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Evaluation of Some Wheat Varieties to Salt Tolerance

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TWO POT experiments were conducted under the wire proof-green house conditions to study the effect of irrigation water salinity on yield and yield components of some different Egyptian and Syrian wheat varieties.

Two Egyptian wheat varieties, *i.e.* Sakha 8, Sakha 92 and six Syrian wheat varieties, *i.e.* Bohos 4, Bohos 5, Bohos 6, Sham 1, Sham 4 and Sham 6 were irrigated with Hogland solution in five water salinity levels: 0.4 (control treatment), 4, 8, 12, 16 dS/m in the first season.

Based on the results of the first season, more tolerant wheat varieties: Sakha 8, Sakha 69, Bohos 5, Bohos 6 and Sham were chosen for the second season study, which were irrigated with Hogland solution in five water salinity levels; 0.4 (control treatment), 6.0, 8.0,10.0 and 12 dS/m

The obtained results indicated that wheat grain and straw yields as well as plant height, spike length, and 1000 grain weight, were significantly affected by increasing irrigation water salinity.

The study showed that the varieties differed in their tolerance to water salinity levels. They could be arranged in the first season as follows: Sakha 8 > Bohos 6> Sakha 92 > Bohos 5 > Sham 4> Sham 6> Sham 1 and they had the following order: Sakha 8> Sakha 69> Bohos 6 > Sham 4 > Bohos 5 in the second season.

Data showed that the Egyptian varieties, *i.e.* Sakha 8 and Sakha 69 could tolerate salinity of irrigation water up to 12 dS/m. While the salt tolerant Syrian variety (Bohos 6) could tolerate irrigation water salinity up to 8 dS/m.

Keywords: Wheat, Salt tolerance .

Drought and salinity are the most important environmental factor influencing the agricultural productivity in arid and semiarid regions. Wheat is one of the most important field crops in Egypt. In 1995/1996 winter season more than two and half millions feddans cultivated with wheat which produce about 5.7 million tons of grains (El-Sayed *et al.*, 1996). There is an increasing pressure on growers to utilize moderately saline irrigation waters as demands on good quality water increase (Mass and Poss, 1989, Omar and Ghowail 1991). Chauhan *et al.* (1991-a) showed that average yields of wheat decreased by 4.7 and 12.5% at irrigation water EC of 6.4 and 9.3 dS/m respectively.

Chauhan *et al.* (1991-b) found that water salinity of 12.0 dS/m reduced grain and straw yields by 25 and 30% respectively. Generally, increasing irrigation water salinity causes harmful effect on the biological processes which related to metabolism in plant, especially sodium ions suppresses the rate of RNA and protein synthesis and inhibit the enzyme activity (Malik and Srivastava, 1985).

The response of wheat grain and straw yields were negatively highly correlated with soil salinity and in particular with the mean soil salinity in the top 50 cm (El-Morsy *et al.*, 1993). They added that the partial regression showed that most of the yield variations under soil salinity are mainly due to the total soluble salts rather than specific ions effect.

The present work aims to evaluate the effect of irrigation water, salinity on yield and some plant characteristics of some Egyptian and Syrian wheat varieties.

Material and Methods

Two pot experiments were carried out under the wire proof-green house condition, at Sakha Agricultural Research Station. The experiments were 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 (= 0.4 dS/m). Eight wheat varieties; two Egyptian varieties, *i.e.* Sakha 8 (Va_1) and Sakha 92 (Va_2) and six Syrian varieties, *i.e.* Bohos 4 (Va_3), Bohos 5 (Va_4), Bohos 6 (Va_5), Sham 1 (Va_6), Sham 4 (Va_7) and Sham 6 (Va_8), were tested. Hogland solutions prepared in five water salinity using NaCl + $CaCl_2$ to attained 6 SAR for each saline levels 0.4 (control), 4.0, 8.0, 12.0 and 16.0 dS/m were used as irrigation treatments in the first season. Based on the results of the first season, the more tolerant wheat varieties; Sakha 8 (Vb_1), Sakha 69 (Vb_2), Bohos 5 (Vb_3), Bohos 6 (Vb_4), and Sham 4 (Vb_5) were chosen for the second season study. Hogland solutions prepared in five different salinity levels 0.4 (control), 6.0, 8.0, 10.0, and 12.0 dS/m were used as irrigation treatments. Plant height, spike length, 1000 grains weight and grain straw yields were recorded.

