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Response of Sugar Beet, *Beta vulgaris* (L.) to Irrigation with Saline Water, Organic Manure and Soil Texture

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A POT experiment was conducted on sugar beet, *Beta vulgaris* (L.), in a greenhouse of National Research Centre, Dokki, Egypt, during the two winter seasons 2006/07 and 2007/08. The treatments included the combinations of two soil textures (clay and sand), three saline water irrigation levels, viz. tap water (Control = 300), 4000 and 8000 ppm and three quantities of organic manure (zero, 12.5 and 25.0m^3/feddan, 1 feddan = 4200.78 m^2). Results indicated that soil texture, saline water irrigation and organic manure significantly affected most of studied traits. Higher values on leaves and root traits were produced by 300 ppm and 25.0 m^3 manure. Root was the biggest in sandy soil. Clay soil produced pronounced root traits increasing salinity in irrigation was significantly detected studied traits. The effect of manure was in opposite to salinity one. The first order interactions: salinity x either soil or manure showed lesser significant differences, in opposite to (soil x manure). Only fresh and dry weights were significantly affected by the second order interactions. The recommended combination was (sand soil x 300 ppm water x 25.0 m^3 manure).

Keywords: Sugar beet, Soil texture, Salinity, Saline water irrigation, Organic manure.

Sugar beet, *Beta vulgaris* (L.), is the second source of sugar (about 30%) after sugar cane (about 70%). Such position covers world and also Egypt. The local gap between sugar production and consumption may reached about 28%. Sugar beet has some advantages: the ability to store high sucrose percentage, the by-products which are used for alcohol production and livestock feeding and the wide adaptability to grow in poor, saline and alkaline soils.

Higazy *et al.* (1995) reported that sugar beet cv. Tribel was the most salt tolerant variety and could withstand up to 6000 ppm salt concentration in irrigation water, without any significant reduction in fresh and dry weights of roots as well as sucrose %. Khafagi & El-Lawendy (1996) found that fresh and dry weights of leaves and roots, number of leaves, diameter and length of root were significantly reduced with the increase of NaCl level. Mekki & El Gazzar

(1999) mentioned that moderate salt concentration (2500 ppm) gave the highest root diameter and fresh root yield. A high salt concentration (7500 ppm) increased sucrose % while, sugar yield (g/plant) was reduced.

With this respect, Jarvis *et al.* (1997) reported that addition of 30-60 kg N + 6 ton poultry manure/feddan (1feddan = 4200.78 m^2) gave higher root yield and root sugar content. In addition, Poustini & Najafi-Nejad (1997) reported that use farmyard manure (FYM) increased root yield but significantly decreased root sugar content. Zalat & Nemeat Alla (2001) found that FYM increased sucrose %. Application of FYM was comparatively more effective than other treatments for overcoming the adverse effects of irrigation with poor quality water, minimizing the adverse effect of crust formation, that usually occurred after irrigation in calcareous soils. Such positive effects can increase the final stand per unit area and consequently increase the yield (Kahlown & Azam, 2003). Thus, this investigation aimed to study the effect of soil texture, saline water irrigation and organic manure as well as their combinations on growth, yield traits and yield, for recommending the probable treatment for high yield with good quality.

Materials and Methods

A pot experiment was carried out on sugar beet *Beta, vulgaris* (L.), in a greenhouse, National Research Centre (NRC), Dokki, Egypt, during the two successive winter seasons 2006/07 and 2007/08. Soil physical properties were analyzed using the procedure described by Black *et al.* (1981). Soil chemical analysis was measured according to the procedure described by Jackson (1973), (Table 1). Chemical analyses of irrigation water and organic manure are presented in Tables 2 and 3, respectively.

TABLE 1. Physical and chemical analyses of the soil used in the experiment in 2006/07 and 2007/08 seasons.

Soil texture	Seasons	Physical analysis			Chemical analysis					
		Sand %	Silt %	Clay %	pH	EC m mohs	Soluble HCO_3 meq/l	Soluble Na meq/l	Soluble Cl meq/l	Organic matter %
Clay	2006/07	20.00	35.00	45.00	8.42	1.98	0.84	0.36	0.19	2.57
	2007/08	21.00	32.00	47.00	8.09	1.84	0.59	0.33	0.15	2.65
Sand	2006/07	94.12	2.00	3.88	7.54	2.21	0.64	0.48	0.25	0.25
	2007/08	93.86	2.00	4.14	7.05	2.12	0.53	0.42	0.50	0.41

TABLE 2. Chemical analysis of irrigation water, during 2006/07 and 2007/08 seasons.

