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EVALUATION OF SOME SUGAR BEET VARIETIES UNDER THREE HARVESTING DATES

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ABSTRACT

Two field experiments were carried out at Tamiya, El-Fayoum Governorate during 2006/2007 and 2007/2008 seasons to evaluate yield, yield components and quality of six sugar beet varieties namely LP 11, Demapoly, LP 13 , Pleno , Kawemira and LP 12 under three harvesting dates (180, 195 and 210 days after sowing). Results revealed the superiority of Demaploy in root weight, root yield, sugar yield, sucrose % and purity % when it was harvested after 210 days from sowing in the two growing seasons. Harvesting dates and varieties had significant effects on all studied traits except root diameter. Interaction between harvest dates x varieties had insignificant effect on all studied traits in both seasons except for sucrose % and purity % in the 1st season only.

Under the conditions of this study, Demapoly is the proper variety for El-Fayoum Governorate environmental. In addition, use the characteristics of yield component which affected yields (root length, root diameter and root fresh weight/plant) as a morphological characteristics which affected root yield, besides high sucrose % and low reducing sugar % as tools can be used to evaluate and select sugar beet varieties for highly sugar production.

Keywords: Sugar beet, harvesting dates, variance components

INTRODUCTION

Sugar beet (*Beta vulgaris* L.) is considered to be a prospective sugar crop in Egypt. Improving its productivity is an urgent demand to meet sugar consumption or at least to decrease the Egyptian gap from sugar. Variety is considered the cornerstone for production process, selecting the superior varieties from the imported one is the main purpose to the breeder, in addition to the recommended package of the agronomical practices. The differences between varieties in gen make up expression may be throwing some light on the relative importance of studying varietals behavior through the growing season. Harvesting age one of the main factors which directly affected on maturity consequently juice quality.

Abo El-Magd *et al.* (2003) tested the effect of three harvesting dates i.e. 180, 195 and 210 days from sowing on sugar beet variety Gloria. The results indicated that harvesting dates affected significantly productivity traits such as root length, root diameter, root, top weight/plant, sugar yields/fed and root quality i.e. reducing sugar , TSS, sucrose and juice purity % in both seasons. The highest productivity and quality traits were produced from harvesting after 210 days from sowing. Aly (2006) studied the effect of harvesting dates 170, 190 and 210 days from sowing on sugar beet varieties at three location. He found that delaying harvest dates up to 210 days from sowing increased significantly root length, root diameter, root weight, sucrose %, root and sugar yields/fed,. Abd El-Razek (2003 and 2006) and Mahmoud

et al (2008) reported that the maximum root and sugar yields/fad were obtained when sugar beet was harvested at 180-210 days after sowing date. They also add that varying varieties and harvesting dates affected sucrose and juice purity percentages, root and sugar yields.

Regarding the effect of sugar beet varieties, Al-Jbawi (2000) evaluated thirteen sugar beet varieties under different locations (Giza, Kafr El-Sheikh, El-Dakahlia and El-Fayoum) for sugar yield and its contributing traits. The author found that root length, diameter and root weight, TSS%, sucrose %, purity % and root, top and sugar yields were significantly differed among location Azzazy *et al* (2007) evaluate four sugar beet varieties (Gloria, Sofie, Sumba and Sultan) under two durations to harvest (180 and 210 days from sowing). The recorded results indicated that the tested sugar beet varieties differed significantly in root and sugar yields, as well as sucrose and purity percentages. Sugar yield showed significant and positive correlation coefficient with root yield, root length, and sucrose %.

The aims of this study were done to evaluate six sugar beet varieties under three harvesting dates.

MATERIALS AND METHODS

This work was carried out at Tamiya district, El-Fayoum governorate in 2006/2007 and 2007/2008 seasons to evaluate six sugar beet varieties (LP 11, Demapoly, LP 13 , Pleno , Kawemira and LP 12) under three harvesting dates (180, 195 and 210 days from sowing). A split plot design with three replicates was used in both seasons. Harvesting dates were arranged in the main plots, while sugar beet varieties were randomly allocated in the sub plots. Other agricultural practices were applied as usual for growing sugar beet in the region. Plot area was 21 m^2 (1/200 fad.), which consisted of 6-ridge of 7 m in length and 50-cm in width with 20-cm spacing between hills. Sugar beet plants were cultivated on the first week of Oct. in both seasons.

