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EFFECT OF HILL SPACING AND POTASSIUM FERTILIZATION AT TWO SOWING DATES, ON SUGARBEET YIELD AND QUALITY

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ABSTRACT

Two field experiments were carried out at the Agricultural Experimental and Research Center, Faculty of Agriculture, Cairo Uinversity, Giza, Egypt during 1995/96 and 1996/97 seasons. These experiments were conducted to investigate the effects of sowing dates (Oct. and Nov.), hill spacing (15,20 and 25 cm) and potassium rates (0,24 and 48 K_2O Kg/fed.) on yield and quality of sugarbeet (*Beta vulgaris* L.).

The main results revealed that sugarbeet sown on October gave significantly higher root length and diameter as well as root weight and top yield. On the other hand root/top ratio and root quality in terms of sucrose, T.S.S. and purity percentages were not significantly affected by sowing date.

Sowing sugar beet at 25 cm between beet plants produced superior root length, diameter and weight, as well as top yield in both seasons.

The distance 20 cm between beet plants outyielded 15 or 25 cm in root yield and sugar yield in both seasons. The distance 15 cm resulted in the best sucrose % where as T.S.S % and purity % were not affected by hill spacing or K.rates.

Significant differences among K rates in most of the studied traits were reported in both seasons.

The highest root yield and sugar yield were obtained with 20

cm between beet plants, 48 K_2O Kg/fed. and sown in October in both seasons.

Key words: *fertilizer , hill spacing , sowing date, sugarbeet*

1.INTRODUCTION

The economic way of increasing sugar productivity could be achieved through developing appropriate new technology package for sugarbeet crop that includes agronomic management to improve the yield and quality of sugarbeet.

Hanna *et al.,* (1988), El-Kassaby & Leilah (1992) and Badawi *et al.,* (1995) in Egypt found that sowing sugarbeet during October markedly increased root diameter, root length, root weight, sugar content as well as root and sugar yields than sowing during Novomber. Azazy (1998) in Shandaweel, Sohag Governorate found the that sugarbeet sown on the first of November always gave the highest sucrose, T.S.S. content, and purity % as well as root and sugar yields compared with beet sown on the 15th of Nov. Ramadan and Hassanin (1999) found that sugarbeet sown on the $10^{th}$of Sept. significantly gave higher root length and diameter, as well as root and recoverable sugar yields. Delaying sowing date up to the 10^{th} of Nov. reduced sucrose and purity percentages, but increased Na, K and amino contents in roots.

Stanacev (1970) in Yogoslavia using different spacings between plants (15, 20 and 30 cm) in rows 50 cm apart, found that root yield was not significantly affected by the different plant spacings. However, the highest sugar yield resulted from 50 X 20 cm plant spacing.

Hanna *et al.,* (1988) stated that dry matter production of beet plants increased as row spacing increased from 35 to 70 cm as well as hill spacing from 10 to 35 cm. Assey *et al.,* (1992) using different row spacings *viz.* 30, 45 and 60cm as well as hill spacing *viz.* 10, 15, 20 and 25 cm, found that sucrose and purity contents significantly decreased as row spacing increased, while hill spacing had no significant effect on such trait.

Cakmakci *et al.,* (1998) reported that plant density at harvest ranged between 49.500 and 124.500 /ha on average depending on

initial establishment, intra-row spacing and thinning.

With respect to potassium fertilization, the review of literature revealed that quality , root and sugar yields responded positively to K application .

El-Hawary (1994) showed that the average of root length, root fresh weight , sucrose percentages as well as root and sugar yields (ton/fed.) were increased significantly with increasing potassium fertilization up to 72 kg K/fed.

Ramadan, (1997) revealed that increasing potassium rate up to 72 kg/fed/ favoured beet growth in terms of root weight, improved quality in terms of sucrose, purity and sugar yield, lowered impurities and increased yields of shoots, roots and sugar per feddan.

Sarhan (1998) in Egypt using different rates of potassium viz. 12, 24 and 48 kg/fed., found that application of 48 kg K/fed. increased leaf area, root weight and root diameter, produced the highest yields of roots, tops and sugar per fed. Sucrose and purity percentages were not significantly affected by K levels.

The present study was conducted to investigate the interaction effect of sowing date, hill spacings and potassium fertilization on sugar beet yield and quality.