Season / Salinity (ppm) / Cations and anions		2006/07			2007/08		
		300 (Control)	4000	8000	300 (Control)	4000	8000
Sodium absorption ratio (SAR)		5.43	12.75	20.95	5.38	12.06	21.56
Soluble cations meq/l	$Ca^{++} + Mg^{++}$	16.10	21.00	36.00	15.78	20.65	35.12
	Na^{+}	15.40	39.80	87.50	14.65	38.21	87.99
	K^{+}	1.50	1.60	1.60	1.54	1.54	1.69
Soluble anions meq/l	$HCO_3^{-} + CO_3^{--}$	1.00	1.40	1.60	1.20	1.36	1.64
	Cl^{-}	22.20	50.80	95.20	21.39	48.35	95.51
	SO_4^{--}	9.80	10.20	28.30	9.38	10.69	27.65

TABLE 3. Chemical analysis of organic manure* during 2006/07 and 2007/08 seasons.

Mineral contents	N %	P %	K %	D.M.%**	O.C. %***	C/N ratio	Fe ppm	Mn ppm	Zn ppm	Cu ppm	Pb ppm
2006/07 season	2.12	1.19	1.43	34.8	26.3	15.29	231	231	141	99	1.09
2007/08 season	2.35	1.68	2.07	42.5	17.0	17.14	250	246	108	54	1.32

* According to Black *et al.* (1981), ** = Dry matter, *** = Organic content.

The experiment tested 18 treatments combination; two soil texture (clay and sand), three saline water; (control, tab water, *i.e.* 300, 4000 and 8000 ppm) and three quantities of organic manure (0.0, 12.5 and 25.0 m^3/feddan). A complete randomized design (C.R.D), with five replicates was used.

Pots of 50 cm diameter were filled, each with 20 kg soil which was carefully mixed with the assigned level of organic manure ensuring homogeneity. A few seeds of sugar beet, H poly cv., were seeded on September 15^{th} and 20^{th}, in the first and second season, respectively. After germination, plants were thinned to ensure five plants, well distributed in each pot. Such plants were equally irrigated with tap water for four weeks, before salinization. Irrigation was carried out daily with saline water, using one liter/pot to maintain suitable soil water content.

Constant level of soil moisture (field capacity + 25%) was devoted by using saline water irrigation when the plants nearly reached the wilting point. Nitrogen

fertilizer was added in the form of ammonium nitrate (33.5% N), at a rate of 6g/pot, in two equal doses, one after 21 days after seeding (DAS)and the second three weeks later. Calcium super phosphate (15.5% P_2O_5) at 10 g/pot was added once before seeding. Potassium sulphate (48% K_2O) was applied at 4 g/pot, after thinning. At harvest, sugar beet plants were pulled on April 15th and 25th, in the first and second season, respectively.

Studied topics and traits

Growth traits

At 60 and 120 DAS, leaves and root were separated and oven dried at 70°C, until constant weight, one sugar beet plant was randomly taken from each pot to determine the following traits:

1-Leaves number/plant. 2-Leaves fresh weight (g/plant). 3-Leaves dryweight (g/plant).
4- Root length (cm). 5- Root diameter (cm). 6- Root fresh weight (g/plant).
7-Root dry weight (g/plant).

Yield and yield components

At harvest, the remainder plants were taken from each pot to determine the following traits:

1-Leaves number/plant. 2-Leaves fresh weight (g/plant).3-Leaves dry weight (g/plant).
4-Root length (cm). 5-Root diameter (cm). 6-Root fresh weight (g/plant).
7-Sucrose % which was determined according to Le-docte (1927).
8-Sugar yield (g/plant), = Root yield x Sucrose %.

Data were subjected to statistical analysis and a combined analysis was performed. Mean values were compared by New Duncan s multiple range test (LSR) at μ 0.05. All process were done according to Steel & Torrie (1980). In all tables, means followed the same letters were insignificantly varied. The absence of letters means presence of insignificance.

Results and Discussion

In this study, the effects of irrigation with saline water and organic manure, in two soil textures and their different interactions are presented.

Growth traits

A-Effect of studied factors

Effect of soil texture: Table 4 shows the effect of soil texture on the studied traits at 60 and 120 days after seeding (DAS). Soil texture significantly affected all the studied traits, except leaves number/plant at 60 DAS. Sugar beet grown in clay soil possessed greater values with respect to fresh weight and dry weight of leaves/plant as compared with those grown in sandy soil. The opposite was true as regards fresh weight, dry weight, length and diameter of root. This may be due to that clay soil is relatively rich in macro and micro elements, organic matter and high water holding capacity which encourage better plant growth. While, in sandy soils it may be noticed some nutrient problems, resulting less fertility, less availability of nutrients, low water holding capacity and adsorption. Ali (2000) reported similar such result.

TABLE 4. Effect of soil texture, saline water irrigation and organic manure on growth traits, 60 and 120 DAS, (combined data of 2006/07 and 2007/08 seasons).

