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RESPONSE OF SUGAR BEET TO TERMINATION OF LAST IRRIGATION, HILL SPACING AND K-FERTILIZATION

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ABSTRACT

Field trials were conducted at Sakha Agricultural Research Station Farm, during the two successive growing seasons of 1999/2000 and 2000/2001 to investigate the response of sugar beet to termination of last irrigation before harvest i.e., (W1) 3 weeks, (W2) 5 weeks and (W3) 7weeks; hill spacing (S1) 20 cm and (S2) 30 cm and K-fertilizer rates 24, 48 and 72 kg K_2O/fed. A split-split plot design with four replicates was used. Termination of last irrigation occupied the main plots while hill spacing arranged in subplots and K-fertilizer rates conducted to sub-subplots. The results could be summarized as follows:

1- Termination of last irrigation 7 weeks before harvest produced the highest root and sugar yields, sucrose percentage, water utilization and water use efficiencies. Moreover, it received the lowest amount of applied irrigation water and lowest water consumptive use.
2- Spacing of 20 cm between hills (S1) produced the highest root and sugar yields, water utilization and water use efficiency as compared to 30 cm space during the two growing seasons.
3- Increasing k-fertilizer rate up to 72 kg K_2O/fed. resulted in high significant increase in root and sugar yields as well as sucrose percentage.
4- Increasing K- fertilizer rates increased K content in roots and leaves and decreased Na content.
5- It could be concluded that the combination between the termination of the last irrigation (7 weeks before harvest), application of 72 kg K_2O /fed. and 20 cm space between hills produced the highest yield and water use efficiency of sugar beet crop.

Keywords: Sugar beet, termination of irrigation, plant spacing, K-fertilization and water relation.

INTRODUCTION

Economic use of irrigation water requires application of water at the proper time and suitable amount to meet the needs of the growing crop, prevent salt accumulation in the soil and increase the income of water unit. Sugar beet crop response to a wide range of drought stress. Emara *et al* (2000) found that holding irrigation at 4 weeks before harvesting decreased root yield of sugar beet but increased sugar yield, water utilization efficiency and water use efficiency. Omar (1998) pointed out that increasing the drought period up to 6 weeks before harvesting of sugar beet increased root and sugar yields and water use efficiency. Also, he added that N content was decreased, while Na and K contents were increased in roots and leaves.

Abo-Soliman *et al.* (1996) reported that irrigation of sugar beet plants at 50% depletion of available water and withholding irrigation at 3 weeks before harvesting resulted in the best water use efficiency, Khalifa and Ibrahim (1995) found that irrigation of sugar beet plants at Kafr El-Shiekh

Governorate every 4 weeks resulted in a significant increase of root and sùgar yields under different levels of soil salinity.

El-Kassaby and Leilah (1992) reported that sowing sugar beet on one side of ridges and 30 cm between hills (20,000 plants/fed.) resulted in the highest root yield, while the highest sugar yield was obtained with sowing on both furrow ridges and 25 cm plant spacing. Analogides *et al* (1981) showed that increasing plant density up to 73,000 plants/ha. increased root yield but decreased sucrose content of sugar beet roots. Hanna *et al* (1988) found that the density of 46,666 plants/fed. produced the highest root and sugar yields. Mohammed *et al* (1990) stated that 50 and 60 cm between ridges and 20 cm space between hills produced the highest root and sugar yields, El-Kassaby *et al.* (1991) concluded that sowing sugar beet on both sides of ridges 90 cm apart and 20 cm space between hills (46.666 plants /fed.) gave the highest root and sugar yields. While sowing seeds on one side of ridges 60 cm apart and 15 cm space between hills resulted the highest sucrose percentage.

Also, potassium has a great role in sugar beet nutrition and consequently root yield and quality. Potassium is required for osmotic regulation under water and salinity stresses, production of high-energy phosphate molecule (ATP), photosynthesis, translocation of sugar, nitrogen uptake and protein synthesis (Samuel *et al.*, 1990).

