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EVALUATION OF SOME SOIL PROPERTIES AND BARLEY PLANT CHARACTERS AS AFFECTED BY LOW IRRIGATION WATER QUALITY

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ABSTRACT

This study was conducted during the two successive winter seasons of (2001 / 2002 and 2002 / 2003) at El-Gemmeiza Agric. Res. Station, El-Gharbia Governorate, in a pot experiment (50 cm in height and 40 cm in diameter). The experiment was carried out in open system under prevailing natural conditions and cultivated by barley seeds variety Giza 123.

The experiment was designed to study the effect of different salinity levels of irrigation water on some soil properties and to evaluate the efficiency of barley plants to grow under irrigation water salinity stress. Randomized complete block design with three replicates were used. The obtained results could be summarized as follows:-

1- The values of bulk density, settling percentage, saturation percentage, moisture content just before harvesting, soil moisture content retained at field capacity and wilting point and soil capillary pores were increased as a result of increase irrigation water salinity levels. While, the values of total porosity, hydraulic conductivity, available water and soil large and medium pores were decreased by increasing salinity levels.
2- The use of high saline irrigation water lead to an increases in soil pH, EC, SAR, SSP, soluble ions (Ca, Mg, Na, Cl and SO_4) and exchangeable cations (Ca and Na) values. While, the values of exchangeable cations (Mg and K) were decreased by increasing salinity levels. But, there were no clear trend in soluble K and HCO_3 with the different salinity levels.
3- Generally, the use of saline irrigation water leads to deterioration of soil physical and chemical properties. So, to avoid salt accumulation in the soil, they mast be dissolved and removed by leaching to allow percolation through the entire root zone. This can be accomplish by leaching in long term periods as needed to reduce the accumulation of salts where the salt balance is achieve in soil.
4- The salinity stress gave highly significant decrease in the values of growth characters for barley plants such as plant height and spike length as compared to the control in the two seasons.
5- There were marked depressions in the values of No. and weight of grains per spike in the two seasons as a result of using high salinity in irrigation water.
6- The biological, straw and grain yields were decreased with increasing irrigation water salinity levels for two seasons.
7- The proline content values of barley straw and Na content of grains and straw were increased with increasing irrigation water salinity levels. While, the values of barley Ca, Mg and K content for grains and straw were decreased with increasing salinity levels.
8- The results revealed that Giza 123 barley variety was resistance to salt stress with increasing irrigation water salinity levels to 7500 ppm. At 10000 ppm salinity level, the vegetative growth, yield and yield components were depressed.

Keywords: Low water quality, soil physical and chemical properties, barley plant, growth characters, yield components.

INTRODUCTION

Water is a growing global problem challenging sustainable development and expansion of cultivated areas to meet the increasing food requirements. Egypt is one of the countries facing great challenges, due to its limited water resources represented mainly by its fixed share of the Nile water and as aridity is the general characteristic of the country (Ministry of Public Works and Water Resources, 1999).

Also, in arid and semi-arid regions salinization hazards are common especially when irrigation is practiced. Secondary salinization is closely related to water movement in soil profile and affected by numerous factors, one of these factors is water quality, salt concentration and cationic and anionic composition (Soliman, 1975).

Thus, water is the most important commodity in agriculture but with limited supply in the dry regions. Therefore, low quality water is recently considered to be used in agriculture expansion, where the shortage of water resources in many regions all over the world, especially in arid and semi-arid regions, has dictated the need for using different water qualities and even low qualities for irrigation purpose (Abdel-Rasheed, 1996). The expansion of agriculture also by reclaiming new areas needs the utilization of different water sources and by special reclamation techniques to increase soil productivity.

The policy of the Egyptian Government is to use drainage water (up to salinity of 4.5 dSm^{-1}) where the drainage water presently used for irrigation amounts to 4.7 BCM and it is likely to increase to 7.0 BCM , specially in the districts of Northern Delta where there are areas of limited better water quality supply in Beheira, Kafr-El-Sheikh, Damietta and Dakhlia Governorates have successfully used drainage water directly for periods of 25 years to irrigate over 10.000 ha of land (FAO, 1992).

In addition, to reclaim soil, growing of salt tolerance crops is of great benefit, which the ability of plants to grow under the adverse condition of high salinity levels depends on their ability to exclude the elements or to withstand them, such as barley plant, which is known for his ability to adapted the environment under stress conditions (drought and salinity), which high levels of the elements are found in barley tissues (Sohsah, 1992 and El-Sodany, 2000).

