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INFLUENCE OF WATER SALINITY ON CHEMICAL COMPOSITION OF FIVE WHEAT CULTIVARS

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ABSTRACT

A sand culture pot experiment was conducted under the wire proof-green house conditions to study the influence of irrigation water salinity on chemical composition of some Egyptian and Syrian wheat cultivars. Two Egyptian wheat cultivars, i.e. Sakha 8 (V_1) and Sakha 69 (V_2) and three Syrian wheat cultivars, i.e. Bohos 5 (V_3), Bohos 6 (V_4) and Sham 4 (V_5) were irrigated with Hogland solution in five water salinity levels; 0.4 (control treatment), 6.0, 8.0, 10.0 and 12.0 dS/m; S_1, S_2, S_3, S_4 and S_5, respectively.

The observed results can be summarized as follows:

* The chemical composition of wheat cultivars was affected by irrigation with different salinity levels and wheat cultivars.
* The greatest N concentration; crude protein and N content in grains were attained by Sham 4 under (S_1). While the lowest N contents in grains and straw tissues were found under high water salinity levels.
* The highest P concentration and P content in grain tissues were attained by Sakha 69 under (S_1) but the lowest were attained by Bohos 5 under S_4.,
* The highest K concentration and K content in grain tissues were found in Bohos 5 under (S_1). While the lowest values in grains, straw and root tissues were attained by Sakha 8 under S_5, Sakha 69 under S_5, and Sakha 8 under S_4, respectively.
* The highest K:Na ratio in root and shoot tissues were obtained by Bohos 5 under (S_1) and Bohos 6 under S_4, respectively. Substantial decrease in K:Na ratio in root tissues was found with increasing water salinity levels.
* With the exception of Fe, trace elements studied accumulated to substantially higher concentrations in grain than in straw and root tissues and lies within the normal range.
* In general the results indicated that Sham 4 cultivar (Syrian cultivar) gave the maximum values of N concentration and crude protein in grains and this increased the nutritional value of wheat cultivar under the experiment conditions.

Keywords: Wheat cultivars, salt tolerance, salinity, water salinity.

INTRODUCTION

Irrigation has already played a major role in increasing food production over the past fifty years. Water availability for irrigation could be enhanced through judicious and proper use of saline water and the recycling of drainage waters for irrigation where considerable amounts of such water are available in various places in the world, including Egypt and other countries. Egypt started to look to waste water reuse for irrigation and crop production in order to cover the shortage of fresh water and meet their demands for more food production. About 7.7 BCM of drainage water are expected to be used for irrigation in the Delta by the year 2000, Abou-Zeid (1995). This water contains more of soluble salts which can affect plant growth. The management of saline irrigation waters require a good understanding of crop-salinity relations and particularly under field conditions. Wheat was chosen for this study because of wheat bread is the main diet for the Egyptian population. Mass (1986) stated that wheat is a tolerant crop to salt concentration.

The objective of the present investigation was to evaluate the effect of irrigation water with different salinity levels on chemical composition of five wheat cultivars.

MATERIALS AND METHODS

A pot experiment was carried out under wire proof-green house conditions, at Sakha Agricultural Research Station. The experiment was carried out under free drainage condition in plastic pots of 40 cm diameter x 40 cm height. Pots were packed with sand washed with tap water until salinity in the drainage water attained that of the tap water. Five wheat cultivars were tested; two Egyptian cultivars, i.e. Sakha 8 (V_1) and Sakha 69 (V_2) and three Syrian cultivars; i.e. Bohos 5 (V_3), Bohos 6 (V_4) and Sham 4 (V_5). Hogland solution prepared (Table 1) in the five water salinity levels using NaCl + $CaCl_2$ to attain 6 SAR for each saline levels 0.4 (S_1), 6.0 (S_2), 8.0 (S_3), 10.0 (S_4) and 12.0 dS/m (S_5) which were used as irrigation treatments. Pots were irrigated every 4 days for November, December, January and February after that irrigation was associated with air temperature. Grain, straw and root samples were taken at harvesting stage for chemical analysis and were dried in an oven at 70°C for 48 hours. The dried samples were ground, and then wet digested according to the method described by Jackson (1958). Total nitrogen percent in the digests was determined by using the micro kjeldahl method as described by Jackson (1958). Phosphorus was determined using the colorimetric method (Jackson, 1958). Potassium and sodium were determined by using a flame photometer (Jackson, 1958). Protein concentration; was calculated from total nitrogen percent in grains multiplied by 5.7 (Davidson, 1922). Iron, manganese, zinc and copper were determined using the Atomic Absorption Spectrometry (Berkin Elmer, 3300).

Data were subjected to statistical analysis according to Snedecor and Cochran (1982).

Prepare fresh solution of 0.5% ferric tartarate and added 1 cm^3 from it (two times every week) to each liter from nutritious solution.

Table (1): Hogland A and B solutions*.

