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Possibility of Sugar Beet Production in Toshka Region :- I. Assessment of the Optimum Harvesting Age

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ABSTRACT

Two field trails were carried out at the Farm of South Valley Development Company, Toshka, (latitude of 22 °.49- N, longitude of 28 °.58- E and an elevation of 188 m above sea level) Aswan Governorate, Upper Egypt in 2014-2015 and 2015-2016 seasons. These trials aimed to find out the optimum harvesting age (180, 195, 210 and 225 days) for five sugar beet varieties four of them are multi-germ varieties namely Misribel, Halawa, Husam, and Habiba and one is mono variety namely Natora. The experimental design was a factorial experiment conducted in a complete randomized block design with three replications. Results indicated that delaying harvesting date up to age 225 days significantly increased root length, root diameter, sucrose, purity, extractable sugar and extractability percentages as well as root and sugar yields/fad. Root contents of impurities (α-amino N, Na and K) were significantly influenced by delaying the harvest age. Results showed that sugar beet varieties differed significantly in root length, root and sugar yields/fad. as well as sucrose, purity, impurities percentages. Under the conditions of Toshka region, the results suggested that harvesting Misribel variety at age of 210 days can be recommended to produce the best quality as well as the highest root and sugar yields/fad.

Keywords: harvest age, juice quality sugar beet varieties, Toshka region.

INTRODUCTION

Egypt suffers from a negative gap between the production and consumption of sugar. As an attempt to minimize this gap, it was necessary to expand the area planted with sugar beet (*Beta vulgaris*, *var. saccharifera, L.*) in the newly reclaimed lands. this work was conducted to evaluate the performance of five beet varieties harvested at different ages to find out the best variety and its proper harvesting age to get the maximum root and sugar yields per unit area in Toshka.

The harvesting age is one of the main factors which directly affect maturity and consequently root yield and juice quality of sugar beet. Sugar beet varieties differ inherently in their maturity ages, which extend from 150 to 240 days, through which changes in quality, yield and its components occurred until they reach their maximum values Abo El-Magd *et al* (2003), Mahmoud *et al.* (2008), Al-Sayed *et al.* (2012), Aly *et al.* (2012), Hemayati *et al.* (2012), Abo El-Ghait (2013) and Mohamed and Yasin (2013).

Sugar beet variety is considered one of the essential wings of sugar production, in terms of its root yield and quality characteristics. In this context, Enan *et al.* (2009), El-Sheikh *et al.* (2009), Shalaby *et al.* (2011), Al-Labody *et al.* (2012), El-Eila *et al.* (2014), Kaloi *et al.* (2014), Mekdad and El-Sherif (2016) and Mekdad and Rady (2016). They found differences among beet varieties.

Therefore, the present work was carried out to determine the optimum harvesting age for five sugar beet varieties under Toshka region conditions.

MATERIALS AND METHODS

In this concern, this research work is the first to be conducted in Toshka region. Two field trails were carried out at the Farm of South Valley Development Company, Toshka, (latitude of 22.49° N, longitude of 28.58° E and an elevation of 188 m above sea level) Aswan Governorate, Upper Egypt in 2014-2015 and 2015-2016 seasons to find out the optimum harvesting age for some sugar beet varieties. The field trait included twenty treatments represent the combination of five sugar beet varieties four of them are multi-germ varieties namely Misribel, Halawa, Husam, and Habiba and one is mono variety namely Natora as well as four harvesting ages (180, 195, 210 and 225 days from sowing).

The experimental design was a factorial experiment conducted in a complete randomized block design with three replications. Sugar beet seeds were manually sown in the first week of October in both seasons. Thinning was done at four leaf stage (after 35 days from sowing) to ensure one plant/hill. Plot area was 21 m^2 (including six ridges of 0.5 m in width and 7.0 m in length).

Phosphorus fertilizer as calcium super phosphate 15.5% P2O5 was added during seed bed preparation at the rate of 30 kg/fad. Nitrogen fertilizer as ammonium nitrate 33.5% N was applied at the rate of 100 kg/fad in four equal portions; the first was applied after thinning, while the other three doses were given thereafter at 15-day intervals. Potassium fertilizer (as potassium sulfate 48% K2O) was applied at the rate of 24 kg K2O/fad. split into two doses, which were given with the third and fourth N-doses. Other agricultural practices required for growing sugar beet were carried out as usual.