Carter (1986 b) found that, sucrose percentage and root quality were higher with low N and Na concentration and high K: Na ratio. Khalifa *et al* (1995) pointed out that K. fertilization of sugar beet plants exerted significant increase in root and sugar yields and sucrose percentage. Abd El-Wahab *et al* (1996) showed that increasing potassium fertilizer rate up to 48 K_2O /fed. increased root and sugar yields. El-Rammady (1997) and Omar (1998) found that increasing K-fertilizer rate up to 96 kg K_2O /fed. Resulted in significant increase in root and sugar yields. So, the objective of this work was to study the effects of termination of last irrigation before harvest, hill spacing and potassium fertilizer levels on sugar beet yield and water relations.

MATERIALS AND METHODS

Two field experiments were conducted at Sakha Agricultural Research Station Farm during the two successive seasons, 1999/2000 and 2000/2001.

A split-split- plot design with four replications was used. The plot area was $21m^2$(3×7 m) and included 5 ridges, 60 cm apart.

Experimental treatments were carried out as follows:

A- The main plots:

W1- Termination of last irrigation at 3 weeks before harvest.

W2- Termination of last irrigation at 5weeks before harvest.

W3- Termination of last irrigation at 7 weeks before harvest.

B- The subplots:

S1- 20 cm space between hills (density 35.000 plant/fed)

S2- 30 cm space between hills (density 23.333 plant/fed).

C- The sub-sub-plots:

K1- Application of 24 kg K_2O/fed.
K2- Application of 48 kg K_2O /fed
K3- Application of 72 kg K_2O/fed.

Sugar beet (Raspoly v.) was planted on Sept., in both seasons. The harvesting date was after 200 days from planting for both seasons. The irrigation interval was 21day. Potassium as K-sulphate (48%K_2O) was added in two equal doses after thinning and before the next irrigation. Nitrogen and phosphorus fertilizers were added according to the recommended doses of North Delta area (80kgN/fed and15.5 P_2O_2/fed). The experimental field was clayey in texture, non-saline and non-alkaline soil and the field has a shallow water table depth (76cm). Data in Table (1) show some soil properties of the experimental site, which determined according to Page (1982) and Garcia (1978).

Table 1: Some soil properties of the experimental site.

Soil Depth, cm	Particle size distribution (%)			Texture class	Total carbonate. %	O.M. %	pH (1:2.5)	ECe dsm^{-1} at 25c°	SAR	Bulk density g/cm^3	Soil moisture characteristics (%)		
	Sand	Silt	clay								F.C.	W.P	A.S.M.
0-30	18.87	32.73	48.4	clayey	2.55	1.61	7.75	1.54	4.70	1.12	3.20	23.36	19.84
30-60	16.66	33.14	50.20	clayey	2.67	1.53	7.91	1.52	5.80	1.28	0.80	23.08	17.72
60-90	14.98	37.15	47.87	clayey	2.10	1.18	8.48	2.15	7.00	1.32	0.10	22.68	17.42
mean	16.84	34.34	48.82	clayey	2.44	1.44	8.05	1.74	5.83	1.24	1.37	23.04	18.33

The studied parameters:

1- Sugar beet yield and its components:

At harvesting time, 10.5 m^2 from the central ridges of each plot was selected to determine root yield, sucrose percentage, Na, K and N % in roots and leaves according to Sach Le Docte as described by Mc Ginnus (1971) and Page (1982).

2-Water relations

2.1-Seasonal water applied(Wa):

Irrigation water was applied using cut through flume according to Michael (1978) .Seasonal water applied included effective rainfall.

2.2-Actual water consumptive use(CU):

Water consumptive use was computed according to the following equation (Israelsen and Hansen, 1962)

$$CU = \frac{\theta_2 - \theta_1}{100} \times Db \times D$$

Where:

CU =Actual Consumptive use (m)
θ_2= Soil moiture after irrigation (%)
θ_1= Soil moisture before irrigation (%)
Db = Bulk density for each layer (kg/m3)
D = Depth of each layer (m)

2.3-Water efficiencies:

A- water utilization efficiency (W.UT.E.)

It was calculated according to Doorenbos and Pruitt (1975) as:

$$W.UT.E. = \frac{\text{Yield of roots or sugar (kg/fed.)}}{\text{Water applied } (m^3/fed)}$$

B- Water use efficiency (W.U.E.)