Solution (A)		Solution (B)	
Salt	**Concentration**	**Salt**	**Concentration**
Calcium nitrate $Ca(NO_3)_2$	10 meq/L	Boric acid H_3BO_3	2.86 g/L
Potassium nitrate $K(NO_3)$	5 meq/L	Manganese chloride $MnCl_2.4H_2O$	1.81 g/L
Mono potassium phosphate KH_2PO_4	1 meq/L	Zinc sulphate $ZnSO_4.7H_2O$	0.22 gm/L
Magnesium sulphate $MgSO_4$	4 meq/L	Copper sulphate $CuSO_4.5H_2O$	0.08 g/L
		Molybdic acid $H_2MoO_4.H_2O$	0.02 g/L

*** Add ml from Hogland solution (B) to each liter from solution (A).**

RESULTS AND DISCUSSION

Nitrogen:

The obtained results in Table 2 show that N concentration in plant parts of wheat cultivars and crude protein percent in grains was affected by water salinity levels and wheat cultivars. The maximum N concentration value in grains of wheat cultivars 2.48% was found in Sham 4 under S_1. This may be due to increasing of plant ability for nitrogen absorption under low water salinity levels. N concentration in grains as affected by water salinity levels and wheat cultivars were in order Sham 4 > Bohos 6 > Bohos 5 > Sakha 8 > Sakha 69. These results indicate that a positive increase in N concentration and its utilization was observed with Sham 4 than the other wheat cultivars. The results also show that the highest N concentrations in straw 0.69% and root tissues 0.89% were obtained by Sakha 69 under S_2 and Sakha 8 under S_4, respectively. Whereas the lowest values in grain 0.74%, straw 0.28% and root tissues 0.28% were obtained by Sakha 69 under S_2, Sham 4 under S_1 and Bohos 6 under S_2, respectively. The observed reduction in N concentration in straw of Sham 4 was usually associated with an increase in N concentration in grains of wheat cultivar. While a considerable decrease in N concentration in grains of Sakha 69 was detected when the N concentration was increased in straw of wheat cultivar. This may be due to nitrogen taken up by plant roots is translocated in the xylem to the upper plant parts, the form in which N translocation occurs depends on the N uptake source and root metabolism. According to Martin (1970) nitrate-N can be translocated unaltered to shoots and leaves but this depends on the nitrate reduction potential of roots. The results also show that the highest percentage of crude protein in grains 14.14% was attained by Sham 4 at the low water salinity level the nutritional value of Sham 4 was therefore increased and this is an important point to the farmers.

The results in Table (3) show that N content in grain and straw tissues of wheat cultivars were significantly affected by water salinity levels and wheat cultivars, and the interaction S x V was significantly higher in grain than straw tissues. The greatest N contents in grains 1.02 g/pot and straw 0.72 g/pot were found in Sham 4 under S_1 and Sakha 69 under S_2, respectively. Whereas the lowest values in grains 0.20 g/pot and straw 0.22 g/pot were attained by Bohos 6 under S_5 and Bohos 5 under S_3, respectively. The results showed that an increase in N contents in grain and straw tissues were observed when water salinity level was decreased. While the lowest N contents in grains and straw tissues were found under high water salinity levels. This is because salinity may affect different metabolic processes, such as protein synthesis. Similar results were reported by Meiri and Shalhevet (1973) who found that saline conditions restrict the synthesis of cytokinins in the roots and their translocation to upper plant parts can also be inhibited. Helal and Mengel (1979) reported that lack of energy as a consequence of salinity may affect various energy requiring processes such as CO_2 assimilation, protein synthesis or the assimilation of inorganic N.

Table (2): Effect of different levels of saline water on the N concentration % in grains, straw, roots and crude protein percent in grains of five wheat cultivars.

Wheat varieties	Saline water dS/m					
	S_1 0.4	S_2 6.0	S_3 8.0	S_4 10.0	S_5 12.0	Mean
			Grains			
Sakha 8	1.08	1.25	1.26	0.89	1.08	1.11
Sakha 69	0.88	0.74	1.08	1.11	1.12	0.99
Bohos 5	1.15	1.13	1.08	1.26	1.12	1.15
Bohos 6	1.68	1.12	1.15	1.25	1.11	1.26
Sham 4	2.48	1.68	1.35	1.02	1.19	1.54
Mean	1.45	1.18	1.18	1.11	1.12	1.21
			Straw			
Sakha 8	0.46	0.49	0.35	0.42	0.35	0.42
Sakha 69	0.38	0.69	0.37	0.55	0.49	0.50
Bohos 5	0.39	0.41	0.35	0.31	0.52	0.40
Bohos 6	0.46	0.31	0.39	0.29	0.39	0.37
Sham 4	0.28	0.31	0.34	0.42	0.45	0.36
Mean	0.39	0.44	0.36	0.40	0.44	0.41
			Roots			
Sakha 8	0.74	0.70	0.77	0.89	0.56	0.73
Sakha 69	0.62	0.56	0.70	0.78	0.85	0.70
Bohos 5	0.46	0.49	0.45	0.42	0.31	0.43
Bohos 6	0.63	0.28	0.32	0.56	0.49	0.46
Sham 4	0.63	0.32	0.34	0.46	0.38	0.43
Mean	0.62	0.47	0.52	0.62	0.52	0.55
			Protein % in grains			
Sakha 8	6.16	7.13	7.18	5.07	6.16	6.34
Sakha 69	5.02	4.22	6.16	6.33	6.38	5.62
Bohos 5	6.56	6.44	6.16	7.18	6.38	6.54
Bohos 6	9.58	6.38	6.56	7.13	6.33	7.20
Sham 4	14.14	9.58	7.70	5.81	6.78	8.80
Mean	8.29	6.75	6.75	6.30	6.41	6.9

Table (3): Effect of different levels of saline water on N content in grains and straw of five wheat cultivars.

