EVALUATION OF SOME SUGAR BEET VARIETIES AS AFFECTED BY HARVESTING DATES UNDER NEWLY RECLAIMED SOIL

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Abstract

Two field experiments were carried out during 2008/2009 and 2009/2010 seasons at Kafr El-Hammam village, Sharkia Governorate to study the effect of harvesting dates on productivity of some sugar beet varieties. Sugar beet varieties Gazella, Carola and Lola were planted on 1st October in both seasons. Harvesting dates were done at 180, 195 and 210 days from sowing. The experimental design was a split-plot design with four replication, harvesting dates were allocated in the main plots and varieties in the sub-plots. Results showed that: delaying harvesting dates from 180 to 210 days from sowing significantly increased root fresh weight (g/plant), sucrose%, as well as root and sugar yield (tons/fed). While, nitrogen%, sodium%, potassium% were decreased significantly in both seasons. Harvesting dates at 195 days from sowing gave the highest values. Sugar beet varieties gave significant increase for root fresh weight (g/plant), sucrose%, as well as, root yield and sugar yield (tons/fed) in both seasons. While, sodium%, potassium% decreased significantly in both seasons. However, root diameter in the 2nd season only. The interaction was significant in both seasons for root fresh weight (g/plant), sucrose%, root and sugar yield (tons/fed). However, root diameter in the 1st season and sodium and potassium% in the 2nd season., respectively. In general it can be concluded that harvesting Lola sugar beet variety at 195 days from sowing was the best treatment for maximizing sugar beet productivity in the newly reclaimed soils under the environment of this study.

INTRODUCTION

Egyptian Government imports about 1.10 milion ton of sugar, every year to face the rapid increase of population. Sugar beet plays a prominent role in sugar production, about 37.27% of the local sugar production, which amounted to 1.61 million ton, is produced from sugar beet, which is considered the second sugar crop after sugar cane. (CCSC, 2010). Many workers found that late harvesting of sugar beet crop increased growth traits, quality%, yields/fed and decreased impurities i.e. nitrogen (N), sodium (Na) and potassium (K%), Abou El-Maged *et al* (2003) in Egypt found significant increase for root length, diameter, root fresh weight/plant, sucrose%, as well as root and sugar yields/fed in both seasons and significant decrease of Na, K and N%. Aly (2006) showed that root diameter, fresh weight/plant, as well as root and sugar yields/fed were positively increased by delaying harvest dates from 170,

190 to 210 days from sowing. Early harvest date at 170 day from sowing gave the highest mean values of Na and K%. Azzazy *et al* (2007) and El-Sheikh *et al* (2009) harvested sugar beet varieties at 210 days from sowing showed significant effect on root weight, sucrose%, impurities, i.e. Na% and K%, as well as root and sugar yields/fed, than the other two harvest dates 180 and 195 days from sowing in both seasons. Except root diameter. Mahmoud *et al* (2008) reported that the max. sucrose%, as well as, root and sugar yields/fed were obtained when increasing harvesting dates from 180 up to 210 days from sowing.

All sugar beet genotypes cultivated in Egypt are imported from foreign countries, so, it is preferable to evaluate them under Egyptian conditions especially under newly reclaimed soil and different harvesting dates to select the best suited ones. The differences between varieties in gene make up expression may be throwing some light on the relative importance of studying varieties behavior through the growing season. Osman *et al* (2003) in Egypt, showed that Kawemira variety was superior in sucrose%, root and sugar yields/fed compared to sugar beet varieties Top, Lola and Pleno. Aly (2006), Azzazy *et al* (2007) and El-Sheikh *et al* (2009) showed that the examined sugar beet varieties varied significantly for root fresh weight/plant, as well as, root and sugar yields/fed, while, root length and diameter, as well as, sucrose% and purity% were insignificant differences. Enan *et al* (2009) in Egypt, showed that sugar beet varieties differed significantly in root length, diameter, fresh weight/plant, TSS% and root yields/fed in both seasons and sugar yield in the 1st season. Farida variety significant increase of total soluble solids%, sucrose%, purity% and sugar yields/fed, while, it recorded the lowest values for impurities%, i.e. N, Na and K% in both seasons. Simple correlation matrix Dewy and Lu (1959) found that positive linear correlation for components of wheat and seed production. The aim of this study, select the best harvest date to obtain highest yield and quality.

