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Effect of Irrigation by Diluted Seawater on Growth and Some Macronutrients of Different Wheat Varieties

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A POT experiment was conducted in the greenhouse of the National Research Centre at Dokki, Cairo Egypt during 2005/2006 winter season to evaluate the effect of different salt stress degrees by diluted seawater [Tap water (250 ppm), 2000 and 4000 ppm] on the growth and yield characters of different wheat varieties. Gemmeza 9 was the superior in flag leaf area among the other varieties followed by Giza 168, where the lowest value of this criterion was by Sakha 69 and Sakha 93. Non significant differences were detected between the used varieties in number of green leaves/mean stem and length of spikes. Increased salt concentration in the root media decreased plant height, area of flag leaf and spike length. The differences in number of green leaves/mean stem were not significant. The highest negative effect of salinity on plant height was in Sakha 93 and Giza 168 varieties. Plant height of Sakha 69 did not affected by this treatment. The decrement in flag leaf area of Gemmaza 9, Gemmaza 7and Sakha 69 seemed to be equal. The lowest effect was in Giza 168 followed by that of Sakha 93. Length of spikes of Gemmeza 9, Gemmeza 7 and Giza 168 indicated similar responses. There are no any differences in N concentration while it was slight in P concentration. However, there are wide differences in K concentration specially between Gemmaza 7 . Gemmaza 9 and Sakha 69, in side, and Giza 128 and Sakha 93 in the another side which the concentration of this element in the 1st group about 5 - 10 folds of those in the 2nd group. The uptake of these elements significantly differ between varieties. Gemmaza 9 and Sakha 93 showed lesser values than in the other varieties. The highest content of N was in Giza 168 and the lowest by Sakha 93 followed by Gemmaza 9. The uptake of P in Giza 168 and Sakha 69 seem to be similar. The concentration of N and P slightly increased by the 1st level of salinity and tended to decrease by the highest level to be lesser than the control while K concentration increased by both salinity levels. Nevertheless, the uptake of N, P and K negatively responded to the increase in salt concentration in water of irrigation.

Keywords: Wheat (*Triticum aestivum* L.), Varieties, Salinity, Diluted seawater, Vegetative growth, Dry matter, Macronutients.

Soil salinity is a major environmental constraint to crop productivity worldwide. The "biological" approach to this problem focuses on the management, exploitation, or development of plants able to thrive on salt-affected soils

(Ashraf *et al,*. 2008). Shortage of water resources needed for irrigation in the new reclaimed soils, now a day, considered one from the great challenges. Therefore, the use of nontraditional sources such as saline water may be as a suitable way to irrigate some areas and this needed also the same type plants to survive against salt stress and drought.

Selecting and improving varieties tolerate salt stress very important for wheat production especially for its growing in soils suffers from salts and or irrigated by saline water. Sharaan (2000) found that wheat varieties were significantly different in plant height, spike length, number of spikes, number of grains/spike and grains weight/spike. Varietals differences between wheat varieties were detected by many authors: Abd El-Gawad *et al.* (1987), Hassanein (2001), Ahmed *et al.* (2006) and Zheng *et al.* (2008).

Salinity affected adversely on growth on plants through its effect in metabolic processes as mentioned by many investigators among of them: Arfan *et al.* (2007), Hussein *et al.* (2007), Hussein *et al.* (2006), Rejili *et al.* (2007) Tuna *et al.* (2008) and Navarro *et al.* (2008). Variation in salt stress tolerance were reported by: Rajpar & Sail (2002), Akram *et al.* (2000), Salama *et al.* (2000) and Angrish *et al.* (2001).

Therefore, this study aimed to investigate the response of growth, yield and some macronutrient status of different wheat varieties to the irrigation by diluted seawater.

Material and Methods

A pot experiment was conducted in the greenhouse of the National Research Centre at Dokki, Cairo Egypt during 2005/2006 winter season to evaluate the effect of different salt stress degrees on the growth and yield characters. The treatments were as follows:

1 - Varieties: Giza 128, Sakha 69, Sakha 93, Gemmexa 7 and Gemmeza 9.

2 - The salt concentration in water of irrigation (by diluting Mediterranean seawater with fresh water): Tap water (250 ppm), 2000 and 4000 ppm.

The experiment included 3 levels of salinity in combination with five varieties, *i.e.* 15 treatments in 6 replicates. Metallic ten pots 35 cm in diameter and 50 cm in depth were used. Every pot contained 30 kg of air dried clay loam soil. The inner surface of the pots was coated with three layers of bitumen to prevent direct contact between the soil and metal. In this system, 2 kg of gravel (Particles about 2-3 cm in diameter), so the movement of water from the base upward.

Seeds of different varieties of bread wheat (*Triticum aestivum* L.) c.vs Giza 168, Sakha 93, Sakha 69, Gemmzeza 7 and Gemmeza 9 were sown in December, 20, 2006. Plants were thinned twice, the 1st after 15 days sowing and the 2nd two weeks latter to leave three plants / pot . Calcium super phosphate (16 % P_2O_5) and potassium sulfate (48.5 % K_2O) in the rate of 3.0 and 1.50 g/pot were added before sowing. Ammonium sulfate (20.5 % N) in the rate of 6.86 g / pot was added in two equal portions, the 1^{st} after two weeks and the 2^{nd} two weeks latter. Irrigation with diluted seawater in different concentrations were started 30 days after sowing (One irrigation by salt water and the next was by fresh water alternatively) till before harvest.