2.MATERIALS AND METHODS

Two field experiments were carried out at the Agricultural Experimental and Research Center, Faculty of Agriculture, Cairo University, Giza, Egypt during 1995/96 and 1996/97 seasons to investigate the effects of sowing date, hill spacings and potassium fertilization on yield and quality of sugar beet (*Beta vulgaris* L.) Variety " Top".

The soil type for the experimental site was clay loam (Table 1).

Table (1) Mechanical and chemical analysis of soil at the experimental site for 1995/96 and 1996/97 seasons.

Season	Mechanical			Chemical Available					
	Clay%	Silt%	Sand %	Ca%Co 3	OM%	N ppm	P ppm	K ppm	PH
1995/96	38.3	23.4	38.4	3.0	1.9	48	16.1	369	7.8
1996/97	37.2	24.6	38.2	3.2	1.7	47	14.0	367	7.9

A sub-sub plot design with four replications was used in both seasons. The sowing date occupied the main plots; 21 Oct. and 12 Nov. in 1995/96 and 24 Oct. and 15 Nov. in 1996/97. Sugar beet seeds were planted in hills at 15,20 and 25 cm apart in the sub- plots. Potassium was applied before planting at rates o,24 and 48 K_2O Kg/fed. in the sub- sub- plot. Each sub- sub- plot consisted of 6 rows, 50 cm between rows and 3.5 m long (plot area 10.5 m^2).

Other macro - fertilization was applied in both experiments; phosphorus (30 kg P_2O_5/fed.) was applied before planting, while nitrogen (80 kg N/fed.) was applied in two equal doses , the first after 40 days from planting and the second at 80 days after planting.

The experiments were harvested at 195 and 200 days after sowing in the first and second seasons, respectively. A random sample of five roots at harvest was taken from each sub-sub plot to determine root length, diameter and weight /plant. At harvest, plants of four guarded rows for each treatment were uprooted and topped to determine root yield, top yield and sugar yield.

Total soluble solids (T.S.S.%) was measured with a hand referactometer. Sucrose content was determined by using saccharometer according to Le Docte (1927).

Data collected from both seasons were statistically analyzed according to Snedecor and Cochran (1967).

Treatments means were compared by using L.S.D. test at 0.05 level of probability according to Waller and Duncan(1969).

3.RESULTS AND DISCUSSION

3.1. Root characters

3.1.1.Root length, diameter, weight and root/top ratio

Results in Tables (2 and 3) indicated that averages of root length, diameter and weight of the individual root were significantly decreased as sowing date was delayed in both seasons. Sowing sugar beet during Oct. resulted in the highest means of root length (22.1 and 23.1 cm) , diameter (9.1 and 9.0 cm) and root weight (768 and 690 g/plant) in both seasons, respectively.

The lowest means of these traits were obtained from beet plants sown at Nov. These findings are in agreement with those obtained by Hanna *et al.*, (1988), El. Kassaby and Leilah (1992) and

Badawi *et al.*, (1995) . They found that sowing sugar beet during Oct. markedly increased root diameter, length and weight than sowing during Nov.

Hill spacings had a significant effects on root characters; length, diameter and weight in both seasons. Data indicated that increasing the distances within the rows from 15 to 25 cm increased root characters in terms of length, diameter and weight in both seasons. Sowing sugarbeet at 25 cm between plants produced large size root length, diameter and weight in the two seasons.

On the other hand, decreasing the distance between plants to 15 cm resulted in the lowest means of root length, diameter and weight in both seasons.

The same results were recorded by Mahmoud *et al.*, (1990), El-Kassaby and Leilah (1992)and Assey *et al.*, (1992).

Results in Tables (2,3) revealed that root characters were significantly affected by K rates. A gradual increase in root length, diameter and weight were recorded as K rate increased up to 48 K_2O kg/fed.

Similar results were obtained by Kandil (1985), El- Hawary (1994) Ramadan (1997) and Sarhan (1998).

As shown in Table (3) root / top ratio did not show great differences according to sowing date. Regarding to hill spacing effects data revealed that root / top ratio tended to decrease with increasing the distance between beet plants from 15 to 25 cm. in the first season.

The distance 20 cm between beet plants gave the highest values from root/top ratio (3.81) in the second season.