MATERIALS AND METHODS

Two field experiments were carried out during 2008/2009 and 2009/2010 seasons at Kafr El-Hammam village, Sharkia Governorate to study the effect of harvesting date on productivity of some sugar beet varieties. Sugar beet varieties Gazella, Carola and Lola were planted on 1st October in both seasons. Harvesting dates were done at 180, 195 and 210 days from sowing. Some chemical and physical properties of the experimental soil were estimated according to Page 1982 in Table 1. Mean of temperature and relative humidity percentage are presented in Table 2.

Table 1.Some physical and Chemical analysis of the experimental soil*

Particle size			Soil textural	E.C. ds/m	Soil pH (1:2.5)	Organic matter %	$CaCO_3$ %
Sand%	Silt %	Clay %	Sand silty loam				
50.3	35.7	14.0		0.80	6.85	0.75	28.5

Soluble Cations (meq/L)				Soluble anions(meq/L)				available contents (ppm)		
Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{--}	HCO_3^{-}	Cl^{-}	SO_4^{--}	N	P	K
3.00	4.50	5.00	0.3	0.20	0.22	7.00	4.00	12.7	23.3	64.0

*Each value represents the mean of 4 samples at 2008/200 and 2009/2010.

Table 2. The temperature and relative humidity percentage

Year	2008/2009 season						2009/2010 season					
Months	Temp. (C°)			Rh %			Temp. (C°)			Rh %		
	Mx	Min	Avr	Mx	Min	Avr	Mx	Min	Avr	Mx	Min	Avr.
October	32.0	18.0	25.0	84	30	57.0	30.8	17.3	24.1	80	26	53.0
November	26.0	16.0	21.0	87	39	61.0	27.1	12.7	19.9	79	28	53.5
December	21.0	11.0	16.0	79	35	57.0	20.2	7.2	13.7	80	35	57.5
January	20.0	10.0	15.0	81	34	57.5	20.1	6.6	13.3	76	32	54.0
February	22.0	10.0	16.0	84	34	59.5	20	5.9	12.9	85	34	59.5
March	24.0	10.0	17.0	80	30	55.0	24.2	8.4	16.3	77	27	52.0
April	28.0	12.0	20.0	79	22	50.5	29.1	12	20.5	75	23	49.0

Source: Agro-meteorological station, Agric. Res. Center, Giza, Egypt. Temp. = Temperature (C°). Rh% = Relative humidity %. Max. = Maximum. Min. = Minimum. Avr.= Average.

The experimental design was a split-plot design with four replications, harvesting dates were allocated in the main plots and varieties in the sub-plots. Each sub plot was 15.60 m^2/fed. Plant density 43077 plants/fed on ridges which consisted of four ridges at 65 cm width, 6 m in length and 15 cm between hills spacing. Nitrogen fertilizer (as ammonium nitrate 33.5% N) at the rate of 100 kg/fed was applied in four equal portions, the first was applied after thinning and 15 days between the others.

Phosphorus fertilizer (as calcium super phosphate 15.5% P_2O_5) at the rate of 45 kg/fed was added during land preparation. Potassium fertilizer (as potassium sulfate 48% K_2O) at the rate of 36 kg/fed was applied with nitrogen fertilizer. Manual planting was achieved in hills with approximately 3-4 seeds/hill and then plants were thinned at four leaf stage (after 45 days from sowing) to obtain one plant/hill. Other agricultural practices required for growing sugar beet were carried out as usually practiced in the region. The previous crop was Maize in both seasons.

Recorded data:

At harvest, two guarded ridges of each plot were harvested to determine the following traits:

A. Vegetative traits: 1. Root dimensions (length and diameter, cm) were measured in ten guarded plants. 2. Root fresh weight/plant was weight on fresh weight basis.

B. Quality traits: Samples of twenty roots were taken randomly, send to the laboratory, cleaned with running tap water, dried, each sample was grated separately with grater into cassettes and mixed thoroughly to determined, the quality traits as described in Cooke and Scott (1993).

1. Sucrose% was estimated in fresh samples of sugar beet roots, polarimeterically on a lead acetate extract of fresh macerated root according to Le Docte (1927).

2. Impurities content, i.e. α-N%, Na% and K% as milliequivalent/100 g beet were estimated according to AOAC (2005).

C. Productivity traits: 1. Root yield (ton/fed): plants of sugar beet from each plot were harvested topped to determine root yield as ton/fed on fresh weight basis.

2. Sugar yield (ton/fed) was calculated using the following equation:

Sugar yield (ton/fed) = Root yield x sugar recovery%.

The collected data were statistically analyzed according to Snedecor and Cochran (1981). Treatment means were compared using LSD at 5% level probability. Also, simple correlation coefficients and linear regression were computed among studied traits according to Steel and Torrie (1980).