Samples from every treatment of salinity in five wheat varieties were collected, cleaned, dried using oven at 70°C over night and ground in a stainless steal mill. Dried samples were digested and N, P and K using the methods described by Cottinne *et al.* (1982).

Data collected were subjected to the proper statistical analysis with the methods described by Snedecor & Cochran (1980).

Results and Discussion

Varietals differences

Growth

Significant differences in stem length, flag leaf and dry weight of leaves, spikes and total plant weight were shown between varieties (Table 1). Giza 168 ranked 1^{st} and Gemmeza 7 ranked 2^{nd} and Sakha 93 came 5^{th} in total dry weight

Gemmeza 9 was the superior in flag leaf area among the other varieties followed by Giza 168, where the lowest value of this criterion was in Sakha 93 and Sakha 69. Non significant differences were detected between the used varieties in number of green leaves/mean stem and length of spikes. Sing, *et al.* (2000), Angrish *et al.* (2001) and Rajpar *et al.* (2002) reported varietals differences in growth, yield and yield attributes of wheat. Sharaan *et al.* (2000) found that Sids 1 suppressed other cultivars, *i.e.* Sakha 8, Sakha 69, Giza 164 and Giza 168 in plant height, spike length and 1000 grain weight. Ahmad *et al.* (2005) indicated that salt stress decreased flag, leaf area and this could be a major cause for low yield. They also added that there was a linear correlation between the flag leaf area and rhe grain weight. Also, Hu *et al.* (2001) revealed that the leaf elongation was spatially decrease by salinity. However, Szegletas *et al.* (2000) demonstrated that different physiological response found were due to the different water uptake capacity. It could be concluded that varietals differences between wheat cultivars may be due to the genetical differences between cultivars and differences between genotypes concerning partition of dry matter, where wheat cultivars differed carbon equivalent and yield energy per plant (Zhang *et al.*, 2003; Poustini & Siosemardeh, 2004; Ahmed *et al.*, 2006 and Zheng *et al.*, 2008).

TABLE 1. Plant growth of different wheat varieties.

Varieties	Stem height.	Leaves No./mean stem	Flag leaf area	Spike length	Dry weight (g)					Grains/ shoots ratio	Grains total %
					Stem	Leaves	Spikes	Grains	Total		
Gemmaza 9	51.8	4.17	38.3	10.77	1.64	0.53	4.37	3.26	6.54	1.50	49.9
Sakha 69	58.8	4.00	21.7	13.50	2.42	0.74	2.40	1.72	5.56	0.54	30.9
Gemmaza 7	70.7	4.17	26.3	12.70	2.94	0.76	3.60	2.29	7.30	0.61	33.4
Giza 169	61.0	4.00	30.0	13.00	3.03	0.87	3.59	2.76	7.49	0.71	36.9
Sakha 93	50.3	3.50	20.7	10.00	1.32	0.51	1.92	1.45	3.75	0.79	38.7
LSD at 5 %	16.5	N.S	15.7	N.S	N.S	0.21	1.76	1.58	2.98	--------	--------

Macronutrients status

Data in Table 2 included the macronutrients concentration in shoots of different wheat varieties. This data did not show any differences in N concentration while it was slight in P concentration. However, wide differences in K concentration specially between Gemmaza 7 , Gemmaza 9 and Sakha 69 in side, and Giza 168 and Sakha 93 in the another side which the concentration of this element in the 1st group about 5 - 10 folds of those in the 2nd group. The uptake of these elements significantly different between varieties. Gemmaza 9 and Sakha 93 showed lesser values than in the other varieties. The highest content of N was in N and K uptake and the lowest by Sakha 93 followed by Gemmaza 9. The uptake of P in Giza 168 and Sakha 69 seem to be similar.

Badr & Shafe (2002) found that the concentration of Cl and Na^+ in leaves of Giza 168 were more than in leaves of Shaka 8 wheat cultivar . The opposite was true for K^+ concentration. El-Bassiony & Bekheta (2001) found differences in macronutrients between Giza 128 and Gemmeza 9.

TABLE 2. Macronutrient status in plant shoots of wheat varieties.

Varieties	Macronutrients %			Macronutrients mg/plant		
	N	P	K	N	P	K
Gemmaza 9	1.06	0.138	2.88	11.3	1.51	30.1
Sakha 69	1.02	0.152	3.20	16.4	2.52	52.3
Gemmaza 7	1.00	0.125	2.77	18.3	2.44	51.8
Giza 168	1.19	0.128	23.4	23.4	2.49	59.0
Sakha 93	1.09	0.123	10.5	10.5	1.14	24.0
LSD at 5%	------	-------	--------	2.67	0.95	0.15

Salt stress

Growth

Increased salt concentration in the root media significantly decreased plant height, area of flag leaf, spike length and stem, leaves and top dry weight. The differences in number of green leaves/mean stem were not significant (Table 3). Singh *et al.* (2000) mentioned that growth of seedlings decline as a result of salt stress.

TABLE 3. Plant growth of wheat as affected by salinity.

Salt conc. ppm	Stem height	Leaves No/main stem	Flag leaf area	Spike length	Dry weight (g)					Grain/ shoots ratio	Grains total weight
					Stem	Leaves	Spikes	Grains	Total		
T.w.	63.5	4.30	33.4	13.8	3.21	0.84	4.50	3.39	8.55	0.84	39.7
2000	58.8	3.80	28.0	11.4	2.05	0.73	2.40	2.15	5.72	0.68	37.6
4000	53.5	3.80	20.8	11.0	1.60	0.48	3.85	1.35	3.85	0.65	35.1
LSD at 5 %	2.88	N.S	5.16	1.99	0.87	0.14	1.72	1.96	5.52	-------	--------

T.w. = Tap water (250 ppm.).

