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GROWTH AND NUTRIENT CONTENT OF SOME WHEAT AND BARELY GENOTYPES IRRIGATED WITH SALINE WATER IN SANDY CALCAREOUS SOIL

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Abstract: A completely randomized design pot experiment with four replications was used to assess the effects of six salinity levels of irrigation water on growth parameters (plant height and fresh and dry weight) and elemental composition of two genotypes of wheat (*Triticum sativum*) and two of barley (*Hordeum vulgare*) under greenhouse conditions. Seeds of genotypes under study are collected from the Plant Materials Center, Arizona, USA. Saline irrigation water was artificially prepared using a mixture of NaCl and $CaCl_2$ salts. The levels of salinity were 500, 1000, 1500, and 2000 mg/l. The fifth treatment was the irrigation with ground water having a salinity level; of 3430 mg /l. The control treatment was the fresh water of 390 mg/l. Seeds of the two genotypes of wheat ("A" and "B") and the two genotypes of barley ("C" and "D") were sown in a sandy calcareous soil. Plant growth parameters and mineral concentrations were determined after 12 weeks from planting.

The obtained results showed a negative relationship between plant growth and the irrigation water salinity. Increasing the irrigation water salinity level led to a significant reduction in N and P uptake but an increase in K uptake by plants. Iron, Mn, Cu and Zn uptake were significantly decreased in all genotypes of barley and wheat. Barley plants is more able to grow than wheat plants under the similar conditions. The barley genotype D had a great ability to build up more dry matter in their tissue under such unfavorable conditions. This barley genotype is relatively more tolerant to saline conditions than wheat genotypes and could be recommended to grow on the sandy calcareous soils.

Key words: saline water, wheat , barley, genotypes

Introduction

In arid and semi-arid regions, saline waters may provide a valuable water source for the irrigation of selected crops as water quality and quantity become limited and as a demand for quality water increases. In recent years, competition for fresh water has increased between agricultural and urban users due to population growth in many regions (Parsons, 2000).Most of the problems that face the agriculture in these regions are the salinity of irrigation water as well as water shortage. Most of the Egyptian lands for which the Nile water is not available lie in the western and eastern deserts. Therefore, other water resources for irrigation demands must be used or looked for.

Egyptian agronomists are facing several problems during cultivating the newly reclaimed soils, such as water deficit and water salinity as well as soils of high content of soluble salts. Consequently, it would be promising if these soils could be cultivated by glucophytes, especially the suitable cultivars of wheat and barley which have good performance with less damage and high productivity under these conditions.

Wheat is one of the most widely cultivated and important cereal crops in Egypt, and considered the main source of food. Since the national production is not sufficient to meet the annual food demand, it is very important to increase the annual wheat production. Barley is another cereal crop which is grown for green forage, feeding animals and Arabian tribes and malt in the brewing industry. Salinity limits the growth and distribution of natural vegetation and yield of cultivated plants more than other environmental factors (Selim and El-Gamal,2004).

The purpose of this investigation was to determine the productivity of some American genotypes of wheat and barley under Egyptian conditions when grown on sandy calcareous soil and irrigated with saline waters.

Materials and Methods

pot experiment was carried out in the greenhouse at the experimental farm, Faculty of Agriculture at Qena, South Valley University, during the winter season of 2002/2003to study the effect of saline irrigation water on the growth, yield and nutrient uptake by two genotypes of wheat and two genotypes of barley. The experimental design was completely randomized, including six levels of saline irrigation water and four genotypes (two of wheat and two of barley) with four replications. The six salinity levels of irrigation water used, were fresh water (390 mg/l) as a control, 500, 1000, 1500, and 2000 mg/l. as well as ground water having 3430 mg/l. Treatments 2-5, were artificially prepared using a mixture of NaCl and $CaCl_2$ salts of a 2:1 molecular weight ratio.. Analysis of fresh water and ground water are shown in Table 1. Wheat genotypes were no. 322279 as genotype A and no. 322280 as genotype B, while barley genotypes, were no 452422 as genotype C and no. 508552 as genotype D. Wheat and barley genotypes were brought from, the Plant Material Center, Arizona USA to be tested under Egyptian conditions.