On the other hand, barley is one of the most important cereal crops not only in Egypt but also all over the world. It is an important main source of human food and animal feeding as well as some artificial purposes. The current plan of development in Egypt aimed at improving barley production both in yields and quality to meet the increasing demands for local consumption (El-Sayed, 2002). Also, barley is the main cereal crop of the areas using low water quality and is rated tolerant among the cereals crops (Ahmed *et al.*, 1993).

The use of different salinity levels in irrigation water gave a marked differences for soil properties and plant characters which have been established by several workers, Epstein *et al.* (1980), Ahmed *et al.* (1998) and El-Sodany (2000).

Several investigators have pointed out that crop plants growing under salinity stress are often designed under controlled conditions, which the levels of salts has been added (Padole, 1991 and Sohsah, 1992). Also most studies of evaluating the use of saline irrigation water in agriculture has been performed in controlled environments while little emphasis has been performance on field to grow plants or on salt affected soils.

The purpose of this experiment is to identify the quantitative changes in some soil physical and chemical properties as influenced by low irrigation water quality. Also, the study includes evaluation of the efficiency and productivity of barley plant to grow under irrigation water salinity stress.

MATERIALS AND METHODS

A pot experiment was carried out in open system under prevailing natural conditions in 2001/2002 and 2002/2003 growing seasons at El-Gemmeiza Agriculture research station.

Five concentrations of saline solutions were prepared, i.e., 492.8 (Control), 2500, 5000, 7500 and 10000 ppm using a mixture of sodium chloride and calcium chloride (3:1 w/w) in various levels. The required amounts of sodium and calcium chloride salts were added to the basic nutrient solution as used by Hoagland and Arnon (1950). The chemical composition of saline solutions were illustrated in Table (1). The irrigation intervals of two weeks were adapted and the quantity of added irrigation water was equal to water quantity at field capacity plus 20% leaching fraction, in order to stay salinity at field capacity in the pot.

Table (1): Chemical composition of the irrigation water used at different salinity levels.

Salinity Levels ppm	pH Water solutions	EC*, dSm^{-1}	Cations meq/l				Anions meq/l				Sodium adsorption ratio SAR	Soluble sodium percentage SSP
			Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{--}	HCO_3^{-}	Cl^{-}	SO_4^{--}		
Control	7.54	0.77	3.11	2.56	1.86	0.16	0.00	2.44	2.75	2.50	1.10	24.19
2500	7.62	3.97	9.40	2.70	27.37	0.18	0.00	3.41	25.88	10.36	11.13	69.03
5000	7.64	7.88	17.70	3.45	57.46	0.18	0.00	2.89	60.75	15.15	17.67	72.93
7500	7.71	11.75	25.65	3.50	88.04	0.19	0.00	3.18	94.75	19.45	23.06	75.00
10000	7.76	15.67	32.40	3.65	120.43	0.19	0.00	3.32	130.75	22.61	28.37	76.87

* EC, dSm^{-1} was measured in prepared solutions.

The plastic pots (50 cm in height and 40 cm in diameter) were filled with 40 kg of soil placed over 0.5 kg of dried washed sand per pot, where the soils in every pots were enough compacted to a depth of 28.43 cm, in order to reach and keep a constant bulk density (1.12 g/cm^3). To prevent salt accumulation in the soil, excess solution was allowed to drain through the pores at the bottom of each pot. The initial soil samples were taken for physical and chemical analysis. The main soil physical and chemical properties were presented in Table (2).

Fifteen seeds were planted in each pot and thinned to eight plants per pot. The experiment was laid down in randomized complete block design with three replicates. Standard analysis of variance using least significant difference (LSD) was performed to estimate the significant differences and the interaction among different treatments (Steel and Torrie, 1980). At harvesting stage the following data were recorded:-

1-Plant height, cm | 2- Spike length, cm
3-No. of grains / spike. | 4- Grain weight / spike
5-Biological yield / pot, gm | 6-Grain yield / pot, gm
7- Straw yield / pot, gm

Table (2): The mean physical and chemical properties of the initial soil (Average of the two seasons).