Szegletas *et al.* (2000) reported that the different physiological responses found were due to the different water uptake capacity based on comparatible organic solutes. Gieve & Poss (2000) concluded that salinity significantly reduced wheat biomass production. Khater *et al.* (2000) noticed that number of leaves, leaves area, relative growth rate and net assimilation rate were affected adversely in both cultivars under salinity. In short- term salinity at crown-root formation stage proved more determinal the salinity at the flowering and soft dough stages in term of all biochemical changes induced.

In arid and semi-arid regions, rainfall and, surface water supplies are unreliable and inadequate to meet crop water requirements. (Shauhan *et al.*, 2008). Used ground water in these regions is mainly marginally saline (2-6 dS/m) to saline (>6 dS/m) and could be exploited to meet crop water requirements if no adverse effect on crops and land resource occurred.

The fear of adverse effects has often restricted the exploitation of naturally occurring saline water. They results concluded that ground saline water is a good source to exploit for irrigation. They found that, in wheat cultivation, saline ground water with an Ec of 6-8 dS/m can be used for at least two supplemental irrigations without any adverse effect on growth and crop yield. The limited amount available and fresh water should be applied during the initial growth stage and supplemental with saline water at later stages. They added that this strategy enables wheat production with saline water with an Ec up to 12 dS/m giving a yield as high as 90% of the optimum crop yield obtained with low salinity water. Furthermore, these effects may be due the depression in photosynthesis and carbohydrates metabolism (Arfan *et al.*, 2007; Abdul Wahid *et al.*, 2007 and López *et al.*, 2008), water adjustment (Patel & Pandey, 2007; Navarro *et al.*, 2008 and Slama *et al.*, 2008), Mineral absorption and distribution (Sariam *et al.*, 2005; Hussein *et al.*, 2006; Rejili *et al.*, 2007 and Gunes *et al.*, 2008), protein building (Abdul Wahid *et al.*, 2007 and Navarro *et al.*, 2008), enzymes and antioxidants activity (Sariam *et al.*, 2005; Abd El-Jaleel *et al.*, 2008 and Tuna *et al.*, 2008) or endogenous hormones (Hussein *et al.*, 2007; Ashraf *et al.*, 2008 and Duan *et al.*, 2008).

Macronutrients status

Examination of data in Table 4 indicated that the concentration of N and P slightly increased by the 1st level of salinity and tended to decrease by the highest level to be lesser than the control while K concentration increased by both salinity levels. Nevertheless, the uptake of N, P and K negatively responded to the increase in salt concentration in water of irrigation.

Heikal (1977) revealed that the total nitrogen content of safflower and sunflower leaves was significantly increased, whereas that of wheat and radish leaves was almost significantly decreased by salinity. Salinity induced non significant effect on phosphorus content of all test plants. Potassium content of the test plants was significantly reduced by salinity.

TABLE 4. Macronutrient status in shoots of wheat plants as affected by salinity.

Salt conc. ppm	Macronutrients %			Macronutrients mg/plant		
	N	P	K	N	P	K
T.w.	1.04	0.134	2.70	21.1	2.74	56.2
2000	1.17	0.144	3.08	15.9	2.01	42.8
4000	1.01	0.122	2.90	11.0	1.31	31.9
LSD at 5%	-------	-------	-------	1.13	0.99	0.78

T.w. = Tap water (250 ppm.).

Shaviv & Hagin (1993) noticed that soil salinity reduced N-uptake in wheat plants. El Bassiouny & Bakheta (2001) found that salinity affected K and P content of two wheat varieties. Irshad *et al.* (2002) indicated that irrespective of N forms most of the nutrient concentrations in the shoot was increased with increasing level of salinity. Abdul Jaleel *et al.* (2008) subjected *Catharanthus roseus* plants to different concentrations of NaCl, 25, 50, 75 and 100 mM on 30, 45, 60 and 75 days after sowing and found that all the treatments altered the mineral contents when compared to the untreated control plants but a significant change was found in 50 mM NaCl concentration, in which the levels of some minerals increased.

Kheir *et al.* (1991) found that increasing salinity decreased shoot concentrations of N and K and increased P concentration in flax shoots when irrigated with saline water containing 0, 1500, 3000 and 4500 ppm NaCl. Khalil (2006) on sesame, noticed that, as regards, N, P, K, Ca and Na in leaves of sesame cultivars irrigated at vegetative stage showed that increasing salinity levels revealed mostly gradual decreased in N, K, P and Ca concentration and increase in Na(%). While at flowering stage low salinity levels caused slight increase in N, K and Ca(%) , further increase led to increase in Na and decrease in P(%). Rehan *et al.* (2002) found that irrigated wheat plants with drainage water (EC 1.68 dS/m^{-1}, SAR 4.6) throughout of the growth season and noticed that N.P and K concentration and total content of grain and straw were significantly decreased while those of Na, Ca and Mg in grains and Na and Mg of straw were significantly increased. Hussein *et al.* (2007) revealed that N and P concentration decreased with both levels of salt stress that the differences between the 1st and 2nd levels was less than to be significant. The content of both nutrients adversely affected by salinity but this effect was higher with the highest salt level used.

