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Effects of Sowing Date and Cultivar on Sugar Beet *(Beta vulgaris* L.*)* Production in the Central Region of Saudi Arabia

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ABSTRACT. This study was carried out to evaluate four sugar beet cultivars grown at four different sowing dates at Deirab Agricultural Experimental Station, College of Agriculture, King Saud University during the winter of 1990 and 1991.

The results indicated that top yield, biological yield, total soluble solids (TSS), reducing sugars (RS) and non-reducing sugars (NRS) differed significantly among seasons and cultivars. In addition, there were significant differences between sowing dates with regard to all characters studied. Highly significant positive correlations were found between root yield and top yield and between biological yield, and root and top yield. A highly significant negative correlation was also found between the average weight of root and TSS.

Statistical analyses indicated that there were no important significant interactions for cultivars x seasons, cultivars x sowing date and cultivar x sowing date x seasons, indicating the stability of the four cultivars under different environments.

It could be concluded that the period from October, 15 to November, 1 was the most suitable period for sowing sugar beet in the Central Region of Saudi Arabia.

The climatic conditions that prevail in many parts of Saudi Arabia allow for different crops to be grown in each season. The present pattern of land use is mainly characterized by predominance of cereal crops due to the high subsidies offered by the government. However, intensified wheat and barley production must be maintained, but with addition of more diversified cropping system to overcome the drawbacks of monoculture.

Sugar consumption in Saudi Arabia is estimated to be about 450-500 thousand tons per year, which indicated that the demand for sugar has been almost doubled within the last five years (Riyadh Chamber of Commerce and Industry 1989).

Sugar beet (*Beta vulgaris* L.) is a herbaceous cold season crop (Martin *et al.* 1976) that can be a substitute for some cultivated land area of wheat and barley crops in Saudi Arabia. Earlier studies (Deirab and Hakma Research Stations 1978; Al-Saad *et at.* 1984 and Ghandorah 1987) confirmed the possibility and the potentiality of growing sugar beet in Saudi Arabia as a sugar crop.

Variance components have been used to estimate the genotype, locations, seasons, replications and the interaction effects, (Jones *et al.* 1960, Liang and Walter 1966 and Miller *et al.* 1959). In addition to the stability of cultivars (Baker 1969).

The objectives of this study were (I) to evaluate the performance of four sugar beet cultivars under the environmental condition of the Central Region of Saudi Arabia, and (II) to study the effect of years (seasons) on root, top, and biological yields in addition to sugar contents and percent of purity in four cultivars of sugar beet.

Materials and Methods

A field experiment was conducted at the College of Agriculture Experimental Research Station at Deirab near Riyadh (24-26́N, 47-46́E, Alt. 600 m) in 1990 and 1991 winter seasons on a non-saline (EC 2455) sandy loam soil.

The experimental design consisted of four treatments replicated four times in a randomized split - plot design, with sowing dates as main plots and cultivars as subplots. The four dates in 1990 were (October 15, November 1, November 15 and December 1) while in 1991 they were (October 15, November 3, November 11 and December 1). The sugar beet cultivars used in this study were Cerespoly, Irlarave, Berla, and Dibbe. A subplot consisted of four ridges. The ridge was 5 m long, and 70 cm apart. The within row spacing was 30 cm between plants. Nitrogen fertilizer was applied at a rate of 200 kg/ha in the form of urea (48% N) splitted three times during the season, at planting, four and eight weeks after planting. Phosphorus as calcium superphosphate (16% P_2O_5) was added before planting at the rate of 200 kg/ha. Chelated iron was added twice at the rate of 1 kg/ha during seed bed preparation and after six weeks from planting. Plots were irrigated whenever needed with treated municipal water throughout the growing season. Plants were harvested when the total soluble solids (TSS) content reached 13-15%.

The characters evaluated in both seasons included root yield (R.Y.) in t/ha, top yield (T.Y.)in t/ha, and biological yield (B.Y.), in t/ha. In addition, the average root weight (A.R.W.) in kg, percentage of total soluble solids (TSS), reducing sugars (R.S.), non-reducing sugars (N.R.S.), total sugars (T.S.) percentage and purity were also evaluated. Plant samples were analysed for sugar content utilizing normal chemical procedures (Dubois *et al.* 1956 and A.O.A.C., 1970).