The soil material used in this experiment was collected from the surface layer (0-30 cm) of the experimental farm, Faculty of Agriculture at Qena South Valley University. The soil material that passed through 2 mm sieve was placed in plastic pots of 15 cm depth and 20 cm diameter. Each pot contained 5 kg soil material and twenty seeds of each cultivar per pot were planted. After germination, seedlings in each pot were thinned to 10 plants/pot. Soil moisture was maintained at the field capacity during the course of the experiment. Irrigation was applied every 5 to 7 days. Nitrogen was applied to each pot as ammonium nitrate (33.5%) at a level of 300 kg /fed in two equal doses. The two doses were applied four and eight weeks after planting, respectively. Superphsphate fertilizer (15.5 P_2O_5%) was added to each pot at a level of 100 kg/fed., and potassium was applied to each pot as potassium sulfate (48 % K_2O) at a level of 100 kg/fed. Superphsphate and potassium sulfate were applied before planting, during the soil preparation. After 12 weeks from planting plants were harvested. At harvest, height and fresh and dry weight of the plants in each pot were recorded. The soil material used had a sandy texture with 86.2% sand, 8.6% silt and 5.2% clay, 12% calcium carbonate, pH of 7.9 and 0.12% organic matter, 0.02% total N, 6.4 ppm available P. The soil water content at saturation and field capacity were 22.1 and 14.5% (v/v), respectively.

Table(1): Analysis of fresh water and ground water used in the study.

Irrigation Water Type	EC (dS/m)	TDS (mg/l)	pH	Soluble cations (mmol/l)				Soluble anions (mmol/l)				SAR
				Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	CO_3^{2-}	HCO_3	Cl^{-}	SO_4	
Fresh water	0.61	390	7.20	1.55	0.65	1.5	0.22	Nil	1.4	2.8	1.0	1.0
Ground water	5.36	3430	7.56	2.3	3.5	41.0	1.4	Nil	6.5	36.0	5.5	17.1

Plant analysis

The plants were washed with distilled water, oven-dried at 70 °C and ground by mill. Three subsamples of plant tissues were analyzed. Total nitrogen was determined by kjeldahl method (Jakson, 1967), Phosphorus content estimated by the chlorostannous molybdophosphoric blue colour method in sulphoric acid system (Page et al.,1982). Concentrations of Fe, Cu, Mn and Zn were determined by atomic absorption spectroscopy and Ca, Na, K were determined by the flame photometer after triacid (HNO_3:H_2SO_4:$HCLO_4$ of the ratio of 10:1:4) digestion. Data were statistically analyzed using procedures described in Steel and Torrie (1960). Means were compared using the least significant difference (LSD) test at the 0.05 level of confidence.

Results and discussions

Plant growth

The salinity levels of irrigation water caused reductions in the studied growth parameters of wheat and barley plants. The lowest salinity level (500 mg/l) caused a significant reductions of 10.6 and 7.05 % in the fresh weight, 18.7and 5.70 % in the dry weight and 6.9 and 6.50 % in plant height of wheat and barley plants respectively, compared with the control. Meanwhile, irrigation with saline water of 3400 mg/l (ground water) caused a significant reductions of wheat and barley plants of 42.4 and 34.5% in the fresh weight, 47.9 and 37.0 % in the dry weight and 28.5 and 29.5% in the plant height (Figure 1). These results are in agreement with those obtained by (Shazia, 2001; Badr and Shafei 2002; Abd Allah et al. 2003 and Selim and El Gamal, 2004).

In general, salinity can reduce the plant growth or damage the plants through a) osmotic effect (causing water deficit),(b) toxic effects of ions, and (c) imbalance of the uptake of essential nutrients. These modes of action may operate on the cellular and influence all the aspects of plant metabolism (Shazia, 2001; Ashrafuzzaman et al.2003).