RESULTS AND DISCUSSION

I. Effect of Harvest dates: I.1. Growth traits:

The results in Table 3 showed that root fresh weight (g/plant) was significant increased in both seasons. Harvesting date at 195 days from sowing out yielded the other dates significantly (1200 and 1100 g/plant) for root fresh weight in both seasons. This result may be due to data in Table 1 were soil textural was sandy silty

loam and organic matter was low 0.75%. These results are in agreement with Aly (2006) and El-Sheikh *et al* (2009).

I.2. Juice quality (sucrose%) and impurities% (α-N%, Na% and K%):

Results presented in Table 3 showed that harvesting date at 195 days from sowing significantly affected sucrose% and impurities% in both seasons. The highest mean values for sucrose% were (17 and 16%) in the 1st and 2nd seasons. This superiority at sucrose% may be due to the decreased temperature at this time of harvest Table 2. While, impurities%, gave the lowest mean values in the 1st season were 0.99 for α-N%, 1.82 for Na% and 4.03 for K% resulted from harvesting date of 195 days from sowing. The same respective values in the 2nd season were, 0.71 for α-N%, 1.42 for Na% and 4.83 for K%., respectively. This result is in agreement with El-Sheikh *et al* (2009).

I.3. Root and sugar yields (ton/fed).

Results collected in Table 3 show the effect of harvesting dates on root yield (ton/fed) in 2008/2009 and 2009/2010 seasons. From results it could be seen that root yield was significantly affected by harvesting dates in both seasons. Harvesting date at 195 days from sowing gave (32 and 31 tons/fed) of root yield and sugar yield, 5.44 and 4.96 tons/fed, in both seasons., respectively. This result may be due to increasing growth characters and sucrose% at this time of harvest compared to values at the other harvesting dates. These results were coincide by Mahmoud *et al* (2008) and El-Sheikh *et al* (2009).

Table 3. Effect of harvesting dates on roots growth, quality and yields at harvest

2008/2009 season									
Characters	Growth traits			Quality%	Yields (ton/fed)		Impurities%		
Harvesting dates	RL	RD	RFW	Sucrose	RY	SY	α-N%	Na%	K%
180	27.11	11.72	800	13.00	27.00	3.51	1.21	2.11	5.99
195	31.60	15.75	1200	17.00	32.00	5.44	0.99	1.82	4.03
210	29.22	13.86	1000	15.00	29.00	4.35	1.13	2.00	5.09
LSD at 5%	NS	NS	0.01	0.23	0.22	0.05	0.19	0.07	0.15
2009/2010 season									
180	28.00	12.94	700	12.00	27.00	3.24	0.96	1.72	5.83
195	32.00	16.64	1100	16.00	31.00	4.96	0.71	1.42	4.83
210	30.00	14.14	900	14.00	29.00	4.06	0.87	1.55	5.00
LSD at 5%	NS	NS	0.07	0.27	0.31	0.08	0.03	0.10	0.10

Growth traits, RL and RD (root length and diameter cm), RFW: root fresh weight (g/plant). Yields, RY and SY (root and sugar yields/fed). Impurities% (N: nitrogen, Na: sodium, K: potassium).

II. Varietal effects: II.1. Growth traits:

The obtained results in Table 4 showed that sugar beet varieties insignificant in root length in both seasons. While, root diameter was affected significantly in the 2nd season and gave the highest value (15 cm). While, root fresh weight was significantly superior to the other varieties in both seasons were it produced (1300 and 1250 g/plant) obtained from Lola variety. This superior may be due to the genetic structure of this variety. These results were similar to those by Aly (2006) and El-Sheikh *et al* (2009).

II.2. Juice Quality (sucrose%) and impurities% (α-N%, Na% and K%):

The results presented in Table 4 showed that varieties effects on sucrose%, sodium% and potassium% in both seasons were significant, except, nitrogen%. The highest mean values (17 and 16 for sucrose%). This superiority at sucrose% may be due to the gene structure of Lola sugar beet variety. Impurities%, gave the lowest mean values were (1.81 and 1.39 for sodium Na%) and (4.65 and 4.44% for potassium K%) were resulted respectively from sowing Lola variety in both seasons. Similar result is obtained by Abou El-Maged *et al* (2003).

II.3. Root and sugar yields (ton/fed).