Varietals differences x salt stress

Growth

Table 5 show the interaction effect of varieties and salt stress on growth of wheat plants. The highest negative effect of salinity on plant height was by Sakha 93 and Giza 168. Plant height of Sakha 69 did not affected by this treatment. The decrement in flag leaf area of Gemmaza 9, Gemmaza 7 and Sakha 69 seemed to be equal. The lowest effect was by Giza 168 followed by that of Sakha 93. Stem dry weight of Gemmeza 7 and Skaha 93 severely affected by the highest level of salt than the other varieties. The increase of salts in water of irrigation drastically decreased the spikes weight/plant t of Gemmeza 9 while the differences were not significant in spike weight of Giza 168 and Gemmeza 7 treated by 2000 and 4000 ppm salt. The spikes weight of plants received water contains 2000 ppm decreased by : 35.75, 20.88, 27.50, 47.61 and 22.38 % but for plants irrigated by water contains 4000 ppm were decreased by : 66.57, 39.38, 63.35, 67.39 and 50.60 % compared to that of plants irrigated by fresh water for Gemmaza 9, Sakha 69, Gemmeza 7, Giza 168 and Sakha 93 varieties, respectively. This means that the lowest affected varieties by the salinity were Sakha 69 and Sakha 93 however, the highest level of salinity induced approximately the same adverse effect on spike weight of Gemmeza 9, Gemmeza 7 and Giza 168. Zheng *et al.* (2008) concluded that salt stresses caused significant declines in growth period of wheat by accelerating leaf senescence at reproductive stage. Salt tolerant cultivars of wheat successfully preserved normal growth by maintained P, K^+/Na^+, CHL/CAR, LAD and DMA, while salt-sensitive cultivars decreased considerably in those parameters. The improvement of photosynthesis and related traits in reproductive stage was a key to the growth of wheat under saline conditions.

TABLE 5. Plant growth of wheat varieties as affected by salinity.

Varieties	Salt conc. ppm	Stem height	Leaves No/ m. stem	Flag/ leaf area	Spike length	Dry weight (g)					Grains/ shoots ratio	Grains/ total %
						Stem	Leaves	Spikes	Grains	Total		
Gemm. 9	T.w.	54.0	4.5	48	11.5	2.26	0.52	7.11	5.35	9.90	1.99	54.0
	2000	52.5	3.5	40	10.0	1.61	0.50	4.29	3.15	6.40	1.50	49.2
	4000	49.0	4.5	29	10.5	1.05	0.55	1.71	1.27	3.31	0.79	38.4
Sakha 69	T.w.	58.5	4.0	32	18.0	3.59	1.08	2.44	1.87	7.11	0.40	26.3
	2000	60.0	4.0	19	11.0	1.68	0.52	3.30	2.29	5.50	0.85	41.6
	4000	58.0	4.0	14	11.5	2.20	0.63	1.48	1.01	4.31	0.36	23.4
Gemm.7	T.w.	77.5	4.5	32	12.5	4.29	0.96	4.46	3.31	9.71	0.63	34.1
	2000	70.5	4.0	28	13.0	3.39	0.94	2.71	2.02	7.04	0.47	28.9
	4000	64.0	4.0	19	11.5	1.14	0.38	2.02	1.55	3.54	1.02	43.8
Giza 168	T.w.	69.0	4.5	31	14.0	4.09	1.02	5.96	4.53	11.07	0.89	40.9
	2000	61.0	4.0	33	13.5	2.18	1.15	2.46	1.84	5.80	0.55	31.7
	4000	57.0	3.5	26	11.5	2.83	0.45	2.33	1.90	5.61	0.58	33.9
Sakha 93	T.w.	58.5	4.0	26	12.0	1.83	0.62	2.51	1.89	4.96	0.77	38.1
	2000	49.0	3.5	20	9.5	1.38	0.52	1.95	1.46	3.85	0.77	37.9
	4000	43.5	3.0	16	8.5	0.76	0.39	1.30	1.00	2.45	0.59	40.8
LSD at 5 %		6.31	N.S	9.72	N.S	0.26	N.S	3.15	3.51	8.84	-------	-------

T.w. = Tap water (250 ppm.).

Macronutrients status

The interaction effects between varieties and salinity on macronutrients concentration were illustrated in Table 6 and Fig. 1 (a,b). Micronutrients (NPK) in Gemmeza 9 plants responded positively to salinity at the level of 2000 ppm except P concentration the reverse were true under 4000 ppm salt level. The increments in N and K concentration under the high salt level were leaser than that with the level of 2000 ppm. In Sakha 69 plants, N increased by both levels of salinity and the increase raised by the increase in salt level however K concentration was reversely responded. In Gemmeza 7 variety plants, P and K showed the same response approximately of P in Gemmeza 9 but N increased by both salt levels. For K concentration in Giza168 plants responded typically to the two level of salinity while N concentration negatively responded. P concentration slightly increased by the first level of salt and slightly decreased by the 2nd level. Zheng *et al.* (2008) concluded that Significant positive correlations among K^+/Na^+, reproductive growth period and total growth period were noted in salt-sensitive cultivars, however, none significant relations appeared among these parameters in wheat salt tolerance cultivars. Concerning the uptake of macronutrients, N uptake depressed by both salinity level in the five varieties except for the Gemmeza 9 with the level 2000 ppm salinity it was raised. Similar responses were observed with K uptake except for Sakha 93 plants. P uptake did not show any effect to the irrigation by diluted seawater with 2000 ppm salts, however, it responded negatively and considerably with salt stress. The highest depression in N as well as P uptake was shown with high salt level in Gemmeza 7 followed by that in Giza 168 with the first level of salt. However, for K, it was in Giza 168 plants by both salt concentrations in water of irrigation.

