Egypt. J. Soil Sci. **45**, No.2, pp.163- 175 (2005)

Effect of Saline Water Irrigation on Nutrients Uptake by Two Halophyte Plants Grown in Different Soil Textured

M.F. Abdel-Sabour, M.A. Rizk, A. M. Elgala* and H. Abuo El-Naga
Nuclear Research Center, Atomic Energy Authority, Cairo ; and
**Faculty of Agriculture, Ain Shams University, Cairo, Egypt.*

A LYSIMETER experiment was conducted at the experimental farm of the Soil and Water Research Department, Nuclear Research Center, Atomic Energy Authority, Egypt, to evaluate the impact of saline water irrigation at three levels namely, 0.3, 4 and 8 dS/m on yield of some selected halophyte plants grown in different textured soils as well as its nutritional values as fodder crops.

The tested plants were Kallar grass and *Atriplex* (Salt bush). The tested soil were sandy, calcareous and clayey soils. Biomass yield and nutrient elements namely N, P, K,Fe, Mn, Zn, and Cu were studied

Data shows a significant decrease in both N and protein content % in plant shoots for both tested plants with increasing salinity. The lowest value of N and protein % was noticed at 8 dS/m treatment in case of Kallar grass grown on clayey soil. P-content in Kallar grass was not significantly affected by salinity, but, it was significantly decreased in shoots of *Atriplex* plants. In general, P-content was low in both tested plants. In most cases *Atriplex* plants exhibited higher amounts of N, P and crude protein content.

Kallar grass showed a negative response to increasing water salinity, which resulted a decrease in K concentration in shoots at any tested soils while, *Atriplex* showed a positive trend, which may indicate variation in the mechanism of salinity tolerance in plants by different elemental uptake and accumulation.

Results reveal that increasing salinity levels in irrigation water usually led to a significant decrease in Fe, Mn, Zn and Cu uptake by the tested plants at any tested soils. *Atriplex* shoots showed the highest Fe, Zn and Cu concentration, if compared to Kallar grass at any tested soils.

Interactions observed within plants between trace elements. The greatest number of antagonistic reactions have been observed for Fe, Mn, Zn and Cu which are obviously, the key elements in plant physiology.

Discrimination factors (DF) between there micronutrients were calculated. DF-values varied between the tested nutrients due to soil type, salinity and plant species. Results indicate that Fe was efficiently absorbed than Mn, Zn or Cu. In general DF-values for Zn/Mn and Cu/Mn showed a tendencity to increase with increasing salinity at any tested plant or soil. However, the opposite was true for the rest of DF values particularly the Mn/Fe, Zn/Fe and Cu/Fe.

Keywords: Halophyte plants, Saline water irrigation, Macro and micronutrients

Interest in the introduction of halophytic fodder (grass or shrubs) to agriculture in different countries appears to have risen in the last few years, particularly in developing countries with arid and semi arid climates. Valuable production has been obtained from salt-affected soil through establishment and use of salt tolerant plants as forage for sheep and cattle. Ashour *et at.* (1999) evaluated the productivity of halophytic plants irrigated with diluted seawater (12.5, 25, 37.5 and 50.0% seawater). They indicated that halophytes were promising for feeding goats and sheep in a desert area by saline irrigation water. *Diplachne Fusca* as a forage crop was grown successfully in highly salt-affected soil (17 dS/m) at south coast of Qaroun lack. Fayoum Governorate, Egypt. They concluded that some halophytes might be used to combat desertification in arid and semiarid regions through depleting soil salts and also as salt-tolerant forage crops. Villiers *et al.* (1995) established that there are feasible potential roles of halophytes in economic agricultural use of salt-affected wasteland. Halophytes, particularly *Atriplex nummularia* and *Leptocola fusca* (Kallar grass) have been introduced into many Mediterranean areas specially for increasing forage productivity and for many other uses.

The protein content in leaves of *Atriplex* species has been found as high as 17.3-18.3% which is comparable to 17.8% in some forage legume species. *Atriplex* species can be considered therefore, a source for replacement of costly protein concentrates in feed for livestock (Aslam, 1999).

Plant mineral contents resulting from salinity irrigation treatments showed extremely variable responses (Lunin & Gallatin, 1965; Hassan *et al.*, 1970b and Bernstein *et al.*, 1974) depending on the crop or plant species, the particular mineral and the portion of the plant tissue sampled. Bernstein *et al.* (1974) stated that plant mineral contents are not reliable indicators of plant responses to the interactive effects of nutrients and salinity. Therefore, only a general statement can be made concerning mineral nutrition of plants under adverse soil salinity conditions. Hassan *et al.* (1970 a), found a negative correlation between soil salinity and the uptake of Fe, Mn, Zn and Cu by corn plants. Micronutrients that are essential for the nutrition of animals are usually required in amounts of 100 mg/kg in dietary dry matter. These elements include Fe, Mn, Cu, Se, I, Co, and Mo.