Recorded data:

At each of the studied harvest ages, a random sample of ten guarded roots of each plot was taken to determine the following traits:

1. Root length (cm).
2. Root diameter (cm).

Plant samples were then sent to the laboratory of quality analyses at Fayoum Sugar Company to determine the following quality characteristics:

3. Sucrose percentage which was estimated in fresh samples of sugar beet root using "Saccharometer" according to the method described by A.O.A.C. (2005).
4. Root impurities in terms of α-amino N, Na and K percentages (meq/100 g beet) according to A.O.A.C. (2005).
5. Purity percentage was calculated according to the following equation, described by Devillers (1988): Purity % = 99.36 – [14.27 (Na + K + α-amino N)/sucrose %].
6. Sugars lost to molasses percentage (SLM %) was calculated as described by Devillers (1988) using the following equation:

   SLM% = [0.14 (Na + K) + 0.25 (α-amino N) + 0.5]
7. Extractable sugar percentage (ES%)was calculated using the equation of Dexter, *et al.* (1967) as follows: ES% = [sucrose % – (sugar lost to molasses % + 0.6)].

8. Extractability = [(extractable sugar % / sucrose %) x 100].
9. Root yield/fad. (ton) was calculated based on root yield/plot (kg).
10. Sugar yield/fad. (ton) was calculated as follows:

Sugar yield/fad. (ton) = [root yield/fad. (ton) x ES%]

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

Table 1. Temperature and relative humidity percentage in Toshka region during 2014/2015 and 2015/2016 seasons

Season	2014/2015 season						2015/2016 season					
Months	Temp. (C°)			Rh %			Temp. (C°)			Rh %		
	Max	Min	Av.	Max	Min	Av.	Max	Min	Av.	Max	Min	Av.
October	30.1	16.4	23.8	54.9	15.9	34.2	42.7	14.7	30.5	42.7	14.7	28.3
November	33.9	8.4	21.9	70.1	11.8	37.4	33.3	12.5	22.4	33.3	12.5	39.1
December	31.6	8.3	19.6	84.8	15.7	44.6	27.2	6.5	16.3	27.2	6.5	44.5
January	32.9	2.4	16.0	85.1	8.9	41.0	27.8	3.2	14.6	27.8	3.2	39.6
February	32.5	7.9	19.5	87.2	9.4	31.9	33.2	3.8	19.1	33.2	3.8	32.0
March	36.3	8.5	20.8	76.8	4.7	22.6	43.6	10.0	24.7	43.6	10.0	24.5
April	39.0	10.4	23.7	58.6	2.6	17.6	44.9	13.2	28.5	44.9	13.2	16.7
May	42.6	16.7	28.4	74.3	1.9	17.1	47.1	17.0	32.0	47.1	17.0	15.3

Source: Agricultural meteorological station in water studies and research complex station, (NWRC) Toshka Aswan

RESULTS AND DISCUSSION

1-Root length:

Results in Table 2 show that root length of sugar beet was significantly increased gradually with delaying harvest age up to 225 days from sowing in both seasons. The results cleared that delaying harvest to 225 days increased the mean value of root length by 6.43 cm (26.13 %) and 2.73 cm (11.39 %) over that of 180 days, in the 1st and 2nd season, respectively. Such effect might be attributed to the continuity in plant growth and more dry matter accumulation at the end of harvesting season. These findings are in line with those reported by Abo El-Magd *et al.* (2003), Mahmoud *et al.* (2008) and Al-Sayed *et al.* (2012). They found that delaying harvest date up to 210 days from sowing resulted in the longest roots.

Data in the same Table clear that the tested sugar beet varieties differed significantly in root length in the 1st season only. Misribel showed superiority over the other varieties in this trait with a significant variance with Natora sugar beet variety only. These results may be due to the genetic differences among varieties in their performance. Enan *et al.* (2009), Al-Labody, *et al.* (2012) and Mekdad and El-Sherif (2016). They reported that significant variation among beet varieties in root length.