Badr & Shafei (2002) noticed that the minerals in leaves of wheat cultivars increased as NaCl increased but the increment in leaves of Giza 162 exceeded those in leaves of Shaka 8 cultivar with the increased in NaCl from 50 to 150 mM. They added that although the tolerant wheat variety was able to reduce leaf Na^+ concentration, this ability was not observed for Cl^- ions since in the present experiment leaf Cl^- concentrations were generally higher for both cultivars and this intern reflected in balance of other nutrients.

TABLE 6. Macronutrient status in plant shoots of wheat varieties as affected by salinity.

Varieties	Salt conc.	Macronutrients %			Macronutrients mg/plant		
		N	P	K	N	P	K
Gemm. 9	T.w.	0.81	o.130	2.70	11.7	1.82	37.8
	2000	1.37	0.170	2.80	14.5	1.50	29.7
	4000	1.00	0.115	3.15	8.0	0.92	25.2
Sakha 69	T.w.	0.97	0.115	3.35	22.7	3.86	87.4
	2000	1.01	0.135	3.20	11.1	1.49	35.2
	4000	1.09	0.155	3.03	15.5	2.21	34.3
Gemm. 7	T.w.	0.94	0.125	2.75	24.6	3.29	72.3
	2000	1.04	0.150	2.90	22.5	3.26	62.9
	4000	1.03	0.100	2.65	7.8	0.71	20.2
Giza 168	T.w.	1.26	0.130	2.50	32.1	3.23	66.5
	2000	1.11	0.135	3.35	18.6	2.26	56.0
	4000	1.19	0.120	3.35	19.5	1.97	54.4
Sakha 93	T.w.	1.21	o.120	2.10	14.4	1.48	25.8
	2000	1.32	0.130	3.15	12.6	1.24	30.0
	4000	0.75	0.120	2.30	4.4	0.74	16.2
LSD at 5 %		------	-------	-------	2.52	N.S	1.74

T.w.= Tap water (250 ppm.).

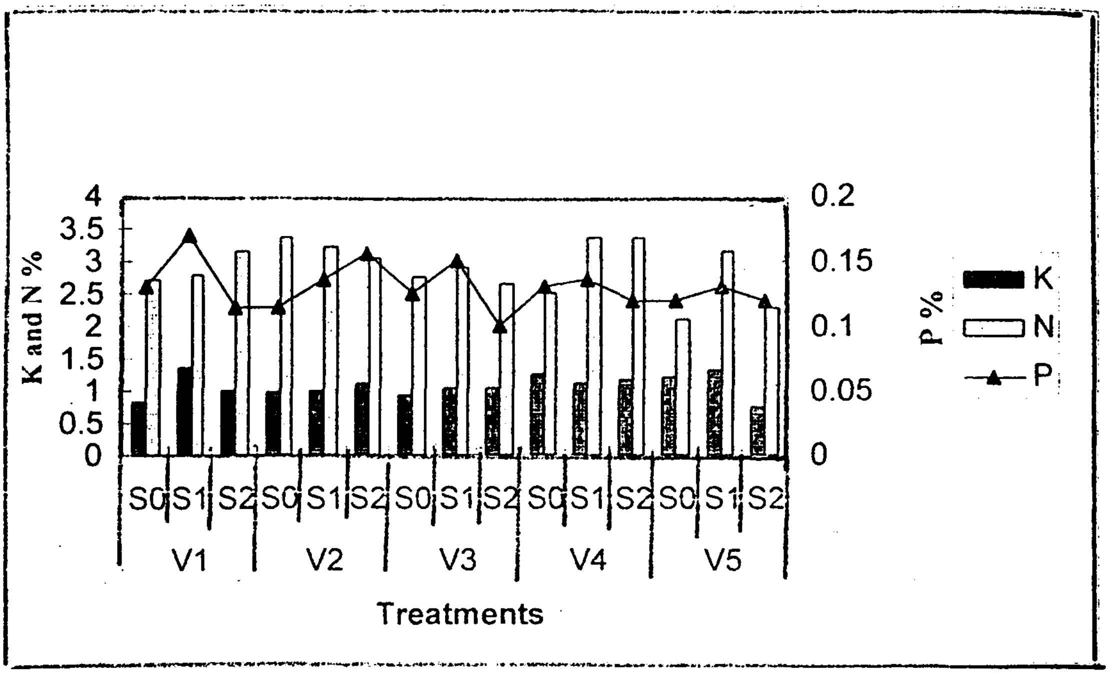

Fig. 1a. Macronutrients status % in plant shoots of wheat varieties as affected by salinity.

