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SOME TECHNIQUES OF WATER AND SOIL MANAGEMENT FOR SUGAR BEET PRODUCTIVITY AT NORTH NILE DELTA

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ABSTRACT

Two field experiments were conducted in 2000/2001 and 2001/2002 growing seasons at Sakha Agric. Res. Station Farm, in clayey salt affected soils, to study the effect of three soil wetting depths (30, 45 and 60 cm), two ploughing depths (15 cm and 30 cm) and three potassium fertilizer levels (24, 48 and 72 kg K_2O/fed.) on sugar beet yield, its water relations and some soil properties. Split-split plot design with four replicates was used. Results indicated that, under salt affected soil conditions, moderate applications of irrigation water, which was watered till a depth of 45 cm. and deep ploughing technique (30 cm) with application of 72 kg K_2O/fed. were the best combination, which enhanced the growth of sugar beet plants, and produced the highest beet yield, average root weight, root size and sugar yield. With regard to irrigation water consumption, it is noticed that values of water consumptive use increased as the soil wetting depth increased. On the other side, values of water consumptive use decreased with increasing ploughing depth, due to the greater ability of root system to reach, and use irrigation water in the deeper ploughing treatment. Concerning the water use efficiency for root and sugar yields, data clearly showed that, the soil wetting depth of 45 cm with deep ploughing technique, achieved the highest values of water use efficiency. While the lowest value was gained from soil wetting depth of 60 cm with shallow ploughing. With respect to chemical properties, after harvesting sugar beet, the mean values of ECe and SAR generally decreased, with increasing soil wetting depth, in both seasons, as well as under tilled treatments, compared with the values obtained before applying the different treatments.

It can be concluded that irrigation to a depth of 45 cm. and deep ploughing technique are the best combination treatments under salt affected soil to obtain favourable physico-chemical properties and consequently high sugar beet yield at North Delta region.

Keywords: Soil wetting depths, ploughing depths, sugar beet yield and water relations.

INTRODUCTION

Sugar beet becomes one of the main newly winter crop in North Nile Delta with more focus in Kafr El-Sheikh governorate. The value of this point resulted from its being a source in manufacturing sugar, short growing season and less consumed water compared to sugar cane. Tremendous efforts should be implemented to overcome the shortage of water, that facing Egypt at present. Different ways are used to achieve the effective irrigation management; some of these ways are the adoption of soil tillage practices, and controlling the applied irrigation water to wet specific depth of root zone, for optimizing irrigation efficiency, and minimizing the downward movement of water under the active root depth.

Effects of irrigation regime on production, and water relations of sugar beet was examined by so many researchers (Ibrahim *et al.*, 1993; Eid, 1994; Abd El-Wahab *et al.*, 1996 and Shams El-Din, 2000). They found that, light irrigations were needed for germination and emergence. An irrigation is usually required after thinning. At mid season irrigations are strongly needed for compensating the soil moisture depleted by evapotranspiration. Also, they found that irrigation frequency intervals of 10, 15 or 20 days, significantly increased the yields of root and sugar content. On the other hand, values of water consumptive use ranged between 50 and 67 cm, and values of water use efficiency ranged between 8.66 and 12.63 kg/m^3.

Tillage is an important soil management practice influenced crop yields, through the changes in the physical properties of the soil. Many investigators i.e. Hammoud (199?); Abo-Soliman *et al.* (1996); El-Sayed (1997) and Sayed *et al.* (1998) stated that tillage operation creates favourable conditions for seed germination and plant growth through decreasing the soil compaction and facilitates the infiltration of water and penetration of roots, accordingly resulted in increasing the yield. Also, deep ploughing used to break down subsoil compaction and help the roots to grow normally in root zone. While, shallow ploughing provide sufficient loose soil in the range of 6 to 8 inches depth.

Response of root yield and other characters of sugar beet to potassium fertilization was reported by many investigators. Basha (1994) and El-Rammady (1997) concluded that, adding potassium fertilizer at rate of 100 kg K_2O/fed. significantly increased root length and diameter, root weigh/plant, root and sugar yields. Omar *et al.* (2002) found that increasing K-fertilizer rate up to 72 kg K_2O/fed. resulted in a significant increase in root and sugar yields, as well as, sucrose percentage. The present study aims to investigate the effect of soil wetting depth, ploughing depth and potassium fertilizer levels on sugar beet productivity, water relations and some soil properties.