Results and Discussion

Plant height

The general mean of plant height for the investigated varieties are shown in Tables 1 and 2. The data reveal that the general mean of plant height for studied wheat varieties were decreased with increasing salinity levels of irrigation water.

Plant heights were reduced by 34.64, 23.94, 24.85, 20.6, 19.11, 8.70, 19.05 and 9.78% for Va_1, Va_2, Va_3, Va_4, Va_5, Va_6, Va_7 and Va8, respectively, as the results of increasing irrigation water salinity levels from 0.4 to 16.0 dS/m in the first season. The reductions were 6.69, 10.27, 23.37, 23.33 and 26.69% for Vb_1, Vb_2, Vb_3, Vb_4 and Va_5, respectively, with increasing salinity levels from 0.4 to 12.0 dS/m in the second season. The same trend was obtained by Ahmed (1980) and Sekina *et al.* (1994). They reported that the general means of plant height for three wheat varieties were decreased with increasing soil salinity levels. The harmful effect of salinity on the plant height could be attributed to the decrease in both number and length of stem internods.

Spike length

Data in Tables 1 and 2 showed that the spike length of different varieties were decreased as a result of increasing salinity levels of irrigation water. The obtained reduction were 36.36, 12.35, 28.14, 20.31, 28.28, 26.02, 14.43 and 21.56% for Va_1, Va_2, Va_3, Va_4, Va_5, Va_6, Va_7 and Va8, respectively, as

TABLE 1. Effect of water salinity levels on grain and straw yields (ton/ha), plant height (cm), spike length (cm), and 1000 grains weight (gm) in the first season (average of 4 replicates)*.

Variety	Irrigation water salinity level dS/m				
	0.4 (control)	4.0	8.0	12.0	16.0
			Plant height (cm)		
Va_1	80.00 b	85.16 a	85.50 a	78.53 a	52.50 de
Va_2	66.67 ef	72.15 f	69.60 e	65.70 e	50.70 de
Va_3	72.87 c	76.19 e	71.50 de	70.30 cd	54.70 cd
Va_4	71.03 cd	82.00 bc	77.30 c	71.80 bc	56.40 c
Va_5	84.99 a	84.17 ab	80.80 b	79.10 a	68.30 a
Va_6	65.78 f	79.45 cd	74.20 d	74.29 b	60.05 b
Va_7	67.99 ef	76.10 e	66.06 f	60.80 f	55.00 cd
Va_8	69.00 de	77.67 de	72.10 de	67.9 de	62.33 b
Mean	72.302	79.113	74.634	71.046	57.537
			Spike length (cm)		
Va_1	9.38 a	8.60 b	7.40 bc	8.79 a	5.70 bc
Va_2	6.80 c	8.15 bc	7.38 bc	6.90 b	5.96 ab
Va_3	7.64 b	8.56 b	7.99 b	6.60 bc	5.49 bc
Va_4	6.35 cd	6.57 d	6.30 d	5.72 d	5.00 c
Va_5	8.91 a	9.46 a	8.64 a	8.28 a	6.39 a
Va_6	5.65 e	6.40 d	5.56 e	5.58 d	4.28 d
Va_7	5.81 de	7.57 c	7.09 c	6.1 cd	5.20 c
Va_8	6.54 c	7.58 c	7.00 c	6.00 cd	5.15 c
Mean	7.134	7.861	7.171	6.667	5.384
			1000 grains weight (gm)		
Va_1	42.30 d	36.16 de	32.35 d	29.45 c	29.30 b
Va_2	39.12 e	39.12 c	28.55 e	27.70 c	26.49 b
Va_3	47.00 c	36.20 de	34.25 cd	33.00 b	26.70 b
Va_4	61.05 a	49.15 a	43.40 a	39.95 a	39.20 a
Va_5	45.50 c	38.20 cd	36.00 c	29.70 c	23.40 c
Va_6	54.20 b	35.10 e	35.10 cd	30.30 c	26.70 b
Va_7	41.85 d	36.00 de	34.60 cd	29.70 c	26.40 b
Va_8	46.80 c	38.17 cd	38.95 b	35.50 b	27.10 b
Mean	47.225	38.513	35.40	31.913	28.161
			Grain yield (ton/ha)		
Va_1	4.36 a	4.44 a	4.32 a	3.94 a	3.10 a
Va_2	4.08 b	3.64 b	3.56 b	2.60 b	1.76 b
Va_3	3.12 e	1.95 e	1.66 e	1.52 d	0.67 b
Va_4	3.45 d	3.10 c	2.28 c	1.94 c	1.38 c
Va_5	2.35 f	2.46 d	2.40 c	1.92 c	0.74 d
Va_6	3.43 d	1.02 f	1.30 f	0.98 e	0.74 d
Va_7	3.44 d	3.02 c	1.98 d	1.82 c	0.58 d
Va_8	3.84 c	1.98 e	1.66 e	1.20 e	0.72 d
Mean	3.509	2.706	2.395	1.990	1.204
			Straw yield (ton/ha)		
Va_1	13.38 a	14.34 b	11.28 b	10.58 b	6.52 a
Va_2	13.64 a	16.24 a	14.34 a	12.36 a	6.20 a
Va_3	6.8 De	7.18 f	5.70 e	4.59 f	2.18 e
Va_4	9.32 b	10.31 c	9.04 c	5.48 d	3.42b
Va_5	8.02 d	8.09 d	6.66 d	6.11 c	2.54 cde
Va_6	6.11 f	7.00 f	5.46 e	5.08 e	2.85 c
Va_7	8.54 c	7.69 e	6.31 d	5.07 e	2.36 de
Va_8	8.51 c	6.51 g	5.57 e	3.98 g	2.60 cd
Mean	9.291	9.670	8.045	6.656	3.584