The recorded data:

- At harvest, a random sample of ten guarded roots was taken from each plot to determine root length (cm), root diameter (cm), root weight (g). Also, sugar beet plants of three guarded rows were up-rooted, topped and weighed to determine root yield (ton/fad).
- Sucrose % was estimated in fresh samples of sugar beet roots, using Saccharemeter according to method described in A.O.A.C. (1995). Theoretical sugar yield (ton/fad) was calculated according to the following equation: Sugar yield = root yield x sucrose %.
- Purity % = Sucrose % x 100/ TSS %. Where Total Soluble Solids percentage (TSS) was determined using hand refractometer.

Statistical analysis:

The recorded data were statistically analyzed according to **Snedecor and Cochran (1981)**. Least significant differences test at 5% level of probability was used to compare means. The form of analysis of variance and mean square expectations obtained is presented in Table (1).

Table (1): Form of analysis of variance.

Souree of variation	Degree of freedom
Reps with years (R)	y(r-1)
Harvest dates (H)	h- 1
Y x H	(y-1)(h-1)
error (y)	y(r-1)(h-1)
Varieties (V)	v-1
Y x V	(y-1)(v-1)
H x V	(h-1)(v-1)
Y x H x V	(y-1)(h-1)(v-1)
error (v)	yh (r-1)(v-1)

RESULTS AND DISCUSSION

1. Root diameter and length:

Data in Table (2) show the effect of harvesting dates and varieties on the root dimension of sugar beet. The available data cleared that root diameter and root length of sugar beet varieties were insignificantly influenced by plant age at harvest. These results were true in both growing seasons. In addition, there was insignificant affect among varieties in root diameter in both seasons. However, they differed significantly in their root length, in both seasons. The differences among varieties may be due their gene make up. Demapoly variety had the longest root, while, Kawemira had the shortest one followed by LP13 then LP11. The interactions between harvesting dates and varieties had insignificant effect on both characters in both seasons.

2. Root fresh weight/plant and root yield:

Results given in Table (3) pointed out the positive response in root fresh weight/plant and root yield, this response was significantly in both traits for the 1st season. Meanwhile, the differences between harvesting dates on both trait did not reach the level of significance in the 2nd season. And regardless the significance, delaying harvest date up to 210 days attained a graduai and significant effect on root fresh weight/plant and root yield in the 1st season, also it is worth mentioned that the difference between 180 and 195 days was negligible in this respect. The increase in fresh root weight associated with the increasing plant age at harvest time may be attributed to the increase in dry mater accumulation, which positively reflected on root yield. Similar results were obtained by Al-Jbawi (2000).

As for, the influence of the studied sugar beet varieties on root fresh weight/plant as well as root yield/fad., the collected data reveled significant and distinct differences between varieties with respect to their effect on this traits. Sugar beet Demapoly over passed the other varieties in this respect followed by LP11 variety. This effect was fairly true in both growing seasons. The differences between varieties on root yield mainly due to varietals performance of the individual root for these varieties.

The interaction between harvesting date and varieties had insignificant effect on root fresh weight/plant and root yield in both seasons.

Table (2): Root diameter and root length of sugar beet varieties as affected by harvesting dates.