soil physical properties													
					Particle size distribution, %						Soil moisture characteristics		
Bulk density, g/cm^3	Total porosity E, %	Hydraulic conductivity K_h, cm/hr	Organic matter, %	$CaCO_3$	Coarse sand	Fine sand	Silt	Clay	Texture class	Saturation percentage SP, %	Field capacity FC, %	Wilting point WP, %	Available water AW, %
1.12	57.74	0.34	2.01	3.84	4.07	10.05	24.20	61.68	Clay	62.04	31.12	15.08	16.04

soil chemical properties											
		Soluble ions in soil saturation extract, meq/l									
		Cations				Anions					
pH Soil suspension 1:2.5	EC dSm^{-1}	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{--}	HCO_3^{-}	Cl^{-}	SO_4^{--}	Sodium adsorption ratio, SAR	Soluble sodium percentage, SSP
7.43	1.81	7.12	5.81	4.73	0.42	--	5.50	6.96	5.62	1.86	26.16

Soil samples were collected from each pot at the end of each season after crop harvesting. The collected soil samples were air-dried, ground and passed through 2 mm sieve and stored to physical and chemical analysis.

Soil physical analysis were determined according to the standard methods described by Black (1965). Soil bulk density (g/cm^3) was determined using the core method, hydraulic conductivity (cm/hr) was determined using undisturbed soil cores using a constant water head, soil particle-size distribution was measured by the international pipette method, settling percentage of the soil aggregates was determined in soil aggregates of 2-5 mm size, the method described by Williams and Cooke (1961), soil moisture characteristics and soil moisture content (? w,%) were determined using the method outlined by Stakman (1969) and pore size distribution was calculated according to De Leenher and De Boodt (1965). Total soil porosity (E, %) was calculated according to the equation:-

$$E, \% = \left(1 - \frac{Db}{Dr}\right) \times 100$$

where Db is the bulk density g/cm^3.

Dr is the real density, taken as 2.65 g/cm^3.

Soil chemical analysis were carried out according to Page *et al.* (1982).Soil electrical conductivity (EC, dSm^{-1}) and soluble cations and anions were determined in soil paste extract, soil pH in soil water suspension (1:2.5), cation exchange capacity (CEC, meq/100g soil) was determined using sodium acetate solution 1.0 N with pH 8.2, exchangeable cations (meq/100g soil) were displaced using 1.0 N ammonium acetate solution. Sodium adsorption ratio (SAR) was calculated as :-

$$SAR = \frac{Na^{+} \ meq/l}{\sqrt{\dfrac{Ca^{++} + Mg^{++} \ meq/l}{2}}}$$

Soluble sodium percentage, % was calculated according to the following equation :-

$$SSP, \% = \frac{Na^{+} \ meq/l}{Na^{+} + K^{+} + Ca^{++} + Mg^{++} \ meq/l} \times 100$$

Plant chemical analysis were carried out according to Cottenie (1980), 0.2 gm of dry ground plant components were wet digested using the H_2SO_4-H_2O_2 mixture, the ionic concentration of the extract including Ca and Mg, were determined by titration against a standard versenate solution, Na and K were determined using a Flamephotometer, according to Page *et al.*(1982). Cations uptake were calculated from cations concentration and dry matter percent. Free proline amino acid was estimated using the method of Bates (1973).

RESULTS AND DISCUSION

1- Effect of irrigation water salinity levels on some soil physical properties.

- Soil bulk density and total soil porosity.

Data presented in Table (3) show that soil bulk density values were slightly increased by increasing salinity levels, where it was 1.12 and 1.30 g/cm^3 at control and 10000 ppm salinity levels. These results are in harmony with that obtained by Zartman and Gichuru (1984). Total soil porosity take the opposite direction, where it was decreased by increasing salinity levels. It decreased to 50.94 % at 10000 ppm salinity level. Similar conclusion was obtained by El-Naggar *et al.* (2002).

- Soil hydraulic conductivity and settling percentage.

Data presented in Table (3) indicate that soil hydraulic conductivity values were relatively decreased with increasing irrigation water salinity levels. It was decreased from 0.35 to 0.03 cm/hr at control and 10000 ppm salinity levels. This can be demonstrated by the addition of Na salts in irrigation water which depress water transmission and decrease hydraulic conductivity in clay soil, while the addition of Ca salts in irrigation water increase hydraulic conductivity in clay soil (Na : Ca ratio in irrigation water was 3 : 1 w/w). Similar results were obtained by Rao and Parvathappa (1993).