Data were analysed by analysis of variance for each year and combined over years (Steel and Torrie 1980). Also, the phenotypic (P.C.V.) and genotypic (G.C.V.) coefficients of variation, broad sense heritability (Hb) and genetic advance (G.A.) at level of significance 5% were calculated (Allard 1960).

Results and Discussion

The weather conditions during the two years of the experiment were substantially different. During 1990-1991 season it was hot during most of the growing season and with high evaporative demand. Whereas, the 1991-1992 season was cooler and with low evaporative demand. The mean monthly minimum and maximum temperatures, the mean monthly average temperature, relative humidity and rainfall during the two growing seasons of the experiment are presented in table 1. Rainfall was scanty with small effects under regular irrigation regimes.

The general performance of all sugar beet cultivars was promising and the plants generally had normal appearance at all sowing dates. However, some entries showed slow growth rate for some time during the early stages of crop establishment and this could be attributed to freezing spell which occurred during the first season (in the third week of December 1990) and second season (in the first two weeks of January 1992) (Table 1). Since the temperatures were below freezing, the day-night extremes could have caused physiological imbalance (Thorn *et al.* 1967).

Agronomic Characters.

The combined analysis of variance of the data collected in the course of the study for the cultivars and the four sowing dates during the two seasons are presented in Table 2. The top and biological yields for the two seasons were significantly different, meanwhile, insignificant differences were obtained for root yield and average root weight. However, despite the insignificant difference in root yield between the two seasons, the yield in the second season was higher than in the first. This trend in root yield could be due to the cooler temperatures that prevailed in the second season. The average root yield over cultivars and sowing dates were 127 and 137 t/ha, whereas those of biological yield were 208 and 252 t/ha for the first and second season, respectively, (Table 3). There were highly significant differences in the root yield, top, and biological yields as well as the averaged root weight (Table 2). The mean values of

Table 1. Mean temperatures, relative humidity and rainfall during the two growing seasons

1990 - 1991							
Month	**Temperature °C**			**R. Humidity %**			**Rain fall mm**
	Max.	**Min**	**Mean**	**Max.**	**Min**	**Mean**	
Oct. 90	37.5	14.6	26.05	54.10	19.66	36.88	00.00
Nov.	30.8	08.0	19.40	66.92	20.75	43.84	00.00
Dec.	25.9	05.9	15.90	83.90	26.60	55.25	00.00
Jan. 91	20.4	07.5	13.95	85.97	38.61	62.29	16.30
Feb.	22.0	09.2	15.60	71.11	25.61	48.36	00.00
Mar.	27.9	12.8	20.35	44.86	16.62	30.73	04.00
Apr.	35.8	18.1	26.95	48.67	10.78	29.73	00.00
May	39.8	19.8	29.80	28.18	06.78	17.48	00.00
June	43.7	21.4	32.55	23.75	05.36	14.56	00.00
1991 - 1992							
Month	**Temperature °C**			**R. Humidity %**			**Rain fall mm**
	Max.	**Min**	**Mean**	**Max.**	**Min**	**Mean**	
Oct. 91	32.8	11.1	21.95	59.51	27.05	43.28	00.00
Nov.	30.3	08.1	19.20	64.69	28.84	46.77	00.00
Dec.	24.9	09.5	17.20	70.47	38.87	54.67	00.00
Jan. 92	17.7	04.0	10.87	69.90	41.40	55.65	00.51
Feb.	21.7	07.1	14.40	62.75	35.42	49.09	13.46
Mar.	24.9	10.7	17.80	50.19	29.88	40.04	11.17
Apr.	33.4	15.9	24.65	46.76	23.63	35.20	10.16
May	39.3	21.5	30.40	31.39	13.75	22.57	1.52

root yield over seasons and sowing dates were 144, 135, 132 and 117 t/ha for cultivars Cerespoly, Trlarave, Berla and Dibbe, respectively (Table 4). The mean values for top yield were 102, 100, 97 and 91, respectively, for cultivars Trlarave, Berla, Cerespoly and Dibbe, whereas those for the biological yield were 241, 238, 232 and 209 t/ha, respectively, for Cerespoly, Trlarave, Berla and Dibbe (Table 4). Meanwhile, the mean values for root weight were 2.78, 2.45, 2.34 and 2.23 kg for cultivars Cerespoly, Trlarave, Berla and Dibbe in the respective order (Table 4).