It was calculated according to Doorenbos and Pruitt (1975) as :

$$W.U.E = \frac{\text{Yield of roots or sugar (kg/fed.)}}{\text{Water consumptive use } (m^3/fed)}$$

3-Soil Chemical Properties:

Soil samples representing each treatment were taken after harvesting from two layers 0-30 and 30-60 cm, to determine soil salinity (ECe) and soluble ions according to Page (1982).

Data were statistically analyzed according to Snedecor and Cochran (1974).

RESULTS AND DISCUSSION

1- Root yield :

The obtained results in Tables (2 and 3) show that time of last irrigation, plant spacing and K- fertilization had a highly significant effect on root yield of sugar beet in the two growing seasons. The termination of last irrigation 7 weeks before harvest (W3) recorded the highest root yield (36.25 and 36.78 ton/fed.) in the 1st and 2nd seasons, respectively. In contrast, delaying the last irrigation produced the lowest root yield during the two seasons. The 20cm between hills produced the highest root yield in both growing seasons (36.15 and 36.11 ton/fed.), respectively. While, increasing, the space between hills to 30 cm caused a significant decrease in root yield (27.04 and 33.88ton/fed.) in the first and second seasons, respectively. Increasing K-fertilizer rate up to 72 kg K_2O/fed. produced the highest root yield in both growing seasons (34.625 and 37.584 ton/fed.), respectively. Data also, reveal that the interactions between last irrigation, hill spacing and K- fertilizer rates were high significant on root yield. The obtained results are in agreement with those obtained by Khalifa and Ibrahim (1995) ; Abo-Soliman *et al.*(1996) ; Hanna *et al.* (1998) and Omar (1998).

Table 2: Sugar beet yield (ton/fed.) and its components as affected by different treatments (1st season).

Treatments	Root yield ton/fed	Sucrose %	Sugar yield ton/fed	Na%		K%		N%	
				Roots	Leaves	Roots	Leaves	Roots	Leaves
Irrigation									
W1	27.433	16.069	4.695	0.115	4.084	0.405	4.560	0.428	1.194
W2	31.096	16.894	5.564	0.135	4.610	0.430	4.955	0.496	1.380
W3	36.253	17.959	6.556	0.150	5.037	0.512	4.981	0.591	1.559
F Test	**	*	**	**	**	**	**	**	**
L.S.D. 0.05	0.921	0.821	0.264	0.002	0.250	0.032	0.134	0.022	0.019
0.01	1.395	--	0.677	0.004	0.378	0.048	0.203	0.034	0.028
Space(S)									
S1	36.147	16.933	6.155	0.144	4.379	0.436	4.363	0.565	1.687
S2	27.041	18.349	5.055	0.156	4.775	0.461	5.302	0.445	1.405
F-Test	**	**	**	**	**	**	**	**	**
L.S.D 0.05	0.695	0.651	0.272	0.004	0.157	0.017	0.072	0.017	0.017
0.01	0.999	0.935	0.391	0.005	0.226	0.024	0.103	0.024	0.024
Potassium									
K1	28.458	16.983	4.872	0.165	5.248	0.355	4.316	0.626	1.341
K2	31.698	17.651	5.625	0.152	4.499	0.459	4.818	0.477	1.507
K3	34.625	18.288	6.319	0.132	3.948	0.533	5.362	0.412	1.790
F-Test	**	**	**	**	**	**	**	**	**
L.S.D. 0.05	0.784	0.640	0.261	0.007	0.569	0.026	0.238	0.037	0.067
0.01	1.051	0.858	0.350	0.009	0.763	0.035	0.320	0.050	0.089
Interactions									
W× S	**	ns	*	ns	**	ns	**	**	**
W× K	*	ns	ns	ns	ns	ns	ns	**	ns
S× K	**	ns	*	ns	ns	*	ns	*	**
W× S× K	**	ns	ns	ns	ns	**	ns	*	ns

2- Sucrose percentage and sugar yield:

With regard to sucrose percentage and sugar yield (Tables 2&3) it is clear that the last irrigation had a significant effect on sucrose percentage and sugar yield. Moreover, hill spacing and K- fertilization had high significant effects on sucrose percentage and sugar yield during both seasons. The highest sucrose percentages in the 1st and 2nd seasons (17.96 and 17.20 %), and sugar yield (6.556 and 6.339 ton/fed.), respectively were obtained due to the termination of last irrigation 7 weeks before harvesting (W3). The lowest sucrose percentages and sugar yield were resulted from the short period of drought (W1) before harvesting.