DAS	60							120						
Traits / Factors	Leaves number/ plant	Leaves fresh weight (g/plant)	Leaves dry weight (g/plant)	Root length (cm)	Root diameter (cm)	Root fresh weight (g/plant)	Root dry weight (g/plant)	Leaves number/ plant	Leaves fresh weight (g/plant)	Leaves dry weight (g/plant)	Root length (cm)	Root diameter (cm)	Root fresh weight (g/plant)	Root dry weight (g/plant)
Soil texture														
Clay	6.80	3.37 a	1.89 a	10.35 b	2.08 b	10.20 b	7.26 b	24.59 a	234.46 a	74.10 a	19.91 b	5.83 b	250.02 b	75.31 b
Sand	6.42	3.10 b	1.65 b	11.71 a	2.50 a	12.40 a	9.21 a	22.69 b	195.37 b	59.80 b	22.95 a	7.24 a	279.29 a	95.24 a
Saline water irrigation (ppm)														
300	7.44 a	3.85 a	2.16 a	11.47 a	2.43 a	11.88 a	8.69 a	24.27 a	221.74 a	68.87 a	22.00 a	6.89 a	273.87 a	88.00 a
4000	6.90 a	3.31 b	1.79 b	11.02 b	2.28 b	11.34 a	8.15 b	23.54 b	214.68 b	66.87 b	21.39 b	6.54 b	264.31 b	85.17 b
8000	5.48 b	2.55 c	1.36 c	10.59 c	2.15 c	10.68 b	7.86 b	23.11 b	208.34 c	65.09 c	20.89 b	6.17 c	255.79 c	82.65 c
Organic manure (m^3/fed)														
0.0	5.44 b	2.37 c	1.27c	9.78 c	1.92 c	10.06 c	7.21 c	22.61 c	205.45 c	62.26 c	20.11 c	5.93 c	255.68 c	78.97 c
12.5	6.96 a	3.36 b	1.80 b	11.17 b	2.23 b	11.38 b	8.37 b	23.61 b	214.72 b	67.19 b	21.47 b	6.49 b	264.33 b	85.53 b
25.0	7.42 a	3.98 a	2.24 a	12.14 a	2.72 a	12.46 a	9.12 a	24.70 a	224.58 a	71.39 a	22.71 a	7.19 a	273.96 a	91.32 a

Effect of saline water irrigation: Data in Table 4 declare that all growth traits were significantly decreased by increasing salinity in irrigation water from 300 to 8000 ppm such decrease was gradual and significant in most cases, either in 60 or 120 DAS. The reduction in growth traits as a result of increasing salinity levels was expected because of the increase in osmotic pressure, which affects the ability of the plant to absorb water for growth processes as well as the toxicity of specific ions and their effects on plant physiological processes. It might be also due to the secondary specific-ions effects of sodium as the excess of exchangeable sodium can lead to soil swelling and dispersion causing water infiltration, aeration and root penetration problems (Ayers, 1952). Similar results were reported by Khafagi & El- Lawendy (1996).

Effect of organic manure: Table 4 indicates that organic manure application led to gradual and significant increases in most studied growth traits, either at 60 or 120 DAS. The only exception was recorded on number of leaves/plant at 60 DAS, where no significant differences was detected between the application of manure by 12.5 and 25.0 m^3/feddan. It is obvious that the greatest increase% was shown on leaves dry weight, *i.e* 76.38% at 60 days, meanwhile at 120 DAS, root diameter reflected the maximum increase percent, *i.e.* 21.25%. Organic manure might promote water holding capacity which gave rise to good aeration and drainage that encouraged better root growth and nutrient absorption. In addition, it may be stated herein that organic manure increased the presence of P, K and Mg in the soil beside encouraging the solubility of Ca, Mg as a result of the continuous lowering of pH and increasing electrical conductivity. Moreover, organic matter as a source of growth promoters, auxins, vitamins, amino acids might enhance the vegetative growth, yield and quality of the plant. Similar results were obtained by Suwara *et al.* (1998) who stated that leaf dry weight reached maximum with NPK+ FYM application.

B- Effect of first order interaction

Effect of interaction between soil texture and saline water irrigation: Data in Table 5 a demonstrate that no significant differences were reported with all traits. It is worthy to note gradual reductions in growth traits as the salinity concentration increased. Such effect was greater on sandy soil, and this might be due to that the adsorption capacity of the soil particles was very low and extracted the harmful effects like the exchangeable sodium.

Effect of interaction between soil texture and organic manure: Data in Table 5 b show no significant differences at 60 DAS, except on root fresh weight. In the second age, all traits significantly responded except leaves fresh weight and leaves dry weight/plant. However, addition of 25.0 m^3/feddan to sand soil recorded the highest significant values with most root aspects at 120 DAS.

Effect of interaction between saline water irrigation and organic manure: Data in Table 5 c declare insignificant differences on all studied traits, except fresh and dry weights of leaves at 60 DAS. Increasing water salinity without organic manure application showed the lowest values on different traits at 60 and 120 DAS. Leaves fresh and dry weights at 60 DAS, did not show significant differences when using FYM at 12.5 m^3/fed in combination with either 300 or 4000 ppm saline water. The combined effect of irrigation by saline water and organic manure, indicated that application of organic manure decreased the adverse effect of salinity on growth. Oraby & Mekki (2008) found similar results on (salinity x ascorbic acid) combination.