The differences among the mean values of fresh weight, dry weight and plant height of both studied wheat genotypes were not significant (Table 2). Using fresh irrigation water, higher values of the fresh weight, dry weight and plant height were recorded for genotype B compared with those of genotype A. Moreover, under the highest salinity level of irrigation water, genotype B had higher values of the fresh weight, dry weight and plant height than genotype A. This superiority means that genotype B has a great ability to build up more dry matter in its tissues under such unfavourable conditions. (Saleh et al. 1997; Hu and Schmidhlter ,1997; Shazia, 2001; El-Sodany, 2004)

The results in Table 2 indicate also that the interaction between salinity and wheat genotype was significant for all studied growth characters. The highest values of the fresh weight, dry weight and plant height were recorded for genotype B that was irrigated by fresh water. However, the lowest values of the fresh weight and plant height were found for genotype B that was irrigated by the saline ground water. Meanwhile, the lowest values of the dry weight was shown for genotype A that was irrigated by ground water. The fresh weight, dry weight and plant height for both wheat genotypes were decreased with increasing the saline irrigation water level. The reductions for both genotypes were relatively higher in the dry weight than in the fresh weight. The reductions in the three studied growth parameters for both genotypes at the highest salinity level of irrigation water did not exceed 50% of these parameters when the fresh water was used for irrigation. Salinity may affect different metabolic processes, such as CO_2 assimilation and protein synthesis. The salinity does not only change the physical and chemical characteristics of the soil but also adversely affect plant growth (Hassan et al., 1970 and Suhayda et al.,1992). The reductions in the plant height for genotype A using the saline irrigation water having 500, 1000, 1500, 2000, and 3430 mg/l were 7.8, 9.2, 11.8, 16.1 and 27.8%, respectively compared with 5.8, 14.1, 15.6, 20.6 and 40.3%, respectively, for genotype B. Meanwhile, the respective reductions in the fresh weight for genotype A were 3.0, 11.1, 15.6, 19.8 and 40.8% and for genotype B were 17.5, 34.6, 35.2, 37.7 and 43.9%. Moreover, genotype A had respective reductions in the dry weight of 15.5, 17.1, 21.6, 41.0 and 49.1% but for genotype B, values were 21.3, 42.1, 45.6, 46.0 and 46.9% .These results are in the same line with those recorded by Nadia (2000), Noureldin et al. (2000) and Nassem, (2001).

The differences between the mean values of both studied genotypes of barley due to salinity were not significant for the fresh weight and plant height, while they were significant for dry weight (Table 3). Results showed that genotype D had higher mean values of the fresh weight, dry weight and plant height than those of genotype C. Under the use of fresh water, higher values of fresh weight, dry weight and plant height were recorded for genotype D compared with genotype C. However, using the highest salinity level of irrigation water, genotype D had also higher values of fresh weight, dry weight and plant height than genotype C. This superiority under such unfavorable conditions means that genotype D has a great ability to build up more dry matter in its tissues than genotype C. Therefore, genotype D could be considered more tolerant to saline conditions than genotype C. Khalifa and Rushdi (1980) showed that the dry matter production of barley cultivars was decreased with increasing soil salinity.

Table 3 also showed that the interaction between salinity and barley genotypes was significant for all studied growth characters. Highest values of fresh weight, dry weight and plant height were found for genotype D that was irrigated by fresh water. On the other hand, the lowest values of these respective parameters were recorded for genotype C that was watered by ground water. The fresh weight, dry weight and plant height of both studied barley genotypes were decreased with increasing the salinity level of irrigation water. The reduction in the dry weight of both genotypes was relatively higher than in the fresh weight (Fig. 2). The reductions in the plant height for genotype C due to the irrigation with saline water having 500, 1000, 1500, 2000, and 3430 mg/l were 4.7, 16.4, 24.7, 24.7 and 32.3%, respectively, compared with use of fresh water. The respective reductions for genotype D were 8.3, 15.3, 21.2, 21.2 and 27.0%. Meanwhile the respective reductions in the fresh weight for genotype C were 2.9, 6.2, 7.9, 11.7 and 34.2%, and for genotype D were 10.7, 21.5, 24.4, 24.6 and 34.8%. Moreover, genotype C showed respective reductions in the dry weight of 2.2, 5.0, 6.0, 9.7 and 42.9% but for genotype D the reductions were 8.4, 22.6, 22.6, 25.9 and 32.7%. Meanwhile, the relative value of the fresh weight, dry weight and plant height for both genotypes due to the irrigation with saline water were decreased due to increasing the salinity level of irrigation water.