MATERIALS AND METHODS

Two field experiments were conducted at Sakha Agriculture Research Station Farm in a clayey salt affected soil, during 2000/01 and 2001/02 growing seasons. The initial physical and chemical properties of soil in the experimental site are shown in Table (1).

Table (1):Some physical and chemical properties of the experimental site soil before growing seasons.

Seasons	Soil Layer (cm)	Particle size distribution			Textural class	CEC, meq/ 100g soil	pH (1:2.5)	EC dS/m^{-1} at 25°C	Bulk density g/cm^3	Soil moisture characteristics		
		Sand %	Silt %	Clay %						F.C. %	W.P.%	Av.W.
2000/ 2001	0-20	22.65	28.50	48.85	Clayey	38.80	7.95	5.20	1.15	42.65	22.40	20.25
	20-40	21.30	27.60	51.10	Clayey	40.60	8.10	4.45	1.22	41.70	21.90	19.80
	40-60	21.15	27.50	51.35	Clayey	41,20	8 06	4.72	1.27	39.35	20.88	18.47
2001/ 2002	0-20	23.20	27.50	49.30	Clayey	38.40	7.86	5.42	1.18	43.15	22.75	20 40
	20-40	22.35	27.05	50.40	Clayey	40.35	7.97	5.36	1.24	40.90	21.25	19.65
	40-60	20.80	28.35	50.85	Clayey	40.40	8.04	5.12	1.26	40.04	21.78	18.26

A split-split plot design with four replicates was used, where the treatments were as follows:

The main plots: (Irrigation frequency)

W_1 : Depth of wetting is 30 cm designated as light applications.

W_2 : Depth of wetting is 45 cm designated as moderate applications.

W_3 : Depth of wetting is 60 cm designated as heavy applications.

The sub-plots: (depth of ploughing)

T_1 : Shallow ploughing at 15 cm depth, using a normal chisel plough (9 shares).

T_2 : Deep ploughing at 30 cm depth, using a special chisel plough (13 long shares).

The sub-sub plots: (potassium fertilizer levels)

K_1 : 24 kg K_2O/fed. (1/2 at planting + 1/2 after thinning).

K_2 : 48 kg K_2O/fed. (1/2 at planting + 1/2 after thinning).

K_3 : 72 kg K_2O/fed. (1/2 at planting + 1/2 after thinning).

Planting of sugar beet seeds (Raspoly V.) was carried out manually in hills, 15 cm apart at the rate of 3-5 seed balls per hill, at the second and third week of October 2000 and 2001, respectively. Plants were thinned twice and the later one was done to obtain a single plant/hill. Harvesting of sugar beet plants was done after 200 days form planting. Calcium superphosphate (15.5% P_2O_5) was applied during tillage operation, at the rate of 100 kg/fed. While nitrogen fertilization as urea (46.5% N), at the rate of 80 kg/fed. was applied in two equal doses, before the first and the second watering.

At maturity stage samples of ten plants were taken at random from each plot and the following characteristics were recorded:

- Root length and diameter (cm).
- Root fresh weight (g/plant).
- Root yield of each plot was estimated in kg and converted, to record root yield (ton/fed.).
- Sucrose percentage was determined polarimetrically in lead acetate extract of fresh roots according to method described by Le-Docte (1927).
- Gross sugar yield (kg/fed.): was calculated by multiplying root yield (kg/fed.) by sucrose percentage.

All data were statistically analyzed according to Snedecor and Cochran (1967).

Water relations:

Amount of irrigation water was applied by fixed cut-throat flume (20 x 90 cm) and calculated as m^3/fed. on the basis of upgrading the soil moisture depletion in the effective root zone till field capacity as follows:

$$I.W. = \sum_{i=1}^{i=n} \frac{F.C. - Q_1}{100} \times D_1 \times Db_i \times A$$

As:

I.W.	=	Irrigation water in m^3/fed.
i	=	Order of soil depth,
n	=	No. of irrigated soil depth,
F.C.	=	Field capacity (%) of the respective soil layer,

Q_1 = Soil moisture content (%) before irrigation,
D_i = Thickness of soil depth (m),
Db_i = Bulk density in g/cm^3,
A = Irrigated area in m^2.