Wheat Cultivars	N content in grains (gm/pot)					
	Saline water dS/m					
	S_1	S_2	S_3	S_4	S_5	Mean
Sakha 8	0.54 c	0.69 a	0.60 a	0.38 b	0.43 a	0.53
Sakha 69	0.48 c	0.41 cd	0.55 a	0.52 a	0.47 a	0.48
Bohos 5	0.53 c	0.48 bc	0.33 b	0.38 b	0.21 b	0.38
Bohos 6	0.68 b	0.33 d	0.32 b	0.26 c	0.20 b	0.36
Sham 4	1.02 a	0.56 b	0.38 b	0.24 c	0.26 b	0.49
Mean	0.65	0.49	0.44	0.36	0.31	
	N content in straw (gm/pot)					
Sakha 8	0.44 a	0.48 b	0.27 b	0.33 b	0.24 b	0.35
Sakha 69	0.46 a	0.72 a	.0.56 a	0.49 a	0.39 a	0.53
Bohos 5	0.38 ab	0.34 c	0.22 b	0.26 b	0.27 b	0.29
Bohos 6	0.46 a	0.29 c	0.28 b	0.26 b	0.32 ab	0.32
Sham 4	0.30 b	0.30 c	0.28 b	0.35 b	0.32 ab	0.31
Mean	0.41	0.43	0.32	0.29	0.31	

Statistical analysis	S	V	S x V	S	V	S x V
LSD 5%	0.09	0.09	*	0.13	0.10	*
LSD 1%	0.12	0.12	**	0.19	0.14	**

In a column, means, followed by a common letter are not significantly different at the 5% level.

Phosphorus:

The results in Table (4) show that P concentration in wheat plant parts was affected by water salinity levels and wheat cultivars. The highest P concentrations in grain 0.55%, straw 0.26% and root tissues 0.20% were attained by Sakha 69 under S_1, Bohos 5 under S_4 and Sakha 8 under S_5, respectively. While the lowest P concentration in grain 0.30%, straw 0.03% and root tissues 0.07% were attained by Bohos 5 under S_5, Sakha 8 under S_5 and Sakha 69 and Sham 4 under S_3, respectively. P concentration as affected by water salinity levels and wheat cultivars were in order Sakha 69 > Sakha 8 > Bohos 5 > Bohos 6 > Sham 4.

The results in Table (5) show that P contents in grain and straw tissues of wheat were affected significantly by water salinity levels and wheat cultivars and the interaction S x V was significantly higher. The highest P content in grain 0.3 g/pot and straw tissues 0.25 g/pot were attained by Sakha 69 under S_1 and Bohos 5 and Bohos 6 under S_1, respectively. The lowest P content in grains 0.06 g/pot and straw 0.05 g/pot were attained by Bohos 5 under S_4. The results showed that an increase in P content in grain and straw tissues of wheat cultivars were observed under low salinity level. While the lowest P contents in grains and straw tissue were found under high water salinity levels. These results were supported by the data obtained by Barber and Thomas (1972) who found that the capability for active uptake of phosphate differs between plant species and may even differ between cultivars of the same species.

Table (4): Effect of different levels of saline water on P concentration (%) in grains, straw and roots of five wheat cultivars.

Wheat varieties	Saline water dS/m					
	S_1	S_2	S_3	S_4	S_5	Mean
			Grains			
Sakha 8	0.40	0.42	0.35	0.46	0.35	0.40
Sakha 69	0.55	0.33	0.35	0.43	0.40	0.41
Bohos 5	0.50	0.38	0.38	0.40	0.30	0.39
Bohos 6	0.39	0.38	0.40	0.38	0.37	0.38
Sham 4	0.40	0.38	0.31	0.35	0.38	0.36
Mean	0.45	0.38	0.36	0.40	0.36	0.39
			Straw			
Sakha 8	0.21	0.21	0.16	0.13	0.03	0.15
Sakha 69	0.17	0.19	0.15	0.21	0.18	0.18
Bohos 5	0.25	0.15	0.14	0.26	0.09	0.18
Bohos 6	0.25	0.23	0.24	0.19	0.13	0.21
Sham 4	0.20	0.13	0.22	0.16	0.18	0.18
Mean	0.22	0.18	0.18	0.19	0.12	0.18
			Roots			
Sakha 8	0.16	0.08	0.13	0.13	0.20	0.14
Sakha 69	0.13	0.11	0.07	0.17	0.10	0.12
Bohos 5	0.13	0.12	0.12	0.17	0.13	0.13
Bohos 6	0.19	0.09	0.08	0.10	0.12	0.12
Sham 4	0.13	0.09	0.07	0.15	0.09	0.11
Mean	0.15	0.10	0.09	0.14	0.13	0.12

Table (5): Effect of different levels of saline water on P content in grains and straw of five wheat cultivars.