These results agree with those obtainded by Panje and Gill (1967) , and Hassanin (1991). Also, the results indicated that root/ top ratio was significantly affected by K rates in both seasons. Root/top ratio was gradually increased with increasing K rates. The highest root /top ratios (3.19 and 3.54) were obtained with 48 K_2O Kg/fed. Similar finding was obtained by Sun *et al.*, (1994). They reported that K_2O increased the distribution of dry matter to roots and improved the ratio of root: shoot and sugar content.

A significant interaction between sowing date and hill spacing was found in root length in both seasons and in root diameter and weight in the first season.

Table (2):Root length and diameter of sugar beet as affected by sowing date hill spacing and potasium fertilization in 1995/96 and 1996/97 seasons.

Sowing date		1995/96				1996/97			
Hill spacing (cm)		Root length (cm)		Root diameter (cm)		Root length (cm)		Root diameter (cm)	
K_2O level Kg/fed.		Oct.	Nov.	Oct.	Nov.	Oct.	Nov.	Oct.	Nov.
15	0	19.30	17.90	7.6	7.9	19.7	17.6	7.9	7.8
	24	20.10	18.98	8.2	8.0	20.3	20.1	8.3	8.0
	48	21.00	20.17	8.6	8.1	23.7	21.1	8.7	8.2
	Mean	20.10	19.00	8.1	8.0	21.9	19.6	8.3	8.0
20	0	20.50	21.50	8.9	8.3	20.8	20.6	8.9	8.4
	24	22.55	23.40	9.3	8.4	23.1	22.9	9.1	8.7
	48	22.80	23.90	9.5	8.5	23.9	23.9	9.6	8.9
	Mean	21.90	23.00	9.2	8.4	22.6	22.5	9.2	8.7
25	0	21.30	22.05	9.4	8.8	23.5	22.2	9.1	8.8
	24	24.88	24.15	9.9	9.2	25.3	24.6	9.6	9.1
	48	26.50	25.10	10.1	9.4	25.8	25.0	10.2	9.9
	Mean	24.20	23.70	9.8	9.1	24.9	23.9	9.6	9.3
Mean For sowing date		22.10	21.90	9.1	8.5	23.1	27.0	9.0	8.6
Significance Level		NS		S		S		S	
Mean for K. level Kg/fed.	0	20.40	20.5	8.7	8.3	21.4	20.1	8.6	8.3
	24	22.50	22.2	9.1	8.5	23.6	22.5	9.0	8.6
	48	23.40	23.0	9.4	8.7	24.4	23.3	9.5	9.0
L.S.D. at 0.05 for									
Hill spacing		0.44		0.15		0.8		0.19	
K. rate		0.36		0.09		0.37		0.10	
S X H		0.63		0.21		1.15		------	
S X K		----		------		------		------	
H X K		----		------		------		------	
S X H X K		0.87		------		------		0.17	

Table (3): Root weight and root / top ratio of sugar beet as affected by sowing date, hill spacing and potassium fertilization in 1995/96 and 1996/97 seasons.

Sowing date		1995/96				1996/97			
Hill spacing (cm)		Root weight g/plant		Root / top ratio		Root weight G/plant		Root / top ratio	
K_2O level Kg/fed.		Oct.	Nov.	Oct.	Nov.	Oct.	Nov.	Oct.	Nov.
15	0	651	595	3.19	3.23	546	514	2.66	2.64
	24	739	619	3.27	3.26	586	595	2.90	3.14
	48	772	636	3.38	3.35	656	624	3.24	3.61
	Mean	721	616	3.28	3.28	596	578	2.93	3.13
20	0	725	678	3.09	3.01	652	616	3.58	3.16
	24	760	743	3.23	3.60	686	650	3.88	3.95
	48	808	757	3.15	3.53	755	696	4.29	3.97
	Mean	764	726	3.16	3.38	698	654	3.92	3.69
25	0	795	729	2.39	2.66	751	721	2.81	2.47
	24	817	786	2.82	2.80	776	757	2.93	3.09
	48	850	824	2.76	2.94	800	767	3.00	3.12
	Mean	821	779	2.66	2.80	775	748	2.91	2.89
Mean For sowing date		768	707	3.03	3.15	690	660	3.25	3.24
Significance Level		S		NS		S		NS	
Mean for K. level Kg/fed.	0	723	667	2.89	2.93	650	617	3.02	2.76
	24	772	716	3.11	3.17	683	667	3.24	3.39
	48	810	739	3.10	3.19	737	696	3.51	3.57
L.S.D. at 0.05 for									
Hill spacing		23.0		0.21		19.0		0.19	
K. rate		10.0		0.12		13.0		0.08	
S X H		32.0		------		------		------	
S X K		------		------		------		------	
H X K		------		------		23.0		0.14	
S X H X K		24.0		------		------		0.20	

