aerenchyma formation in the roots but also by decreaseing the transport of toxic ions to the leaf blade (Garcia *et al.*, 1997). Moreover, Jafri and Ahmad (1995) noted that adaptation to saline environments was adjusted by increasing mesopyll surface area to ensure normal exchange of gases and photosynthetic activities.

Yield and its components:

Data presented in table (5) show that yield and its components represented by number of spikes per plant; spike length (cm); number of spikelets per spike, grain weight per spike (g) and 1000-grain weight (g) were significantly decreased with increasing salinity levels. On the other hand, application of both trehalose and glycinebetine alone as well as their interactions with salinity levels significantly increased yield and its components compared with control plants. Trehalose was most effective in this respect.

Table (5): Effects of salinity and some osmoregulators and their interactions on yield and its components of wheat plant during the two growing seasons 2002/2003 and 2003/2004.

Treatments	Seasons									
	2003					2004				
	No. of Spikes/ plant	Spike/ length (cm)	No of spikelet /spike	Grain weight/ plant(g)	1000 grain weight /plant	No. of Spikes /plant	Spike/ length (cm)	No of spikelet /spike	Grain weight/ plant(g)	1000 grain weight/ plant
Control	3.5	8.5	14.0	6.4	29.1	4.0	8.8	14.5	7.0	30.5
2500 ppm NaCl	3.0	7.1	11.8	5.1	25.4	3.0	7.5	12.6	6.3	26.4
5000 ppm NaCl	2.0	4.3	7.6	4.8	23.5	2.2	4.9	8.2	5.2	24.1
Trehalose	8.1	11.5	23.3	14.5	60.3	8.1	12.4	23.7	15.3	61.2
Glycinebetaine	6.0	9.4	18.2	11.2	53.0	7.2	10.2	19.1	11.8	54.7
Tri + 2500 ppm NaCl	5.1	7.4	15.1	12.8	30.5	6.5	7.9	16.0	13.2	32.2
Tri + 5000 ppm NaCl	4.5	6.1	14.2	10.4	29.8	5.4	6.3	14.9	10.5	30.1
GB. +2500 ppm NaCl	5.4	9.1	16.1	6.8	57.0	5.6	10.2	16.7	6.8	58.4
GB. +5000 ppm NaCl	3.8	8.2	15.1	5.9	49.0	4.0	9.0	15.8	6.4	50.1
L.S.D. at 5%	0.5	0.8	1.2	1.1	2.4	0.7	0.7	1.3	0.6	2.3

Tr. : Trehalose **GB: Glycinebetaine**

The dipressing effect of salinity on yield may be attributed to decreasing number of fertile tillers and leaf area (Table 1) resulting in, reduction in the supply of carbon assimilate and photosynthetic rate which lead to slow translocation of photoassimialtes towards the developing grains. Another possibility to reduce the yield due to salt stress is increasing of osmotic pressure of soil solution, leading to accumulation of certain toxic ions which reduces CO_2-exchange rates and net photosynthesis (Asche *et al.*, 2000)

The increase in yield and its components by treatment with both osmoregulators due to an increase in number of fertile tillers (Table 1) by reduction in apical dominance (Romero *et al.*, 1997) and an increase in number of spikes per plant as well an increase in net photosynthtic CO_2 fixation activity (Yu Mei *et al.*, 1999).

Grains quality:

Data in Table (6) indicate that salinity at both concentrations used markedly decreased carbohydrate and protein, N, P and K percentages in the grains.

On the other hand, treatment with trehalose or glycinebetine to non-stressed and stressed plant increased significantly these parameters.

The reduction effect of salinity on carbohydrate accumulation may be attributed to reduction of photosynthetic activity (Rahman *et al.*, 2002), probably due to an inhibition of leaf expansion, photosynthetic pigments formation and consequently reduced assimilation rate (He and Cramer 1993 b). Moreover, the reduction in carbohydrate accumulation in grains could be related not only to an inhibition of carbohydrate translocation and photoassimilates as well as reducing CO_2-exchange rates (Asche *et al.*, 2000) but also due to damage in chloroplasts, accelerating chlorophyll degradation and inactivation of RuBP carboxylase by oxidative damage (Rahman *et al.*, 2002).