The aim of this experiment was to investigate the effect of saline water irrigation on the nutritional values of some selected salt tolerant plants grown in different textured soils types as fodder crops.

Material and Methods

Soil samples

Three soil samples (0-30 cm) were collected from different areas sandy soil from Inshas, calcareous soil from Ras Suder and clayey soils from Al-Husaniah. The soil samples were air dried, crushed, finely ground, then sieved through a 2 mm sieve and kept for analysis. Physical analysis, organic matter content (O.M), calcium carbonate content ($CaCO_3$), pH, EC, soluble cations and anions (Na^+, K^+, Ca^{2+}, Mg^{2+}, Cl^-, CO_3^{2-}, SO_4^{2-} and HCO_3^-) were determined according to standard methods (Jackson, 1976). Selected soils physical and chemical properties are shown in Table 1 a and b.

TABLE 1. Some physical and chemical properties of the experimental soils.

a. Physical properties

Soil type	Particles size (%)			Texture class	ECe 1:2.5 dS/m	PH (1:2-5 soil-suspension)	CEC meq/100g soil	Bulk Density (g/cm³)	F.C θ_v	CaCO3 %	O.M. %
	Sand	Silt	Clay								
Sandy (Inshas)	96	2	2	Sandy	0.27	7.8	2.07	1.76	9.34	1.6	0.43
Calcareous (Ras Sudr)	89	5	6	Loam sand	4.3	8.3	2.05	1.65	17.3	44	0.66
Clay (Al Husayniah)	16	12	72	Clay	19.5	8.6	23.8	1.18	41.1	2	1.38

b. Chemical properties

Soil Type	Soluble Cations (meq/l)				Soluble Anions (meq/l)				SAR	ESP
	Na^+	K^+	Ca^{++}	Mg^{++}	Cl^-	$CO3^{--}$	SO_4^{--}	HCO_3^-		
Sandy	0.52	0.10	1.0	1.07	0.6	--	1.89	0.2	0.51	0.51
Calcareous	25.2	1.25	7.58	7.90	10.8	--	25.5	5.6	9.06	10.8
Clay	122	1.59	24.2	31.3	52.5	--	124	2.6	23.15	25.1

Soil and lysimeter preparation

In lysimeter outdoor trial, the effect of saline water irrigation and soil types on halophyte plant growth, biomass yield and nutrient elements namely: N, P, K, Fe, Mn, Zn and Cu was studied for two seasons. The trial was conducted at the experimental farm of the Soil and Water Research Department, Nuclear Research Center, Atomic energy Authority, Inshas, and arranged in a complete randomized block design. Two halophytic plant species were selected for this study, a perennial grass plant namely Kallar grass (*Leptachloa fusca*) and perennial shrub known as salt bush plant namely *Atriplex* (*Atriplex nummularia*). Each soil sample was packed in Lysimeters (100 cm in height and 54 cm in diameter). A gravel bed layer (20-cm in height) was served in the bottom of each lysimeter to improve the drainage efficiency. Each lysimeter was filled with soil to give soil column 50 cm in height (about 201.44, 78.64 and 135.06 Kg for sandy, calcareous and clayey soil, respectively). Access tubes (for neutron moisture meter measurements), were installed in the center of each lysimeter.

Three levels of saline water were used. The represented regular water (0.3 dS/m) as a control treatment, moderately saline (EC = 4 dS/m) and highly saline (EC = 8 dS/m). Preparation of the artificial saline water used in this experiment was prepared according to Haider & Ghafoor (1992), to simulate the status of saline ground water.

Seedlings of the tested halophytic species were planted in each lysimeter (three seedlings each) in three replicates. NPK fertilizers were applied to enhance seedling growth. Nitrogen as urea, phosphorus as super phosphate and potassium as potassium sulfate were added at the rate of 50 kg/fed. Soil moisture content were maintained at each soil field capacity. The lysimeters were irrigated when the soil moisture content becomes equal to 15 bar, as determined by the Neutron Moisture Meter technique.

After 6 months from cultivation, plant sample were harvested, separated to shoots and roots, air-dried, ground, and kept for chemical analysis. Also, soil samples were collected, dried, ground and extracted by DTPA according to Lindsay & Norvell (1978).