The treatment 25 cm between beet plants and sown at Oct. resulted in the highest means of root length (24.2 cm) root diameter (9.8 cm) and root weight (821 g/plant) in the first season (Table 4).

The interaction between sowing date and potassium rate had a significant effect on root diameter in the first season.

Concerning the interaction between hill spacing X K rate, significant effects were obtained on root diameter, root weight g/plant and root /top ratio in the second season. (Table 5).

Table (4): Root length, diameter and weight of sugarbeet as affected by the interaction between sowing date and hill spacing in 1995/96 season.

Sowing date	Hill spacing (cm)		
	15	20	25
		Root length (cm)	
Oct.	20.1	21.9	24.2
Nov.	19.0	23.0	23.7
L.S.D at 0.05		0.63	
		Root diameter	
Oct.	8.1	9.2	9.8
Nov.	8.0	8.4	9.1
L.S.D at 0.05		0.21	
		Root weight g/plant	
Oct.	721	764	821
Nov.	616	726	779
L.S.D at 0.05		32.8	

The highest means of root diameter (10.1cm) and root weight (783) were recorded with 25cm distance between beet plants and with 48 K_2O Kg/ fed., whereas the highest root/top ratio was obtained from 20 cm hill spacing with the three levels of K rates .

Root weight and root length were significantly affected by the interaction among the three main factors in the first season. The treatment 25 cm between beet plants gave the highest means of root length and weight with 48 k_2O Kg/fed and sown at Oct.

Also , the interaction between sowing date X hill spacing X K.rate had a significant effect on root/top ratio in the second season.

Table (5): Root diameter, root weight and root / top ratio in sugar beet as affected by the interaction between hill spacing X K rate in 1996 / 97 season.

Hill spacing (cm)	K_2O kg / fed.		
	0	24	48
		Root dimeter (cm)	
15	7.8	8.1	8.4
20	8.6	8.9	9.3
25	9.0	9.3	10.1
L.S.D at 0.05 level		0.18	
		Root weight g/plant	
15	530	591	640
20	634	668	726
25	736	766	783
L.S.D at 0.05 level		22.6	
		Root / top ratio	
15	2.65	3.02	3.43
20	3.37	3.92	4.13
25	2.64	3.01	3.06
L.S.D at 0.05 level		0.14	

The treatments 20 cm between beet plants with 24 or 48 K_2O Kg/fed. gave the highest values of root/top ratio as compared with 15 or 25 cm hill spacings under the two sowing dates in the second season.

3.3 Top yield (t/fed.)

Data in Table (6) indicated that sowing dates exhibited significant effects on top yield in both seasons. Delaying planting date decreased top yield by 0.67 t/fed . in the 1 st and 0.43 t/fed. in the 2nd seasons respectively. The present results agree with those obtained by Dillon and Schmehll (1971).

Data in Table (6) revealed that top yield (t/fed.) was significantly affected by hill spacing in both seasons.

The highest top yield (8.63 and 7.81 t/fed) were recorded with 25 cm distance between beet plants. On the other hand , the distance 15 cm between plants gave the lowest top yield t/fed (6.50 and 6.18 t/fed.) Such effects may be due to the wide spacing that enabled the sugarbeet plant to use the eviromental factors, light , CO_2

and humidity with high capacity and that was clear from the superior top yield of the lower density (25 X 50 cm).

Our results are in agreement with those obtained by Assey *et al.*, (1992) and Mahmoud *et al.*, (1990) and Hassanin (1991). They reported that 20cm distance between hills gave the highest top yield when plants were grown at wider spacings between and within rows. Potassium fertilization exhibited significant effects on top yield t/fed. in both seasons. A gradual increase in top yield was recorded as K rate increased. Similar findings were recorded by El-Hawary (1994), Ramadan (1997) and Sarhan (1998).