Wheat Cultivars	P content in grains (gm/pot)					
	Saline water dS/m					
	S_1	S_2	S_3	S_4	S_5	Mean
Sakha 8	0.20 b	0.23 a	0.18 a	0.20 a	0.14 b	0.19
Sakha 69	0.30 a	0.18 b	0.18 a	0.20 a	0.17 a	0.21
Bohos 5	0.23 b	0.16 b	0.11 b	0.12 b	0.06 c	0.14
Bohos 6	0.16 c	0.11 c	0.11 b	0.08 c	0.07 c	0.11
Sham 4	0.16 c	0.13 c	0.09 b	0.09 c	0.08 c	0.11
	0.21	0.16	0.13	0.14	0.10	
	P content in straw (gm/pot)					
Sakha 8	0.20 a	0.21 a	0.12 bc	0.10 c	0.17 a	0.16
Sakha 69	0.21 a	0.20 a	0.12 bc	0.19 ab	0.15 ab	0.17
Bohos 5	0.25 a	0.13 b	0.08 c	0.22 a	0.05 c	0.15
Bohos 6	0.25 a	0.22 a	0.18 a	0.17 ab	0.11 b	0.19
Sham 4	0.22 a	0.12 b	0.18 a	0.13bc	0.13 ab	0.16
Mean	0.23	0.18	0.14	0.16	0.12	

Statistical analysis	S	V	S x V	S	V	S x V
LSD 5%	0.03	0.03	*	0.08	0.06	*
LSD 1%	0.04	0.04	**	0.11	0.08	**

In a column, means, followed by a common letter are not significantly different at the 5% level.

Potassium:

The results in Table (6) show that K concentration in grain and straw tissues were affected significantly by water salinity levels and wheat cultivars. The interaction S x V was significantly higher in grain tissues. Root tissues were not affected significantly. The highest K concentration in grain 0.72%, straw 3.75 and root tissues 0.70% were obtained by Bohos 5 under S_1 for grain and straw tissues and Sakha 8 under S_1 for root tissues. While the lowest values in grain 0.34%, straw 2.46% and root tissues 0.23% were attained by Sakha 8 under S_5, Sakha 69 under S_5 and Sakha 8 under S_4, respectively. The obtained results showed that an increase in K concentration in wheat plant parts were observed under low water salinity level. While the lowest values were found under high salinity levels. It is of important to note that the mean K concentration in straw is 6-fold higher than the mean value in grain and 8-fold higher than the mean value in root tissues. These data were supported by the data obtained by El-Yamani (1994) who found that K concentration in straw tissues was much higher than in grain tissues of wheat.

The results in Table (7) show that K contents in grain and straw tissues were affected significantly by water salinity levels and wheat cultivars. The interaction S x V was significantly higher in grain and had not in straw tissues. The highest K contents in grains 0.33 g/pot and straw 3.91 g/pot were obtained by Bohos 5 under S_1 and Sham 4 under S_1, respectively. While the lowest values in grain 0.08 g/pot and straw 1.39 g/pot were attained by Bohos 6, Sham 4 under S_5 for grain and Bohos 5 under S_5 for straw-tissues. K content in grain tissues as affected by water salinity levels and wheat cultivars were in order Sakha 69 > Sakha 8 > Bohos 5 > Sham 4 > Bohos 6. The obtained results showed that K contents in grain and straw tissues were much higher under low than high water salinity levels.

Table (6): Effect of different levels of saline water on K concentration (%) in grains, straw and roots of five wheat cultivars.

Wheat varieties	Saline water dS/m					
	S_1	S_2	S_3	S_4	S_5	Mean
Grains						
Sakha 8	0.43 c	0.49 b	0.52 a	0.47 ab	0.34 c	0.45
Sakha 69	0.57 b	0.47 b	0.52 a	0.35 c	0.44 b	0.47
Bohos 5	0.72 a	0.37 c	0.49 ab	0.54 a	0.55 a	0.54
Bohos 6	0.41 c	0.60 a	0.42 b	0.52 ab	0.45 b	0.48
Sham 4	0.56 b	0.47 b	0.43 ab	0.43 bc	0.41 bc	0.46
Mean	0.54	0.48	0.48	0.46	0.44	0.48
Straw						
Sakha 8	3.06 a	2.65 b	3.02 ab	2.81 a	2.78 a	2.86 bc
Sakha 69	3.16 a	3.16 ab	2.62 b	2.60 a	2.46 a	2.80 b
Bohos 5	0.75 a	2.57 b	2.95 ab	2.70 a	2.68 a	2.93 bc
Bohos 6	3.19 a	2.90 ab	3.40 a	3.24 a	3.06 a	3.16 ab
Sham 4	3.62 a	3.54 a	3.36 ab	2.94 a	3.19 a	3.33 a
Mean	3.36	2.97	3.07	2.86	2.83	3.02
Roots						
Sakha 8	0.70 a	0.34 a	0.27 a	0.23 a	0.25 a	0.36 a
Sakha 69	0.52 a	0.29 a	0.31 a	0.40 a	0.24 a	0.35 a
Bohos 5	0.58 a	0.30 a	0.39 a	0.27 a	0.30 a	0.37 a
Bohos 6	0.53a	0.31 a	0.28 a	0.27 a	0.28 a	0.33 a
Sham 4	0.54 a	0.29 a	0.32 a	0.34 a	0.29 a	0.36 a
Mean	0.58	0.31	0.32	0.30	0.27	0.35

In a column, means, followed by a common letter are not significantly different at the 5% level.

Table (7): Effect of different levels of saline water on K content in grains and straw of five wheat cultivars.