Plan analysis

Plant samples were digested according to Chapman & Pratt (1961). Plant N contents were determined using Kjeldahl method. Total P was calorimetrically determined, using stannous chloride ammonium molybdate. Na and K contents were determined using Flame Photometer. Fe, Mn, Zn and Cu either in the digest mixture or DTPA extract were estimated by Atomic Absorption (model GBC 902).

Statistical analysis

Data were statistically analyzed, using statistical software program (PC-Mstat) according to Power (1985). The values of Least significant difference (L.S.D) were calculated according to Gomez & Gomez (1984).

Results and Discussion

Dry matter yield in tested plants

Table 2 shows the mean of saline water irrigation on dry matter yield of both Kallar grass and *Atriplex* plants after 6 months growth period. The plant response varied due to soil type and saline of irrigation water. In sandy soil, a significant increase in shoot of dry matter yield in both tested plants was noticed with the increase of water salinity which agree with previous work (El-Gala *et al*., 2004).

However, a significant decrease in shoot dry matter yield of both tested plant grown in calcareous and clayey soils due to the increase of water salinity. The highest biomass accumulation for *Atriplex* was observed in case of calcareous soil (8.7 ton Fed.). However, the highest values for Kallar grass were obtained in sandy soil (8.1 ton Fed).

TABLE 2. Dry matter yield of Kallar grass and *Atriplex* (mean of two seasons) shoots as affected by salinity and soil types.

Soil texture	Irrigation Water EC (dS/m)	Kallar grass	*Atriplex*
		Shoots	
		Ton/Fed	
Sandy	0.3	7.83	4.73
	4	7.80	6.60
	8	8.68	6.34
Mean		8.10	5.89
Calcareous	0.3	7.36	9.17
	4	6.07	9.43
	8	5.04	7.62
Mean		6.16	8.74
Clayey	0.3	2.84	4.58
	4	4.81	4.49
	8	3.63	3.90
Mean		3.76	4.32
L.S.D (5%) Soil		0.47	0.47
EC		0.32	0.39
Soil x EC		0.55	0.68

Nutritional values of the tested halophytic plants as fodder

Table 3 present N%, P content (ug/g), and K content (mg/g) in shoots of Kallar grass and *Atriplex* grown on different textured soils as affected by salinity of irrigation water. A significant decrease in both N and protein content % in plant shoots was observed due to increasing water salinity for both tested plants which confirm previous results in a solution culture experiment (Abou El-Naga, 2004). The lowest N and protein % value was noticed at 8 dS/m treatment in case of Kallar grass grown in clayey soil. Similar results were reported by Harrouni *et al*. (1999). They investigated seven halophytic plants, which were subjected to 25, 50, 75 and 100% seawater irrigation. Their results indicated that the nitrogen concentration in shoots and roots decreased with the increase of salinity, except for *Atriplex marina*, which N increased in shoots with the increase of seawater percentage. The obtained crude protein for Kallar grass ranged from 2.58 to 6.34 % while for *Atriplex* ranged from 3.39 to 7.25 %which seems to be lower than the reported values in the literature. Crude protein content was reported to range from 10-20 % of the DM, (Yaron, 1985; Benjamin *et al.*, 1986; Benjamin & Oren, 1986 and Teifert, 1989).

Concerning P-content as affected by salinity, result showed that there is no significant effect in kallar grass P-content due to salinity. But was significantly decreased in shoot of *Atriplex* plant. However, the phosphorus content was relatively low in both tested plants. Data on mineral composition of *Atriplex spp.* grown in Egypt showed that all plant species attained sufficient concentrations of major elements which appeared to be more than enough to cover the mineral requirements of grazing animals except for S and P elements (Gihad & El-Shaer, 1994).

It is worth to mention that in most cases *Atriplex* plants exhibited higher amounts of N, P and crude protein content as shown in Table 3. El-Shaer & Kandil (1999) concluded that *Atriplex* could greatly increase the productivity of salt-affected soils in Egypt. They stated that *Atriplex spp.* can play a significant role in providing available and valuable nutrients to ruminants, particularly during seasonal feed shortage.

TABLE 3. Nitrogen, phosphorus, potassium and protein, content in Kallar grass and *Atriplex* shoots as affected by salinity and soil texture.