In the first season, the interaction between the three main factors on top yield (t/fed.) was significant. The interaction between hill spacing and K. rates was significant with respect to top yield t/fed. in the second season.

The highest top yield (8.68 t/fed.) was obtained from 25 cm hill spacing with 48 K_2O kg/fed. and sown in Oct.

3.4.Root yield, t/fed

Data presented in Table (6) indicated that differences between planting dates in root yield t/fed. were insignificant in both seasons. Delayed planting date decreased root yield by 1.03 t/fed. in the 1st season and 1.53 t/fed. in the 2nd season. Similar results are in harmony with those reported by Badawi *et al.*, (1995) Lauer (1995) and Ramadan and Hassanin (1999).

Significant differences between hill spacings were detected in root yield in both seasons The differences in root yield between 25 cm and 20 cm plant spacing were about 2.38 t and 3.58 t/fed. in the first and second seasons, respectively. Decreasing the distance between beet plants from 20 to 15 decreased root yield by 4.57 t/fed in the 1st season and 7.56 t/fed in the 2nd season, resepctively.

Similar results were obtained by Assey *et al.*, (1992), El-Kassaby and Leilah (1992), Cakmakci *et al.*, (1998) and Hassanin & Ramadan (1999).

Potassium fertilization exhibited significant effect on root yieldt/ in both seasons . Root yield. increased as K rates increased from O to 48 K_2O Kg/fed. Such increase was 5.23 and 6.48 t/fed in the 1st and the 2nd seasons, respectively. This trend is in good

Table (6): Top yield and root yield of sugar beet as affected by sowing date, hill spacing and potassium fertilization in 1995/96 and 1996/97 seasons.

Sowing date		1995/96				1996/97			
Hill spacing (cm)		Top yield T/fed.		Root yield T/fed.		Top yield T/fed.		Root yield T/fed.	
K_2O level Kg/fed.		Oct.	Nov.	Oct.	Nov.	Oct.	Nov.	Oct.	Nov.
15	0	6.15	5.74	19.59	18.53	6.11	5.93	16.33	15.70
	24	6.67	6.39	21.80	20.85	6.34	5.91	18.41	18.54
	48	7.12	6.93	24.13	23.19	6.53	6.24	21.15	22.51
	Mean	6.65	6.35	21.84	20.86	6.32	6.03	18.63	18.92
20	0	7.48	7.18	23.14	21.58	6.75	6.48	24.17	20.50
	24	8.60	7.46	27.86	26.85	7.07	6.71	27.48	26.53
	48	8.94	7.91	28.12	27.95	7.40	6.94	31.74	27.61
	Mean	8.34	7.52	26.37	25.46	7.07	6.71	27.80	24.88
25	0	8.72	7.70	20.80	20.52	7.49	7.01	21.06	17.32
	24	8.79	8.23	24.76	23.03	8.21	7.51	24.09	23.18
	48	9.72	8.60	26.85	25.29	8.68	7.95	26.07	24.84
	Mean	9.08	8.18	24.14	22.94	8.13	7.49	23.74	21.78
Mean For sowing date		8.02	7.35	24.12	23.09	7.17	6.74	23.39	21.86
Significance Level		S		NS		S		NS	
Mean for K. rate Kg/fed.	0	7.45	6.87	21.18	20.21	6.78	6.47	20.52	17.84
	24	8.02	7.36	24.81	23.58	7.21	6.71	23.33	22.75
	48	8.59	7.81	26.37	25.48	7.53	7.05	26.32	24.99
L.S.D. at 0.05 for									
Hill spacing		0.33		1.17		0.26		1.07	
K. rate		0.15		0.53		0.10		0.56	
S X H		------		------		------		1.52	
S X K		------		------		------		0.79	
H X K		------		0.91		0.17		0.97	
S X H X K		0.37		------		------		1.38	

agreement with the findings of Kamel *et al.*, (1979), Orlovius (1984), Kandil (1985) , El-Hawary (1994) and Sarhan (1998).

Sowing date X hill spacing interaction had a significant effect on root yield (t/fed.) in the second season. (Table 7).

The highest root yield was obtained from 20 cm hill spacing and sown in October.