Sugar beet varieties	2006/2007 season							
	Root diameter (cm)				Root Length (cm)			
	Age at harvest (days)				Age at harvest (days)			
	180	195	210	Mean	180	195	210	Mean
LP 11	10.7	10.6	10.9	10.7	23.1	20.3	20.0	21.1
Demapoly	11.2	10.2	11.1	10.8	23.1	24.2	24.6	23.9
LP 13	9.8	8.3	11.6	9.9	22.0	20.9	25.5	22.8
Pleno	10.9	11.3	10.8	11.0	20.8	20.3	21.1	20.7
Kawemira	11.2	10.8	10.2	10.7	17.8	21.8	20.0	19.9
LP 12	9.8	10.0	9.2	9.7	20.7	17.0	24.0	20.6
Mean	10.6	10.2	10.6	10.5	21.2	20.7	22.5	21.5
L.S.D at 0.05 % level for:	Harvest dates (A)			NS				NS
	Varieties (B)			NS				2.50
	AXB			NS				NS
	2007/2008 season							
LP 11	13.33	13.19	13.61	13.38	28.89	25.42	24.96	26.42
Demapoly	14.02	12.77	13.89	13.56	28.89	30.21	30.69	29.93
LP 13	12.22	10.41	14.44	12.36	27.50	26.11	31.87	28.49
Pleno	13.61	14.17	13.47	13.75	25.97	25.41	26.32	25.90
Kawemira	14.03	13.47	12.78	13.42	22.29	27.22	25.00	24.84
LP 12	12.20	12.50	11.53	12.08	25.83	21.25	30.00	25.69
Mean	13.23	12.75	13.28	13.09	26.56	25.94	28.14	26.88
L.S.D at 0.05 % level for:	Harvest dates (A)			NS				NS
	Varieties (B)			NS				3.12
	AXB			NS				NS

3. Reducing sugar, Total Soluble Solids and Purity percentages:

Data presented in Table 4 revealed that delaying harvesting dates gradually and significantly reduced reducing sugar %, this observation means that the plant reach to full growth and in turn full maturity than that had been harvested early. This observation was completely true in both seasons. Similar results were obtained by Abo El-Magd *et al* (2003) and Aly (2006).

Data also revealed that LP11 and Kawemira varieties recorded the highest values of RS % in the 1st and 2nd seasons compared with the other verities. This variation may be due to the gene make up.

Results indicated that the interaction between variety and harvesting dates insignificantly influenced RS% in both seasons.

Concerning TSS % shown in Table 4 showed that harvesting dates significantly affected TSS % in both seasons. Harvest at 210 days from sowing surpassed the other harvesting dates by 0.60 and 0.28% in the 1st seasons respectively, corresponding to 0.45 and 0.22 % in the 2nd season. This superiority may be due to increase growth period let to full mature consequently high TSS %. In addition it was noticed that the difference among varieties were significant in both seasons. Pleno variety exhibited the highest TSS % as compared with the other verities. On the other hand, LP11 attained the lowest TSS% in both seasons.

Table (3): Root weight and root yield of sugar beet varieties as affected by harvesting dates.

Sugar beet varieties	2006/2007season							
	Fresh root weight (g)				Root yield (ton/fed)			
	Age at harvest (days)				Age at harvest (days)			
	180	195	210	Mean	180	195	210	Mean
LP 11	863.3	872.4	1057.5	**931.1**	32.1	32.4	39.3	**34.6**
Demapoly	955.7	964.8	1244.3	**1054.9**	35.5	35.9	46.3	**39.2**
LP 13	765.4	777.8	868.5	**803.9**	28.4	28.9	32.3	**29.9**
Pleno	797.5	814.1	910.0	**840.5**	29.6	30.3	33.8	**31.2**
Kawemira	726.4	764.2	826.8	**772.4**	27.0	28.4	30.7	**28.7**
LP 12	825.2	832.8	896.7	**851.6**	30.7	31.0	33.3	**31.6**
Mean	**822.2**	**837.7**	**967.3**	875.7	**30.6**	**31.1**	**36.0**	32.5
L.S.D at 0.05 % level for:	Harvest dates (A)			**71.62**				**2.67**
	Varieties (B)			**76.76**				**2.87**
	AXB			**NS**				**NS**
	2007/2008 season							
LP 11	863.3	889.7	980.1	**911.0**	33.34	34.38	37.92	**35.21**
Demapoly	919.9	946.7	1005.5	**957.4**	35.60	36.61	38.89	**37.04**
LP 13	813.6	802.5	889.2	**835.1**	31.46	31.04	34.39	**32.30**
Pleno	857.4	841.8	915.2	**871.5**	33.16	32.56	35.42	**33.71**
Kawemira	735.6	741.3	777.3	**751.4**	28.50	28.72	30.12	**29.12**
LP 12	840.5	800.7	866.8	**836.0**	32.55	31.02	33.58	**32.39**
Mean	**838.4**	**837.1**	**905.7**	860.4	**32.44**	**32.39**	**35.06**	33.29
L.S.D at 0.05 % level for:	Harvest dates (A)			**NS**				**NS**
	Varieties (B)			**60.74**				**2.33**
	AXB			**NS**				**NS**