*Means followed by a common letter in the same column are not significantly different at the 5% level..

TABLE 2. Effect of irrigation water salinity on grain and straw yields (ton/ha), plant height (cm), spike length (cm), and 1000 grains weight (gm) in the second season.

Variety	Irrigation water salinity level dS/m				
	0.4 (control)	6.0	8.0	10.0	12.0
Plant height (cm)					
Vb_1	85.177 a	90.30 a	91.61 a	83.70 ab	80.75 a
Vb_2	82.297 ab	87.50 ab	87.313 ab	89.683 a	84.10 a
Vb_3	67.717 c	79.40 b	76.433 c	75.333 bc	61.76 b
Vb_4	74.20 bc	80.417 b	75.267 c	75.583 bc	60.367 b
Vb_5	81.733 ab	87.0 ab	79.383 bc	71.383 c	63.783 b
Mean	78.225	84.923	82.001	79.137	170.152
Spike length (cm)					
Vb_1	9.317 bc	9.25 a	9.217 a	8.683 bc	8.733 b
Vb_2	8.867 c	9.967 a	9.617 a	10.383 a	10.10 a
Vb_3	6.883 d	6.867 b	7.35 b	7.067 d	5.617 d
Vb_4	9.883 ab	9.787 a	9.583 a	9.25 b	7.583 c
Vb_5	10.467 a	10.017 a	8.917 a	8.033 c	8.533 b
Mean	9.083	9.177	8.937	8.683	8.113
1000 grains weight (gm)					
Vb_1	44.23 b	37.87 b	34.47 b	29.23 b	27.30 a
Vb_2	46.83 ab	44.53 a	41.53 a	34.83 a	28.47 a
Vb_3	50.07 a	43.53 a	38.60 ab	37.37 a	32.23 a
Vb_4	37.30 c	33.17 bc	27.17 c	25.17 bc	22.03 b
Vb_5	31.50 d	30.50 c	28.23 c	23.63 c	19.00 b
Mean	41.986	37.920	34.000	30.046	25.806
Grain yield (ton/ha)					
Vb_1	4.29 ab	4.72 a	4.08 a	3.67 a	3.45 a
Vb_2	4.67 a	4.70 a	4.12 a	4.01 a	3.60 a
Vb_3	3.94 bc	3.62 b	2.62 b	2.53 b	1.53 b
Vb_4	3.46 c	2.57 c	2.34 b	1.84 c	1.57 b
Vb_5	3.53 c	2.88 c	2.39 b	2.05 bc	1.83 b
Mean	3.978	3.698	3.11	2.82	2.396
Straw yield (ton/ha)					
Vb_1	10.74 a	8.77 ab	7.89 ab	6.99 a	6.12 a
Vb_2	10.91 a	9.40 a	8.20 a	7.89 a	6.62 a
Vb_3	9.46 a	7.78 b	6.58 b	6.56 a	3.66 b
Vb_4	9.57 a	8.38 ab	7.33 ab	6.76 a	5.22 a
Vb_5	9.67 a	8.44 ab	7.41 ab	6.72 a	5.91 a
Mean	10.07	8.554	7.482	6.984	5.506

*Means followed by a common letter are not significantly different at the 5% level.

increasing salinity levels from 0.4 to16.0 dS/m in the first season. The reductions were recorded as 13.07, 18.59, 24.44, 25.07 and 23.97% for Vb_1, Vb_2, Vb_3, Vb_4 and Va_5, respectively with increasing salinity levels from 0.4 to 12.0 dS/m in the

second season, these results are in agreement with those obtained by El--Mancy (1994).