So, the total water duty for all treatments was equal to the summation of the applied irrigation water as explained before plus the recorded rainfall.

Consumptive use for different treatments was calculated according to the following equation : (Israelsen and Hansen, 1962).

$$C.U. = \sum_{i=1}^{i=n} \frac{Q_2 - Q_1}{100} \times D_i \times Db_i \times A$$

As:
C.U. = Consumptive use in m^3/fed.,
Q_2 = Percentage of soil moisture content after 48 hours irrigation,

The remaining items are the same as before.

Water use efficiency was calculated for different treatments in kg/m^3 according to Abd El-Rasool *et al.* (1971) by the following formula:

$$W.U.E. = \frac{\text{Yield (kg / fed.)}}{\text{Water consumptive use } (m^3 / \text{fed.})} \times 100$$

Soil samples from three layers (0-20, 20-40 and 40-60 cm) were taken before planting and after harvesting sugar beet, for physical and chemical analysis according to Black (1965).

RESULTS AND DISCUSSION

Sugar beet yield and weight of the root per plant:

It is clear from data presented in Table (2), that the wetting depth of soil has a highly significant effect upon the root yield and the average of the root weight per plant, in the two growing seasons. The highest root yields in the 1st and 2nd seasons (26.92 and 25.76 ton/fed., respectively) were scored from wetting depth of 45 cm (W_2) treatment (Moderate applications). While the lowest root yields in both seasons (24.43 and 23.73 ton/fed., respectively) were produced with treatment (W_1) which was watered until 30 cm depth. Regarding the influence of soil wetting depth on root weight per plant, data indicated that the average root weight took the same trend of root yield. Maximum root weight (1.40 kg/plant) in both seasons were scored from (W_2) treatment. The differences in root yield between soil wetting depth treatments may be attributed to the amount of irrigation water, which was enough to meet the crop water need. As for the effect of tillage technique on sugar beet yield, and average root weight per plant, data in Table (2) indicated that it has a significant effect. Deep ploughing (30 cm depth) yielded more than the shallow ploughing (15 cm depth), by about 6.61 and 7.70% in the 1st and 2nd, respectively. Also, deep ploughing surpassed the shallow ploughing technique in increasing the average root weight per plant, in both seasons, which tends to improve the beet growth.

Concerning the potassium fertilization, data in Table (2) showed that a highly significant effect was found on sugar beet yield and average root weight per plant in both seasons. Highest root yields (27.86 and 26.80 ton/fed.) were obtained with addition of 72 kg K_2O/fed. in the 1st and 2nd seasons, respectively. As for root weight per plant, the highest values were gained by application of 72 kg K_2O/fed. The increment of root weight may be attributed to the positive effect of potassium on the beneficial use of the water for different crops.

Table (2):Sugar beet yield (ton/fed.) and weight of single root (kg) for the two seasons as affected by different treatments.

Treatments	Beet yield (ton/fed.)			Weight of the beet root (kg/plant)		
	1st season	2nd season	Average	1st season	2nd season	Average
Irrigation regime:						
W_1 (30 cm)	24.43	23.73	24.08	1.29	1.24	1.27
W_2 (45 cm)	26.92	25.76	26.34	1.40	1.40	1.40
W_3 (60 cm)	25.97	24.95	25.46	1.33	1.32	1.33
F-test	**	**		**	**	
L.S.D. 0.05	0.516	0.565		0.056	0.030	
L.S.D. 0.01	0.782	0.857		0.084	0.042	
Tillage technique:						
T_1 (15 cm)	24.95	23.89	24.42	1.27	1.28	1.28
T_2 (30 cm)	26.60	25.73	26.17	1.42	1.36	1.39
F-test	**	**		**	**	
L.S.D. 0.05	0.308	0.363		0.061	0.023	
L.S.D. 0.01	0.442	0.500		0.088	0.032	
Potassium fertilizer level:						
24 kg K_2O/fed.	23.83	22.80	23.32	1.25	1.16	1.21
48 kg K_2O/fed.	25.63	24.85	25.24	1.32	1.33	1.33
72 kg K_2O/fed.	27.86	26.80	27.33	1.46	1.47	1.47
F-test	**	**		**	**	
L.S.D. 0.05	0.475	0.340		0.034	0.026	
L.S.D. 0.01	0.637	0.456		0.046	0.035	