Table (3): Some soil physical properties as affected by irrigation water salinity levels (Average of the two seasons).

Salinity levels ppm	Bulk density, g/cm^3	Total porosity E, %	K_h, cm/hr	Settling percentage	Saturation percentage SP, %	Soil moisture characteristics			Soil moisture content just before harvesting (?w,%)	Pore size distribution as a % of total porosity		
						Field capacity FC, %	Wilting point WP, %	Available water AW, %		> 9 µ	9 - 0.2 µ	< 0.2 µ
Control	1.12	57.74	0.35	7.79	62.55	31.47	15.03	16.44	4.18	49.69	26.28	24.03
2500	1.16	56.23	0.22	8.29	63.21	32.21	17.87	14.34	4:19	49.04	22.69	28.27
5000	1.22	53.96	0.12	13.66	63.47	32.85	19.05	13.80	5.06	48.24	21.74	30.02
7500	1.29	51.32	0.04	16.32	64.13	34.38	21.14	13.24	5.70	46.39	20.65	32.96
10000	1.30	50.94	0.03	18.01	64.16	34.67	22.29	12.38	5.78	45.96	19 30	34.74

Concerning the structural stability, the settling percentage of the soil aggregates were determined. The low values of settling percentage indicates high degree of structure stability and vice versa. The results in Table (3) indicate that settling percentage values were increased with increasing salinity levels which were 7.79 and 18.01 for control and 10000 ppm levels, respectively, this can be explained that the addition of Na salts in irrigation water led to compact of soil layer as a result of damage of soil structure.

- Soil moisture characteristics.

Data presented in Table (3) indicate that the saturation percentage values (SP) and soil moisture content just before harvesting (?w) were gradually increased by increasing irrigation water salinity levels, where the SP values were ranged between 62.55 to 64.16 % and the ?w values were increased from 4.18 to 5.78% at the control and 10000 ppm salinity levels, respectively. These results may be due to destroy of soil structure and increase of capillary-pores (< 0.2µ). Similar results were obtained by Gouda *et al.* (1989).

Regarding to the soil moisture content at field capacity (FC) and wilting point (WP), the data presented in Table (3) reveal that the FC and WP values were gradually increased by increasing salinity levels, where the FC values were ranged between 31.47 and 34.67% and the WP values were between 15.03 and 22.29% at the control and 10000 ppm salinity levels, respectively. These results are in agreement with that obtained by Gouda *et al.* (1989).

Referring to soil available water (AW), results presented in Table (3) reveal that the AW values were decreased by increasing salinity levels. However, the AW values were decreased from 16.44 to 12.38% at the control and 10000 ppm levels, respectively. The same results were obtained by Kandil (1990). FAO (1976) reported that salinity has an effect on soil water availability which decrease availability of water to the crop in proportion to its salinity. This is called the osmotic effect can be measured as a force the plant must overcome (osmotic potential).

- Pore size distribution.

The data recorded in Table (3) indicate that the large pores (> 9µ) and the medium pores (9 – 0.2 µ) as a percent of total porosity were decreased with increasing salinity levels, where the large pores percent were ranged between 49.69 and 45.96 % and the medium pores percent were ranged between 26.28 and 19.30 % with increasing saline irrigation water levels from control to 10000 ppm, respectively. Similar conclusion were obtained by Abdel-Rasheed (1996). While, the pore size distribution of micropores (<0.2µ) had the same expected trend as that of the amount of moisture retained at wilting point. Generally, it can be stated that increasing of micropores occurred by increasing salinity levels. Similar conclusion were obtained by Abdel-Rasheed (1996).

2- Effect of irrigation water salinity levels on some soil chemical properties.

- Soil pH

Data in Table (4) indicate that soil pH values were slightly increased with increasing salinity levels where the pH values were ranged between 7.42 and 7.66 from control to 10000 ppm, respectively. This result revealed that there is no wide variation on soil pH as affected by different salinity levels, the increase percentage were 0.13, 0.40 and 0.67% at salinity levels 5000, 7500 and 10000 ppm, respectively. Similar results was obtained by El-Sodany (2000).

- Soil salinity and soluble ions.