The tabulated results in Table 4 showed that the effect of varieties on root and sugar yields (ton/fed) were significant in the two seasons. Lola variety ranked the first were the highest mean values of root yield were (31 and 30 tons/fed) and sugar yield (5.27 and 4.80 tons/fed) followed by Carola variety. While, Gazella variety gave the lowest root and sugar yields/fed in both seasons., respectively. Similar results were obtained by Aly (2006) and El-Sheikh *et al* (2009).

Table 4. Effect of sugar beet varieties on roots growth, quality and yields at harvest

2008/2009 season									
Characters	Growth traits			Quality%	Yields (ton/fed)		Impurities%		
Varieties	RL	RD	RFW	Sucrose	RY	SY	α-N%	Na%	K%
Gazella	25.00	12.00	723.0	13.00	27.00	3.51	1.18	2.18	5.35
Carola	31.00	14..0 0	1000	15.00	29.00	4.35	1.10	2.00	5.00
Lola	28.00	16.00	1300	17.00	31.00	5.27	1.05	1.81	4.65
LSD at 5%	NS	NS	0.07	0.31	0.23	0.05	NS	0.15	0.11
2009/2010 season									
Gazella	24.00	11.00	700	12.00	26.00	3.12	0.91	1.79	5.65
Carola	30.00	13.00	1100	14.00	28.00	3.92	0.81	1.65	5.10
Lola	27.00	15.00	1250	16.00	30.00	4.80	0.71	1.39	4.44
LSD at 5%	NS	0.65	0.09	0.36	0.23	0.08	NS	0.12	0.10

Growth traits, RL and RD (root length and diameter cm), RFW: root fresh weight (g/plant). Yields, RY and SY (root and sugar yields/fed). Impurities% (N: nitrogen, Na: sodium, K: potassium).

III. INTERACTIONS EFFECTS:

III. 1. Growth traits: Root diameter (cm) and root fresh weight (g/plant).

Results presented in Tables 5 and 6 showed that the interaction effect between harvesting dates and sugar beet varieties on root fresh weight (g/plant) was significant in both seasons. Harvesting Lola variety at 195 day gave the highest root fresh weight values (1300 and 1220 g/plant). While, root diameter was significantly affected in the 1st season and it gave 18 cm.

Table 5. the interaction between harvesting dates and varieties

Characters	Growth traits		Quality%	Yields (ton/fed)	
	Root diameter (cm)	Root fresh weight (g/plants)	Sucrose	Root	Sugar
2008/2009 season					
180 x Gazella	14.0	1009	14.0	27.0	3.78
195 x Gazella	15.0	1272	16.0	31.0	4.96
210 x Gazella	16.0	1089	15.0	29.0	4.35
180 x Carola	16.0	1000	15.0	29.0	4.64
195 x Carola	18.0	1210	17.5	31.0	5.27
210 x Carola	17.0	1150	16.0	30.0	4.80
180 x Lola	15.0	1159	15.0	28.0	4.06
195 x Lola	18.0	1300	17.0	33.0	5.78
210 x Lola	17.0	1275	17.0	32.0	5.44
LSD at 5%	0.92	0.08	0.32	0.59	0.17

III.2. Root and sugar yields (ton/fed):

Results presented in Tables 5 and 6 indicated that the interaction effect between harvesting dates and sugar beet varieties on root and sugar yields (ton/fed) were significant in both seasons. Harvesting Lola variety at 195 days from sowing gave the highest root yield, the values were (33 and 32 tons/fed) and sugar yields were (5.78 and 5.76 tons/fed) for the 1st and 2nd seasons., respectively.

III.3. Juice quality (sucrose%) and impurities % (α-N%, Na% and K%).

Results in Table 5 and 6 pointed out that the interaction effect between harvesting dates and sugar beet varieties on sucrose% was significant in both seasons. Harvesting Lola variety at 195 days from sowing gave the highest mean values. Impurities%, sodium and potassium% were decrease significant in the 2nd season. Harvesting Lola variety at 195 days from sowing gave the lowest mean values (1.30 and 4.20%).