Differences between sowing dates in both seasons were highly significant in regard to root yield, top yield, biological yield and average root weight (Table 2). Delaying sowing date resulted in a linear reduction in root, top, and biological yields, whereas the reduction in average root weight was not linear as well (Table 4). The combined

Table 2. Analysis of variance for suger beet data for top yield (T.Y), root yield (R.Y), biological yield (B.Y), average root weight (A.R.W), total soluble solids (TSS), reducing sugar (R.S), non-reducing sugar (N.R.S), total sugar (T.S) and purity over sowing dates and cultivars

S.O.V	T.Y	R.Y	B.Y	A.R.W	TSS	R.S.	N.R.S	T.S	Purt.
	t/ha			kg	%				
Seasons	**	NS	*	NS	**	NS	*	**	NS
Dates	**	**	**	**	**	**	**	**	**
Cultivars	**	**	**	**	**	NS	**	**	**
S D	**	NS	*	NS	**	**	**	**	*
S C	NS	NS	NS	NS	**	NS	NS	NS	NS
D C	NS	NS	NS	NS	NS	NS	NS	NS	NS
S D C	NS	NS	NS	NS	NS	NS	NS	NS	NS

* Significant at .05 level of probability.
** Significant at .01 level of probability.
NS Not Significant.

Table 3. Phenotypic variation (Means and Standard Errors) data for top yield (T.Y), root yield (R.Y), biological yield (B.Y), average root weight (A.R.W), total soluble solids (TSS), reducing sugar (R.S), non- reducing sugar (N.R.S), total sugar (T.S) and purity in sugar beet averaged over sowing dates and cultivars during 1990 and 1991 seasons

Cbaracters	1990		1991	
	Means	SE±	Means	SE±
T.Y (t/ha)	080.36	1.20	115.33	2.28
R.Y (t/ha)	127.85	4.12	137.36	2.90
B.Y (t/ha)	208.21	3.39	252.70	3.58
A.R.W (kg)	002.33	0.57	002.58	0.51
TSS (%)	012.84	1.05	011.89	0.60
R.S.(%)	000.23	0.14	000.20	0.52
N.R.S.(%)	010.66	1.38	009.40	1.13
TS (%)	010.89	1.38	009.59	1.10
Purity(%)	084.47	1.49	080.56	1.73

Table 4. Means of different characters for sugar beet cultivars and sowing dates data for top yield (T.Y), root yield (R.Y), biological yield (B.Y), average root weight (A.R.W), total soluble solids (TSS), reducing sugar (R.S), non-reducing sugar (N.R.S), total sugar (T.S) and purity averaged over season

Treatments		T.Y	R.Y	B.Y	A.R.W	TSS	R.S	N.R.S	T.S	Purity
			t/ha		kg			%		
CV.1	D1	126.18	154.75	280.94	2.91	12.43	0.25	10.08	10.33	83.13
	D2	99.42	161.18	260.61	2.91	11.45	0.14	9.23	9.38	81.07
	D3	94.28	143.14	237.42	2.90	11.85	0.28	8.63	8.91	75.29
	D4	94.28	120.09	188.28	2.39	11.38	0.29	7.62	7.90	69.97
MEAN		97.02	144.79	241.81	2.78	11.78	0.24	8.89	9.13	77.36
CV.2	D1	126.09	153.90	279.99	2.52	13.37	0.25	11.81	12.06	90.08
	D2	108.38	151.42	259.80	2.57	12.00	0.16	9.76	9.92	82.47
	D3	100.95	127.71	228.65	2.35	12.23	0.12	9.83	9.95	81.41
	D4	75.42	108.57	183.99	1.94	11.97	0.17	9.11	9.28	77.46
MEAN		102.71	135.39	238.11	2.34	12.39	0.18	10.13	10.30	82.85
CV.3	D1	122.66	150.71	273.37	2.70	12.77	0.27	10.49	10.77	84.41
	D2	114.38	149.04	263.42	2.70	11.40	0.12	9.86	9.98	87.40
	D3	93.42	125.23	218.66	2.52	12.00	0.14	9.66	9.80	81.55
	D4	71.23	104.47	175.71	1.88	10.98	0.25	8.15	8.40	76.82
MEAN		100.42	132.36	232.79	2.45	11.79	0.20	9.54	9.73	82.55
CV.4	D1	116.57	132.37	248.94	2.46	14.00	0.28	12.46	12.74	91.16
	D2	99.23	134.28	233.51	2.69	12.45	0.16	11.18	11.34	91.07
	D3	80.95	107.42	188.37	2.00	14.37	0.28	12.87	13.15	91.65
	D4	68.19	97.42	165.61	1.76	13.20	0.25	9.70	9.96	75.32
MEAN		91.23	117.88	209.11	2.23	13.50	0.24	11.55	11.79	87.30
LSD 0.05		7.47	9.06	14.16	0.23	1.40	0.10	0.95	0.94	7.15