Nutrient Contents

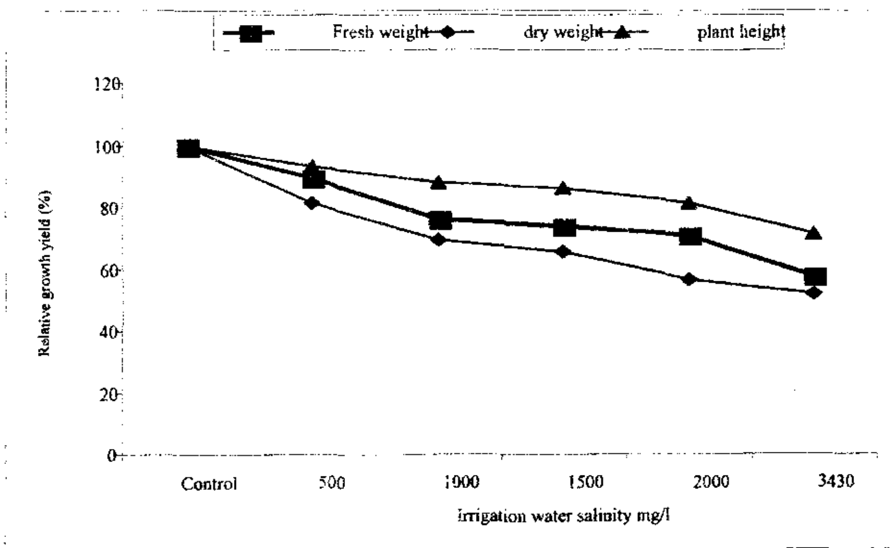
Nitrogen (N)

The uptake of N by wheat and barley plants was significantly decreased due to increasing the salinity level of irrigation water (Tables 4 and 5). A negative relationship was obtained between N content in plant tissues and the salt concentrations of irrigation water. The interaction effects of the salinity of irrigation water and genotypes on N uptake showed, a significant difference between the two genotypes. The highest values of N uptake (80.6 mg/pot) were recorded for genotype B of wheat irrigated by fresh water, while the lowest ones (19.4 mg/pot) was found for genotype A using the saline ground water (3430 mg/l). Moreover, highest values of N uptake (201.1 mg N/pot) were found for barley genotype D. It is obvious that wheat genotype B and barley genotype D tolerate more salinity and have more ability to absorb N under different salinity levels of irrigation water than wheat genotype A and barley genotype C that has lower N content. (Zein et al, 2002). The decrease in the nitrogen uptake may reflect the increasing in sodium chloride in irrigation water with increasing salinity. This led to increase chlorine uptake and accumulation is mostly accompanied by a decrease in shoot nitrate concentration (Mostafa (1995; Garg and Gupta, 1997; El-Garhi et al. 2003).

Table(2): Effect of salinity of irrigation water on the fresh weight, dry weight and plant height of wheat genotype plants

Salinity level (mg/l)	Fresh weight (g/pot)			Dry weight (g/pot)			Plant height (cm/plant)		
	Genotype A	Genotype B	Mean	Genotype A	Genotype B	Mean	Genotype A	Genotype B	Mean
Control	6.01*	6.76	6.39	4.44	5.20	4.82	51.0	53.3	52.2
500	5.83	5.58	5.71	3.75	4.09	3.92	47.0	50.2	48.6
1000	5.34	4.42	4.88	3.68	3.01	3.35	46.3	45.8	46.1
1500	5.07	4.38	4.73	3.48	2.83	3.16	45.0	45.0	45.0
2000	4.82	4.21	4.52	2.62	2.81	2.72	42.8	42.3	42.6
3430	3.56	3.79	3.68	2.26	2.76	2..51	36.8	31.8	37.3
Mean	5.11	4.86		3.37	3.45		44.8	45.7	
$LSD_{0.05}$									
SalinityS.	1.18			0.98			2.22		
GenotypeG	n.s.			n.s.			n.s.		
SXG	1.47			1.19			5.19		