TABLE 5 a. Effect of interaction between soil texture and saline water irrigation on growth traits (combined data of 2006/07 and 2007/08 seasons).

DAS		60							120						
Traits / Factors		Leaves number/ plant	Leaves fresh weight (g/plant)	Leaves dry weight (g/plant)	Root length (cm)	Root diameter (cm)	Root fresh weight (g/plant)	Root dry weight (g/plant)	Leaves number/ plant	Leaves fresh weight (g/plant)	Leaves dry weight (g/plant)	Root length (cm)	Root diameter (cm)	Root fresh weight (g/plant)	Root dry weight (g/plant)
Clay	300	7.70	3.88	2.27	10.78	2.20	10.73	7.74	25.37	241.11	75.99	20.47	6.14	259.16	77.82
	4000	6.92	3.50	1.91	10.34	2.08	10.20	7.04	24.44	233.97	73.94	19.84	5.88	249.60	75.19
	8000	5.78	2.74	1.49	9.93	1.96	9.66	7.01	23.96	228.30	72.35	19.41	5.48	241.29	72.91
Sand	300	7.18	3.83	2.06	12.17	2.67	13.03	9.65	23.18	202.36	61.75	23.53	7.64	288.57	98.17
	4000	6.88	3.12	1.66	11.70	2.49	12.48	9.26	22.63	195.38	59.80	22.94	7.21	279.02	95.16
	8000	5.18	2.35	1.23	11.26	2.34	11.69	8.70	22.25	188.38	57.84	22.37	6.87	270.29	92.39

TABLE 5 b. Effect of interaction between soil texture and organic manure on growth traits (combined data of 2006/07 and 2007/08 seasons).

Clay	0.0	5.44	2.46	1.37	8.89	1.73	8.56 e	6.04	23.40 c	225.17	69.26	19.13 e	5.40 e	238.76 f	68.66 f
	12.5	7.18	3.47	1.87	10.54	2.03	10.2 d	7.39	24.26 b	234.16	74.34	19.91 de	5.83 d	249.39 e	75.43 e
	25.0	7.77	4.19	2.43	11.62	2.47	11.83 bc	8.36	26.11 a	244.05	78.69	20.68 cd	6.27 c	261.91 d	81.83 d
Sand	0.0	5.44	2.29	1.18	10.67	2.11	11.55 c	8.37	21.81 d	185.73	55.27	21.08 c	6.46 c	272.60 c	89.29 c
	12.5	6.74	3.25	1.73	11.79	2.42	12.56 ab	9.35	22.96 c	195.29	60.04	23.03 b	7.16 b	279.27 b	95.64 b
	25.0	7.07	3.76	2.04	12.67	2.97	13.10 a	9.89	23.29 c	205.11	64.08	24.73 a	8.11 a	286.01 a	100.80 a

TABLE 5 c. Effect of interaction between organic manure and saline water irrigation on traits (combined data of 2006/07 and 2007/08 seasons).

DAS		60						120							
Traits / Factors		Leaves number/ plant	Leaves fresh weight (g/plant)	Leaves dry weight (g/plant)	Root length (cm)	Root diameter (cm)	Root fresh weight (g/plant)	Root dry weight (g/plant)	Leaves number/ plant	Leaves fresh weight (g/plant)	Leaves dry weight (g/plant)	Root length (cm)	Root diameter (cm)	Root fresh weight (g/plant)	Root dry weight (g/plant)
300	0.0	6.50	2.80 cd	1.53 de	10.20	2.07	10.66	7.69	23.22	211.83	64.72	20.72	6.27	264.43	82.30
	12.5	7.72	3.88 b	2.16 b	11.60	2.37	11.96	8.74	24.22	221.55	68.78	21.98	6.85	272.98	87.64
	25.0	8.11	4.88 a	2.80 a	12.62	2.87	13.04	9.65	25.39	231.83	73.12	23.30	7.57	284.18	94.06
4000	0.0	6.05	2.35 ef	1.26 ef	9.75	1.92	10.07	7.21	22.50	205.21	62.17	20.07	5.93	254.98	78.75
	12.5	7.05	3.72 b	1.93 bc	11.15	2.23	11.45	8.43	23.44	214.59	67.16	21.48	6.48	263.98	85.44
	25.0	7.61	3.86 b	2.17 b	12.17	2.70	12.49	8.82	24.67	224.24	71.29	22.63	7.22	273.99	91.34
8000	0.0	3.78	1.97 f	1.03 f	9.38	1.78	96.45	6.72	22.11	199.32	59.90	19.53	5.58	247.63	75.88
	12.5	6.11	2.49 de	1.31 ef	10.75	2.08	10.72	7.94	23.16	208.04	65.63	20.95	6.15	256.04	83.52
	25.0	6.55	3.19 c	1.73 cd	11.65	2.58	11.86	8.90	24.05	217.67	69.75	22.18	6.78	263.71	88.55

C-Effect of second order interaction

The interaction did not show any significant effects on the studied traits at 60 and 120 DAS.