Concerning purity percentage delaying harvesting dates had insignificant effect on the values of purity % in 1st season only. On the other hand, data showed that Demaploy and Kawemira varieties exhibited the highest and the lowest purity percentage in both seasons (Table 4). As for, the interaction between harvest dates x varieties was significantly affected purity % in 1st season only. Meantime, harvested sugar beet variety Demapoly at 210 days from sowing produced the highest values in this respect. Similar results were reviewed by Azzazy *et al* 2007.

It is clearly shown that the results obtained in table 4 assured that the measurements of quality in sugar beet crop in terms of RS %, TSS % and purity % mainly affected by gen make up in addition to the prevailing environments.

Table 4: Reducing sugars percentage, TSS and purity percentages of sugar beet varieties as affected by harvesting dates.

Sugar beet varieties	Reducing sugars percentage				TSS percentage				Purity percentage			
	Age at harvest (days)				Age at harvest (days)				Age at harvest (days)			
	180	195	210	Mean	180	195	210	Mean	180	195	210	Mean
2006/ 2007 season												
LP 11	1.33	0.79	0.54	0.89	21.46	21.89	22.36	**21.90**	73.65	74.33	74.20	**74.06**
Demapoly	2.74	2.52	1.20	2.16	22.34	22.55	23.10	**22.66**	78.74	79.78	79.52	**79.35**
LP 13	1.66	1.08	0.67	1.13	22.95	23.07	23.32	**23.11**	61.32	67.44	67.91	**65.56**
Pleno	2.94	1.83	1.06	1.94	23.46	23.76	24.03	**23.75**	71.01	71.71	73.79	**72.17**
Kawemira	1.21	0.86	0.62	0.90	22.67	22.94	23.08	**22.90**	55.21	69.23	68.36	**64.27**
LP 12	2.21	1.27	0.90	1.46	23.06	23.68	23.64	**23.46**	69.39	72.90	74.86	**72.38**
Mean	2.02	1.39	0.83	1.41	22.66	22.98	23.26	22.96	68.22	72.57	73.11	71.30
L.S.D at 0.05 % level for: Harvest dates (A)				0.26				0.17				NS
Varieties (B)				0.40				0.51				3.26
AXB				NS				NS				5.64
2007/ 2008 season												
LP 11	1.61	1.13	0.79	1.18	22.41	22.29	22.72	**22.47**	73.79	77.89	77.28	**76.32**
Demapoly	2.94	2.60	1.68	2.41	23.02	23.42	23.78	**23.41**	80.74	79.99	79.76	**80.16**
LP 13	2.07	1.33	1.09	1.50	23.40	23.47	23.65	**23.51**	62.75	67.47	69.12	**66.44**
Pleno	3.21	3.09	1.60	2.63	23.83	24.13	24.24	**24.07**	72.58	73.17	76.77	**74.17**
Kawemira	1.38	1.08	0.95	1.14	22.36	22.49	22.65	**22.50**	64.52	75.70	75.27	**71.83**
LP 12	2.22	1.61	1.29	1.70	23.13	23.71	23.76	**23.53**	73.37	75.32	78.03	**75.58**
Mean	2.24	1.80	1.23	1.76	23.02	23.25	23.47	23.25	71.29	74.92	76.04	74.08
L.S.D at 0.05 % level for: Harvest dates (A)				0.26				0.10				2.12
Varieties (B)				0.45				0.60				5.32
AXB				NS				NS				NS