Soil texture	Irrigation Water EC(dS/m)	Kallar grass				*Atriplex*			
		N	P	K	Protein	N	P	K	Protein
		%	(ug/g)		%	%	(ug/g)		%
Sandy	0.3	0.77	887	14.8	4.93	0.96	1260	10.6	6.14
	4	0.93	887	12.0	6.02	0.89	1673	12.3	5.70
	8	0.99	1163	8.00	6.34	0.53	1485	13.5	3.39
Mean		0.90	979	11.6	5.74	0.79	1473	12.1	5.08
Calcareous	0.3	1.04	1016	1.85	6.63	1.13	1998	0.95	7.25
	4	0.80	950	1.18	5.12	0.90	1525	1.55	5.76
	8	0.64	857	1.08	4.10	0.65	1285	1.45	4.18
Mean		0.83	914	1.37	5.29	0.90	1603	1.32	5.73
Clayey	0.3	0.55	916	12.8	3.52	0.65	1493	12.4	4.16
	4	0.56	858	10.3	3.58	0.70	1284	15.3	4.48
	8	0.40	738	9.25	2.58	0.59	1231	16.2	3.78
Mean		0.50	837	10.8	3.23	0.65	1336	14.6	4.14
L.S.D (5%) soil		0.04	N.S	2.62	0.28	0.04	162	0.02	0.25
EC		0.03	N.S	2.05	0.21	0.03	162	0.02	0.20
Soil x EC		0.06	97.4	N.S	0.37	0.05	281	0.03	0.35

Concerning K content, Kallar grass showed a negative response to increasing water salinity, which resulted in a decrease of K concentration in shoots at any tested soil. While, *Atriplex* showed a positive trend, which may indicate variation in the mechanism of salinity tolerance in plants by different elemental uptake and accumulation. The lowest K content was obtained in the plants grown in the calcareous soil, followed by the sandy then the clayey soil. It is well known fact that the saline ions compete with chemically similar nutrient ion (for *e.g.*, Na with K and Cl with nitrate) which may lead to nutrient deficiencies. Harrouni *et al.* (1999) reported that the response of the species studied at high salinity was an accumulation of Na^+ accompanied by a decrease in K^+ absorption. However, the reduction in K uptake occurred in the absence of a detrimental injury in the tested plant species, which survived.

Micronutrients uptake

Results reveal that increasing salinity levels in irrigation water usually led to a significant decrease in Fe, Mn, Zn and Cu content by the tested plants at any used soil texture (Table 4). *Atriplex* shoots showed the highest Fe, Zn and Cu concentration, compared to Kallar grass at any tested soils.

Iron

Iron content in plant shoot sample samples varied with plant species, soil texture and salinity treatments (Table 4). Averages of Fe concentration in Kallar grass shoots were 515, 211 and 333 ug/g while, it was 586, 362 and 514 ug/gin Atriplex shoots when, plant in the plants grown in sandy, calcareous, and clayey soil, respectively. These level of Fe content is more than optimum. Average concentration of Fe in plants was reported to be 100 mg/kg (Epstein, 1972). Pasture Fe contents vary with plant species and generally are around 300 mg/kg on dry matter basis (NRC, 1988). It is generally accepted that the Fe requirements of young ruminant animals are higher than those of nature ruminants and are thought to be about 100 mg/kg (NRC, 1988).

Manganese

Manganese concentration in Kallar grass shoots ranged between 33.7 to 119 ug/g with an average of 76.3 ug/g in Kallar grass shoots. However, in case of *Atriplex* shoots Mn-concentration ranged between 22.8 to 63.9 ug/g with an average of 43.4 ug/g. Manganese content was affected by soil texture, for example Kallar grass shoots contained average values of 72.1, 40.5 and 88.7 ug Mn/g for the three tested soils, respectively. The relevant Mn-values for *Atriplex* shoots were always lower (38.7, 29.9 and 46.5 ug/g above mentioned for three tested soils). Animal requirement in the diet is generally > 40 mg Mn /kg dry matter. It is worth mentioning that average Mn concentration in plant was reported by Epstein (1972) to be around 20 mg/kg.

Zinc

Zinc levels in plant shoots varied due to plant species, soil texture and salinity treatment (Table 4). Averages of Zn concentrations in Kallar grass shoots were 60.0, 58.7 and 55.3 ug/g while, they were 84.1, 77.8 and 88.7 ug/g for *Atriplex* plants when grown in sandy, calcareous and clayey soil, respectively. The Zn requirement of cattle is less well studied than that of non-ruminants (NRC, 1988). A Zn level of 40 mg/kg has been suggested for diets of calves, dairy cows, and bulls (NRC, 1988). Zinc concentrations in pasture herbage ranged between 17 and 60 mg/kg on a dry basis, with most values falling between 20 and 30 mg/kg (Underwood, 1981). Kabata-Pendias & Pendias (1992) indicated that the approximate normal concentration of Zn in nature-leaf tissue is 27-150 mg/kg.