Yield and yield components

A- Effect of studied factor

Effect of soil texture : Table 6 indicates that significant differences were observed with all respects. Obviously, the three traits of leaves in clay soil surpassed the corresponding ones in sandy soil. As regards the remainder traits, the opposite was quite true. It seemed that the increase in length and diameter of root may be attributed to sandy texture which allowed good root penetration. Consequently, the root (length & width) take the ideal shape which gave the highest sucrose. In this concern, El Maghraby *et al.* (1997) found a linear relationship between sucrose % and both root length and diameter. They also reported that an increase by one cm in root length as well as in root diameter increased sucrose % by 0.30 and 0.12%, respectively.

Effect of saline water irrigation: Table 6 approves that yield and yield components were significantly decreased by increasing salinity in irrigation water except sucrose % which showed the opposite. No significant differences between saline water irrigation at 4000 and 8000 ppm with respect to leaves number/plant, sugar yield, and sucrose %. The depression in dry matter accumulation may mainly due to the increase in Na and Cl under high salt concentration, which caused a reduction in both activity of CO_2 fixation in photosynthesis and the enzymatic activity, resulting inhibition of chlorophyllase enzyme activity responsible for synthesis in the metabolic processes (Ahmed, 1990). The harmful effects of irrigation with saline water might be related to the injurious effect of specific ions such as NaCl, $CaCl_2$ and Na_2SO_4 which may inhibited the production of chlorophyll in leaves, high sodium concentration that induced calcium and magnesium nutritional deficiencies and influenced the respiratory pathways in roots (Abel & Mackenzie, 1964). However, long term exposure of roots to high salt concentration make the plants suffer from physiological drought, reduced water and nutrient availability (Bernstein, 1975), making direct toxic effect of different ions because of emplaces of mineral nutrition (Bower, 1976), minimized photosynthesis due to reduction in stomatal conduction and increasing stomatal limitations to CO_2 uptake and changed enzymatic activities in the plant. Similar observation were reported by Kandil (1993) and Mekki & El Gazzar (1999).

Effect of organic manure : Table 6 demonstrates that increasing organic manure attained significant surpluses in the studied traits, except leaves number/plant, where no significant differences between the control and application of 12.5 m^3/feddan. Obtained results were in agreement with those reported by Ouda *et al.* (1999) who found that root length and diameter, sucrose % and sugar yield were significantly affected by FYM and nitrogen fertilizer application. Also, Marinovic *et al.* (2004) reported that application of organic fertilizer increased the root yield between 1.41 - 2.13 ton/ha. They added that organic matter may turns improves soil moisture holding capacity in sandy soils.

TABLE 6. Effect of soil texture, saline water irrigation and organic manure on yield and yield attributes of sugar beet (combined data of 2006/07 and 2007/08 seasons).

Traits / Factors	Leaves number/ plant	Leaves fresh weight (g/plant)	Leaves dry weight (g/plant)	Root length (cm)	Root diameter (cm)	Root fresh weight (g/plant)	Sucrose %	Sugar yield (g/plant)
Soil texture								
Clay	21.39 a	260.74 a	54.90 a	20.71 b	8.64 b	400.06 b	16.23 b	65.00 b
Sand	18.13 b	228.96 b	41.42 b	23.39 a	10.66 a	481.06 a	16.62 a	79.98 a
Saline water irrigation (ppm)								
300	20.55 a	249.39 a	48.92 a	22.62 a	10.01 a	456.68 a	16.16 b	73.91 a
4000	19.65 b	244.68 b	48.08 b	22.05 b	9.65 b	440.64 b	16.41 ab	72.43 ab
8000	19.09 b	240.49 c	47.48 c	21.49 c	9.29 c	424.36 c	16.70 a	71.13 b
Organic manure (m^3/fed)								
0.0	19.02 b	236.79 c	43.46 c	20.83 c	8.97 c	419.81 c	15.76 c	66.28 c
12.5	19.55 b	245.01 b	48.55 b	22.08 b	9.71 b	444.12 b	16.51 b	73.41 b
25.0	20.72 a	252.76 a	52.47 a	23.24 a	10.27 a	457.76 a	16.98 a	77.78 a

B- Effect of first order interaction

Effect of interaction between soil texture and saline water irrigation: Table 7a indicates, in almost, no significant differences in sandy and clay soil, due to their interaction with saline water levels. The exception significant differences were detected on root fresh weight in sandy soil. The significance was reported on root fresh weight and sugar yield in clay soil. The maximum yield fresh weight, *i.e.* 489.85 g/plant was produced by the combination (sand soil x control irrigation).