4. Sucrose percentage and sugar yield:

Data in Table 5 revealed that sucrose percentage and sugar yield positively and significantly responded to the increase in the plant age. Delaying harvesting date from 180 to 195 and up to 210 days attained additional increase in the values of sucrose percentage amounted to (1.3%) and (1.6 %) in the 1st season, corresponding to (0.97 %) and (1.42 %) in the 2nd one. Similar results were shown with respect to the effect of harvesting dates on sugar yield. Prolonging growing season from 180 to 195 and to 210 days increased sugar yield by 0.49 ton/fed (9.58%) and1.51 ton/fed (29.5%) in the 1st season, corresponding to 0.3 ton/fed (5.40%) and 0.97 ton/fed (17.4%) in the 2nd season. Similar results were obtained by Abd El- Razek (2003 and 2006) and Mahmoud *et al* (2008) and Abo El-Magd *et al* (2003).

Table 5: Sucrose percentage and sugar yield of sugar beet varieties as affected by harvest dates.

Sugar beet Varieties	2006/ 2007 season							
	Sucrose percentage				Sugar yield (ton/fed)			
	Age at harvest (days)				Age at harvest (days)			
	180	195	210	Mean	180	195	210	Mean
LP 11	15.8	16.3	16.6	16.2	5.45	5.68	7.01	6.05
Demapoly	17.6	18.0	18.4	18.0	6.72	6.94	9.17	7.61
LP 13	14.1	15.6	15.8	15.2	4.26	4.83	5.50	4.86
Pleno	16.7	17.0	17.7	17.1	5.31	5.55	6.46	5.77
Kawemira	12.5	15.9	15.8	14.7	3.64	4.85	5.22	4.57
LP 12	16.0	17.3	17.7	17.0	5.27	5.75	6.35	5.79
Mean	15.4	16.7	17.0	16.4	5.11	5.60	6.62	5.77
L.S.D at 0.05 % level for: Harvest dates (A)				0.57				0.41
Varieties (B)				0.67				0.56
AXB				1.15				NS
	2007/ 2008 season							
LP 11	16.56	17.39	17.59	17.18	5.70	6.18	6.94	6.27
Demapoly	18.59	18.72	18.97	18.76	6.87	7.11	7.68	7.22
LP 13	14.70	15.87	16.38	15.65	4.72	5.07	5.81	5.20
Pleno	17.33	17.69	18.64	17.89	5.91	5.93	6.83	6.22
Kawemira	14.53	17.05	17.12	16.24	4.33	5.08	5.38	4.93
LP 12	17.07	17.89	18.57	17.84	5.77	5.76	6.47	6.00
Mean	16.46	17.43	17.88	17.26	5.55	5.85	6.52	5.97
L.S.D at 0.05 % level for: Harvest dates (A)				0.40				0.35
Varieties (B)				1.10				0.54
AXB				NS				NS

Results in Table 5 showed that there were significant differences among the examined varieties in sucrose percentage and sugar yield. Demapoly variety, regarded the highest sucrose percentage followed by both of Pleno and L P12 varieties. This observation was true in both seasons (Al-Jbawi, 2000 and Azzazy *et al,* 2007). Moreover, there was a close and distinct relationship between sugar yield and its sucrose percentage. In other words, the superiority in sugar yield for the above mentioned varieties was mainly attributed to the highest root yield (Table 3) and the highest sucrose % (Table 5) .These findings may throw some light on the relative importance of such characteristics which are the cornerstones for the breeder in his selection program.

The interaction between the studied factors had a significant effect on sucrose percentage in the 1st season only. In general and regardless the significance, it could be noticed that sucrose percentage and sugar yield tended to increase with delaying harvesting dates from 180 up to 210 days, this result was true with all studied varieties.

REFFRENCES

Abd El-Razek, A. M. (2003). Effect of agricultural practices on the productivity of some sugar beet varieties. Ph.D. Thesis, fac. Agric., Suez Canal Univ., Egypt.