Copper

Copper content in Kallar grass and *Atriplex* shoots showed a slight variation relatively, as compared with other micronutrient (Table 4). Averages of Cu concentrations in Kallar grass shoots were 6.1, 6.5 and 5.2 ug/g while, they were 7.6, 11.9 and 11.6 ug/g for *Atriplex* plants when grown in sandy, calcareous and clayey soil, respectively. The normal Cu concentration in plant tissues ranged from 5 to 20 mg/kg, (Melsted *et al.*, 1969). As copper requirements of animals are powerfully influenced by the interaction between this metal and other dietary components, it is necessary to specify the conditions under which the requirements are to be applied. Although 4 mg/kg of dietary Cu will meet the requirement of cattle under certain conditions, 10 mg Cu/kg is a more practical minimum requirement (Underwood, 1981). More than 10 mg/kg of Cu may be required, however, for cattle grazing pastures or consuming feedstuffs that contain high level of Mo or other interfering substances (NRC, 1988).

TABLE 4. Concentration of some nutrients in Kallar grass and *Atriplex* shoots as affected by salinity and soil texture.

Soil texture	Irrigation Water EC(dS/m)	Kallar grass				*Atriplex*			
		Fe	Mn	Zn	Cu	Fe	Mn	Zn	Cu
		(ug/g)				(ug/g)			
Sandy	0.3	586	96.3	63.9	8.4	617	41.9	94.8	9.0
	4	537	62.2	59.9	6.9	576	39.4	90.2	8.2
	8	423	57.8	56.1	3.1	512	34.9	67.3	5.7
Mean		515	72.1	60.0	6.1	568	38.7	84.1	7.6
Calcareous	0.3	337	48.0	67.3	7.4	608	47.4	81.2	12.7
	4	256	39.9	56.3	6.4	362	25.7	78.3	11.8
	8	211	33.7	52.6	5.8	276	16.7	74.0	11.1
Mean		211	40.5	58.7	6.5	362	29.9	77.8	11.9
Clayey	0.3	420	119	61.5	6.4	560	63.9	115	12.3
	4	319	90.0	59.5	5.1	522	52.9	84.3	11.8
	8	260	57.0	45.0	4.1	459	22.8	66.6	10.8
Mean		333	88.7	55.3	5.2	514	46.5	88.7	11.6
L.S.D (5%) soil		19.6	11.0	0.99	0.30	79.2	8.20	5.27	1.18
EC		29.4	5.14	2.52	0.31	36.5	6.25	3.69	1.08
Soil x EC		N.S	8.90	4.37	0.54	63.2	10.8	6.39	N.S

As it might be expected increasing HCO_3^- level in the soil, due to irrigation with high saline water, could depress plant micronutrient content. This finding is thought due the effect of pH on micronutrients availability to plant (Romheld & Marschner, 1986). Again the solution culture experiment data support this finding (El-Gala *et al.*, 2004).

Micronutrient interactions as affected by soil texture and salinity

Interactions observed within plants between trace elements have indicated that these processes are quite complex, being at times both antagonistic and synergistic in nature, and occasionally are involved in the metabolism of more than two elements (Kabta-Pendias & pendias, 1992). The greatest number of antagonistic reactions have been observed for Fe, Mn, Zn and Cu which are obviously, the key elements in plant physiology. Several factors could effect the mechanism of nutrient interactions one of them is soil solution chemistry (pH, EC, soluble cations and anions, ... etc.).

Discrimination factor (DF) is a good parameter to illustrate the kinetics of elements uptake and its possible interactions, defined as:

DF = (A plant/B plant)/(A soil/B soil)

Where A and B are the concentration of two nutrient analogue to each other, (either in plant or available in soil).

For example values of DF below unity indicate that B is more efficiently absorbed than A (Menzel & Heald, 1955 and Smolders *et al.,* 1996). Table 5 Shows DF values between different tested nutrients (such as Mn/Fe, Zn/Fe, Cu/Fe, Zn/Mn, Cu/Mn, Cu/Zn, Mn/Zn and Mn/Cu) for both Kallar grass and *Atriplex* shoots grown on different soils type. Results indicates that Fe was efficiently absorbed than Mn, Zn or Cu. DF-values varied between the tested nutrients due to soil texture, salinity and plant species. In general DF-values for Zn/Mn and Cu/Mn showed a tendencity to increase with increasing salinity at any tested plant or soil. However, the opposite was true for the rest of DF-values particularly the Mn/Fe, Zn/Fe and Cu/Fe. In most cases DF-values were higher in case of Zn/Mn followed by Cu/Mn particularly in the clayey soil. These variable results could be attributed to the interactions between major elements in soil solution (Ca, Mg,...etc.) and trace elements (Fe, Mn, Zn, Cu,... etc.). Several reports have showed that clearly Ca, P and Mg are the main antagonistic elements against the absorption and metabolism of several trace elements ((Kabta-Pendias & pendias, 1992; Olsen, 1972 and Wallace, 1971). Example of :