In general, it can be stated that changes and alteration of some soil properties by tillage operations, and optimum irrigation practices led to considerable impacts in root elongation and turgidity, in addition to effects on the whole plant growth. Similar findings have been found by El-Sayed (1997); Shams El-Din (2000) and Omar *et al.* (2002).

Root size: (length and diameter):

Data of the average root length and diameter at harvest time, as affected by different treatments, are shown in Table (3). It is obvious from data that soil wetting depth highly significantly affected on root length and diameter. Moderate application treatment (W_2) recorded the highest root length and diameter values (36.46 and 13.83 cm, respectively) in the 1st season and (34.97 and 12.88 cm, respectively) in the 2nd season. However lowest values were found in light application (W_1). Concerning the tillage technique, it can be noted, that increasing ploughing depth from 15 to 30 cm by using chisel plough, tended to increase the root length form 31.76 to 38.30 cm and from 30.63 to 36.31 cm for the 1st and 2nd seasons, respectively. On the other side, results showed that the deep ploughing technique, produced the highest root diameter (13.31 and 12.29 cm) for the 1st and 2nd seasons, respectively. It is evident from these results, that in the deeper tillage, the root growth tended to grow vertically rather than horizontally as observed during the experimental period.

Table(3):Root size (length-diameter) in cm for the two seasons as affected by different treatments.

Treatments	Root length (cm)			Root diameter (cm)		
	1st season	2nd season	Average	1st season	2nd season	Average
Irrigation regime:						
W_1 (30 cm)	34.14	32.63	33.39	10.98	10.17	10.58
W_2 (45 cm)	36.46	34.97	35.72	13.83	12.88	13.36
W_3 (60 cm)	34.49	32.81	33.65	12.21	11.35	11.78
F-test	**	**		**	**	
L.S.D. 0.05	0.267	0.402		0.533	0.618	
L.S.D. 0.01	0.396	0.609		0.807	0.936	
Tillage technique:						
T_1 (15 cm)	31.76	30.63	31.20	11.37	10.64	11.01
T_2 (30 cm)	38.30	36.31	37.31	13.31	12.29	12.80
F-test	**	**		**	**	
L.S.D. 0.05	0.178	0.711		0.354	0.351	
L.S.D. 0.01	0.255	1.022		0.509	0.504	
Potassium fertilizer level:						
24 kg K_2O/fed.	34.14	32.77	33.46	11.67	10.88	11.28
48 kg K_2O/fed.	34.85	33.30	34.08	12.55	11.52	12.04
72 kg K_2O/fed.	36.10	34.34	35.22	12.81	11.99	12.40
F-test	**	**		**	**	
L.S.D. 0.05	0.419	0.511		0.488	0.402	
L.S.D. 0.01	0.561	0.685		0.654	0.539	

As regard to potassium fertilization, it has a highly significant effect on both root length and diameter. Application of 72 kg K_2O/fed. resulted in the highest values of both parameters in the 1st season (36.10 and 12.81 cm, respectively) and the 2nd season (34.34 and 11.99 cm, respectively). This can be explained through the fact that potassium has great role in photosynthesis enzymes activities and carbohydrates accumulation. The above mentioned results are in agreement with those obtained by Basha (1994); El-Sayed (1997) and Sayed *et al.* (1998).

Sucrose percentage and sugar yield:

The sugar yield is an important parameter for sugar beet, because it is the final form that the consumer uses. Values of sucrose percentage and sugar yield as affected by different treatments were presented in Table (4).