- Each value represents the mean of 4 replications

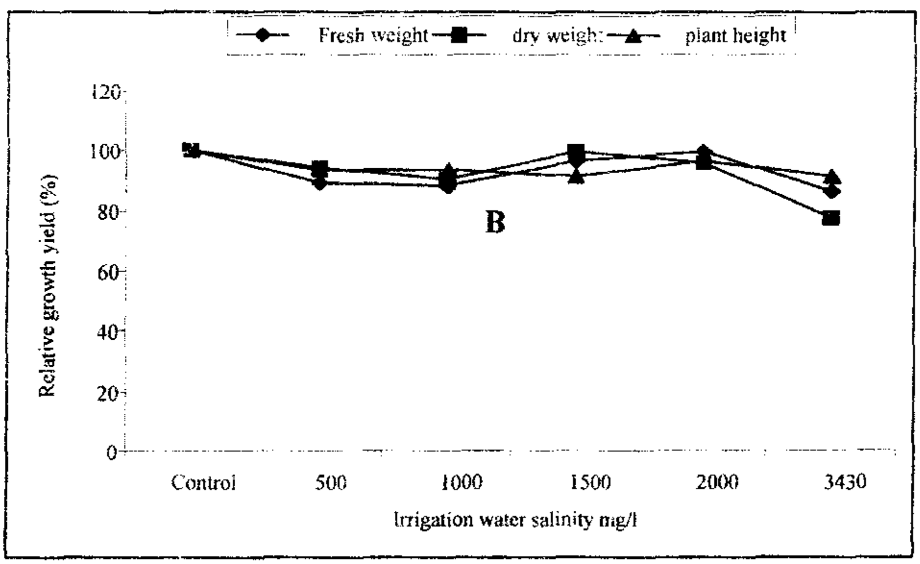


Figure(1): Mean effects of salinity of irrigation water on the relative reductions of the studied growth parameters of wheat plants

Table(3): Effect of salinity of irrigation water on the fresh weight, dry weight, and plant height of barley genotype plants.

Salinity level (mg/l)	Fresh weight (g/pot)			Dry weight (g/pot)			Plant height (cm/plant)		
	Genotype C	Genotype D	Mean	Genotype C	Genotype D	Mean	Genotype C	Genotype D	Mean
Control	12.63*	14.89	13.76	8.47	11.49	9.98	59.8	60.0	59.9
500	12.27	13.30	12.79	8.28	10.53	9.41	57.0	55.0	56.0
1000	11.85	11.69	11.77	8.05	8.89	8.47	50.0	50..8	52.5
1500	11.63	11.26	11.45	7.96	8.89	8.43	45.0	47.3	47.9
2000	11.15	11.23	11.19	7.65	8.51	8.08	45.0	47.3	46.2
3430	8.31	9.71	9.01	4.84	7.73	6.29	40.5	43.8	42.2
Mean	11.31	12.01		7.54	9.34		49.6	50.7	
$LSD_{0.05}$ SalinityS GenotypeG SxG	1.39 n.s 1.94			0.98 0.59 1.45			3.32 n.s 4.08		

- Each value represents the mean of 4 replications



Figure(2): Mean effects of salinity of irrigation water on the relative growth yield of the studied growth parameters of barley plants

Phosphorus (P):