1000 grains weight

Concerning the effect of salinity levels on 1000 grains weight, data recorded in Tables 1 and 2 revealed that 1000 grains weight decreased with increasing water salinity levels in both two seasons. The observed reductions were 30.73, 32.23, 43.19, 35.77, 48.5,7, 50.74: 36.92 and 42.09% for Va_1, Va_2, Va_3, Va_4, Va_5, Va_6, Va_7 and Va_8, respectively, when salinity levels were increased from 0.4 to 16.0 dS/m in the first season. The 1000 grains weight reduction in the second season were 38.28, 39.22, 35.62, 40.39 and 39.68% for Vb_1, Vb_2, Vb_3, Vb_4 and Va_5, respectively, as a result of increasing water salinity from 0.4 to 12.0 dS/m. Similar results were found by Ahmed (1980) and Sekina *et al.* (1994).

Wheat yield

Data presented in Tables 1 and 2 revealed, in general, that the increase of water salinity levels decreases the grain yield of investigated varieties. The observed reductions in grain yield caused by increasing water salinity from 0.4 to 16.0 dS/m were 28.89, 56.86, 80.13, 60.12, 68.64, 78,49,83.14 and 81.25% for Va_1, Va_2, Va_3, Va_4, Va_5, Va_6, Va_7 and Va_8, respectively in the first season while they were 19.58, 22.91, 60.41, 46.91 and 48.160/0 for Vb_1, Vb_2, Vb_3, Vb_4 and Vb_5, respectively in the second season. According to FAO (1973) scale for salinity tolerance depending on relative yields (75% of the control) the data of the first season. Figure 1 showed that varieties, Va_3, Va_6 and Va_8 were sensitive to irrigation water salinity, where their relative grain yields decreased to be 61.54, 29.65 and 51.56% at 4.0 dS/m water salinity level, respectively. Data also showed that Va_4, Va_7 and Va_2 were more tolerant than Va_3, Va_6 and Va_8,Va_4 and Va_7 wheat varieties. The varieties Va_4, and Va_7 were tolerant up to 8 S/m and Va_2 wheat variety was tolerate up to 12.0 dS/m water salinity. Va_1 and Va_5 were the most tolerant varieties up to 12 dS/m water salinity. In the second season, relative grain yield (Fig. 2) showed that the Egyptian varieties Sakha 8 (Vb_1) and Sakha 69 (Vb_2) were the most tolerant varieties up to 12 dS/m while the Syrian varieties Bohos 6 (Vb_4) and Bohos S (Vb_3) were tolerant up to 8 dS/m and Sham 4 (Vb_5) was tolerant up to 6 dS/m. Straw yield, data in Tables 1, 2 showed that straw yield was decreased by increasing water salinity levels. The relative reductions caused by increasing water salinity from 0.4 to 16.0 dS/m in the first season were 51.27, 54.55. 67.98, 63.30, 68.33, 53.36 72.36. and 69.45%

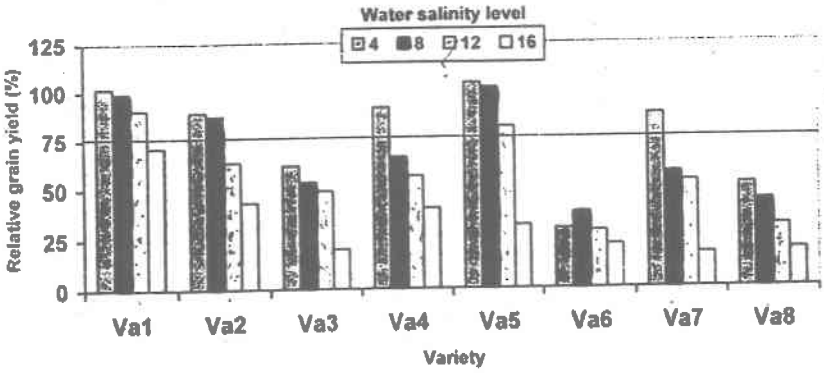

Fig. 1. Relative grain yield (0.04 dS/m as a control) of studied wheat varieties in the first season 1996/97.