The data recorded in Tables (1 and 4) show that saline irrigation water with EC values of 3.9, 7.88, 11.75 and 15.67 dSm^{-1} increased soil EC values to 6.59, 10.26, 14.46 and 18.66 dSm^{-1}, respectively. Similar results were obtained by Abo El-Defan (1990).

Concerning soil soluble cations, the results in Table (4) generally indicate that the soluble sodium, calcium and magnesium increase with increasing their concentration in the used irrigation water. The increase of soluble Ca was ranged between 8.02 and 57.55 meq/l, soluble Mg was between 6.25 and 12.75 meq/l and soluble Na was between 5.47 and 114.52 meq/l at the different salinity levels from control to 10000 ppm, respectively. Similar results were obtained by Mostafa *et al.* (1992). These results may be due to the increases of soluble sodium than the soluble calcium where the mixture of the used irrigation water contains Na : Ca ratio as 3:1 (w/w) in all levels, Table (1). This may be leads to the sodium ions are first attracted to the external surfaces of the clay plate which its occupy the space between the parallel platelets of the oriented and associated clay particles, FAO (1992). While soluble K has no clear trend with different salinity levels in irrigation water. The same results was reported by El -Wakeel *et al.* (1985).

Table (4): Some soil chemical properties as affected by irrigation water salinity levels (Average of the two seasons).

Salinity levels ppm	pH Soil suspension 1:2.5	EC dSm^{-1}	Soluble ions in soil saturation extract, meq/l: Cations				Anions				Sodium adsorption ratio, SAR	Soluble sodium percentage, SSP	Exchangeable cations, meq/100g soil				Cation exchange capacity CEC meq/100g soil
			Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{--}	HCO_3^{-}	Cl^{-}	SO_4^{--}			Ca^{++}	Mg^{++}	Na^{+}	K^{+}	
Control	7.42	2.02	8.02	6.25	5.47	0.45	-	5.20	8.13	6.86	2.05	27.09	16.50	14.00	12.42	3.32	46.24
2500	7.42	6.59	21.00	8.75	34.53	1.54	-	5.56	53.65	6.61	8.95	52.46	17.50	9.00	17.52	2.28	46.30
5000	7.43	10.26	31.50	9.19	60.23	1.53	-	4.18	91.25	7.02	13.35	58.79	18.02	5.50	20.98	1.96	46.46
7500	7.45	14.46	44.75	10.50	88.02	1.28	-	4.28	132.77	7.50	16.75	60.89	19.50	3.40	22.26	1.10	46.26
10000	7.47	18.66	57.55	12.75	114.52	1.92	-	4.20	174.50	8.04	19.32	61.33	20.20	1.30	23.92	0.92	46.34

Referring to soluble anions which recorded in Table (4) ,data reveal that there were no clear trend in the concentration of soluble HCO_3 with the different salinity levels, the same results were obtained by Alawi *et al.* (1980). Also, the data show that soluble SO_4 was slightly increased with increasing salinity levels. Also, the results reveal that soluble chloride was increased with increasing of Cl concentration in irrigation water. Soluble chloride was ranged between 8.13 and 174.50 meq/l at the different salinity levels from control to 10000 ppm, respectively. Similar results were obtained by Hamdy (1989).

Regarding to the sodium adsorption ratio and soluble sodium percentage, the results in Table (4) indicate that the SAR and SSP values were increased with increasing different salinity levels in irrigation water where the SAR values were increased from 2.05 to 19.32 and SSP values were increased from 27.09 to 61.33 at the control and 10000 ppm, respectively. Similar findings were obtained by El-Wakeel *et al.* (1985).

- Exchangeable cations.

The data presented in Table (4) indicate that the values of exchangeable cations were increased in soil by increasing their concentrations in irrigation water. The exchangeable Ca and Na were increased from 16.50 to 20.20 meq/100 g soil for exchangeable Ca and from 12.42 to 23.92 meq/100 g soil for exchangeable Na as the salinity levels increased from control to 10000 ppm, respectively. Similar conclusion were obtained by El-Sawaby and Abu-El-Anine (1977).

While, the exchangeable Mg and K were decreased with increasing salinity levels in irrigation water because the amounts of Mg and K in irrigation water were less than the amounts of Na and Ca. Also, the ability of Na or Ca cations to displace Mg and K cations from clay particles surfaces was increased by increasing Na or Ca concentrations in the irrigation water, moreover the Na or Ca ions are first adsorbed to the external surfaces of the clay particles and takes place of Mg and K cations, FAO (1992) and El-Sodany (2000).