The uptake of phosphorus by wheat and barley plants was significantly decreased due to increasing the salinity of irrigation water. Significant differences in P uptake were found between both wheat and barley genotypes (Tables 4 and 5). Genotype A showed higher values of P uptake (16.3 mg P /pot) than genotype B (14.1 mg P/pot) when irrigated with fresh water, In case of barley plants the genotype D had a higher P content than genotype C. The highest P content of wheat genotype A and barley genotype D may be associated with the ability of these genotypes to develop a strong root system necessary for absorption of P (Abou-Zeid et al., 1999). Wheat genotype B and barley genotype C were much more adversely affected by water salinity than genotype Wheat genotype A and barley genotype D. These results are in an agreement with those of Soliman et al. (1994). The interaction between salinity and P is very complex and there is no clear cut mechanistic explanation for decreased P uptake in response to salinity of irrigation water in different plant species. However, it is known that P uptake is related to the rate of photosynthesis. Meanwhile, decrease of P in leaves decreases the conversion of fixed carbon into starch and will reduce shoot growth, (Grattan and Grieve, 1992 and Hag et al. 2003).

Potassium (K):

Unlike N and P; K uptake by wheat and barley plants significantly increased with increasing the salinity level of irrigation water (Tables 4 and 5). Concentrations of K in wheat plants increased from 2.11% (using fresh water) to 4.24 % when the saline ground water (3430 mg/l) was used for irrigation. Moreover, in barley plants the mean values of K uptake were increased from 205.9 mg K/pot, with using the fresh water to 326.8 mg K/pot, when the highest level of saline irrigation water was used for irrigation. Significant differences in K uptake were found between both wheat and barley genotypes (Tables 4 and 5). Wheat genotype A and barley genotype C showed higher values of K uptake than wheat genotype B and barley genotype D. Increases of K uptake by plants due to the irrigation with saline water could be attributed to the release of this nutrient from the exchangeable form to the soil solution that becomes available for plants. The interaction effects of water salinity and wheat and barley genotypes on K concentrations were significant (Tables 4 and 5). Concentrations of K in each genotype was increased with increasing the salinity level of irrigation water (Nadia, 2000). However, under high saline conditions, it could be useful to apply additional K fertilizers to wheat and barley plants to overcome the effect of salinity (Sherif et al., 1998).

Table (4): Effect of salinity irrigation water on N, P, K uptake by the plants of wheat genotypes

Wheat genotype	Saline water (mg/l)						
	Control	500	1000	1500	2000	3430	Mean
	N (mg /pot)						
A	*64.4	49.9	46.0	43.5	26.7	19.4	41.6
B	80.6	59.3	39.7	37.1	36.3	33.6	47.8
Mean	72.5	54.6	54.6	40.3	31.5	26.5	
L.S.D $_{0.05}$	**S =10.3		***G= 5.8			SxG =105	
	P (mg /pot)						
A	16.3	10.8	10.4	9.6	7.1	6.1	10.0
B	14.1	10.9	7.8	7.2	6.8	5.8	8.8
Mean	15.2	10.9	9.1	8.4	7.0	6.0	
L.S.D $_{0.05}$	S =4.1		G= 1.4			SxG =10.1	
	K (mg /pot)						
A	99.9	106.1	124.8	122.8	104.8	101.3	110
B	102.4	81.4	84.6	99.1	102.3	109.5	96.5
Mean	101.2	93.8	104.7	111.0	103.5	105.4	
L.S.D $_{0.05}$	S = 0.192		G= 0.12			SxG =8.6	

- Each value represents the mean of 4 replications, **S salinity level', ***G genotype

Table (5): Effect of salinity of irrigation water on N, P, K uptake by the plants of barley genotypes