Table 3: Sugar beet yield (ton/fed.) and its components as affected by different treatments (2nd season).

Treatments	Root yield, ton/fed	Sucrose %	Sugar yield, ton/fed	Na%		K%		N%	
				Roots	Leaves	Roots	Leaves	Roots	Leaves
Irrigation									
W1	33.155	15.967	5.297	0.124	3.595	0.362	4.494	0.989	1.336
W2	35.039	16.467	5.793	0.138	4.012	0.400	4.649	1.355	1.451
W3	36.781	17.204	6.339	0.149	4.642	0.465	4.887	1.475	1.607
F Test	**	*	**	**	**	**	**	ns	**
L.S.D. 0.05	0.339	0.916	0.352	0.003	0.205	0.022	0.120	--	0.022
0.01	0.513	-	0.533	0.005	0.310	0.034	0.182	--	0.034
Space(S)									
S1	36.107	16.208	5.869	0.134	3.877	0.414	4.256	0.463	1.502
S2	33.877	16.883	5.744	0.140	4.290	0.404	5.097	0.423	1.428
F-Test	**	**	**	ns	**	ns	**	ns	*
L.S.D 0.05	0.423	0.219	0.067	--	0.139	--	0.080	--	0.053
0.01	0.608	0.314	0.097	--	0.199	--	0.116	--	--
Potassium									
K1	32.350	15.046	4.868	0.150	4.579	0.341	4.313	1.570	1.274
K2	35.042	16.883	5.920	0.143	3.963	0.381	4.652	1.295	1.409
K3	37.584	17.708	6.630	0.118	3.708	0.506	5.066	0.954	1.712
F-Test	**	**	**	**	**	**	**		**
L.S.D. 0.05	0.340	0.679	0.219	0.008	0.470	0.037	0.098	--	0.064
0.01	0.457	0.911	0.293	0.011	0.630	0.050	0.131	--	0.086
Interactions									
W× S	**	ns	**	ns	**	**	**	ns	**
W× K	**	ns	ns	ns	ns	ns	*	ns	ns
S× K	**	ns	ns	ns	ns	ns	**	ns	**
W× S× K	**	ns	ns	ns	ns	ns	**	ns	ns

Also, data reveal that, planting sugar beet in 20 cm between hills (S1) produced the lowest sucrose percentage in the 1 st and 2nd seasons (16.93 and 16.21 %), respectively but , achieved the highest sugar yield (6.155 and 5.864 ton/fed.), during both seasons respectively. Increasing K fertilizer rate from 24 to 48 or 72 kg K_2O/fed resulted in highly significant increases in sucrose percentage and sugar yield in the two growing seasons. In the 1st and 2nd seasons the highest sucrose percentages (18.29 and 17.71%), respectively and sugar yields (6.319 and 6.630 ton/fed.), respectively were obtained with 72 kg K_2O/fed. The interaction between W ×S and K had no significant effect on sucrose percentage in both seasons

. While, last irrigation with hill spacing (W x S) had a significant effect on sugar yield in both seasons. These results are in agreement with those obtained by El-Kassaby *et al* (1991) Khalifa and Ibrahim (1995), EL-Rammady (1997) and Omar(1998).