Generally, the use of saline irrigation water leads to deteriorations of soil physical and chemical properties, where most of the salts added with the irrigation water are accumulate in the root zone in soil. These may be reduce the availability of soil solution to the crop. So, to avoid salt accumulation , it must be dissolve and remove the salts to allow percolation through the entire root zone (leaching). This can be done at each irrigation but needs to be done only after the salts have accumulated to near damaging concentrations. This can be accomplish by leaching a long term periods where the salt balance is achieved in soil as needed to reduce concentration of accumulation salts and the upper root zone will contain less salinity than the lower parts, FAO (1976).

3- Effect of irrigation water salinity levels on barley characters.

Referring to growth characters of barley plant, the results in Table (5) indicate that increasing irrigation water salinity stress gave highly significant decrease in the values of plant height and spike length, where the values of plant height were ranged between 58.53 and 31.50 cm, while the values of spike length were between 6.73 and 3.62 cm at salinity levels from control to 10000 ppm respectively. The decrease percentage for the morphological characters under 10000 ppm salinity level was about 46 % for plant height and spike length as compared to the control.

Table (5) : Effect of irrigation water salinity levels on characters of Giza 123 barley variety (Combined of the two seasons).

Salinity levels ppm	Plant height, cm	Spike length, cm	No. of grains per spike	Grain weight per spike, gm	Biological yield, gm/pot	Straw yield gm/pot	Grain yield, gm/pot
Control	58.53	6.73	38.33	1.58	287.83	212.17	75.67
2500	49.83	5.90	33.50	1.45	261.33	199.83	62.50
5000	47.87	5.18	34.50	1.42	209.83	157.17	52.67
7500	40.10	4.78	32.67	1.34	186.00	129.17	51.83
10000	31.50	3.62	23.00	0.95	124.00	91.67	27.83
LSD 5%	6.88	0.52	8.61	0.26	34.03	32.39	9.39
LSD 1%	9.48	0.71	11.86	0.36	46.89	44.63	12.94

The deleterious effect of salinity on plant growth may be attributed to the inability of the roots to absorb adequate amounts of water due to high osmotic pressure of ambient saline solution, also the inhibitory effect of salinity is either due to excessive absorption of particulars ion from the saline solution and that levels to toxic accumulation in absorption of some essential elements. The obtained reduction in vegetation growth with increasing salinity levels was agree with findings of Epstein *et al.* (1980).

Also, the increases of salinity of irrigation water (ECw) from 5.30 to 6.70, 8.70, 12.00 and 18.67dSm^{-1} and EC values of soil saturation extract (ECe) from 8.00 to 10.00, 13.00, 18.00 and 28.00 dSm^{-1} will be decrement the barley yield by zero, 10, 25, 50 and 100% respectively (FAO, 1976). These effects may be due to the osmotic effect and reduction in crop water availability.

Concerning the relationship between mineral ions accumulation, osmotic potential and barley plant growth, the results show that at the high levels of sodium chloride over than calcium chloride, the elongating tissues of barley contained high amounts of Na and Cl and these ions contributed about 55% of the osmotic pressure of plants adapted to salinity(Delane *et al.*,1982). Also, Khafagi *et al.* (1986) attributed the adverse effects of salinity on plant growth to the specific toxic effects of ions excessively absorbed from saline solution and to the imbalance in nutritive cations in tissues of salt affected plants.

Results in Table (5) show that there was a marked depression in yield and yield components of barley plant with increasing salinity levels. The values of number of grains per spike ranged between 38.33 and 23.00 at the control and 10000 ppm, respectively. The decrease percentage in number of grains and grain weight per spike at salinity level 10000 ppm was about 40 % as compared to control for the two seasons.

Data in Table (5) show that a significant decrease in biological, straw and grain yields with increasing salinity level. The reduction percentage were about 57 % for biological and straw yield and 63 % for grain yield at 10000 ppm salinity level as compared to control. The reduction in vegetative growth and grain yield of cereals with increasing salinity levels has been reported by many investigators (Epstein *et al.*, 1980 and Ahmed *et al.*, 1998).