Wheat cultivars	K content in grains (gm/pot)					
	Saline water dS/m					
	S_1	S_2	S_3	S_4	S_5	Mean
Sakha 8	0.21 b	0.26 a	0.25 a	0.20 a	0.14 b	0.21
Sakha 69	0.31 a	0.26 a	0.26 a	0.16 a	0.18 a	0.23
Bohos 5	0.33 a	0.15 b	0.15 b	0.16 a	0.10 bc	0.18
Bohos 6	0.17 c	0.13 b	0.12 b	0.11 b	0.08 c	0.12
Sham 4	0.23 b	0.16 b	0.12 b	0.10 b	0.08 c	0.14
Mean	0.25	0.19	0.18	0.15	0.12	
	K content in straw (gm/pot)					
Sakha 8	2.94 b	2.60 ab	2.30 ab	2.20 a	1.91 ab	2.39 b
Sakha 69	3.85 a	3.33 a	2.19 ab	2.29 a	1.97 ab	2.73 a
Bohos 5	3.39 ab	2.14 b	1.85 b	2.24 a	1.39 b	2.20 b
Bohos 6	3.23 ab	2.72 ab	2.82 a	2.93 a	2.46 a	2.83 a
Sham 4	3.91 a	3.33 a	2.78 a	2.42 a	2.30 a	2.95 a
	3.46	2.82	2.39	2.42	2.01	

Statistical analysis	S	V	S x V	S	V	S x V
LSD 5%	0.05	0.05	*	0.96	0.73	ns
LSD 1%	0.06	0.06	**	1.34	0.97	ns

In a column, means, followed by a common letter are not significantly different at the 5% level.

Sodium:

The results in Table (8) show that Na concentration in grain of wheat cultivars was affected significantly by water salinity S_1 and was not affected by other water salinity levels. Na concentration in straw tissues of wheat cultivars was affected significantly by water salinity levels under S_2, S_4 and S_5 and root tissues under S_2, S_3 sand S_4. The highest Na Concentrations in grain 0.20%, straw 2.81% and root tissues 1.81 % were attained by Sakha 69 under S_1, Bohos 5 under S_5 and Bohos 5 under S_2 for grain, straw and root tissues, respectively. The lowest Na concentration in grain 0.06%, straw 0.54% and root tissues 0.58% were attained by Sakha 69 under S_5, Sakha 69 under S_1 and Bohos 5 under S_1 for grain, straw and root tissues, respectively. The obtained results showed that Na concentration in straw and root tissues were much higher than in grain tissues.

Table (8): Effect of different levels of saline water on Na concentration (%) in grains, straw and roots of five wheat cultivars.

Wheat varieties	Saline water dS/m					
	S_1	S_2	S_3	S_4	S_5	Mean
			Grains			
Sakha 8	0.09 ab	0.09 a	0.17 a	0.10 a	0.13 a	0.12 a
Sakha 69	0.20 a	0.08 a	0.17 a	0.10 a	0.06 a	0.12 a
Bohos 5	0.09 ab	0.07 a	0.09a	0.09 a	0.10 a	0.10 a
Bohos 6	0.07 b	0.11 a	0.07 a	0.08 a	0.07 a	0.08 a
Sham 4	0.07 b	0.09 a	0.10 a	0.12 a	0.12 a	0.10 a
Mean	0.10	0.09	0.12	0.10	0.10	0.10
			Straw			
Sakha 8	0.66 a	1.68 b	1.82 a	1.70 b	1.47 b	1.47 b
Sakha 69	0.54 a	1.98 ab	1.64 a	1.27 b	1.97 b	1.48 b
Bohos 5	1.06 a	2.43 a	2.12 a	2.68 a	2.81 a	2.22 a
Bohos 6	1.12 a	1.93 ab	1.63 a	1.71 b	1.86 b	1.64 b
Sham 4	0.57 a	1.97 ab	2.05 a	1.44 b	1.96 b	1.6 b
Mean	0.79	2.00	1.85	1.76	2.01	1.68
			Roots			
Sakha 8	0.71 a	0.98 b	1.08 b	1.20 b	1.51 a	1.10 b
Sakha 69	.0.65 a	1.01 b	1.45 ab	1.31 ab	1.46 a	1.19 b
Bohos 5	0.58 a	1.81 a	1.57 a	1.76 a	1.68 a	1.48 a
Bohos 6	0.62 a	1.04 b	1.35 ab	1.39 ab	1.43 a	1.17 b
Sham 4	0.66 a	0.81 b	1.47 ab	1.71 a	1.75 a	1.28 b
Mean	0.65	1.13	1.39	1.47	1.57	1.24

In a column, means, followed by a common letter are not significantly different at the 5% level.

The results in Table (9) show that increasing Na contents in grain, straw and roots tissues were obtained by increasing water salinity. The obtained results showed that Na content in grains as affected by water salinity levels and wheat cultivars were in order Sakha 8 > Sakha 69 > Sham 4 > Bohos 5 > Bohos 6.

Table (9): Effect of different levels of saline water on Na contents in grains and straw of five wheat cultivars.