CV.1 = Cerespoly CV.2 = Irlarave CV.3 = Berla CV.4 = Dibbe analysis of variance also showed insignificant interactions of season x cultivar, sowing date x cultivar and season x sowing date x cultivar for all of the agronomic characters evaluated with the exception of top and biological yields (Table 2). This is an indication that the studied cultivars were stable in their performance across seasons, and their ranking in both seasons, for all studied characters was similar.

Chemical Characters

Analysis of variance for the effects of season, cultivar, sowing date and their interactions on the chemical characters are summarized in table 2. Seasonal differences were highly significant for only total soluble solid (TSS) and total sugar (TS). Their respective means over cultivars and sowing dates were 12.84, 11.89% and 10.89, 9.59% in 1990 and 1991 seasons, respectively (Table 5). Differences among cultivars and sowing dates were highly significant for all chemical characters under study, except for percentage of reducing sugars (RS) in case of cultivars (Table 2). The average means over seasons and planting dates were 13.50, 12.39, 11.79 and 11.78% for TSS; 11.79, 10.30, 9.73 and 9.13% for TS and 87.30, 82.85, 82.55% and 77.36% for purity, respectively for cultivars Dibbe, Berla, Trlarave and Cerespoly (Table 4). The two factor interactions between season and sowing dates were highly significant for TSS (Table 2), reducing sugars, non reducing sugars and total sugars, but significant for purity, indicating that the effects of sowing date on chemical characters were not the same for different seasons (Table 6). On the other hand, interactions between season and cultivar were found to be highly significant for only TSS (Table 2). This is an indication that total soluble solids were not the same in different cultivars and it also differed among seasons (Table 5).

Correlation And Genetic Parameters

Correlations coefficients among different traits had been studied and the results are given in table 7. Highly significant correlations occurred between top yield and root yield ($r = 0.66$), top yield and biological yield ($r = 0.93$) and between top yield and average root weight ($r = 0.54$). This indicates that the cultivars with good vegetative growth had more leaves throughout the growing period and thus tended to produce both substantial root and biological yields. Moreover, a significant negative correlation ($r = -0.20$) occurred between root yield and reducing sugars, indicating that increasing root yield resuited in decreasing the percentage of reducing sugars. Also, a highly significant negative correlation ($r = -0.27$) has been recorded for the average root weight and TSS which indicates that breeding and /or producing larger size sugar beet root may result in reducing the percentatge of total soluble solids.

The data further revealed highly significant correlations between TSS and reducing sugars ($r = 0.24$), TSS and non-reducing ($r = 0.73$), TSS and TS ($r = 0.74$), TSS and purity ($r = 0.24$). This suggests that increasing the total soluble solids may result in an increases of the magnitudes of these constituents.

Table 5. Means of different characters for sugar beet cultivars data for top yield (T.Y), root yield (R.Y), biological yield (B.Y), average root weight (A.R.W), total soluble solids (TSS), reducing sugar (R.S),non-reducing sugar (N.R.S), total sugar (T.S) and purity averaged over sowing dates in 1990 and 1991 seasons

Treatments	T.Y		R.Y		B.Y		A.R.W		TSS		R.S		N.R.S		T.S		Purity	
	t/ha						kg		%									
	1990	1991	1990	1991	1990	1991	1990	1991	1990	1991	1990	1991	1990	1991	1990	1991	1990	1991
CV.1	78.49	115.54	145.35	144.23	223.8	259.8	2.65	2.91	12.30	11.26	0.21	0.27	9.58	8.20	9.78	8.48	79.6	75.1
CV.2	83.65	121.78	127.37	143.42	211.0	265.2	2.28	2.41	12.95	11.83	0.22	0.13	10.62	9.63	10.84	9.77	83.4	82.3
CV.3	82.26	118.59	126.07	138.66	208.3	257.2	2.34	2.56	11.81	11.77	0.24	0.15	9.93	9.14	10.17	9.29	85.9	79.2
CV.4	77.04	105.42	112.61	123.14	189.7	228.6	2.04	2.41	14.31	12.70	0.25	0.23	12.50	10.61	12.75	10.84	89.0	85.6
MEANS	80.36	115.33	127.85	137.36	208.2	252.7	2.33	2.58	12.84	11.89	0.23	0.20	10.66	9.40	10.89	9.59	84.5	80.6
LSD (0.05)	5.41	11.36	8.91	12.40	9.68	21.81	0.18	0.34	0.58	0.74	0.04	0.16	0.65	1.45	0.65	1.44	5.53	10.70