The interaction between hill spacing X K rate had a significant effect on root yield in both seasons. Also, the interaction between sowing date X hill spacing X K rate in the second season had a significant effect on root yield. (Tables 6, 7 and 8).

Table (7): Root yield (ton/fed.) as affected by sowing date X hill spacing, as well as sowing date X K rate in 1996 / 97 season.

Sowing date	Hill spacing (cm)			K_2O rate		
	15	20	25	O	24	48
Oct.	18.63	27.80	23.74	20.52	23.33	26.32
Nov.	18.92	24.88	21.78	17.84	22.75	24.99
L .S.D at 0.05	1.52			0.79		

Table (8):Root yield (t/ fed.) as affected by Hill spacing X K rate in 1995 / 96 and 1996 / 97 seasons.

Hill spacing (cm)	K. rate 1995 / 96			K. rate 1996 / 97		
	O	24	48	O	24	48
15	19.07	21.33	23.66	16.02	18.48	21.83
20	22.36	27.36	28.03	22.33	27.00	29.68
25	20.66	23.89	26.07	19.19	23.64	25.45
L .S.D at 0.05	0.91			0.97		

In both seasons the highest root yield resulted from 20 cm distance between beet plants receiving 48 K_2O Kg/fed. and sown in October.

3.5. Root quality (total soluble solids, surose and purity percentages)

Data in (Tables, 9 and 10) revealed that delaying sowing from Oct. to Nov. had a significant effect on sucrose percentage only in the first season, whereas total soluble solids and purity percentages were not affected with sowing dates in both seasons.

Sowing on Oct. gave the highest value of sucrose (16.50%) as compared with sowing on in Nov. only in the first season.

Table (9): Total soluble solids (T.S.S%) and purity percentages of sugar beet as affected by sowing date, hill spacing and potassium fertilization in 1995/96 and 1996/97 seasons.

Sowing date		1995/96				1996/97			
Hill spacing (cm)		T.S.S %		Purity %		T.S.S %		Purity %	
K_2O level Kg/fed.		Oct.	Nov.	Oct.	Nov.	Oct.	Nov.	Oct.	Nov.
	0	22.55	22.53	73.8	73.3	20.5	20.2	80.0	81.0
15	24	22.23	21.85	75.7	75.8	20.6	20.3	80.0	81.0
	48	21.35	21.53	79.0	77.0	20.5	20.4	80.0	81.0
Mean		22.00	21.97	76.2	75.4	20.5	20.3	80.0	81.0
	0	22.50	22.40	72.8	72.7	21.0	20.7	76.0	79.0
20	24	22.38	22.38	73.4	72.9	21.1	20.7	77.0	79.0
	48	21.20	21.45	77.7	76.2	21.1	20.8	77.0	79.0
Mean		22.05	22.08	74.6	73.9	21.1	20.7	76.7	79.0
	0	22.45	22.83	72.0	70.7	21.6	21.0	74.0	76.0
25	24	22.03	22.75	73.9	71.0	21.6	21.2	74.0	76.0
	48	21.40	21.80	76.5	74.1	21.6	21.1	73.0	77.0
Mean		22.21	22.46	74.1	71.9	21.6	21.1	73.7	76.7
Mean For sowing date		22.01	22.17	75.0	73.7	21.1	20.7	77.0	79.0
Significance Level		NS		NS		NS		NS	
Mean for K. rate Kg/fed.	0	21.95	21.97	72.9	72.8	20.8	20.6	78.1	79.1
	24	22.03	22.08	74.4	73.2	20.9	20.7	77.8	78.7
	48	22.04	22.46	77.7	76.9	20.9	20.7	77.9	78.7
L.S.D. at 0.05 for									
Hill spacing		-----		0.02		0.42		0.9	
K. rate		0.25		0.03		-----		-----	
S X H		-----		-----		-----		-----	
S X K		-----		-----		-----		-----	
H X K		-----		-----		-----		-----	
S X H X K		-----		-----		-----		-----	

Table (10) : Sucrose percentage and sugar yield of sugar beet as affected by sowing date, hill spacing and potassium fertilization in 1995/96 and 1996/97 seasons.