Generally, the results reveal that Giza 123 barley variety was resistance to increasing salinity levels in irrigation water to 7500 ppm then it's yield and yield components were depressed at 10000 ppm level, where the values of number of grains per spike were 33.50, 34.50 and 32.67, grain weight per spike were 1.45, 1.42 and 1.34 gm and grain yield were 62.50, 52.67 and 51.83 gm/pot at salinity levels 2500, 5000 and 7500 ppm, then these values were depressed to 23.00, 0.95 gm and 27.83 gm/pot at 10000 ppm salinity level, respectively.

5- Effect of irrigation water salinity levels on chemical composition of barley plant.

- Proline accumulation.

Data presented in Table (6) show the response of barley plant to grow under irrigation water salinity stress. The proline accumulation in barley plant were gradually increased with increasing salinity levels, where the mean values of amino acid proline were ranged between 80.46 and 330.39 µmole/g dry weight from control to 10000 ppm levels, respectively. Similar results were obtained by Sohsah (1992). She concluded that the accumulation of amino acid proline in barley plant tissues was increased with increasing salinity stress. Proline play an adaptive role in the tolerance of plant cells by increasing salinity concentration in the root media in order to equalize the osmotic potential of the cytoplasm. Also, the retarding effect of irrigation water salinity on growth of barley plant may be due to high rate of energy consumption in building up the osmoregulants such as proline, glycine and betaine where would be accumulated in plant cells in concentrations enough to regulate the osmotic pressure between vacuoles and cytoplasm (Sohsah, 1992).

- Cations uptake.

Concerning the sodium and potassium uptake in barley, the data in Table (6) reveal that the Na uptake values for barley straw and grain were generally increased with increasing salinity levels, where the mean values of Na uptake were ranged between 13.40 and 26.89 mg/g dry weight for straw and between 1.78 and 3.88 mg/g for grain at control and 10000 ppm levels, respectively. Similar results were obtained by Padole (1991).

On the other hand, the results indicate that the K uptake values take the opposite trend, where it was adversely affected with increasing salinity levels. The mean values of K uptake were ranged between 25.09 and 18.26 mg/g dry weight for straw and from 4.04 to 2.76 mg/g for grain, at control and 10000 ppm levels, respectively. Similar results were obtained by Padole (1991).

Table (6) : Mean values of cations uptake (mg/g dry wt.) and free proline content (µmole/g dry wt.) in barley plant grown under irrigation water salinity stress (Average of the two seasons).

Salinity levels ppm	Free proline content µmole/g dry wt.	Cations uptake, mg/g dry wt.							
		Na^+		K^+		Ca^{++}		Mg^{++}	
	Straw	Straw	Grain	Straw	Grain	Straw	Grain	Straw	Grain
Control	80.46	13.40	1.78	25.09	4.04	20.21	16.85	9.08	9.34
2500	157.01	13 11	1.75	23.92	3.79	24.69	17.95	8.77	8.58
5000	234.76	18.20	1.86	22.80	3.31	24.49	18.79	8.68	7.74
7500	277.16	20 66	2.29	20.77	3.09	10.44	8.46	7.85	7.58
10000	330.39	26.89	3.88	18.26	2.76	7.55	6.45	6.88	5.98

Regarding to the calcium and magnesium uptake by barley plant, the results reveal that, Ca and Mg uptake values for barley straw and grain were generally decreased with increasing salinity levels. The values of Ca uptake were increased with increasing salinity levels until 5000 ppm level where increased from 20.21 to 24.49 mg/g dry weight for straw and from 16.85 to 18.79 mg/g for grain at control and 5000 ppm levels, then decreased with increasing salinity levels more than 5000 ppm which were 10.44 and 7.55 mg/g dry weight for straw and were 8.46 and 6.45 mg/g for grain at 7500 and

10000 ppm levels, respectively. The values of Mg uptake were ranged between 9.08 and 6.88 mg/g dry weight for straw and between 9.34 and 5.98 mg/g for grain, at control and 10000 ppm levels, respectively. Similar results were obtained by Shalaby *et al.*(1993).

Generally, the depressive effect of different salinity levels on growth of barley plant may be due to the specific toxic effects of Na and Cl ions excessively absorbed from the saline solution. The imbalance or deficiency in nutritive cations in tissues of salt affected plants may be responsible for the reduction of growth, Sohsah (1992). Also, the reduction in yield and yield components could be due to the increase of osmotic pressure of soil solution and accumulation of certain ions in high concentration in plant tissue and alteration of the mineral balance of plants. These results are in agreement with Ahmed *et al.* (1998).