Effect of interaction between soil texture and organic manure: Data in Table 7 b mostly, reported significant superiorities in favor to the combination of 25.0m^3/feddan FYM with both clay soil (on leaves traits) and sandy one on the remainder traits. The greatest yield/plant, *i.e.* 497.87 g was a product of combination (sand soil x 25.0 m^3/fed. FYM). The explanations herein are in close with those previously mentioned.

Effect of interaction between saline water irrigation and organic manure: Table 7 c shows insignificant differences on all studied traits except leaves dry weight, yield fresh weight and sugar yield. Increasing manure level to 25.0m^3/feddan and irrigation by control water produced the significant highest value with respect to leaves dry weight/plant, yield fresh weight (468.12 g) and sugar yield/plant (77.86 g). It seemed that FYM successfully interacted with control irrigation. In other words, salinity may negatively affected the contribution of manure, which did the opposite with salinity.

TABLE 7 a. Effect of interaction between soil texture and saline water irrigation on yield and yield attributes of sugar beet (combined data of 2006/07 and 2007/08 seasons).

Factors	Traits	Leaves number/ plant	Leaves fresh weight (g/plant)	Leaves dry weight (g/plant)	Root length (cm)	Root diameter (cm)	Root fresh weight (g/plant)	Sucrose %	Sugar yield (g)
Clay	300	22.11	265.22	55.75	21.29	9.03	423.52 d	15.93	67.53 b
	4000	21.26	260.46	54.78	20.74	8.62	400.23 e	16.24	65.05 b
	8000	20.81	256.36	54.18	20.11	8.27	376.43 f	16.51	62.41 c
Sand	300	19.00	233.57	42.10	23.96	10.99	489.85 a	16.38	80.29 a
	4000	18.03	228.90	41.39	23.36	10.68	481.05 b	16.58	79.80 a
	8000	17.37	224.41	40.77	22.87	10.32	472.29 c	16.89	79.85 a

TABLE 7 b. Effect of interaction between soil texture and organic manure on yield and yield attributes of sugar beet (combined data of 2006/07 and 2007/08 seasons)

Clay	0.0	20.55 b	253.04 c	49.98 c	20.07 d	7.86	373.44 f	15.48	57.77
	12.5	21.55 a	261.68 b	55.60 b	20.69 d	8.72	409.07 e	16.29	66.63
	25.0	22.07 a	267.51 a	59.13 a	21.39 c	9.34	417.68 d	16.91	70.60
Sand	0.0	17.48 d	220.53 f	36.94 f	21.60 c	10.09	466.18 c	16.05	74.79
	12.5	17.55 d	228.34 e	41.51 e	23.48 b	10.70	479.17 b	16.74	80.19
	25.0	19.37 c	238.02 d	45.81 d	25.10 a	11.20	497.87 a	17.07	84.95

TABLE 7 c. Effect of interaction between organic manure and saline water irrigation on yield and yield attributes of sugar beet (combined data of 2006/07 and 2007/08 seasons).

300	0.0	19.50	240.94	44.82 e	21.32	9.33	440.28 d	15.58	68.69 d
	12.5	20.61	249.42	48.88 c	22.70	10.08	461.65 b	16.27	75.19 ab
	25.0	21.55	257.83	53.08 a	23.85	10.62	468.12 a	16.62	77.86 a
4000	0.0	19.11	236.70	43.44 f	20.82	8.95	429.39 e	15.73	67.66 d
	12.5	19.28	245.13	48.55 cd	22.03	9.72	435.70 d	16.48	71.94 c
	25.0	20.55	252.20	52.27 b	23.30	10.28	456.83 b	17.01	77.69 a
8000	0.0	18.44	232.72	42.13 g	20.37	8.63	389.76 f	15.98	62.50 e
	12.5	18.78	240.48	48.23 d	21.52	9.33	435.00 de	16.79	73.11 bc
	25.0	20.05	248.27	52.06 b	22.58	9.92	448.33 c	17.34	77.79 a