3- Mineral content:

Values of Na, K and N concentrations in the dry matter of sugar beet roots and leaves are shown in Tables (2and3). Data reveal that, the last irrigation time had highly significant effects on Na, K and N contents in roots and leaves in the 1^{st} and 2^{nd} growing seasons. Increasing the period of drought before harvesting increased Na, K and N contents in root and leaves during the two growing seasons. The increase of Na and K contents of sugar beet under soil moisture stress conditions could be attributed to the osmotic regulation process which enable the plant to extract the soil moisture under stress conditions. However, Samuel *et al* (1990) stated that potassium provides much of the osmotic regulation that draws water into plant roots. The early termination of irrigation (W3), recorded the highest values of Na, K and N in roots (0.15, 0.512 and 0.591%, respectively) and in leaves (5.037, 4.981 and 1.559%, respectively) during the 1^{st} season. The corresponding values for Na, K and N contents in the 2^{nd} season were 0.149, 0.465 and 1.475%, respectively in roots and 4.642, 4.887 and 1.607 %, respectively in leaves.

Hill spacing had highly significant effects on Na, K and N contents in roots and leaves during the 1^{st} season and Na, K and N contents in leaves during the 2^{nd} season. Data clear that sowing sugar beet in 30 between hills increased Na and K contents in roots and leaves of sugar beet but the content of N was decreased. Under low plant density (30 cm spacing) the ground covered area is less than that under 20 cm spacing and consequently the evaporation will be higher which resulted in higher salt concentration in the soil and plants. Regarding the potassium fertilization, data show highly significant effects of K-fertilizer on Na, K and N contents in roots and leaves of sugar beet during the two growing seasons. Increasing K- fertilizer rate increased K content in roots and leaves and N content in leaves during the two growing seasons. In contrast, increasing K-fertilizer rate decreased Na content in roots and leaves and N content in roots during the two growing seasons. The same trend was found by Hamid and Talibudeen (1976) , Kochl (1978)and Rathert *et al*(1981a) who observed the antagonism between K and Na in sugarbeet plant. The highest values of K content in roots (0.533 and 0.506%) and in leaves (5.362 and 5.066%) in the 1^{st} and 2^{nd} seasons, respectively were obtained under the highest K-fertilizer rate, (72 kg K_2O/fed.) While the highest values of Na content in roots (0.165 and 0.150%) and in leaves (5.248 and 4.579%) in the 1^{st} and 2^{nd} season, respectively were achieved under the lowest K-fertilizer rate (24 kg K_2O/fed.).

The interaction between W and S treatments had highly significant effects on leaves Na, K and N contents in the two growing seasons. Also, the interaction between S ×K had high significant effect on leaves N content in the two studied seasons. The obtained results are in agreement with those of Mengel and Kirkby(1982), Winter(1989) El-Rammady(1997) and Omar(1998).

4- Water relations:

4.1 Applied irrigation water(Wa):

Applied irrigation water values are shown in Table (4). The obtained results reveal that decreasing the period of drought before harvesting increased irrigation water applied for sugar beet during the two growing seasons. On the other hand, decreased plant spacing from 30 cm to 20 cm between hills increased the amount of water applied for sugar beet crop. This could be attributed to the higher plant population with 20-cm space (35,000plant/fed.), which consumed more water and consequently more soil dryness before irrigation. The highest values of irrigation water applied in the 1st and 2nd seasons (3005.1 and 3155.5 m^3/fed., respectively) were recorded under treatment with (W1) with 20 cm spacing (S1)the lowest values of applied water (2397.4 and 2561.2 m^3/fed.) were obtained with treatment (W3) under (S1) in the first and second seasons, respectively. Therefore, the treatment (W3) saved about 20.22 and 18.83% of irrigation water applied comparing with (W1) and (W2), respectively. These results are in agreement with those of Winter (1989), Omar (1998) and Emara *et al* (2000) .

4.2 Actual water consumptive use(CU):

Data in Table (4) illustrate the values of water consumptive use by sugar beet during the two growing seasons. It is clear from data that delaying the last irrigation increased water consumptive use by sugar beet. On the other hand, planting sugar beet in 60-cm rows and 20-cm space between hills (S1) increased water consumptive use comparing to 30-cm space between hills. The highest values of water consumptive use in the 1st and 2nd seasons (2448.6 and 2556.5 m^3/fed.) were obtained with treatment W_1 (stopping irrigation, 3 weeks before harvest) under 20cm planting space (S1). These results are in agreement with those of Winter (1989) Omar(1998) and Emara *et al* (2000) .