Table 2. Root length (cm) of sugar beet varieties as affected by harvesting age in 2014/2015 and 2015/2016

varieties	2014/2015				Mean	2015/2016				Mean
	Harvest age (days from sowing)					Harvest age (days from sowing)				
	180	195	210	225		180	195	210	225	
Misribel	27.67	28.33	30.33	31.67	29.50	23.00	26.83	24.00	31.33	26.29
Halawa	22.83	27.67	29.17	30.17	27.45	25.83	26.00	23.50	22.33	24.42
Husam	24.50	27.67	29.50	33.00	28.67	25.33	26.83	23.00	27.67	25.71
Natora	23.30	27.67	28.00	29.33	27.08	22.83	23.33	25.00	25.83	24.25
Habiba	24.67	26.67	29.67	32.00	28.00	22.83	26.17	26.17	26.33	25.38
Mean	24.60	27.60	29.33	31.03		23.97	25.83	24.33	26.70	
LSD.at 0.05 level for										
Harvest age (A)					2.12					2.09
Varieties (B)					2.32					NS
A x B					5.19					4.39

Root length was significantly affected by the interaction between sugar beet varieties and their harvesting age in both seasons. The root length of all beet varieties under investigation does not behave the same at the different harvesting ages. Generally, tallest root was recorded by Husam and Misribel sugar beet varieties, harvested at 225 days from sowing, in the 1st and 2nd season, successively.

2.Root diameter:

Results obtained in Table 3 show that root diameter was significantly affected by harvest age in both seasons. Root diameter was gradually and significantly increased by increasing plant age and reached to its maximum mean values (14.66 and 14.80 Cm) at the harvesting date of 225 days, in the 1st and 2nd seasons, respectively. The increases in root diameter were more pronounced at 210 and 225 days from sowing. This finding hold fairly true in both seasons. Abou El-Maged *et al* (2003), Mahmoud *et al.* (2008) and Al -Sayed *et al.* (2012). They found that delaying harvest date up to 210 days gave the highest root diameter.

Data presented in the same Table indicated that the tested sugar beet varieties differed insignificantly in root diameter in both seasons. The highest and the lowest mean values of root diameter were recorded with Misribel and Natora varieties respectively.

Also, the same results showed that root diameter was significantly affected by the interaction between the two studied factors in both seasons. In the first season root diameter of Natora and Habiba sugar beet varieties were significantly increased by delaying harvesting ages from 210 to 225 days, but other varieties have insignificant difference. Generally, maximum root diameter (15.83 and 16.33 cm) were obtained from Habiba and Misribel sugar beet varieties when it harvested at 225 days' age in the first and the second seasons, respectively.

3. Sucrose percentage

Data in Table 4 clear that sucrose content was significantly increased by increasing harvest age from 180 up to 210 days old, in the 1st and 2nd seasons, the increase in

sucrose% at the age of 210 days might be due to positive impact of age which allow accumulation of additional sucrose on the harvest age. These results are in agreement with those obtained by Abo El-Magd *et. al.* (2003), Mahmoud *et al.* (2008), Al -Sayed *et. al.* (2012) and Mohamed and Yasin (2013). They reported that delaying harvesting date from 180 to 195 and 210 days significantly increased sucrose percentage.

Table 3. Root diameter (cm) of sugar beet varieties as affected by harvesting age in 2014/2015 and 2015/2016

varieties	2014/2015				Mean	2015/2016				Mean
	Harvest age (days from sowing)					Harvest age (days from sowing)				
	180	195	210	225		180	195	210	225	
Misribel	12.17	12.83	13.27	14.63	13.23	10.00	12.17	13.47	16.33	12.99
Halawa	10.67	11.67	13.33	13.67	12.33	11.00	12.17	13.00	14.00	12.54
Husam	11.53	12.30	13.70	14.83	13.09	11.83	12.00	12.33	14.50	12.67
Natora	10.67	11.40	12.00	14.33	12.10	10.33	11.00	12.67	14.17	12.04
Habiba	11.17	11.37	12.83	15.83	12.80	10.33	11.67	12.83	15.00	12.46
Mean	11.24	11.93	13.03	14.66		10.70	11.80	12.86	14.80	
LSD.at 0.05 level for										
Harvest age (A)					1.06					1.00
Varieties (B)					NS					NS
A x B					2.31					2.24