Barley genotype	Saline water (mg/l)						
	Control	500	1000	1500	2000	3430	Mean
	N (mg/pot)						
C	143.1*	125.0	115.9	112.2	101.8	44.5	107.1
D	201.1	169.5	126.2	119.1	111.5	97.4	137.5
Mean	172.1	147.3	121.1	115.7	106.6	71.0	
L.S.D $_{0.05}$	**S = 5.3		***G= 21.4			SxG= 6.5	
	P (mg/pot)						
C	23..6	18.7	18.1	17.5	16.3	9.4	17.3
D	51.6	44.3	29.0	25.4	20.4	14.1	30.8
Mean	37.6	31.5	23.5	21.5	18.4	11.8	
L.S.D $_{0.05}$	S = 2.1		G= 12.6			SxG= 3.1	
	K (mg/pot)						
C	192.3	207.0	272.9	305.7	311.4	352.8	273.7
D	219.5	259.0	279.1	325.4	327.6	327.8	289.7
Mean	205.9	233.0	276.0	315.5	319.5	326.8	
L.S.D $_{0.05}$	S = 1.1		G= 15.8			SxG= 50.4	

- Each value represents the mean of 4 replications, **S salinity level, ***G genotype

Micronutrients (Fe, Mn, Zn and Cu):

There was a significant reduction in the uptake of Fe in wheat and barley plants in response to the increase of salt concentration. Concentrations of Mn did not change significantly in barley plant while it was significantly declined in wheat plants in response to increasing the salt stress. There was a gradual decline in Cu content of plants in response to water salinity. A negative relationship was obtained between soil salinity and concentration of Zn (Saleh et al., 2002). The interaction effect of salinity level of irrigation water and wheat and barley genotypes showed that wheat genotype A and barley genotype D had higher values of Fe, Mn ,Zn and Cu uptake than wheat genotype B and barley genotype C (Tables 6 and 7).

It is difficult to suggest mechanistic explanations of salinity influence on micro-nutrients uptake due to the relatively smaller differences between control and plants irrigated by saline water and the non-linear relationships between the content of micronutrients in plant tissues and irrigation water salinity .

Table (6): Effect of salinity of irrigation water on Fe, Mn, Zn and Cu uptake by the plants of wheat genotypes

Wheat genotype	Saline water (mg/l)						
	Control	500	1000	1500	2000	3430	Mean
			Fe (mg/pot)				
A	3.97	2.97	2.51	2.28	1.65	1.28	2.44
B	4.78	3.22	2.31	1.86	1.76	1.37	2.55
Mean	4.38	3.09	2.41	2.07	1.71	1.33	
L.S.D $_{0.05}$	S = 0.23		G= 0.10			SxG =0.12	
			Mn (ug/pot)				
A	1343	966	765	510	365	239	698
B	1284	943	649	303	29]3	266	623
Mean	1314	954	707	406	329	253	
L.S.D $_{0.05}$	S = 9		G= 70			SxG =15	
			Zn (ug/pot)				
A	997	827	702	681	493	409	690
B	1124	803	656	587	478	444	647
Mean	1061	815	656	587	485	427	
LSD $_{0.05}$	S= 72		G= 33			SxG =24	
			Cu (ug/pot)				
A	306	177	168	118	52	18	140
B	333	214	100	80	56	42	137
Mean	319	196	134	99	54	30	
L.S.D $_{0.05}$	S = 5		G= 2			SxG =6	

Table (7): Effect of salinity of irrigation water on Fe, Mn, Zn and Cu uptake by the plants of barley genotypes

Barley genotype	Saline water (mg/l)						
	Control	500	1000	1500	2000	3430	Mean
	Fe (mg/pot)						
A	7.28	6.63	5.63	5.56	4.83	2.96	4.99
B	11.32	9.68	7.43	7.11	6.62	5.69	7.98
Mean	9.30	8.16	6.53	6.34	5.73	4.33	
L.S.D 0.05	S = 0.15		G= 1.99				SxG = 0.45
	Mn (ug/ pot)						
A	1067	994	942	900	861	465	872
B	1390	1164	978	945	902	783	1027
Mean	1229	1079	960	923	882	624	
L.S.D 0.05	S = 130		G= 119				SxG= 42
	Zn (ug/pot)						
A	1144	1071	966	907	757	416	877
B	1383	1222	934	749	715	417	903
Mean	1264	1147	950	828	736	417	
LSD0.05	S =115		G = n.s			SxG= 31	
	Cu (ug/pot)						
A	334	319	292	255	199	121	253
B	459	400	194	294	239	186	312
Mean	396	360	293	275	219	154	
L.S.D 0.05	S = 20		G= 51				SxG= 13

In conclusion,

First: the primary results indicated the ability of the studied wheat and barley genotypes to grow with the irrigation by saline ground water under a similar experimental conditions.