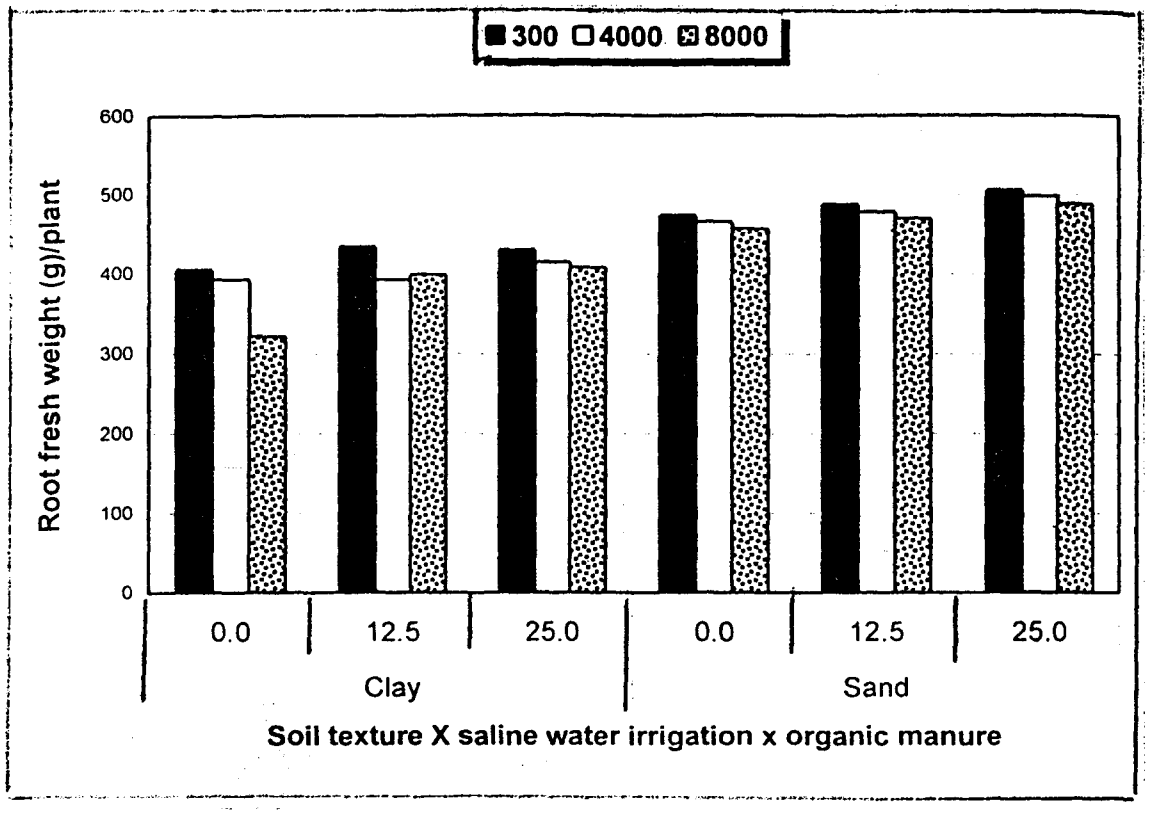

Fig . 1. Effect of the second order interaction on root fresh weight/plant.

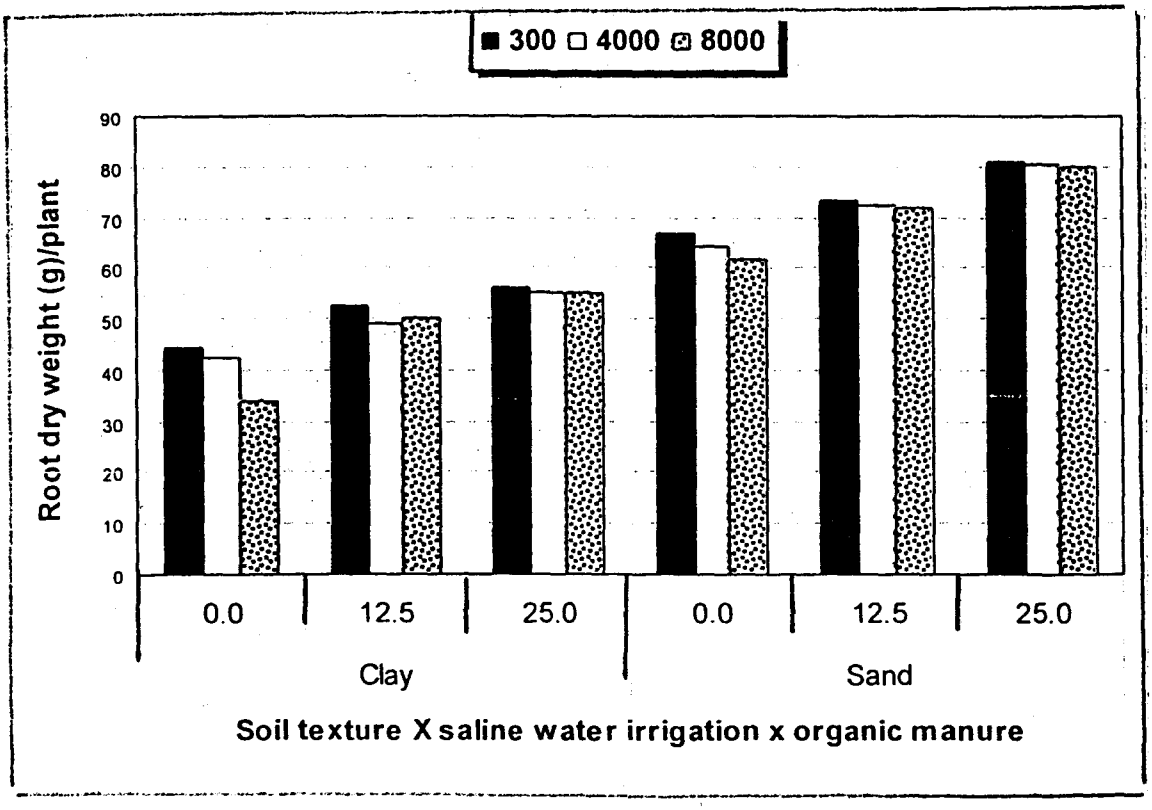

Fig. 2. Effect of the second order interaction on root dry weight /plant.