The sucrose percentage ranged between (18.30 and 17.51%) and (17.14 and 16.38) for the 1st and 2nd seasons, respectively. Highest sucrose percentage values were obtained by using a soil wetting depth of 30 cm, deep ploughing and K fertilization rate at 72 kg K_2O/fed. in the two growing seasons compared with other treatments. As for the effect of wetting depth on sugar yield, data in Table (4) indicated that, it has significant effect and the highest sugar yield (4826.96 and 4373.02 kg/fed.) was found to be detected with treatment (W_2) in the 1st and 2nd seasons, respectively. While the lowest values in both seasons (4446.58 and 4040.48 kg/fed., respectively) were recorded from soil wetting depth of 30 cm. Regarding the effect of tillage technique, the results indicated that, deep ploughing highly significantly affected sugar yield. The sugar yield increased from 4356.62 to 486.33 kg/fed. in the 1st season and from 3958.25 to 4399.01 kg/fed. in the 2nd season, when the ploughing depth increased from 15 to 30 cm.

Table (4):Sucrose percent and sugar yield (kg/fed.) for the two seasons as affected by different treatments.

Treatments	Sucrose (%)			Sugar yield (kg/fed.)		
	1st season	2nd season	Average	1st season	2nd season	Average
Irrigation regime:						
W_1 (30 cm)	18.16	17.00	17.58	4446.58	4040.48	4243.53
W_2 (45 cm)	17.90	16.94	17.42	4826.96	4373.02	4599.99
W_3 (60 cm)	17.51	16.50	17.01	4563.88	4122.39	4343.14
F-test	**	**		**	**	
L.S.D. 0.05	0.267	0.140		4.376	9.251	
L.S.D. 0.01	0.393	0.203		6.629	13.280	
Tillage technique:						
T_1 (15 cm)	17.42	16.55	16.99	4356.62	3958.25	4157.44
T_2 (30 cm)	18.30	17.07	17.69	4868.33	4399.01	4633.67
F-test	**	**		**	**	
L.S.D. 0.05	0.213	0.075		9.142	6.035	
L.S.D. 0.01	0.306	0.108		13.130	8.281	
Potassium fertilizer level:						
24 kg K_2O/fed.	17.59	16.38		4193.49	3732.74	3963.12
48 kg K_2O/fed.	17.84	16.92		4584.55	4206.63	4395.59
72 kg K_2O/fed.	18.15	17.14		5059.38	4596.51	4827.95
F-test	**	**		**	**	
L.S.D. 0.05	0.171	0.106		10.499	7.194	
L.S.D. 0.01	0.230	0.142		14.078	9.786	

Concerning potassium fertilization, data showed that the highest values (5059.38 and 4596.51 kg/fed.) were obtained from 72 kg K_2O/fed. in the first and second seasons, respectively. The trend of these results are similar to those obtained by El-Sayed (1997) and Shams El-Din (2000).

Water relations:

Water consumptive use (WCU):

Actual water consumptive use for sugar beet plants, as a function of irrigation treatments for both seasons, are presented in Table (5). It is noticed that, as the amount of water applied increased, values of water consumptive use increased and vice versa. Heavy application treatment (W_3) which was watered till 60 cm. depth, recorded the highest values of water consumptive use (2677.66 and 2752.66 m^3/fed.) in the 1[st] and 2[nd] seasons, respectively While the light application treatment (W_1) was scored the lowest values (2229.29 and 254.03 m^3/fed.) in the two seasons, respectively. With regard to tillage technique, the ploughing depth affected water consumptive use. Data revealed that the shallow ploughing (15 cm) consumed more water rather than deep ploughing (30 cm) in the two growing seasons. This phenomenon can be explained if the root system is taken into consideration. At the beginning, roots are small to reach the water percolating through the deeply plowed treatment. Whereas, the crop roots in the deeply plowed treatment grow vertically rather than horizontally such as it to reach the irrigation water, and thus can make use of most of this water is leading to a decrease in water consumption, as has been found from the experimental results. Similar results were reported by Ibrahim *et al.* (1993) and Eid (1994).

Table (5):Water consumptive use (m^3/fed.) for sugar beet in two seasons as affected by different treatments.