Data also show that there were significant differences among varieties in sucrose percentage in the first season only. Halawa variety, recorded the highest sucrose percentage followed by Husam without significant deference. While Misrabel variety recorded the lowest one. Differences among examined sugar beet varieties in sucrose percentage depend on the interaction between this varieties and environmental factors during growth, sucrose formation and storage periods. The results of the present investigation are in line with those of Shalaby, *et al.*, (2011), Aly *et al.* (2012), Abo El-Ghait (2013) and Mekdad and El-Sherif (2016). They revealed that sugar beet varieties differed significantly in sucrose percentage.

Sucrose % was significantly affected by the interaction between harvesting age and sugar beet varieties. In the first season, sucrose percentages of all varieties were significantly increased by delaying harvesting age from 180 to 210 days, but this was not the case delayed to 225 days. The highest values of sucrose percentage (18.50 and 16.31) were obtained from Halawa and Husam when harvested at 210- day old in the 1st and 2nd seasons, respectively.

Table 4. Sucrose percentage of sugar beet varieties as affected by harvesting age in 2014/2015 and 2015/2016

varieties	2014/2015				Mean	2015/2016				Mean
	Harvest age (days from sowing)					Harvest age (days from sowing)				
	180	195	210	225		180	195	210	225	
Misribel	12.17	16.08	18.47	15.07	15.44	15.11	15.57	15.98	14.96	15.40
Halawa	12.87	17.57	18.50	15.37	16.08	14.80	14.83	15.26	16.06	15.24
Husam	11.87	17.80	17.80	16.67	16.03	15.27	15.50	16.31	15.12	15.55
Natora	12.23	16.93	17.47	16.13	15.69	15.00	14.93	15.41	16.14	15.37
Habiba	12.27	16.30	18.07	17.07	15.93	14.27	15.37	15.43	16.10	15.29
Mean	12.28	16.933	18.06	16.06		14.89	15.24	15.69	15.68	
LSD.at 0.05 level for										
Harvest age (A)					0.43					0.46
Varieties (B)					0.51					N.S
A x B					1.36					1.21

4. Impurities% (α- amino N%, Na% and K %):

Data presented in Tables 5,6 and 7 show that the significant effect of harvesting ages on impurities percentages (sodium, Potassium and α- amino nitrogen percentages) in the two seasons. From results it could be seen that impurities percentages were significantly affected by harvesting ages. These results are in line with those obtained by El-Sheikh *et al* (2009) and Mohamed and Yasin (2013). They reported that delaying harvest from 180 to 210 days after sowing significantly influenced impurities content.

Table 5. Sodium % of sugar beet varieties as affected by harvesting age in 2014/2015 and 2015/2016

varieties	2014/2015				Mean	2015/2016				Mean
	Harvest age (days from sowing)					Harvest age (days from sowing)				
	180	195	210	225		180	195	210	225	
Misribel	1.160	0.870	2.700	2.073	1.701	2.227	2.800	2.223	1.400	2.163
Halawa	1.493	0.250	2.300	1.937	1.495	1.617	2.533	1.433	1.967	1.888
Husam	1.237	1.723	2.700	2.147	1.952	2.333	1.297	0.587	1.767	1.496
Natora	1.413	0.657	2.633	2.153	1.714	2.600	3.333	2.233	1.133	2.325
Habiba	1.057	1.327	2.733	2.207	1.831	1.830	2.800	1.267	1.067	1.741
Mean	1.272	0.965	2.613	2.103		2.121	2.553	1.549	1.467	
LSD at 0.05 level for										
Harvesting age (A)					0.293					0.687
Varieties (B)					0.305					0.721
A x B					0.655					1.292

Results collected in the same Tables showed that impurities characteristics % among studied sugar beet varieties, were significantly affected in both seasons except, Potassium in the first season only. Halawa and Misribel had the lowest mean values of impurities characteristics in the first season. While in the second season Husam recorded the lowest sodium%, Potassium % as well as Halawa gave the lowest α- amino nitrogen %. Similar results were obtained

by Abou El-Magd *et al* (2003) and Shalaby, *et al.*, (2011). They found that differed significantly in, impurities% Na, K and N% between the studied sugar beet varieties.