Table 4: Effect of last irrigation and hill spacing on applied water, consumptive use and water use efficiencies of sugar beet.

Irrg.	Irrig. Water applied m^3/fed.		Water consumptive use, m3/fed.		Root yields, kg/fed.		Sugar yield, kg/fed.		Water utilization efficiency (kg/m3)				Water use efficiency (kg/m^3.)			
									Root		Sugar		Root		Sugar	
	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
FIRST SEASON																
W1	3005.	2842.	448.6	341.1	2625	2240	530	4019	10.86	7.82	1.76	1.41	13.32	9.50	2.16	1.72
W2	2708.	2526.	220.5	047.5	7175	25017	637	4754	13.72	9.90	2.35	1.88	16.74	12.22	2.87	2.30
W3	2397.	2250.	966.1	838.8	8640	33865	679	6320	16.12	15.04	2.83	2.81	19.65	18.42	3.46	3.44
SECOND SEASON																
W1	3155.	3004.	556.5	445.2	2571	3740	505	5538	10.32	11.23	1.60	1.84	12.74	13.80	1.98	2.26
W2	2856.	2727.	314.6	225.2	6767	3311	593	5637	12.87	12.21	2.08	2.07	15.88	14.97	2.56	2.53
W3	2561.	2459.5	077.3	978.6	983	559	6622	6056	15.22	14.05	2.59	2.46	18.77	17.47	3.19	3.06

4.3 Water utilization efficiency(W.UT.E):

The obtained results in Table (4) reveal that the early termination of irrigation before harvest augmented the water utilization efficiency for both root and sugar yields in the two studied seasons. Stopping the last irrigation 7 weeks before harvest (W3) resulted in the highest (W.UT.E) for both root and sugar yields under 20 or 30 cm plant spacing. Data also, show that sowing sugar beet in 60 cm rows and 20 cm between hills (S1) produced the highest (W.UT.E) for root and sugar yields compared to 30 cm plant spacing (S2) under different irrigation treatments. The highest average values of water utilization efficiency in the 1st and 2nd seasons (16.12 and 15.22 kg/m^{3} respectively) for roots and (2.83 and 2.59 kg/m^{3}) for sugar yield, were obtained when sugar beet sown in 20 cm plant spacing (S1) and the last irrigation was terminated 7 weeks (W3) before harvesting. The obtained results are in agreement with those of Winter(1989), Omar (1998) and Emara ***et al*** (2000).

4.4 Water use efficiency (W.U.E):

Data in Table (4) show that early irrigation holding increased water use efficiency of sugar beet plants. 20 cm spacing between hills increased water use efficiency. Such increase in WUE may be attributed to that 20 cm hill spacing produced a higher root and sugar yields and consequently higher water use efficiency. The highest values of W.U.E (14.65 and 18.77kg/m^{3}) for root yield and (3.46 and 3.19 kg/m^{3}) for sugar yield in the 1st and 2nd seasons, respectively, were obtained when the last irrigation was terminated 7 weeks before harvest (W3) and 20 cm(S1) between hills. These results are in agreement with those of Winter (1989), Omar (1998) and Emara *et al* (2000).

5- Soil salinity and alkalinity:

The obtained results in Table (5) show that soil salinity (ECe) and SAR were increased with increasing the period of drought before harvesting sugar beet during the two growing seasons, this could be attributed to the upward movement of soluble salts under the condition of soil water stress. The highest mean values of ECe (1.72 and 2.25dS/m) and SAR (6.11 and 6.81) in the 1st and 2nd seasons, respectively, were obtained under the most drought treatment W3 (7weeks before harvest). It is obvious from data that ECe values were increased after the 2nd season under irrigation treatments W2 and W3 comparing to the initial ECe values 1.53 dS/m. Data also reveal that ECe and SAR values were higher in the surface layer (0-30cm) than in the sub soil layer (30-60 cm) during the two seasons. Regarding the effect of plant spacing, the obtained results show that ECe and SAR values were higher under 30 cm space than under 20 cm space between hills in the two growing seasons. This result could be attributed to the higher uptake of salts under 20 cm space (high plant density) than under 30 cm space (low plant density), also under the low plant density there is more evaporation from soil surface by solar radiation and consequently secondary salinization. The obtained results are in agreement with those Khalifa and Ibrahim (1995) and Omar (1998).