Table 6. the interaction between harvesting dates and varieties

Characters	Growth traits	Quality%	Yields (ton/fed)		Impurities	
	Root fresh weight (g/plant)	Sucrose	Root	Sugar	Sodium %	Potassium %
2009/2010						
180 x Gazella	929	15.0	28.0	4.20	1.97	5.80
195 x Gazella	1199	17.0	31.0	5.27	1.49	4.70
210 x Gazella	1008	16.0	30.0	4.80	1.80	5.00
180 x Carola	900	14.0	27.0	3.78	1.65	5.80
195 x Carola	1189	16.5	31.0	5.12	1.40	4.60
210 x Carola	1075	16.0	28.0	4.48	1.50	5.10
180 x Lola	915	16.0	29.0	4.64	1.70	5.10
195 x Lola	1220	18.0	32.0	5.76	1.30	4.20
210 x Lola	1061	17.0	30.0	5.10	1.50	4.90
LSD 5%	0.06	0.39	0.10	0.15	0.18	0.28

IV. CORRELATION STUDY:

Results in Table 7 showed that in the 1st season 2008/2009, matrices of simple correlation coefficients between studied sugar beet characters. Sugar yield ton/fed was strongly positive correlated with root yield ton/fed and sucrose%. The correlation coefficient values between sugar yield ton/fed and these characters were 0.749 and 0.381. these results indicated that sugar yield was highly influenced with root yield and sucrose%. Negative correlation was occurred between root yield ton/fed with sucrose%. The values for these relationship were 0.326. Also, in the 2nd season 2009/2010, the same trend presented in the 1st season 2008/2009. These results were accordance with those reported by Dewy and Lu (1959).

Table 7. simple correlation matrix between some variables

20008/2009			
Variable	Sugar yield ton/fed	Root yield ton/fed	Sucrose %
Sugar yield ton/fed	-	-	-
Root yield ton/fed	0.7492**	-	-
Sucrose %	0.3808*	- 0.3258*	-
2009/2010			
Sugar yield ton/fed	-	-	-
Root yield ton/fed	0.7808**	-	-
Sucrose %	0.4814*	- 0.1711	-

Correlation coefficiens at the 0.05 and 0.01 levels of significance.

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تقييم بعض اصناف بنجر السكر وتاثرها بمواعيد الحصاد فى الاراضى الجديدة المستصلحة

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اقيمت تجربتان حقليتان فى قرية كفر الحمام بمحافظة الشرقية خلال موسمى الزراعة 2009/2008 و 2010/2009 لدراسة تأثير ثلاثة مواعيد حصاد (180 و 195 و 210 يوم من الزراعة) على ثلاثة أصناف من بنجر السكر (جازبلا و كارولا ولولا) للحصول على أعلى محصول جذور وسكر. استخدم تصميم القطع المنشقة مرة واحدة فى اربعة مكررات حيث وضعت مواعيد الحصاد فى القطع الرئيسية والاصناف فى القطع الشقية الاولى. أوضحت النتائج ما يلى: – تباين مواعيد الحصاد المختبرة معنويا فى كلا الموسميين لكلا من الصفات الاتية وهى: الوزن الطازج للجذر جم/للنبات و النسبة المئوية للسكروز ومحتوى النيتروجين والصوديوم والبوتاسيوم وكذلك محصولى الجذور والسكر طن/فدان. وقد حقق ميعاد الحصاد 195 يوم اعلى محصول وجودة. – بينما اختلفت الاصناف معنويا فى الصفات التالية قطر الساق فى الموسم الثانى فقط وكانت معنوية فى الموسميين لكلا من وزن الجذر الطازج والنسبة المئوية للسكروز وكذلك محتوى الصوديوم والبوتاسيوم ومحصولى الجذور والسكر طن/فدان وقد نتفوق لصنف لولا على الصنفين كارولا وجازيلا.اوضحت النتائج ان هناك زيادة معنوية للتفاعل بين مواعيد الحصاد واصناف بنجر السكر فقد زاد كلا من الوزن الطازج للجذر جم للنبات والنسبة المئوية للسكروز ومحصولى الجذور والسكر طن/فدان فى كلا الموسميين وكانت عمعنوية لمحتوى الصوديوم والبوتاسيوم فى الجذور فى الموسم الثانى فقط وكانت معنوية لقطر الجذر فى الموسم الاول فقط. تم الحصول على اعلى محصول جذور وسكر لكلا الموسميين من حصاد الصنف لولا عند 195 يوم من الزراعة وكانت النتائج كالتالى (33 و 32 طن جذور/فدان) ثم (5.78 و 5.76 طن سكر/فدان) على التوالى. – ووجد ارتباط معنوى موجب بين صفة محصول السكر وكلا من محصول الجذور والنسبة المئوية للسكروز فى الموسميين كما وجد ارتباط سالب بين صفة محصول الجذور والنسبة المئوية للسكروز فى كلا الموسميين. تحت ظروف محافظة الشرقية يوصى هذا البحث بحصاد الاصناف تحت الدراسة عند 195 يوم من الزراعة للحصول على اعلى محصول وجودة.