Table (6): Effects of salinity and some osmoregulators and their interactions on carbohydrates, nitrogen, protein, potasium and phosphorus in wheat grains during the second season of 2003/2004

Treatments	Total soluble carbohydrates	N%	Protein %	P%	K%
Control	56.8	1.56	8.89	0.38	0.40
2500ppm NaCl	54.6	0.85	4.85	0.33	0.35
5000 ppm NaCl	52.3	0.62	3.53	0.31	0.28
Trehalose	70.1	1.90	10.83	0.59	0.63
Glycinebetaine	67.8	1.73	9.86	0.47	0.58
Tr.+2500 ppm NaCl	64.2	1.63	9.29	0.57	0.51
Tr.+5000 ppm NaCl	62.7	1.55	8.84	0.54	0.46
GB.+2500 ppm NaCl	62.2	1.64	9.35	0.45	0.47
GB.+5000 ppm NaCl	60.5	1.49	8.49	0.39	0.43
L.S.D.	1.6	0.29	1.30	0.03	0.02

Tr.: Trehalose **GB.: Glycinebetaine**

Overcoming the adverse effect of salinity by application of both osmoregulators may be attributed to an increase in stomatal conductance and net photosynthetic Co_2 fixation activity under salt stress (Yu Mei et al., 1999 and lopez et al., 2002); prevent the damage of chloroplasts under salt stress and inhibit the degradation of chlorophyll and soluble proteins (Rahman et al., 2002, and Qifang *et al.*, 2004).

Salinity stress generally caused disturbing the ion imbalance resulting in an increase in the accumulation of excessive amount of Na^+ and Cl^- which may impare the selectivity of the root membranes (Khan *et al.*, 1997).

The competitive inhibition of K^+ absorption by Na^+ is well known. In addition, salinity decreased ATP synthesis, consequently, decrease Na^+/ H^+ antiporter and the ATP-ase / H^+ pump (Robert et al., 2000)

The reduction in nitrogen concentration by salinity may be attributed not only to reduce nitrogen fixation and nitrogenase activity but also to decrease N uptake (Hafeez *et al.*, 1988). Moreover, salinity caused an increase of membrane permeability and lipid peroxidation, probably due to changes in membrane composition and structure (Santos *et al.*, 2001).

Treatment with osmoregulators ameliorting the effects of salinity on mineral uptake may be integrity and stability of the cell membranes (Qifang *et al.*, 2004) and increase ATP production which, supply additional energy for osmotic adaptation and for selective uptake and transport processes (Rahman *et al.*, 2002).

In addition, glycinebetine enhanced exclusion of Na^+ and increased absorpition of K^+ (Gregorio and senadhira 1993) as well as reduced the translocation of Na^+ from the root to the shoot (Rahman *et al.*, 2002). Moreover, trehalose increased lipid bilayer fluidity (Crowe *et al.*, 1984 a) and preserved enzyme stability during stress (Colaco *et al.* 1992).

It could be concluded that treatment with both glycinebetaine and trehalose at 100ppm are recommended for recovery the adverse effects of salinity. Treatment with trehalose was the most .effective in this respect.

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تحسين نمو ومحصول نبات القمح النامى فى تربة ملحية باستخدام بعض المـواد المنظمة الأسموزية

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يهدف هذا البحث الى دراسة تأثير كل من الملوحة بكلوريد الصوديوم بتركيزات ٢٥٠٠، ٥٠٠٠ جزء فى المليون وكذلك التريهالوز والجلسينبيتن على النمو والمحصول والتركيب التشريحى للجذور العرضية وورقة العلم فى نبات القمح ودور تلك المواد المنظمة للأسموزية فى ملاشاة الأثر الضار للملوحة ويمكن تلخيص النتائج فى الآتى:

أدت الملوحة بالتركيزات المستخدمة الى نقص نمو النبات معبرا عنه بطول النبات وعدد الخلفات الخصية والوزن الجاف للمجموع الخضرى ومساحة العلم كما أدت الملوحة الى نقص صبغات البناء الضوئى فى ورقة العلم وزيادة محتوى عنصرى الصوديوم والكلور بينما نقص محتوى البوتاسيوم فى المجموع الخضرى كما أدت الملوحة الى نقص المحصول ومكوناتة معبرا عنه بعدد السنابل للنبات وطول السنبلة وعدد السينبلات للسنبلة ووزن حبوب السنبلة ووزن الألف حبه كما أدت الى نقص النسب المئوية للكربوهيدرات والبروتين وعناصر النيتروجين والفسفور والبوتاسيوم فى الحبوب .

تشريحيا أدت الملوحة الى نقص قطر الجذر وسمك القشرة وقطر كل من الاسطوانة الوعائية والخشب التالى كما أدت الى نقص سمك ورقة العلم فى منطقة العرق الوسطى والنسيج المتوسط وأبعاد الحزمة الوعائية الرئيسية وسمك نسيجى الخشب واللحاء وقطر أوعية الخشب التالى أدت المعاملة بأى من التريهالوز والجلسين بيتين بتركيز ١٠٠ جزء فى المليون منفردة وكذلك تفاعلاتها مع الملوحة الى زيادة كل الصفات السابقة ويمكن التوصية باستخدام كل من سكر التريهالوز والجلسين بيين لملاشاه الاثر الضار للملوحة.