Antagonistic elements		Synergistic elements
Ca X Fe, Cu, Mn	and	Zn and Cu, Mn
Mg X Fe, Mn, Cu	and	Zn
Fe X Mn, Zn, Cu		

Some synergistic effects, have also been observed for antagonistic pairs of elements, depending on the specific reaction of the plant genotype or species (Wallace, 1971)

Conclusion

Data shows a significant decrease in both N and protein content % in plant shoots for both tested plants with increasing salinity. P-content in Kallar grass was not significantly affected by salinity, but, it was significantly decreased in shoots of *Atriplex* plants. Kallar grass showed a negative response to increasing water salinity, which resulted a decrease in K concentration in shoots at any tested soils. Results reveal that increasing salinity levels in irrigation water usually led to a significant decrease in Fe, Mn, Zn and Cu uptake by the tested plants at any tested soils. Results suggest that there is a possibility of filling a significant proportion of the feed gap in Egypt by establishing salt bushes on salt-affected lands. Benefits of ***halophyte*** spp., include high biomass yield, evergreen habits, drought and salinity tolerance .

TABLE 5. Discrimination factor (DF) of some micronutrients in Kallar grass and *Atriplex* shoots as affected by salinity and soil types.

Soil texture	Irrigation Water EC(dS/m)	Kallar grass Discrimination factor (DF)							
		Mn/Fe	Zn/Fe	Cu/Fe	Zn/Mn	Cu/Mn	Cu/Zn	Mn/Zn	Mn/Cu
Sandy	0.3	0.35	0.19	0.17	0.53	0.62	0.91	1.88	2.05
	4	0.25	0.19	0.16	0.77	0.49	0.80	1.29	1.61
	8	0.30	0.23	0.08	0.78	0.30	0.38	1.28	3.34
Calcareous	0.3	0.02	0.10	0.04	4.53	1.75	0.39	0.22	0.57
	4	0.02	0.11	0.04	4.56	1.82	0.40	0.21	0.55
	8	0.02	0.13	0.05	5.05	1.95	0.39	0.20	0.51
Clayey	0.3	0.02	0.09	0.01	4.00	0.31	0.08	0.25	3.25
	4	0.02	0.11	0.01	5.11	0.32	0.06	0.20	3.08
	8	0.02	0.10	0.01	6.10	0.41	0.07	0.16	2.43
Atriplex									
Sandy	0.3	0.15	0.27	0.18	1.82	1.20	0.66	0.55	0.83
	4	0.15	0.27	0.17	1.84	1.16	0.63	0.54	0.86
	8	0.15	0.23	0.13	1.95	0.91	0.59	0.50	1.10
Calcareous	0.3	0.01	0.07	0.04	5.54	3.04	0.55	0.18	0.33
	4	0.01	0.11	0.06	9.85	5.20	0.53	0.11	0.19
	8	0.01	0.14	0.07	14.33	7.53	0.53	0.07	0.13
Clayey	0.3	0.01	0.12	0.01	13.91	1.10	0.08	0.07	0.91
	4	0.01	0.10	0.01	12.32	1.28	0.10	0.08	0.78
	8	0.01	0.09	0.01	22.58	2.71	0.12	0.04	0.37

References

Abou El-Nga, H. A. (2004) Utilization of wasteland and saline water for the production of certain crops, *Ph. D. Thesis,* Ins. of Environ. Studies & Res. Ain Shams Univ.

Ashour, N. I.; Arafat, S.M.; Abd El-Haleem, M.; Serage, S. and Hndour & Mekki, B. (1999) Growing halophyte in Egypt for forage production. Fac. of Sci., Mansoura Univ.

Aslam, Z. (1999) Groth utilization and salt tolerance of *Atriplex* species. In: "*Halophyte Uses in different Climates*", A. Hamdy *et al.* (Ed.), II. Backhuys Pub., Leiden, Netherlands.

Benjamin, R.W.; Barkai, D.; Hefetz, Y.; Lavie, Y. and Yaron, A. (1986) The apparent digestibility of Atriplex nummularia and nitrogen balance of sheep consuming it. In: *"Compiler: Fodder Production and its Utilization by Small Ruminants in Arid Regions"*, A. Dovrat, pp. 59-82, Inst. of Appl. Research, Ben Gurion Univ., Beer-Sheva.

Benjamin, R. W. and Oren, A. (1986) The apparent digestibility of Atriplex barclayana and the nitrogen balance of sheep consuming this shrub. In: "*Analysis of Animal*

Nutrition in Shrub-Grassland Grazing Systems with Special Reference to Semi-Arid Africa", R.W. Benjamin; N.G. Seligman; M. Forti and K. Becker (Ed.), pp. 7-35, Inst. of Appl. Research, Ben Gurion Univ., Beer-Sheva.