Second: the large-scale and field application of the findings of our research, is necessary to proof final gaudies for the studied new USA genotypes of wheat and barley.

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النمو والمحتوى العنصرى لبعض أصناف القمح والشعير النامية فى تربة رملية جيرية وتروي بمياه مالحة

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تـم إجـراء تجربة أصص في تربة رملية جيرية بصوبة مزرعة كلية الزراعة جامعة جنوب الوادي بقـنا لدراسـة تأثـير الري بمستويات مختلفة من المياه المالحة علي النمو الخضري والمادة الجافة وعلي تركيز العناصر الغذائية لصنفين من القمح (B،A) وصنفين من الشعير (D،C)- تم احضارهما من ولاية اريـزونا بالولايـات المتحدة الامريكية. ولقد استخدام ٦ مستويات ملحية من مياه ري محضرة باستخدام خليط من ملحي كلوريد الصوديوم و كلوريد الكالسيوم. والمستويات المستخدمة في هذه التجربة هي: مياه عذبـة (٣٩٠ مللـيجرام /لتر معاملة الكنترول) ، ٥٠٠، ١٠٠٠، ١٥٠٠، ٢٠٠٠ ،(٣٤٣٠ مللیجرام/لتر- مياه جوفيه).

ويمكن تلخيص النتائج المتحصل عليها كما يلي :

١- أدي الـري بالمياه المالحة إلي انخفاض كلا من الوزن الطازج والجاف وطول النبات لكل من صنفي القمـح والشعير وقد ازداد الانخفاض في كل من الوزن الطازج والجاف وطول النباتات مقارنة بالكنترول بـزيادة مستويات ملوحة مياه الري من ٥٠٠ إلى ٣٤٣٠ مللیجرام/لتر. كما أظهرت نباتات القمح والشعير التي تم ريها بالمياه الجوفية (٣٤٣٠ مللیجرام/لتر) أقل قيم لهذه القياسات.

٢- أعطـي صـنف القمـح B أعلي قيم لكل من الوزن الطازج والجاف وطول النباتات مما يوضح أن الصـنف B له قـدرة عالية علي تكوين المادة الجافة في أنسجته تحت هذه الظروف وبالتالى القدرة علي تحمل الملوحة عن الصنف A.

٣- أعطـي صنف الشعير D اعلي قيم لمتوسطات كل من الوزن الطازج والجاف وطول النباتات مما يدل على أنه يفوق الصنف C في قدرته علي تكوين المادة الجافة في أنسجته وبالتالي علي تحمله للملحية.

٤- توجـد فـروق معـنوية لكـل الصفات المختبرة نتيجة للتفاعل بين مستويات الملوحة وأصناف القمح والشـعير. فنجد أن صنف القمح B وصنف الشعير D قد أعطيا أعلي قيم لكل من الوزن الطازج والجاف وطول النباتات كما أن هذه الانخفاضات في القياسات المدروسة عند مستويات الملوحة المرتفعة لمياه الري لا تصل إلي ٥٠%.

٥- انخفـض الممـتص من عنصري النيتروجين والفوسفور في أصناف القمح والشعير بزيادة مستويات ملوحـة مياه الري. وهذا الانخفاض ربما يعزي إلي ارتفاع الضغط الإسموزي لمحلول التربة الذي يعتبر العامل الأساسي في نقص امتصاص الماء وبالتالي العناصر.

٦- ازداد الممتص من عنصر البوتاسيوم بنباتات القمح والشعير معنويا بزيادة مستويات ملوحة مياه الري.

٧- أدت زيـادة مسـتويات الملوحة في مياه الري إلى انخفاض الممتص من العناصر الصغرى (الحديد والمنجنيز والزنك والنحاس) في كل من أصناف القمح والشعير.