Sowing date		1995/96				1996/97			
Hill spacing (cm)		Sucrose %		Sugar yield T/fed.		Sucrose %		Sugar yield T/fed.	
K_2O level Kg/fed.		Oct.	Nov.	Oct.	Nov.	Oct.	Nov.	Oct.	Nov.
15	0	16.6	16.5	3.25	3.06	16.4	16.4	2.68	2.57
	24	16.8	16.5	3.66	3.44	16.4	16.4	3.02	3.04
	48	16.9	16.5	4.08	3.85	16.4	16.5	3.74	3.71
	Mean	16.8	16.5	3.66	3.36	16.4	16.4	3.06	3.11
20	0	16.4	16.3	3.79	3.52	16.1	16.3	3.89	3.34
	24	16.4	16.3	4.57	4.38	16.2	16.3	4.45	4.32
	48	16.5	16.4	4.64	4.58	16.2	16.3	5.14	4.50
	Mean	16.4	16.3	4.33	4.16	16.2	16.3	4.49	4.05
25	0	16.1	16.1	3.35	3.30	15.9	16.1	3.35	2.79
	24	16.3	16.1	4.04	3.71	15.9	16.1	3.83	3.73
	48	16.4	16.1	4.40	4.07	15.9	16.2	4.15	4.02
	Mean	16.3	16.1	3.93	3.69	15.9	16.1	3.78	3.51
Mean For sowing date		16.5	16.3	3.97	3.74	16.2	16.3	3.78	3.56
Significance Level		S		NS		NS		NS	
Mean for K. rate Kg/fed.	0	16.4	16.3	3.46	3.29	16.1	16.2	3.31	2.90
	24	16.5	16.3	4.09	3.84	16.2	16.2	3.77	3.70
	48	16.6	16.4	4.37	4.17	16.2	16.3	4.26	4.08
L.S.D. at 0.05 for									
Hill spacing		0.10		0.20		0.05		0.17	
K. rate		0.05		0.09		0.04		0.09	
S X H		-----		-----		0.08		0.24	
S X K		-----		-----		-----		0.13	
H X K		-----		0.16		-----		0.16	
S X H X K		-----		-----		0.06		0.23	

These findings are in agreement with those obtained by Analogides (1979) and Martin *et al.*, (1982) reported that sugar content and juice purity were not significantly affected by date of sowings.

The distance 15 cm between beet plants resulted in the highest means of sucrose of 16.8 and 16.4% as compared with 20 or 25 cm hill spacings in both seasons, respectively. Significant increase in sucrose % resulted from 15 X 50 cm plant spacing. Also, 15 cm distance between hills produced the highest values of purity percentages in both seasons, respectively Similar results were obtained by Cakmakci *et al.*, (1998).

Contrary trend was obtained by Kamel *et al.*,(1981) and Assey *et al.*, (1992) using different row spacings, viz 30,45 and 60 cm, as well as, hill spacing, viz 10, 15, 20 and 25 cm, found that sucrose and purity percentages significantly decreased as row spacing increased while hill spacing had no significant effect on such trait.

Sucrose and total soluble solids were significantly affected by K rates in both seasons and purity only in the first season. The role of potassium in improving beet quality was reported by Zeidan *et al.*, (1987).

In the second season, sucrose percentage was significantly affected with the interaction between planting date X hill spacing.

The highest sucrose % was obtained with 15 cm, and sown in Oct. or Nov. The interaction between planting date X hill spacing X K rate had a significant effect on sucrose percentage in the second season, whereas 15 cm between beet plants , 48 K_2O kg/fed. and sowning in Nov. resulted in the highest value of sucrose percentage (16.5).

3.6.Suagr yield (ton/fed.)

As shown in Table (10) the differences between Oct and Nov. sowing dates in sugar yield did not reach to a significant level in both seasons. Delaying sowing from Oct. to Nov. decreased sugar yield by 0.23 t/fed. in the 1st season and o.22t/fed in the 2nd season respectively. These findings agree with those obtained by Lauer (1995), Azazy (1998) and Ramadan & Hassanin (1999).

Sugar yield (t/fed.) was significantly affected by hill spacing in the two seasons. The distance 20cm between beet plants outyielded the other hill spacings 15 or 25 cm in sugar yield (4.16 and 4.27 t/fed) in the 1st and the 2nd seasons, respectively. Such increase in sugar yield may be due to suitable environmental conditions hence increase root characters in terms of root weight with suitable size and increase in root yield, as well as sucrose % and that was clear from the superior 20 X 50 cm plant spacing in root and sugar yields in the two seasons.