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تقييم بعض خواص الأرض وصفات نبات الشعير الناتجة بعد استخدام مياة منخفضة الجودة في الري

منصور الدسوقي السوداني
معهد بحوث الأراضي والمياة والبيئة – مركز البحوث الزراعية – الجيزة – مصر.

أجرى هذا البحث خلال موسمين شتويين متتالبين (٢٠٠٢/٢٠٠١ ، ٢٠٠٣/٢٠٠٢) في محطة البحوث الزراعية بالجميزة محافظة الغربية ، في تجربة أصص أبعادها (٥٠ سم ارتفاع ، ٤٠ سم قطر) وضعت في نظام مفتوح تحت الظروف الطبيعية السائدة و زرعت بالشعير صنف جيزة ١٢٣.

استخدم تصميم القطاعات الكاملة العشوائية في هذه التجربة لدراسة تأثير مستويات الملوحة المختلفة في ماء الري علي بعض خصائص الأرض وكذلك لتقييم كفاءة نبات الشعير للنمو تحت ظروف الإجهاد الملحي لماء الري. ويمكن تلخيص النتائج المتحصل عليها كالآتي :-

١. قيم الكثافة الظاهرية، نسبة التحبب، نسبة التشبع، المحتوى الرطوبي قبل الحصاد ، محتوى رطوبة التربة الممسوكة عند السعة الحقلية ونقطة الذبول وكذلك المسام الشعرية في التربة تزداد نتيجة لزيادة مستويات الملوحة في ماء الري. بينما قيم المسامية الكلية، التوصيل الهيدروليكي، الماء الميسر وكذلك المسام الكبيرة والمتوسطة في التربة تقل بزيادة مستويات الملوحة.
٢. استخدام مياة ري عالية الملوحة أدت إلي زيادة قيم رقم حموضة التربة، التوصيل الكهربي، نسبة الصوديوم المدمص، نسبة الصوديوم الذائب، الايونات الذائبة (كالسيوم، ماغنسيوم، صوديوم، كلوريد، كبريتات) والكاتيونات المتبادلة (كالسيوم وصوديوم). بينما قيم الكاتيونات المتبادلة (ماغنيسيوم وبوتاسيوم) تقل بزيادة مستويات الملوحة. ولكن ليس هناك اتجاة واضح للبوتاسيوم والبيكربونات الذائبة مع مختلف مستويات الملوحة.
٣. وعموما فان استخدام مياة ري ملحية تؤدى إلي تدهور خصائص الأرض الطبيعية والكيميائية ، ولذلك لتجنب تجمع الأملاح في الأرض يجب ذوبان وانتقال الأملاح بالغسيل لكي يسمح لها بالترشيح خلال منطقة الجذور وهذا يمكن أن يتم بالغسيل في دورات طويلة الأجل لكي تنخفض الأملاح المتجمعة ويحدث التوازن الملحي في التربة.
٤. الإجهاد الملحي يعطي نقص معنوي عالي في القيم الخاصة بصفات النمو في نبات الشعير مثل طول النبات وطول السنبلة عند مقارنتها بمعاملة المقارنة في الموسمين.
٥. يوجد انخفاض واضح في قيم عدد ووزن الحبوب في السنبلة في الموسمين نتيجة لاستخدام ملوحة عالية في ماء الري.
٦. المحصول البيولوجي ومحصول القش ومحصول الحبوب يقل بزيادة مستويات الملوحة في ماء الرى في الموسمين.
٧. قيم محتوى الشعير من البرولين في القش ومحتوى الشعير من الصوديوم في الحبوب والقش تزداد بزيادة مستوى الملوحة في ماء الري. بينما قيم محتوى الشعير من الكالسيوم والماغنسيوم والبوتاسيوم في الحبوب والقش تقل بزيادة مستوى الملوحة.
٨. النتائج تؤكد أن الشعير صنف جيزة ١٢٣ كان مقاوم للإجهاد الملحي مع زيادة مستويات الملوحة في ماء الري إلي ٧٥٠٠ جزء في المليون. وعند مستوى الملوحة ١٠٠٠٠ جزء في المليون يحدث تدهور في النمو الخضري والمحصول ومكونات المحصول.