CV.1 = Cerespoly CV.2 = Irlarave CV.3 = Berla CV.4 = Dibbe

Table 6. Means of different characters for sugar beet sowing data for top yield (T.Y), root yield (R.Y), biological yield (B.Y), average root weight (A.R.W), total soluble solids (TSS), reducing sugar (R.S),non-reducing sugar (N.R.S), total sugar (T.S) and purity averaged over cultivers in 1990 and 1991 seasons

Sowing dates	T.Y		R.Y		B.Y		A.R.W		TSS		R.S		N.R.S		T.S		Purity	
	t/ha						kg		%									
	1990	1991	1990	1991	1990	1991	1990	1991	1990	1991	1990	1991	1990	1991	1990	1991	1990	1991
SD.1	93.88	151.87	140.83	155.04	234.7	306.9	2.52	2.78	13.74	12.54	0.43	0.10	11.84	10.58	12.27	10.67	89.3	85.1
SD.2	90.42	120.28	141.54	156.42	231.9	276.7	2.44	3.00	12.87	10.78	0.20	0.09	11.57	08.45	11.77	08.53	91.6	79.4
SD.3	82.14	102.66	120.71	131.04	202.9	233.7	2.32	2.56	13.02	12.21	0.16	0.25	10.51	9.99	10.68	10.23	81.6	83.4
SD.4	55.00	086.52	108.33	106.95	163.3	193.5	2.02	1.96	11.74	12.03	0.12	0.36	08.71	08.58	08.83	08.94	75.4	74.4
MEANS	80.36	115.33	127.85	137.36	208.2	252.7	2.33	2.58	12.84	11.89	0.23	0.20	10.66	9.40	10.89	9.59	84.5	80.6
LSD (0.05)	4.78	20.54	9.06	24.33	9.37	35.24	0.23	0.63	0.63	0.84	0.03	0.13	0.60	0.67	0.61	0.63	8.36	5.85

SD.1 = Oct. 15 SD.2 = Nov. 15 SD.3 = Nov. 15 SD.4 = Dec. 1

Table 7. Pooled correlation coefficients among top yield (T.Y), root Yield (R.Y), biological yield (B.Y), average root weight (A.R.W), total soluble solids (TSS), reducing sugar (R.S), non reducing sugar (N.R.S), total sugar (T.S) and purity for 1990 and 1991 seasons

Treatments	T.Y	R.Y	B.Y	A.R.W	TSS	R.S	N.R.S	T.S	Purit.
	t/ha			kg	%				
T.Y (t/ha)	1.00	0.66**	0.93**	0.54**	−0.15	−0.18	0.010	−0.01	0.12
R.Y (t/ha)		1.00	0.89	0.83**	−0.17	−0.20*	−0.01	−0.03	0.10
B.Y (t/ha)			1.00	0.73	−0.18	−0.21	−0.04	−0.02	0.12
A.R.W.(kg)				1.00	−0.27**	−0.19	−0.13	−0.15	−0.01
TSS (%)					1.00	0.24**	0.73**	0.74**	0.24**
R.S.(%)						1.00	0.11	0.20*	0.08
N.R.S.(%)							1.00	0.99**	0.83**
T.S (%)								1.00	0.83
Purity(%)									1.00

* Significant at .05 level of probability.
** Significant at .01 level of probability.

The data on the phenotypic coefficient of variation (P.C.V.), the genotypic coefficient of variation (G.C.V.), broad senses heritability (Hb) and the genetic advance (G.A.) averaged over the two seasons are presented in table 8. The P.C.V. ranged from 7.30% for reducing sugar to 96.86% for root yield, whereas the G.C.V. ranged from 5.35% for reducing sugars to 95.53% for root yield. The differences in value of P.C.V. and G.C.V. for all agronomic and chemical characters indicated that these traits are likely to be affected by environment and / or genotypes. The high G.C.V. values of root yield, biological yield and top yield, in comparison to other traits, indicated that further improvement for these characters could be possible through selection. The estimates of heritability (Hb) in the broad sense ranged from 54% for reducing sugars to 97% for root yield (Table 8). These high heritability values express the reliability of the phenotypic values as guideline in selection programs. However, although high heritability estimates are relevant indicators of high genotypic variance, they do not, necessarily, always reveal high genetic gain in selection programs (Allard 1960). The genetic advance (G.A.) under selection values estimated in this study were moderate for biological and root yields, while they were low for other characters (Table 8). The high (G.A.) values for biological and root yields coupled with the high heritability estimates, indicated that heritability could mainly be due to additive gene action.