Wheat cultivars	Na content in grains (gm/pot)					
	Saline water dS/m					
	S_1	S_2	S_3	S_4	S_5	Mean
Sakha 8	0.54	0.69	0.60	0.38	0.43	0.52
Sakha 69	0.48	0.41	0.55	0.52	0.47	0.49
Bohos 5	0.53	0.48	0.33	0.38	0.20	0.38
Bohos 6	0.68	0.34	0.31	0.26	0.20	0.35
Sham 4	1.02	0.57	0.38	0.24	0.25	0.46
Mean	0.65	0.50	0.43	0.36	0.31	0.44
	Na content in straw (gm/pot)					
Sakha 8	0.44	0.48	0.27	0.33	0.24	0.35
Sakha 69	0.46	0.72	0.29	0.49	0.39	0.47
Bohos 5	0.38	0.34	0.22	0.26	0.27	0.30
Bohos 6	0.47	0.29	0.28	0.26	0.31	0.33
Sham 4	0.30	0.29	0.28	0.35	0.32	0.32
Mean	0.41	0.42	0.27	0.34	0.31	0.35

K: Na ratio in root:

The results in Table (10) revealed that K: Na ratio in root and shoot tissues were affected by water salinity levels and wheat cultivars. The highest K:Na ratio in root 1.0 and shoot tissues 5.58 were obtained by Bohos 5 under S_1 and Bohos 6 under S_4, respectively. While the lowest values in grain 0.15 ratio was found in Bohos 5 under S_4 and shoot tissues 2.43 ratio was attained by Sakha 69 under S_4. The obtained results showed that a substantial decrease in K:Na ratio in root tissues was observed with increasing water salinity levels. Leight *et al.* (1988) reported that wheat plants containing chromosome 4 D were able to maintain high K: Na ratio when grown under saline conditions. Ahsan *et al.* (1996) found that salt-tolerant lines had significantly lower accumulation of Na in the leaves and higher K/Na ratio than salt-sensitive lines. The obtained results showed that Bohos 6 wheat cultivar gave the highest K: Na ratio in shoot tissues under all salinity levels except S_1. The results also show that the K/Na ratio in shoot tissues of wheat cultivars was much higher than in root tissues.

Iron:

The results in Table (11) show that Fe concentration in wheat plant parts; grain, straw and root tissues were affected by different water salinity levels and wheat cultivars. The highest Fe concentrations in grain 192 mg kg^{-1}, straw 232 mg. kg^{-1} and root tissues 181 mg kg^{-1} were obtained by Sakha 69 under S_4 for grain and Sakha 8 under S_5 for straw and root tissues. Whereas the lowest values in grain 90 mg.kg^{-1}, straw 82 mg.kg^{-1} and root tissues 37 mg. kg^{-1} were attained by Sakha 69 under S_2, Bohos 6 under S_4 and Bohos 5 under S_1 for grain, straw and root tissues, respectively. The results also show that the mean values of Fe concentration in grain tissues of wheat cultivars as affected by different water salinity levels were in order Sham 4 > Bohos 5 > Sakha 8 > Bohos 6 > Sakha 69.

Table (10): Effect of irrigation with different levels of saline water on K: Na ratio in roots and shoots of five wheat cultivars.

Wheat varieties	Saline water dS/m					
	S_1	S_2	S_3	S_4	S_5	Mean
Roots						
Sakha 8	0.99	0.35	0.25	0.19	0.17	0.33
Sakha 69	0.80	0.29	0.21	0.31	0.16	0.29
Bohos 5	1.00	0.17	0.25	0.15	0.19	0.25
Bohos 6	0.85	0.30	0.21	0.19	0.20	0.28
Sham 4	0.82	0.36	0.22	0.20	0.17	0.28
Mean	0.89	0.29	0.23	0.21	0.18	0.29
Shoots						
Sakha 8	3.21	2.44	2.93	3.38	3.06	3.00
Sakha 69	4.37	3.18	2.92	2.43	2.50	3.08
Bohos 5	4.09	2.79	3.64	3.75	3.17	3.49
Bohos 6	2.96	4.52	4.98	5.85	4.98	4.66
Sham 4	3.14	4.06	4.39	4.27	4.18	4.01
Mean	3.55	3.40	3.77	3.94	3.58	3.65

Table (11): Effect of different levels of saline water on Fe* concentration (mg/kg) in grains, straw and root tissues of wheat cultivars.

Wheat Varieties	Saline water dS/m					
	S_1	S_2	S_3	S_4	S_5	Mean
Grains						
Sakha 8	145	130	143	133	154	141.0
Sakha 69	111	90	92	192	190	135.0
Bohos 5	170	170	103	174	172	157.8
Bohos 6	106	168	112	150	140	135.2
Sham 4	172	179	156	163	182	170.4
Mean	140.8	147.4	121.2	162.4	167.6	147.9
Straw						
Sakha 8	132	183	216	148	232	182.2
Sakha 69	154	149	206	183	178	174.0
Bohos 5	111	169	112	168	157	143.4
Bohos 6	154	164	188	82	189	155.4
Sham 4	187	171	173	201	181	187.6
Mean	147.6	167.2	179.0	156.4	187.4	167.5
Roots						
Sakha 8	155	113	118	162	181	145.8
Sakha 69	116	140	52	54	104	93.2
Bohos 5	37	70	58	125	43	66.6
Bohos 6	145	128	134	144	88	127.8
Sham 4	166	87	62	107	66	97.6
Mean	123.8	107.6	84.8	118.4	96.4	106.2

* The high Fe concentration in the range of 300-1000 $mg.kg^{-1}$ dry weight (Ottow *et al.*, 1983).

The obtained results also showed that Fe concentration in wheat plant parts ranged from 37 to 232 mg. kg^{-1} less than the high Fe concentration in the range of 300 to 1000 mg.kg^{-1} dry weight (Ottow *et al.*, 1983).