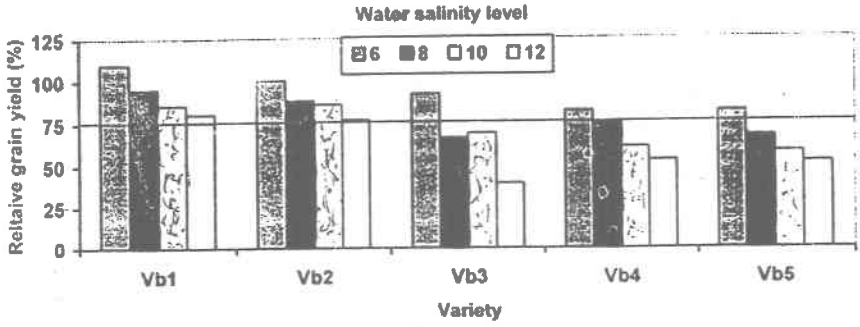

Fig. 2. Relative grain yield (0.4 dS/m as a control) of studied wheat varieties in the second season 1997/98.

for Va_1, Va_2, Va_3, Va_4, Va_5, Va_6, Va_7 and Va_8, respectively. In the second season these reductions were 42.7, 39.4, 61.30, 45.50 and 38.8% for Vb_1, Vb_2, Vb_3, Vb_4 and Vb_5, respectively. raising salinity levels from 0.4 to 12.0 dS/m. These results are in agreement with those obtained by El-Sherbieny *et al.* (1985), El-Fouly and Jung (1972) and Fawzy *et al.* (1977).

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تقـيـيـم بعض اصنـاف القـمـح لمقـاومـة الملوحـة

فـاروق ابراهيم زين، صـلاح على عـبـد الوهاب، مـحـمـد انور الاباصيرى واحمد طاهر الصادق مصطفى

معهد بحوث الاراضى والمياه والبيئة - مركز البحوث الزراعية - القاهرة - مصر .

أقـيـمت تجـربـتين فى اصص بالصوبة السلكيـة بمحطة البـحـوث الزارعيـة بسـخـا لدراسـة تأثيـر مـيـاه الرى المالحـة على المحصـول ومكوناته لاصناف مختلفة من الاقمـاح المصرية والسورية. اختبر فى السنة الاولى ثمانيـة اصناف من القمح هى: سـخـا ٨، سـخـا ٩٢ (اصناف مصرية)، بحوث ٤ ، وبحوث ٥، بحوث ٦ وشام ١، وشام ٤، شام ٦ (اصناف سـورية) رويت هذه الاصناف بمحلول هوجلاند فى خمس مستويات ملوحة لمياه الرى وهى ٤ . . (معامل المقارنة)، و٤، ٨، . و١٢، ١٦ ملليموز/سم.

من نتائج الدراسة فى السنة الاولى إختيرت الاصناف الاكثر مقاومة للملوحة وهى سخا ٨ ، بحوث ٥، بحوث ٦، شام ٤ للدراسة فى الموسم الثانى ورويت بمحلول هوجلاند فى خمس مستويات ملوحة (مياه الرى وهى ٤ . . (معامل المقارنة)، ٦و. ، ٨ و١٠، ١٢ ملليموز/سم.

أوضحت نتائج التجربتين التالى:

١- أن محصول الحبوب ومحصول القش وطول النبات وطول السنبلة ووزن الالف حبة قد تأثروا معنويا بزيادة ملوحة مياه الرى.

٢- اختلفت الاصناف المدروسة فى درجة مقاومتها لمستويات ملوحة مياه الرى واخذت الترتيب التالى فى السنة الاولى سخا ٨ > بحوث ٦ > سخا ٩٢ > بحوث ٥ > شام ٤ > بحوث ٦ > شام ١ بينما اخذت الترتيب التالى: سخا ٨ > سخا ٦٩، بحوث ٦ > شام ٤ > بحوث ٥ فى السنة الثانية للزراعة.

٣- ان الاصناف المصرية سخا ٨ وسخا ٦٩ كانت درجه مقاومتها لملوحة ماء الرى حتى ١٢ ملليموز/سم بينما كانت مقاومة الصنف السورى بحوث ٦ حتى ٨ ملليموز/سم.