Bernstein, L.; Francois, L. E. and Clark, R. A. (1974) Interactive effects of salinity and fertility on yields of grains and vegetables. *Agron. J.* **66,** 412.

Chapman, H. D. and Pratt, P. E. (1961) *"Method of Analysis for Soils, Plant and Waters"*, Univ. of Calif., Div. of Agric. Sci.

El-Gala, A. M.; Seham, M. M.; Abdel-Sabour, M. F. and Abou El-Naga, H. (2004) Effect of salinity and Calcium Crbonate on biomass accumulation and cationic balance of two halophyte plants. *J. Environ. Sci.* **9,**18.

El-Shaer, H. M. and Kandil, H. M. (1999) Potential of atriplex species as fodder shrubs under the arid conditions of Egypt. In: *"Halophyte Uses in Different Climates"*, A. Hamdy *et al.* (Ed.), pp . 57-75,II Backhuys Pub.

Epstein, E. (1972) *"Mineral Nutrition of Plants: Principles and Perspectives"*, Jon Wiley and Sons, New York.

Gihad, E. A. and El-Shaer, H.M. (1994) Utilization of halophytes by livestock on rangelands: Problems and Prospects (this volume, Ch. 6).

Gomez, K. A. and Gomez, A. A. (1984) *"Statistical Procedures for Agriculture Research"*, 2nd ed., P. 680, John Willey and Sons, New York,

Haider, G. and Ghafoor, A. (1992) Manual of salinity research method. Iwasri Publication No., 147 Lahore, Pakistan.

Harrouni, M. C.; Daoud, S.; Alami, A. and Debbagh, B. (1999) Responses of some halophytes to seawater irrigation in Morocco; In: *"Halophyte Uses in Different Climates"*, A. Hamdy *et al.* (Ed.), pp. 57-75, II Backhuys Pub.,

Hassan, N. A. K.; Drew, J. V.; Knudsen, D. and Olson, R. A. (1970a) Influence of soil salinity on production of dry matter and uptake and distribution of nutrients in barley and corn: I. Barley (*Hordeum vulgare L.*), *Agron. J.* **62,**43.

Hassan, N. A. K.; Drew, J. V.; Knudsen, D. and Olson, R. A. (1970b) Influence of soil salinity on production of dry matter and uptake and distribution of nutrients in barley and corn: II. Corn (*Zea mays L.*). *Agron. J.* **62,**46.

Jackson, M. L. (1976) *"Soil Chemical Analysis"*, Constable and Comp. LTD., England.

Kabata-Pendias, A. and Pendias, H. (1992) *"Trace Elements in Soils and Plants"*, 2nd ed., CRC Press, Inc. Boca Raton, Florida.

Lindsay, W. L. and Norvell, W. A. (1978) Development of a DTPA soil test for zinc, iron, manganese and copper. *Soil Sci. Soc. Am. Proc.* **42,**421.

Lunin, J. and Gallatin, M.H. (1965) Salinity-fertility interactions in relation to the growth and composition of beans: I. Effects of N. P. L. II. Varying levels of N and P. *Agron. J.* **57**, 339.

Melsted, S. W.; Motto, H. L. and Peck, T. R. (1969) Critical plant nutrient composition values useful in interpreting plant analysis data. *Agron. J.* **61**, 17.

Menzel, R. G. and Heald, W. R. (1955) Distribution of potassium, rubidium, cesium, and strontium within plants grown in nutrient solutions. *Soil. Sci.* **78**, 287.

National Research Council (NRC) (1988) "*Nutrient Requirements of Diary Cattle*" 8th ed., Natl. Acad. Sci., Washington, DC.

Olsen, S.R. (1972) Micronutrient interactions. *In: "Micronutrients in Agriculture"*, J. J. Mordvedt, P.M. Giordano and W.L. Lindsay (Ed.), Soil Science Society of America, Madison, Wis. 242.

Power, P. (1985) Users guide to MSTAT (Ver. 3.0), Michigan States Univ. USA.

Romheld, V. and Marschner, H. (1986) Mobilization of iron in the rhizospere of different plant species. *Adv. Plant Nutr.* **2**,155.

Smolders, E. ; Kiebooms, L.; Buysse, J. and Merckx, R. (1996) ^{137}Cs uptake in spring wheat at varying K supply. I. The effect in solution culture. *Plant and Soil.* **181**, 205.