Differences between 25 and 15 cm plant spacings in sugar yield were 0.33 and 0.56 t/fed. in the 1st and the 2 nd seasons, respectively. The results are in harmony with those obtained by Stanacev (1970) Yonts and Smith (1997) and Cakmakci *et al.*, (1998).

Sugar yield differed significantly with K rates in both seasons. Potassium application increased sugar yield from 3.38 to 4.27 t/fed. and from 3.11 to 4.17 t/fed. in the 1 st and the 2 nd seasons, respectively.

This effect might have been due to improving juice quality (sucrose and purity percentages) as a result of increasing K.

Similar findings were reported by Kandil (1985), El-Hawary (1994) and Sarhan (1998). The interaction between planting date X K rate was significant with respect to sugar yield in the second season.

Also, the interaction between hill spacing X K rates was significant in both seasons. (Table 11).

Table (11) Sugar yield (t/fed.) as affected by hill spacing X K rate in 1995/96 and 1996/97 seasons.

Hill spacing (cm)	K. rate 1995/96			K. rate 1996 / 97		
	O	24	48	O	24	48
15	3.16	3.55	3.97	2.63	3.03	3.59
20	3.66	4.48	4.61	3.62	4.39	4.82
25	3.33	3.88	4.24	3.07	3.78	4.09
L .S.D 0.05	0.16			0.16		

Hill spacing 20 cm with 48 K_2O Kg/fed. produced the highest sugar yield t/fed. in the two seasons.

The interaction between planting date X hill spacing X K rate

was significant in the second season. Hill spacing 20 cm with 48 K_2O Kg/fed. and sowing in Oct. gave the highest sugar yield (5.14 t/fed.) in the second season. (Table 10).

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تأثير المسافة بين الجور والتسميد البوتاسى تحت ميعادين للزراعة على محصول بنجر السكر وجودته

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الملخص

أجريت تجربتان حقليتان خلال موسمي 1996/1995 و 1997/1996 في محطة التجارب والبحوث التابعة لمزرعة كلية الزراعة – جامعة القاهرة – بالجيزة لدراسة تأثير مواعيد الزراعة (أكتوبر أو نوفمبر) والمسافة بين الجور

(15، 20 ، 25سم) وثلاث مستويات من التسميد البوتاسى (صفـــر ، 24 ، 48 بو$_2$أ كجم/فدان) وقد استخدم تصميم القطع المنشقة مرتين فى أربع مكررات . وتتلخص أهم نتائج الدراسة فيما يأتى :

1- أوضحت النتائج أن ميعادالزراعة فى اكتوبر أعطى أعلى القيم المعنوية لكل من صفة الطول والقطر وكذلك متوسط وزن الجـــذر الواحـــد ومحصـــول الأوراق طن /فدان ولم تتأثر صفة النسبة بيـــن الجـــذور والأوراق وكذلـــك صفات الجذر النوعية المتمثلة فى نسبة السكروز والمـــواد الصلبـــة الكليـــة ونقاوة العصير معنويا بتأثير ميعادى الزراعة .
2- كانت هناك اختلافات معنوية نتيجة لتأثير المسافة بين الجور وكذلك معـــدلات البوتاسيوم لمعظم الصفات المدروسة فى كلا الموسمين .
3- نتج أعلى محصول من الأوراق وزيادة حجم الجذور وزنا وطولا وقطرا عند زراعة البنجر على مسافة 25 سم بين النباتات .
4- تفوقت المسافة 20 سم بين الجور فى محصول الجذر والسكر على المســـافات 15و 25 سم بين الجور بينما كانت أحسن نسبة سكروز % عند الزراعة 15 سم بين الجور ولم تتأثر نسبة المواد الصلبة والنقاوة فى العصير بكـــل مـــن المسافات بين الجور والتسميد البوتاسى.
5-أعطت المعاملة 20 سم بين النباتات مع التسميد بمعدل 48 بو$_2$أ كجـــم / فـــدان وعند الزراعة فى أكتوبر أعلى محصول من الجـــذور والســـكر فـــى كـــلا الموسمين .

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