C-Effect of second order interaction

The second order interaction did not show any significant differences in the studied traits, except root fresh weight (Fig. 1) and root dry weight (Fig. 2). It could be concluded that addition of organic manure to sugar beet may mitigated the harmful effects of salinity in water irrigation either in clay or sandy soils. Its clear that the maximum yield/plant allover the experiments, *i.e.* 506.08 g was the product of interaction between (sand soil x 300 ppm x 25.0 m^3/fed). Such combination may be recommended for pronounced yield under the condition of the experiment and similar ones.

Conclusions

From all the above mentioned results the following may be summarized :

- Soil texture showed significant differences with most respects. It was found that superiority was in favor to clay soil with leave traits and to sandy soil on root ones.
- Significance was detected on all respects with saline water irrigation. A gradual decrease could be obtained as salinity increased.
- Also, significant differences were observed among manure levels with all aspects. A positive relationship was noticed between all trait products and FYM quantities.
- For the first order interaction both (Soil x Salinity) and (Salinity x FYM) combinations showed lesser significant differences. Meanwhile, the combination (Soil x FYM) significantly affected most traits. The pronounced values on root traits were obtained by (Sand x 25 m^3 FYM).
- For second order interaction, only root fresh and dry weight were significantly affected. The recommended combination my be (Sand x 300 ppm x 25 m^3 FYM) which yielded 506.08 g/plant.

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إستجابة بنجر السكر للرى بالماء المالح ، وإضافة السماد العضوى فى نوعين من التربة

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قسم بحوث المحاصيل و* قسم العلاقات المائية والرى الحقلى – المركز القومى للبحوث –القاهرة – مصر .

أجريت تجربتان فى أحدى صوب المركز القومى للبحوث، خلال موسمى ٢٠٠٦/٢٠٠٧ - ٢٠٠٧/٢٠٠٨ على بنجر السكر-وقد زرعت النباتات فى أصص قطر ٥٠ سم، ملئت بالتربة النظيفة والمجنسة والمخلوطة بالمعدلات المطلوبة من السماد العضوى - وقد أجرى الرى منذ الزراعة وحتى الشهر الأول من عمر النباتات بالماء العادى ثم بدأ برنامج الرى بعد ذلك وفق معدلات الملوحة المختبرة. وقد أجريت التجربة لدراسة تأثير معدلات الرى بالماء المالح (ماء الصنبور ، ٣٠٠ ، ٤٠٠٠ ، ٨٠٠٠ جزء فى المليون) إضافة السماد العضوى (صفر، ١٢,٥، ٢٥,٠م^{3}/فدان) وذلك فى نوعين من التربة (الطينية و الرملية) وقد سجلت البيانات على ١٥ صفة موزعة بين مرحلتى النمو (بعد ٦٠ ، ١٢٠ يوماً من الزراعة) ومرحلة الحصاد ولقد بينت النتائج ما يلى :-

أن العوامل الثلاثة أثرت معنوياً على معظم الصفات المدروسة فى المراحل الثلاث حيث أن صفات الأوراق والجذور المتفوقة قد سجلت عند الرى بمعدل ٣٠٠ جزء فى المليون وإضافة ٢٥,٠م٣ سماد عضوى/فدان. ولقد تفوقت صفات الأوراق فى التربة الطينية بينما تفوقت صفات الجذور فى التربة الرملية . ولوحظ أن زيادة ملوحة ماء الرى قد قللت معنوياً من جميع الصفات فى حين أن العكس كان صحيحاً بالنسبة لإضافة السماد العضوى . أوضح تفاعل الدرجة الأولى "الملوحة مع كل من التربة والمادة العضوية" أن التفاعلات المعنوية كانت عدداً من التفاعل الأحادى (التربة x السماد العضوى) . كان الوزن الغض والجاف للجذور هما الصفتان الوحيدتان التى تأثرت معنوياً بتفاعل الدرجة الثانية. ولقد أعطى التفاعل بين (التربة الرملية x الري بماء الصنبور x ٢٥,٠م^{3}سماد عضوى/فدان) أعلى محصول وقدره ٥٠٦,٠٨ جرام/نبات ويمكن التوصية بهذه المعاملة تحت ظروف التجربة والظروف الأخرى المشابهة.