Wetting Depth (cm)	Tillage technique		Mean	Tillage technique		Mean
	Shallow ploughing	Deep ploughing		Shallow ploughing	Deep ploughing	
	1st season			2nd season		
W_1 (30 cm)	2247.60	2211.54	2229.57	2273.46	2234.60	2254.03
W_2 (45 cm)	2359.18	2323.20	2341.19	2426.60	2335.44	2381.02
W_3 (60 cm)	2738.38	2616.93	2677.66	2789.96	2715.36	2752.66
Mean	2448.39	2383.89		2496.67	2428.47	

Irrigation water applied (IWA):

Total amount of irrigation water applied for sugar beet, consists of two main components namely irrigation water and rainfall was measured and recorded as shown in Table (6). It is clear from the data that the amount of water applied was increased with increasing soil wetting depth from 30 to 60 cm (2466.78 to 3183.20 m^3/fed.) in the 1st season and (2440.80 to 3160.80 m^3/fed.) in the 2[nd] season. On the other hand, the total quantity of irrigation water slightly decreased with increasing ploughing depth.

Table (6):Amount of water applied (irrigation water + rainfall) in m^3/fed. for sugar beet in the two seasons as affected by different treatments.

Wetting Depth (cm)	Tillage technique		Mean	Tillage technique		Mean
	Shallow ploughing	Deep ploughing		Shallow ploughing	Deep ploughing	
	1st season			2nd season		
W_1 (30 cm)	2496.35	2437.20	2466.78	2462.45	2419.15	2440.80
W_2 (45 cm)	2781.50	2719.40	2750.45	2757.30	2694.30	2725.80
W_3 (60 cm)	3239.15	3127.25	3183.20	3205.10	3116.50	3160.80
Mean	2839.00	2761.28		2808.28	2743.32	

Water use efficiency (WUE):

Water use efficiency for sugar beet, as kilogram of root and sugar yield per one cubic meter of water consumed, can be increased either by increasing beet productivity, or decreasing water consumptive use. Data in Table (7) showed that moderate application treatment (W_2) produced the highest values of W.U.E. for root yield (11.50 and 10.83 kg/m^3) and (1.96 and 1.77 kg/m^3) for sugar yield in the 1st and 2nd seasons, respectively. Concerning the effect of tillage technique on the efficiency of water use, results showed that deep ploughing surpassed the shallow ploughing and achieved the highest values of W.U.E. for root yield (11.2 and 10.66 kg/m^3) and for sugar yield (2.04 and 1.81 kg/m^3) in the 1st and 2nd seasons, respectively. These results are in agreement with those obtained by Eid (1994) and Abd El-Wahab *et al.* (1996).

Table(7):Water use efficiency for beet and sugar yield (kg/m^3) consumed water for different treatments.

Wetting Depth (cm)	WUE for beet yield				WUE for sugar yield			
	Shallow ploughing		Deep ploughing		Shallow ploughing		Deep ploughing	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
W_1 (30 cm)	10.20	10.04	11.42	11.02	1.76	1.58	2.00	1.73
W_2 (45 cm)	10.98	10.15	12.02	11.51	1.83	1.63	2.09	1.91
W_3 (60 cm)	9.25	8.68	10.17	9.46	1.76	1.55	2.03	1.80
Mean	10.14	9.62	11.20	10.66	1.78	1.59	2.04	1.81

Effect of different treatments on salt balance:

The change in soil chemical analysis (ECe and SAR) after the two growing seasons of sugar beet crop, comparing with those before planting for different treatments, are listed in Table (8). Results indicated that all treatments cause a leaching of salts from soil profile, but the best treatments were (W_2 T_2), (W_3 T_1) and (W_3 T_2) since they recorded the highest reduction of ECe, in the two growing seasons.

Table (8):Date of change in soil chemical analysis (ECe and SAR) after the two growing seasons compared with soil before, applying experiment (mean of 60 cm depth).