V1-Gemmaza 9 V2- Sahka 69 V3-Gemmaza 7 V4- Giza 168 V5-Sakha 93

S0- Tap water S1- 2000ppm S2- 4000 ppm

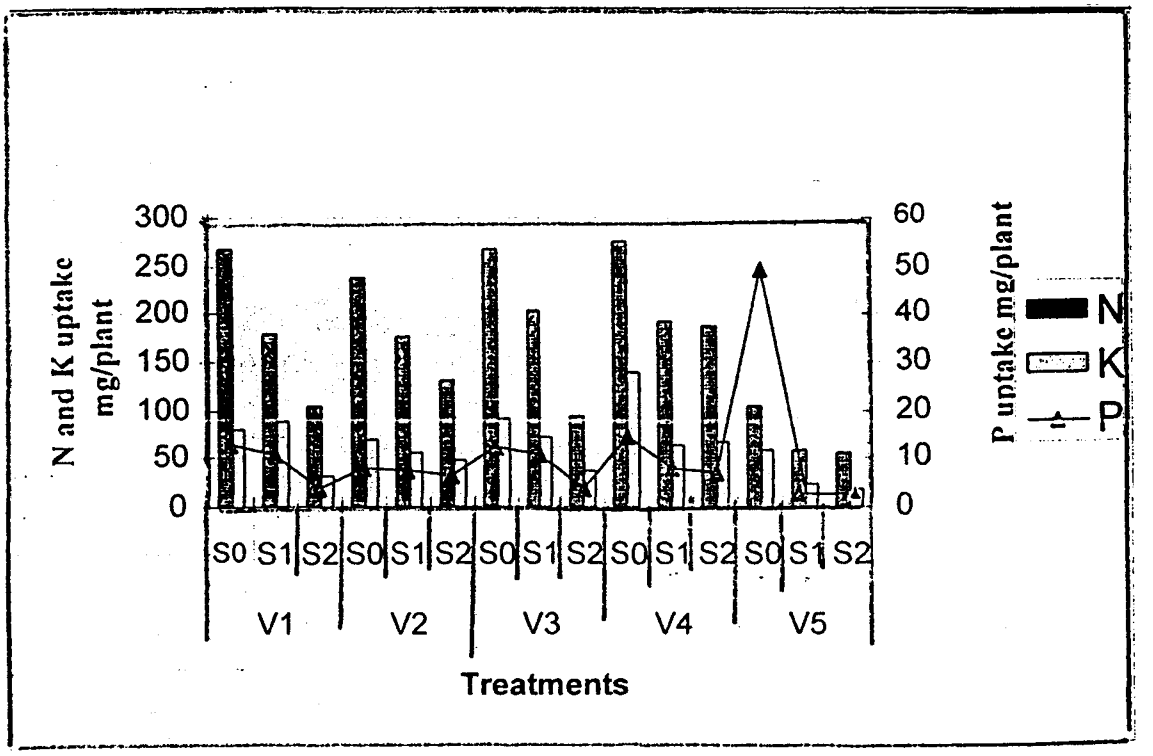

Fig. 1b. Macronutrients uptake in plant shoots of wheat varieties as affected by salinity.

V1-Gemmaza 9 V2- Sahka 69 V3-Gemmaza 7 V4- Giza 168 V5-Sakha 93

S0- Tap water S1- 2000ppm S2- 4000 ppm

Zheng *et al.* (2008) indicated that salt tolerant cultivars had higher K^+ selectivity against Na^+ than salt-sensitive cultivars with the former could maintain relatively stable balance of ions, K^+/Na^+ was found not to be the limited factor for salt tolerant wheat cultivars but it was in salt-sensitive cultivars, P*n* (net photosynthetic rate) significantly positively correlated with leaf K^+/Na^+, RWC, CHL/CAR and LAD. So those four parameters might be ideal criterions of salt tolerance in wheat cultivars.

References

Abdul Jaleel, C., Gopi, R., Manivannan, P., Gomathinayagam, M., Murali, P.V. and Panneerselvam, R. (2008) Soil applied propiconazole alleviates the impact of salinity on *Catharanthus roseus* by improving antioxidant status. *Pesticide Biochemistry and Physiology*, **90** (2). 135 -139.

Abdul Jaleel, C., Gopi, R., Manivannan, P. and Panneerselvam, R. (2008) Soil salinity alters the morphology in *Catharanthus roseus* and its effects on endogenous mineral constituents. *Eur. Asia. J. Bio. Sci.* **2**, 18 - 25.

Abd El-Gawad, A.A., El-Shouny, K.A., Saleh, S.A. and Hamed, M.A. (1987) Partition and migration of dry matter in newly cultivated wheat varieties. *Egypt. J. Agron.* **12**, 1-10.

Abdul Wahid, A.M., Perveen, M., Shahzad, S.G. and Basra, M.A. (2007) Pretreatment of seed with H_2O_2 improves salt tolerance of wheat seedlings by alleviation of oxidative damage and expression of stress proteins. *Journal of Plant Physiology*, **164** (3), 283-294

Ahmed, M.B., Niazi, M., Zaman, B. and Alhar, M. (2005) Varietals differences in agronomic performance of six wheat varieties grown under saline field environment. *Int. J. Environ. Sci. Tech.* **2** (1), 49-57.

Ahmed, A.G., Hassanain, M.S. and El-Gazar, M.M. (2006) Growth and yield response of two wheat cultivars to complete foliar fertilizer compound "Dogoplas". *J. Appl. Sci. Res.* **2** (1), 20–26.

Akram, M., Shanshad, A., Javed, L., UL, H., Wahed, A. and Rasoul, E. (2000) Anatomic and attributes of different wheat (*Triticum aestivum* L.) varieties to NaCl salinity. *Inter. J. Agric. and Bot.* **4** (1). 166–168.

Angrish, R., Kumar, B. and Datta, K.S. (2001) Effect of gibberellic acid and kinetin on N content and nitrate reduction activity in wheat under saline conditions. *Indian J. Plant Physiol.* **6** (2). 171 – 177.