Manganese:

The results in Table (12) show that the Mn concentrations in wheat plant parts were affected by different water salinity levels and wheat cultivars. The highest Mn concentrations in grain 90 mg.kg^{-1}, straw 75 mg.kg^{-1} and roots tissues 58 mg.kg^{-1} were attained by Sakha 69 under S_5, Bohos 5 under S_2 and Sham 4 under S_5 for grain, straw and root tissues, respectively. Whereas, the lowest values 45, 25 and 23 mg.kg^{-1} for grain, straw and root tissues were attained by Bohos 5 under S_3, Sakha 69 under S_5 and Sham 4 under S_3, respectively. The results also show that Mn concentration in grain tissues of wheat cultivars as affected by different water salinity levels were in order Sham 4 = Bohos 6 > Sakha 69 > Sakha 8 > Bohos 5. The obtained results showed that Mn concentrations in wheat plant parts ranged from 23 to 90 mg.kg^{-1} being within the critical concentration range of Mn in different plants 15-100 mg.kg^{-1} according to Helal *et al.* (1984).

Table (12): Effect of different levels of saline water on Mn * concentration (mg/kg) in different parts of wheat cultivars.

Wheat cultivars	Saline water dS/m					
	S_1	S_2	S_3	S_4	S_5	Mean
			Grains			
Sakha 8	70	70	72	60	70	68.4
Sakha 69	60	60	65	74	90	69.8
Bohos 5	55	60	45	80	72	62.4
Bohos 6	70	74	70	82	60	71.2
Sham 4	72	76	78	80	80	71.2
Mean	65.4	68.0	66.0	75.2	76.4	69.8
			Straw			
Sakha 8	40	70	65	35	60	54.0
Sakha 69	35	30	50	30	25	34.0
Bohos 5	70	75	55	55	50	61.0
Bohos 6	55	40	40	30	55	44.0
Sham 4	60	60	50	55	65	58.0
Mean	52	55	52	41	51	50.2
			Roots			
Sakha 8	40	33	28	42	48	39.4
Sakha 69	55	45	53	43	35	46.2
Bohos 5	45	40	35	38	38	39.2
Bohos 6	53	30	38	75	30	45.2
Sham 4	35	33	23	33	58	36.4
Mean	45.6	36.2	35.4	46.2	41.8	41.3

* Critical concentration range of Mn in different plants 15-100 mg.kg^{-1} (Helal *et al.*, 1984).

Zinc:

The results in Table (13) show that Zn concentration in wheat plant parts was affected by different water salinity levels and wheat cultivars. The highest Zn concentrations in grain 98 $mg.kg^{-1}$, straw 62 $mg.kg^{-1}$ and root tissues 62 $mg.kg^{-1}$ were attained by Sham 4 under S_1, Sakha 69 under S_3 and Sham 4 under S_1 for grain, straw and root tissues, respectively. Whereas the lowest values for grain, straw and root tissues 27, 20 and 20 $mg.kg^{-1}$ were obtained by Sakha 8 under S_4 and S_5, Sakha 69 under S_5 and Bohos 5 under S_1 for grain, straw and root tissues, respectively.

Table (13): Effect of different levels of saline water on Zn * concentration (mg/kg) in different parts of wheat cultivars.

Wheat cultivars	Saline water dS/m					
	S_1	S_2	S_3	S_4	S_5	Mean
			Grains			
Sakha 8	86	74	62	27	27	55.2
Sakha 69	45	45	85	89	83	69.4
Bohos 5	88	85	86	58	85	80.4
Bohos 6	61	79	40	60	50	58.0
Sham 4	98	86	80	78	82	84.8
Mean	75.6	73.8	70.6	62.4	65.4	69.6
			Straw			
Sakha 8	29	37	31	28	52	35.4
Sakha 69	29	59	62	58	20	45.6
Bohos 5	43	60	58	57	37	51.0
Bohos 6	40	58	31	23	58	42.0
Sham 4	56	32	56	53	57	50.8
Mean	39.4	49.2	47.6	43.8	44.8	45.0
			Roots			
Sakha 8	32	25	51	25	31	32.8
Sakha 69	41	39	34	29	21	32.8
Bohos 5	20	22	21	31	28	24.4
Bohos 6	25	22	21	46	29	28.6
Sham 4	62	52	21	29	41	41.0
Mean	36.0	32.0	29.6	32.0	30.0	31.9

*** Critical levels of Zn in plants 15-200 $mg.kg^{-1}$ (Helal *et al.*, 1984).**

Zn concentration in grain of wheat cultivars as affected by different water salinity levels were in order Sham 4 > Bohos 5 > Sakha 69 > Bohos 6 > Sakha 8.

The obtained results in Table (13) showed that Zn concentration in plant parts of wheat cultivars ranged from 20 to 98 $mg.kg^{-1}$ dry matter lies with the critical levels of Zn in plants 15-200 $mg.kg^{-1}$ as reported by Helal *et al.* (1984).

Copper:

The results in Table (14) show that Cu concentration in wheat plant parts were affected by water salinity levels and wheat cultivars. The highest Cu concentration in grains 16 $mg.kg^{-1}$, straw 10 $mg.kg^{-1}$ and root tissues 13.6 $mg.kg^{-1}$ were attained by Sakha 69 under S_5, Sakha 69 under S_1 and Sham 4 under S_5 for grain, straw and root tissues, respectively. Cu concentration in grain tissues of wheat cultivars as affected by water salinity levels were in order Sakha 69 > Sakha 8 = Bohos 5 > Sham 4 > Bohos 6.