Table 5: Effect of different treatments on soil salinity (ECe) and sodium adsorption ratio (SAR)

Seasons	Treatments	ECe, dSm^{-1}			SAR		
		Soil depth, cm		Mean	Soil depth, cm		Mean
		0-30	30-60		0-30	30-60	
First season	*W1*	1.32	1.29	1.39	4.99	4.63	4.81
	W2	1.44	1.43	1.44	5.82	5.54	6.68
	W3	1.72	1.72	1.72	6.17	6.05	6.11
	S1	1.27	1.40	1.34	5.58	5.44	5.51
	S2	1.71	1.55	1.63	5.73	5.36	5.55
Second season	*W1*	1.49	1.33	1.41	5.59	5.49	5.54
	W2	1.65	1.53	1.59	6.65	6.43	6.54
	W3	2.37	2.12	2.25	7.11	6.51	6.81
	S1	1.72	1.58	1.65	6.19	6.03	6.11
	S2	1.94	1.74	1.84	6.71	6.26	6.49

CONCLUSION

It could be concluded that application of 72 kg K2O/fed with plant spacing 20 cm between hills and termination of the last irrigation 7 weeks before harvest produced the higher root and sugar yields and water utilization and water use efficiency of sugar beet crop in the clay soil at North Nile Delta. The importance of K-fertilization is to producing higher values of sucrose percentage, root and sugar yields, moreover inhibits Na uptake and consequently achieve good root quality. The importance of higher plant density is to obtaining high root and sugar yields. The importance of the early termination of irrigation is to achieve high sucrose, sugar yields and maximizing the water utilization efficiency of sugar beet plant and saving about 20.2% from irrigation water applied.

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استجابة بنجر السكر لميعاد أخر ريه و مسافات الزراعة و التسميد البوتاسى

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أقيمت تجربة حقلية بمحطة البحوث الزراعية بسخا فى موسمين زراعيين ١٩٩٩/ ٢٠٠٠ ، ٢٠٠٠/ ٢٠٠١ لدراسة مدى استجابة محصول بنجر السكر لوقف الرى قبل الحصاد بثلاث أسابيع ، ٥ أسابيع و سبعة أسابيع مع مسافات زراعة ٢٠ ، ٣٠ سم بين الجور إلى جانب التسميد البوتاسى بالمعدلات ٢٤ ، ٤٨ ، ٧٢ وحدة بو٢أ لكل فدان.

ويمكن تلخيص النتائج كما يلى:

١- وقف الرى قبل الحصاد بسبعة أسابيع (W3) أعطي أعلى إنتاجية لمحصول الجذور و محصول السكر و زيادة فى نسبة السكر و أيضا زيادة كفاءة استخدام مياه الرى . و انخفاض كمية مياه الرى المضافة و كذا الماء المستهلك.
٢- زراعة محصول البنجر على مسافات ٢٠ سم بين الجذور افضل من الزراعة على مسافة ٣٠ سم حيث أن الزراعة على مسافة ٢٠ سم أعطت أعلى محصول إلى جانب زيادة فى كفاءة استخدام مياه الرى.
٣- زيادة التسميد البوتاسى إلى ٧٢ وحدة بوتاسيوم / فدان أدى إلى زيادة محصول الجذور و السكر و كذا النسبة المئوية للسكر فى محصول بنجر السكر
٤- زيادة التسميد البوتاسى أدى إلى زيادة البوتاسيوم فى الجذور و الأوراق و أدى إلى انخفاض الصوديوم فى بنجر السكر.
٥- يمكن استنتاج أن حرمان بنجر السكر من الرى قبل الحصاد بحوالى سبعة أسابيع مع الزراعة على مسافات ٢٠ سم و التسميد البوتاسى حتى ٧٢ وحدة/ فدان أعطت أعلى محصول و أعلى كفاءة لاستخدام مياه الرى.