Arfan, M., Athar, H.R. and Ashraf, M. (2007) Does exogenous application of salicylic acid through the rooting medium modulate growth and photosynthetic capacity in two differently adapted spring wheat cultivars under salt stress? *Journal of Plant Physiology*, **164** (6), 685-690.

Ashraf, M., Athar, H.R., Harris, P.J.C. and Kwon, T.R. (2008) Some prospective strategies for improving crop salt tolerance. *Advan. in_Agronomy*, **97**, 45-110.

Badr, M.A. and Shafei, A.M (2002) Salt tolerance in two wheat varieties and its relation to potassium nutrition. *Al-Azhar J. Agric. Res.* **35**, 115 -128.

Cottenie, A., Verloo, M., Kiekense, L., Velghe, G. and Camerlynck, R. (1982) "*Chemical Analysis of Plants and Soils*". State Univ. of Gent, Belgium, Hand Book, 1– 63.

Duan, J., Li, J., Guo, S.R. and Kang, Y. (2008) Exogenous spermidine affects polyamine metabolism in salinity-stressed *Cucumis sativus* roots and enhances short-term salinity tolerance. *Journal of Plant Physiology*, In Press, Corrected Proof, Available online 19 February 2008.

El-Bassiouny, Hala M.S. and Bekheta, M.A. (2001) Role of putrescine on growth regulation of stomatal aperture, ionic contents and yield by two wheat cultivars under salinity stress. *Egypt. J. Physiol. Sci.* **25**, 239-258.

Hassanein, M.S. (2001) Effect of variety and nitrogen levels on growth, yield and yield components of wheat (*Triticum aestivum L.*) in newely cultivated land. *Egypt J. Agron.* **23**, 111–131.

Hu, Y.S., Schmidhalter, U., Horest, W.J., Schack, M.K., Burket, A., Gassen, N., Flessa, H., Frommer, W.B., Gadbach, H., Ofs, H.W. and Romheld, A.J. (2001) Response of leaf elongation and nutrient status in growing leaves of wheat to salinity. *Proc. 4th Inter. Plant Nutr*, Collequium, Hanover, Germany, pp. 380 – 381.

Hussein, M.M., Abd El-Kadier, A.A.,Abo El Kheir, M.S. and Kassab, O.M. (2006) Effects of diluted sea water and benzyl adenine on macro and micronutrients content of barley shoots. *Egypt. J. Agron.* **28** (2), 47-56.

Hussein, M.M., Abd El-Kadier, A.A., El-Kady, A.K. and Abo Youssef, R.A. (2007) Effect of salinity and supplementary phosphorus and potassium on growth yield nutrients development and anatomical structure of sorghum plants. *Egypt. Soc. Soil Sci., 8th Conf.* Oct., 23- 26, 2007. Cairo.

Irshad, M., Honna, T., Eneji, A.E. and Yamamoto, S. (2002) Wheat response to nitrogen source under saline conditions. *Journal of Plant Nutrition*. **25** (12), 2603-2612.

Gieve, C.M. and Poss, J.A. (2000) Wheat response to interactive effects of boron and salinity. *J. of Plant Nutrition*, **23** (9), 1217.

Gunes, A., Inal, A., Alpaslan, M., Eraslan, F. and Bagci, E.G. (2008) Salicylic acid induced changes on some physiological parameters symptomatic for oxidative stress and mineral nutrition in maize (*Zea mays* L.) grown under salinity *J. of Plant Physiol.* **164** (6), 728-736.

Heikal, M.M. (1977) Physiological studies on salinity. VI: Changes in water content and mineral composition of some plants over a range of salinity stresses, *Plant and Soil*, **48** (1), 223 - 232.

Khatkar, D., Kuhad, M.S. and Khatkar, D. (2000) Stage sensitivity of wheat cultivars to short term salinity stress. *Indian J. Plant Physiol.* **5** (1), 26 - 31.

Khalil, S.M. (2006) Physiological studies on sesame plants grown under saline water irrigation conditions. *Ph.D. Thesis*. Faculty of Sci., Cairo Univ., Cairo. Egypt.

Kheir, N.F., Harb, E.Z., Moursy, H.A. and El-Gayar, S.H. (1991) Effect of salinity and fertilization of flax plants (*Linum usitatissimum* L.) Ii- Chemical composition. *Bull. Fac. of Agric, Cairo Univ.* **42**(10). 57–70.

López, M., Herrera-Cervera, J.A., Iribarne, C., Tejera, N.A. and Lluch, C. (2008) Growth and nitrogen fixation in *Lotus japonicus* and *Medicago truncatula* under NaCl stress: Nodule carbon metabolism *Journal of Plant Physiology*, **165** (6), 641-650.

Navarro, A., Bañón, S., Conejero, W. and Sánchez-Blanco, M.J. (2008) Ornamental characters, ion accumulation and water status in *Arbutus unedo* seedlings irrigated with saline water and subsequent relief and transplanting. *Environmental and Experimental Botany*, **62** (3), 364-370.

Patel, A.D. and Pandey, A.N. (2007) Effect of soil salinity on growth, water status and nutrient accumulation in seedlings of *Cassia montana* (Fabaceae) *Journal of Arid Environments*, **70** (1). 174-182.

Poustini, K. and Siosemardeh, A. (2004) Ion distribution in wheat cultivars in response to salinity stress. *Field Crop Research*, **85**. 125 -- 133.

Rajpar, R. and Sail, N.B. (2002) Effect of hydroponic salinity (120 md/m-3 NaCl) on the ion uptake and growth of different wheat varieties. *Pakistan J. Appl. Sci.* **2**(5), 541–545.