Abd El-Razek, A.M. (2006). Response of sugar beet to planting date and number of days to harvest under North Sinai conditions. Egypt. J. Agric. Res., 84 (3).

Abo El-Magd, B. M., M. F. Ebraheim and KH. A. Aboushady (2003). Some chemical and technological characteristics by planting methods and different harvesting dates. J. Agric. Sci. Mansoura Univ. 28 (7): 5115-5128.

Al-Jbawi, Entessar M. (2000). Performance of some sugar beet varieties under different environments. M. Sc. Thesis Fac. of Agric. Cairo Univ., Egypt.

Aly, E. F. (2006). Effect of environmental conditions on productivity and quality of some sugar beet varieties. Ph. D. Thesis. Fac. of Agric. Benha . University, Egypt.

A.O.A.C. (1995). Association of Official Analytical Chemists. Official methods of analysis, 16th Ed., A.O.A.C. International,Washington, D.C., USA.

Azzazy, N. B., N.M.S. Shalaby and A.M. Abd El-Razek (2007). Effect of planting density and days to harvest on yield and quality of some sugar beet varieties under Fayoum Governorate condition. Egypt J. of Appl. Sci.,.22 (I2A): 101-114.

Mahmoud, S.A., B. Hasanin, I. H. El-Geddawy and D. T. A. Mosa (2008). Effect of sowing and harvesting dates on yield and quality of some sugar beet varieties. Proc. Inter. Confer. (IS-2008) Al Arish, Egypt, September 11-14, pp 22-29

Snedecor, G.W. and W.G. Cochran (1981) Statistical Methods. Seventh Ed., Iowa State Univ. Press, Ames, Iowa, USA.

قييم بعض أصناف بنجر السكر تحت ثلاث مواعيد حصاد

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أقيمت تجربتان حقليتان بمركز طامية-محافظة الفيوم خلال موسمى الزراعة ٢٠٠٦/٢٠٠٧-٢٠٠٧/٢٠٠٨ لتقييم ستة أصناف من بنجر السكر هي , LP 11, Demapoly, LP 13 , Pleno Kawemira and LP 12 تحت ثلاث أعمار حصاد (١٨٠و ١٩٥و٢١٠) يوما من الزراعة واستخدم تصميم القطع المنشقة مرة واحدة حيث وضعت مواعيد الزراعة في القطع الرئيسية والأصناف تم توزيعها عشوائيا فى القطع المنشقة.

أظهرت النتائج وجود تأثير معنوى لمواعيد الحصاد و الأصناف على جميع الصفات المدروسة فيما عدا صفة قطر الجذر حيث لم يكن لها تأثير معنوى على هذه الصفة فى كلا الموسمين. كما أن التفاعل بين مواعيد الحصاد و الاصناف لم يكن له تأثير معنوى على جميع الصفات المدروسة فيما عدا صفات النسبة المئوية للسكروز والنقاوة حيث أظهرت النتائج وجود تأثير معنوى للتفاعل بين مواعيد الحصاد و الاصناف المستخدمة فى الموسم الأول فقط.

أ شارت النتائج الى تفوق الصنف Demapoly فى صفات وزن الجذر ومحصول الجذور ومحصول السكر و النسبة المئوية السكروز و النسبة للمئوية النقاوة عند حصاده بعد ٢١٠ يوم من تاريخ الزراعة فى كلا الموسمين.

من خلال النتائج المتحصل عليها وتحت ظروف التجربة يوصى البحث بزراعة الصنف Demapoly تحت ظروف منطقة طامية بمحافظة الفيوم ، كما يوصى البحث بالتركيز علي الصفات المحصولية المؤثرة علي المحصول (طول- قطر- وزن الجذر/ نبات) كأحد الصفات المورفولوجية المؤثرة علي المحصول وكذلك التركيز علي نسبة السكر وانخفاض قيمة السكريات المختزلة كأدوات عند الانتخاب لاصناف عالية في انتاج السكر.