Teifert, M. A. (1989) Nitrogen compounds in *Atriplex* nummularia. In: "*Compiler: Fodder Production and its Utilization by Small Ruminants in Arid Regions*, A. Dovrat, pp. 66-75, Inst. of Appl. Research, Ben Gurion Univ., Beer-Sheva, Israel.

Underwood, E. J. (1981) " *The Mineral Nutrition of Livestock*", 2nd ed., Common-wealth Agric. Bureau, Slough, England.

Villiers, D.; Van Royen, M.A.; Theron, G. and Classens, A. (1995) The effect of leaching and irrigation on the growth of *Atriplex scmbaccata iland* Degradation, Rehabilitation **20**, 125.

Wallace, A. (1971) " *Regulation of the Micronutrient Status of Plants by Chelating Agents and other Factors*". A.Wallace (Ed.), Los Angeles, 309.

Yaron, A.; Levi, L. and Benjamin, R. W. (1985) Analysis of shrubs leaves for crude protein content. In: "*Compiler: Fodder Production and its Utilization by Small Ruminants in Arid Regions*", A. Dovrat, pp. 82-92, Inst. of Appl. Research, Ben Gurion Univ., Beer-Sheva, Israel.

(*Received* 12/2004;
accepted 5/2005)

تأثير الرى بمياه مالحة على امتصاص المغذيات بواسطة اثنتين من نباتات الهلوفيت النامية فى اراض مختلفة القوام

ممدوح فتحي عبد الصبور، مجدى أحمد رزق ، عبد المنعم محمد الجلا*
وحمدي على أبو النجا
مركز البحوث النووية– هيئة الطاقة الذرية و*كلية الزراعة–جامعة عين شمس–
القاهرة – مصر.

اجريت تجربة ليزيميتر فى مزرعة التجارب بقسم بحوث الاراضى مركز البحوث النووية بهيئة الطاقة الذرية لتقييم تاثير الرى بمياه مالحة عند ثلاث مستويات (كنترول٠,٣ ، ٤، ٨ ديسيمنس/متر) على محصول نباتين من نباتات الهالوفيت النامية فى اراضى مختلفة القوام كقيمة غذائية للنباتين المستخدمين وهما نبات Kallar grass ونبات *Atriplex* اما الاراضى المختبرة فهى رملية–جيرية–طينية درس خلالها الكتلة الحيوية والعناصر المغذية Mn, Zn, Cu N, P, K, Fe.

اوضحت النتائج انخفاض المعنوية لكل من النيتروجين والمحتوى البروتينى فى سيقــان كلا النباتين مع زيادة الملوحة. وقد لوحظ انخفاض قيم النيتروجين والنسبــة المئوية للبروتين عند المعاملة ٨ ديسيمنس / متر فى حالة نبات Kallar grass النامى فى الارض الطينية. محتوى الفوسفورفى نبات Kallar grass لم يتاثر معنويا بالملوحة بينما قل معنويا فى سوق نبات *Atriplex* وعموما كان محتوى النباتات من الفوسفور منخفضا فى كلا النباتين. وفى معظم الحالات فأن نباتات *Atriplex* احتوت على كميات كبيرة من الفوسفور والنيتروجين والبروتين الخام و أظهر نبات Kallar grass استجابة سلبية للزيادة فى ملوحة المياه ونتيجة لذلك انخفض تركيز البوتاسيوم فى السوق فى كل الاراضى تحت الدراسة بينما اعطى نبات *Atriplex* أتجاه موجب مشيرا الى الاختلاف فى ميكانيكية تحمل الملوحة فى النباتات من حيث تراكم وامتصاص العناصر .

بينت النتائج ايضا ان زيادة مستويات الملوحة فى مياه الرى يؤدى الى انخفاض معنوى فى Fe, Zn, Mn, Cu الممتص فى كلا النباتين فى جميع الاراضى المستخدمة فى التجربة وأن سوق نبات Atriplex اعطى تركيز عالى من Fe, Zn, Cu اذا قورن بنبات Kallar grass فى كل الاراضى المستخدمة.

قدرت معاملات التميز Discrimination factors (DF) للعناصر الصغرى وقد وجد ان قيمها تختلف بين المغذيات وهو راجع الى نوع التربة والملوحة ونوع النبات وتشير النتائج الى ان Fe نو فاعلية فى الامتصاص عن كل من Mn, Zn, Cu عموما قيم DF الزنك/المنجنيز و النحاس/المنجنيز تميل للزيادة بزيادة الملوحة فى كلا النباتات المختبرة والاراضى ايضا بينما العكس صحيح فى بقية قيم DF خصوصا المنجنيز/الحديد ، الزنك/ الحديد والنحاس/ الحديد.