Rehan, M.G., El-Sayed, H., Segan, A.M. and El-Kholy, M.H. (2002) Response of wheat to K fertilization under irrigation with drainage water. *Egypt. Soil Sci. Soc., 8th Confer.*, Oct., 23–28. 2007, Cairo.

Rejili, M., Vadel, A.M., Guetet, A. and Neffatti, M. (2007) Effect of NaCl on the growth and the ionic balance K^+/Na^+ of two populations of *Lotus creticus* (L.) (Papilionaceae). *South African Journal of Botany*, 73 (4). 623-631

Salama, Zeinab A., Fawzi, A.A. and Ghanem, S.A. (2000) Growth, nutrient uptake and antioxidant levels in salinized wheat plants. *Egypt J. Physiol.Sci.* **24** (1), 129 - 148.

Sairam, P.K., Srivistava, G.C., Agaral, S. and Meena, R.C. (2005) Differences in antioxidant activity in response to salinity stress in tolerant and susceptible wheat genotypes. *Biologia Plantarum*, **49** (1). 85 – 91.

Sharaan, A.N., Abd El-Samie, F.S. and Abd El-Gawad, I.A. (2000) Response of wheat varieties (*Triticum aestivum* L.) to some environmental influences. II: Effect of planting date and drought at different plant stages on yield and its componemts . *Porc. of the Ninth Conf. of Agronomy*. Minufiya Univ. pp. 1-15.

Shauhan, C.P, Sing, R.B. and Gupta, S.K. (2008) Supplemental irrigation of wheat with saline water. *Agric. Water Manag.* **95**. 253 –258.

Slama, I., Ghnaya, T., Savouré, A. and Abdelly, C. (2008) Combined effects of long-term salinity and soil drying on growth, water relations, nutrient status and proline accumulation of *Sesuvium portulacastrum*. *Comptes Rendus Biologies* (In Press) Corrected Proof, Available online 23 April 2008

Shaviv, A. and Hagin (1993) Interaction of salinity and enhanced ammonium and potassium nutrition in wheat. *Plant and Soil*, **154** (1), 133-137.

Singh, A.K., Vijay-Prakash, Sastry, E.V. and Parkash, V. (2000) Variation in seedling growth parameters in wheat under normal and saline environments. *Indian J. Agric. Res.* **34** (3), 185 – 187.

Snedecor, G.W. and Cochran, W.G. (1980) "*Statistical Methods*". 7^{th} ed. Iowa State Univ, Iowa, USA.

Szegletas, Z.S., Erden, L.A., Tori, J. and Cseuz, L. (2000) Accumulation of osmoprolectants in wheat cultivars of drought tolerance. *Cereal Res. Communications*, **28** (4), 403 – 410.

Tuna, A.L., Kaya, C., Dikilitas, M. and Higgs, D. (2008) The combined effects of gibberellic acid and salinity on some antioxidant enzyme activities, plant growth parameters and nutritional status in maize. *Environmental and Experimental Botany*, **62** (1) , 1-9.

Zhang, K., Yang, X. and Zhang, M. (2003) Salt tolerant and high yield winter wheat cultivar-dekang 961.*Bull. Agric. Sci. Technol.* **12**, 39.

Zheng, Y., Wang, Z., Sun, X., Jia, A., Jiang, G. and Li, Z. (2008) Higher salinity tolerance cultivars of winter wheat relieved senescence at reproductive stage. *Environ. & Exper. Bot.* **62**, 129 – 138.

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تأثير الري بماء البحر المخفف على النمو وبعض العناصر الغذائيه الكبرى لأصناف القمح المختلفة

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اجريت تجربة أصص في صوبة المركز االقومى للبحوث –الدقى – خلال الموسم الشتوى ٢٠٠٦/٢٠٠٧ لتقييم بعض اصناف القمح (جميزة٩، سخا ٦٩ ، جميزة ٧، جيزة ١٦٨ و سخا ٩٣) تحت درجات من الأجهاد الملحى بتخفيف مياه البحر(ماء الصنبور ٢٥٠، ٢٠٠٠ ، ٤٠٠٠ جزء فى المليون) وذلك على النمو والمحصول .وأوضحت النتائج ما يلى :

- تفوق صنف جميزة ٩ فى مساحة ورقة العلم ووزن الحبوب الجاف يلية جيزة ١٦٨ بينما كانت اقل الأصناف لهذه الصفة سخا ٦٩ ، سخا ٩٣ . ولم تكن هناك أى فروق معنوية بين الأصناف بالنسبة لعدد الأوراق وطول السنبلة .كذلك لا يوجد أى تباين بين الأصناف فى تركيز النيتروجين وكان هناك اختلاف قليل فى تركيز الفسفور وتباين كبير فى تركيز البوتاسيوم خاصة بين جميزة ٧، جميزة ٩ وسخا ٦٩ من جهة وجيزة ١٦٨و سخا ٩٣ من جهة اخرى .

- أدى زيادة تركيز الأملاح فى مياه الرى إلى نقص ارتفاع النبات ، مساحة ورقة العلم وكذلك طول السنبلة ولم تكن هناك أى فروق معنوية لعدد الأوراق الخضراء بالنسبة للساق الرئيسى .

- امتصاص النيتروجين والفسفور والبوتاسيوم كان له استجابة سلبية بزيادة تركيز الأملاح فى مياه الرى .