Table (14): Effect of different levels of saline water on Cu* concentration (mg/kg) in different parts of wheat cultivars.

Wheat cultivars	Saline water dS/m					
	S_1	S_2	S_3	S_4	S_5	Mean
			Grains			
Sakha 8	6	6	6	3	15	7.2
Sakha 69	5	3	2	11	16	7.4
Bohos 5	6	9	5	5	11	7.2
Bohos 6	6	2	3	4	2	3.4
Sham 4	9	9	4	4	8	6.8
Mean	6.4	5.8	4.0	5.4	10.4	6.4
			Straw			
Sakha 8	5	4	4	2	3	3.6
Sakha 69	10	3	2	2	2	3.8
Bohos 5	3	3	2	2	2	2.4
Bohos 6	2	2	2	2	2	2.0
Sham 4	2	2	2	2	2	2.0
Mean	4.4	2.8	2.4	2.0	2.2	2.80
			Roots			
Sakha 8	3.4	5.1	5.1	2.0	2.0	3.5
Sakha 69	2.0	8.5	3.4	5.1	8.5	5.5
Bohos 5	3.4	3.4	5.1	3.4	5.1	4.1
Bohos 6	3.4	2.0	2.0	11.9	3.4	4.5
Sham 4	5.1	2.0	2.0	5.1	13.6	5.6
Mean	3.46	4.2	3.52	5.5	6.52	4.6

*** The normal range of Cu in plants 15-20 $mg.kg^{-1}$ (Sauerbeck, 1982).**

The obtained results in Table (14) also showed that Cu concentrations in wheat plant parts ranged from 2 to 16 $mg.kg^{-1}$ dry matter being within the normal range of Cu in plants 15-20 $mg.kg^{-1}$ as reported by Sauerbeck (1982).

In general the results indicate that Sham 4 cultivar (Syrian cultivar) gave the maximum values of N concentration and crude protein in grains and this increased the nutritional value of wheat cultivar under the experiment conditions.

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تأثير ملوحة مياه الرى على التركيب الكيماوى لخمسة أصناف قمح

فاروق ابراهيم زيـــن ــ أســماء أحمــد البســيونى ــ صــلاح علـــى عبدالوهـــاب ــ محمد صابر اليمانى
معهد بحوث الأراضى والمياه ــ مركز البحوث الزراعية ــ الجيزه ــ مصر

أقيمت تجربة بيئة رملية أصص بالصوبه السلكية بمحطة البحوث الزراعية بسخا لدراســة تــأثير الرى بمياه ملحية على التركيب الكيماوى لبعض أصناف القمح المصرى والسورى.

وكانت الأصناف المصرية سخا ٨ ، وسخا ٦٩ والأصناف السورية بحوث ٥ ، بحوث ٦ ، وشــام ٤. رويت هذه الأصناف بمحلول هوجلاند فى خمس مستويات ملوحة لمياه الرى ٠,٤ (معاملة المقارنــة) ٦ ، ٨ ، ١٠ ، ١٢ ديسمتر/م dS/m.

ويمكن تلخيص النتائج المتحصل عليها كما يلى:

- تأثر التركيب الكيمائى لأصناف القمح تحت الدراسة بمستوى ملوحة مياه الرى والصنف
- كانت أعلى قيمة لتركيز النتروجين فى الحبوب والبروتين الخام ومحتوى النتروجين فى حبوب الصنــف شام ٤ تحت معاملة المقارنة ، بينما كان أقل محتوى للنتروجين فى الحبوب والقش عند الرى بمياه ذات مستويات عالية من الملوحة..
- اعلى قيمة لمحتوى الحبوب من الفوسفور كان فى الصنف سخا ٦٩ فى معاملة المقارنة و كان أقلها فــى حبوب الصنف بحوث٥ عند ملوحة لمياه الرى ١٠ ديسيمتر/م
- أعطى الصنف بحوث ٥ أعلى قيمة لتركيز ومحتوى الحبوب من لبوتاسيوم تحت المعاملة المقارنة بينما إنخفض محتوى الحبوب والقش والجذور بزيادة ملوحة مياه الرى حيث كان أقل قيمة فى الصنف ســخا ٨ وسخا ٦٩ عند مستوى ملوحة ١٢ ديسميتر/م .
- كانت أعلى قيمة للنسبة بو: ص فى الجذور والجزء الهوائى فى الصنفين بحوث ٥ وبحوث ٦ تحـــت معاملة المقارنة وادت بصفة عامة لزيادة ملوحة مياه الرى إلى إنخفاض هذه النسبة وبصفة خاصة فـــى أنسجة الجذور.
- وجد أنا العناصر الدقيقة فيما عدا الحديد حدث لها تجمع فى الحبوب اكثر من كل من القـــش والجـــذور وتقع جميعها فى مدى التركيز الطبيعى لهذه العناصر.
- وبصفة عامة أوضحت النتائج أن الصنف شام ٤ (صنف سورى) أعطـــى أعلـــى تركـــيز للنـــتروجين والبروتين فى الحبوب وهذا أدى إلى زيادة القيمة الغذائية لهذا الصنف من القمح تحت ظروف التجربة.