Treatments	Initial		Season 2000/2001				Initial		Season 2000/2001			
	EC mmhos/ cm at 25°C	SAR	EC mmhos/ cm at 25°C	Rate of change %	SAR	Rate of change %	EC mmhos/ cm at 25°C	SAR	EC mmhos/ cm at 25°C	Rate of change %	SAR	Rate of change %
W_1 T_1	4.79	12.70	4.32	-9.81	11.82	-6.93	5.30	12.86	4.96	-6.42	11.65	-9.41
W_1 T_2			4.16	-13.15	11.64	-8.35			4.75	-10.19	11.57	-10.03
W_2 T_1			4.18	-12.73	10.55	-16.93			4.60	-13.21	11.20	-12.91
W_2 T_2			4.04	-15.66	10.48	-17.48			4.42	-16.60	10.80	-16.02
W_3 T_1			3.77	-21.29	9.96	-21.96			4.30	-18.87	10.25	-20.30
W_3 T_2			3.50	-26.93	9.75	-23.23			4.05	-23.58	10.03	-22.01

Concerning the irrigation regime, soil wetting depth of 60 cm, especially with deep ploughing technique, led to the highest leaching rate of salts (-26.93 and -23.58%) in the two seasons, respectively. Such reduction in total soluble salts can be explained by that deep ploughing technique allowed water percolated and downward moved taking with high amounts of soluble salts from the upper layer down to the deeper one. It is worthy to mentioned that the recorded SAR values of the treatments did not reach to the sodicity hazards within the effective root zone (0-60 cm). It could be observed from the data that deep tillage technique enhanced positive effect of irrigation treatment in leaching soluble Na^+ from soil profile. These results are in harmony with those obtained by El-Barbary *et al.* (1996) and Abo-Soliman *et al.* (1996).

Thus, it could be concluded that irrigation to depth of 45 cm. and deep ploughing technique are the best combination under salt affected soils, to obtain favourable physico-chemical properties and consequently high sugar beet yield at North Delta region.

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بعض أساليب إدارة المياه والتربه لإنتاجية بنجر السكر فى شمال الدلتا

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أجريت تجربتين حقليتين فى الموســمين الزراعييــن ٢٠٠٠/٢٠٠١م ، ٢٠٠١/٢٠٠٢م بمزرعـة محطة البحوث الزراعية بسخا في أرض طينية متأثرة بالأملاح لدراسة تأثير إضافة مياه الرى بأعماق مختلفة (٣٠ ، ٤٥ ، ٦٠سم) والحرث لأعماق (١٥ ، ٣٠سم) وثلاثة معدلات للتســميد البوتاســى (٢٤ ، ٤٨ ، ٧٢ وحدة بو٢أ/فدان) على محصول بنجر السكر والعلاقات المائية له وبعض الخواص الكيميائية للتربـــه. وقـد استخدم تصميم القطع المنشقة مرتين مع أربعة مكررات حيث مثلت أعماق البلل القطع الرئيسية بينما مثلـــت أعماق الحرث القطع الشقية الأولى ومعاملات التسميد البوتاسى القطع الشقية الثانية.

وتشير النتائج أنه تحت ظروف الأرض المتأثرة بالأملاح فإن إضافة مياه الرى بالعمق المتوســـط (٤٥ســم) والحرث العميق (٣٠سم) مع التسميد بمعدل ٧٢ وحدة بو٢أ/فدان يمكن الحصول على أعلى محصول لجـذور البنجر ومتوسط وزن الجذر لكل نبات وحجم الجذر وكذلك محصول السكر بالمقارنة بالمعاملات الأخرى.

كما أوضحت النتائج أنه بزيادة عمق البلل للتربة زادت كمية المياه المضافة والأســتهلاك الكلــى لمياه الرى وعلى العكس تناقصت كمية المياه المضافة والمستهلكة مع زيادة عمق الحرث. أما بالنسبة لكفــاءة استخدام مياه الرى فقد حققت معاملة الرى لعمق ٤٥سم مع الحرث العميق أعلى القيم لمحصولـــى الجـذور والسكر.

وبصفة عامة انخفضت قيم التوصيل الكهربى (ECe) ونسبة إدمصاص الصوديوم (SAR) بعـد حصاد المحصول بالمقارنة بالنتائج المتحصل عليها قبل تطبيق المعاملات المختلفة. ويمكن استنتاج أن الــرى للعمق المتوسط (٤٥سم) والحرث العميق للتربه (٣٠سـم) ينصح باستخدامهم للحصول على خواص طبيعيـــة وكيميائية جيدة للتربه وبالتالى إنتاجية عالية لبنجر السكر فى منطقة شمال الدلتا.