Based on the previous results, it could be concluded that the performance and productivity of the four sugar beet cultivars; Cerespoly, Irlarave, Berla and Dibbe were high with regard to root, top, and biological yields. Cultivars Irlarave and Berla

Table 8. Phenotypic coefficient of variation (P.C.V), Genotypic coefficient of variation (G.C.V), Hertability of broad sense (Hb) and genetic advance (G.A) in percent of mean for Sugar beet cultivars averaged over 1990 and 1991 seasons

Characters	P.C.V	G.C.V	Hb	G.A
T.Y (t/ha)	50.44	45.43	0.81	8.33
R.Y (t/ha)	96.86	95.53	0.97	22.35
B.Y (t/ha)	96.86	94.78	0.96	29.01
A.R.W (kg)	15.19	14.57	0.91	0.45
TSS (%)	23.08	22.46	0.94	1.59
T.S.(%)	7.30	5.35	0.54	0.04
N.R.S.(%)	35.89	34.71	0.94	2.20
T.S (%)	35.70	34.52	0.94	2.21
Purity(%)	44.74	41.34	0.86	7.16

produced the highest root yield in the first sowing date (October 15), while cultivar Cerespoly produced the highest root yield in the second sowing date (November 1). Cultivar Dibbe on the other hand, was the lowest producer among the four cultivars in both seasons. However, all of the three high yielding cultivars were lower in TSS than Dibbe cultivar. Generally, it can be stated that the period between October 15 and November 1 might be the most suitable period for planting sugar beet in the Central Region of Saudi Arabia.

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تأثير الأصناف ومواعيد الزراعة على انتاجية محصول بنجر السكر في المنطقة الوسطى من المملكة العربية السعودية

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قسم الانتاج النباتي ـ كلية الزراعة ـ جامعة الملك سعود ـ ص. ب (٢٤٦٠) ـ الرياض ١١٤٥١ ـ المملكة العربية السعودية

اجريت هذه الدراسة لتقييم انتاجية أربعة أصناف من بنجر السكر (صنفين عديدة الاجنة وصنفين احادية الاجنة) تمت زراعتها في أربعة مواعيد زراعية مختلفة بمحطة الأبحاث والتجارب الزراعية بمنطقة ديراب التابعة لكلية الزراعة جامعة الملك سعود وذلك خلال عامي ١٩٩٠ و ١٩٩١م.

أوضح التحليل الاحصائي لنتائج التجربة أن هناك اختلافات معنوية بين المواسم بالنسبة لمحصول المجموع الخضري والمحصول الكلي ونسبة المواد الصلبة الذائبة الكلية والسكريات الكلية. كما وجدت أيضاً اختلافات جوهرية بين مواعيد الزراعة في جميع الصفات المحصولية والكيميائية. كذلك أوضحت نتائج التحليل الاحصائي على وجود علاقة طردية بين محصول المجموع الخضري ومحصول الجذور وبين محصول المجموع الخضري والجذور وبين المحصول الكلي لمحصول بنجر السكر. وأيضاً وجود علاقة عكسية بين متوسط وزن الجذر الواحد ونسبة المواد

الصلبة الذائبـة الكلية. كـما أوضحت النتائـج على عـدم وجود تفـاعلات معنـوية ذات أهميـة بين الأصنـاف والسنـوات وبـين الأصنـاف ومـواعيـد الزراعة، وبين الأصناف والسنوات ومواعيـد الزراعـة مما يـدل على ثبـات انتـاجية وسلوك الـتراكيب الوراثيـة لهذه الأصنـاف الأربعة من مـوسم إلى آخر.

ومن النتائج المتحصل عليها يتبـين أن الفترة من ١٥ اكتـوبر إلى الأول من نـوفمبر تعتـبر أنسب فترة لـزراعة محصـول بنجر السكـر تحت ظـروف المنطقة الوسطى من المملكة العربية السعودية.