The variation among the examined varieties in impurities content are mainly due to their gene make-up. Varietal differences in this trait were also reported by Al-Jbawi, (2000) and Enan *et al.* (2009). They found that Farida variety recorded the lowest values for impurities.

Data also clearly showed that impurities percentages were significantly affected by the interaction between the two studied factors. Generally, the lowest sodium % (0.250 and 0.587) were recorded by harvesting Halawa and Husam varieties at 195 and 210 days' age in first and second seasons respectively. Meanwhile, the lowest potassium % (1.20 and 1.80) were recorded by harvesting Misribel and Natora at 180 and 225 days' age in the first and the second seasons, respectively. The lowest α- amino nitrogen (1.043 and 0.427) were recorded by harvesting Halawa variety at 195 and 180 days' age in the first and second seasons, respectively.

Table 6. Potassium % of sugar beet varieties as affected by harvesting age in 2014/2015 and 2015/2016

varieties	2014/2015				Mean	2015/2016				Mean
	Harvest age (days from sowing)					Harvest age (days from sowing)				
	180	195	210	225		180	195	210	225	
Misribel	1.200	1.997	2.467	4.293	2.489	3.440	5.900	1.933	2.667	3.485
Halawa	1.557	1.477	2.900	4.167	2.525	1.967	5.833	1.801	3.132	3.183
Husam	1.250	2.423	2.867	4.160	2.675	5.467	1.933	1.620	2.200	2.805
Natora	1.730	1.470	2.933	4.200	2.583	5.600	3.933	2.167	1.800	3.375
Habiba	1.373	2.397	3.000	4.203	2.743	1.897	5.467	2.320	2.300	2.996
Mean	1.422	1.953	2.833	4.205		3.674	4.613	1.968	2.420	
LSD at 0.05 level for										
Harvesting age (A)					0.370					0.610
Varieties (B)					N.S					0.641
A x B					0.828					1.622

Table 7. α- amino nitrogen % of sugar beet varieties as affected by harvesting age in 2014/2015 and 2015/2016

variety	2014/2015				Mean	2015/2016				Mean
	Harvest age (days from sowing)					Harvest age (days from sowing)				
	180	195	210	225		180	195	210	225	
Misribel	1.210	1.213	1.100	1.143	1.167	0.463	1.700	1.500	0.967	1.157
Halawa	1.377	1.043	1.100	1.180	1.175	0.427	1.867	0.967	0.967	1.057
Husam	1.310	1.163	1.133	1.167	1.193	1.767	2.333	0.443	1.433	1.494
Natora	1.430	1.120	1.200	1.137	1.222	1.800	0.733	1.033	2.000	1.392
Habiba	1.270	1.153	1.233	1.137	1.198	0.993	1.867	1.867	2.367	1.798
Mean	1.319	1.139	1.153	1.153		1.090	1.700	1.182	1.547	
LSD at 0.05 level for										
Harvesting age (A)					0.042					0.444
Varieties (B)					0.053					0.557
A x B					0.277					0.856

5.Purity percentage:

Results in Table 8: indicate that increasing harvesting age from 180 to 195 and 210 days led to significant and gradual increases in purity % which amounted 3.67 and 9.84 in the 1st season, being 0.70 and 7.24 in the 2nd one. While increasing harvesting age from 210 up to 225 days led to significant decreases amounted 2.7% and 7.78 in its 1st and the 2nd seasons, respectively. These results are in accordance with those obtained by Abo El-Magd *et al.* (2003) and Abo El-Ghait (2013). They found that significant variation was observed by harvesting age on purity %.

Data also showed that purity percentage was significantly affected by beet varieties in the first season only. Generally, the highest purity percentage of beet variety were recorded with Husam variety in the two seasons. Variations among Misribel, Halawa, Habiba and Natora were, insignificant. As well as the among Husam, Halawa, Habiba and Natora. Only, the variation between Husam and Misribel varieties was significant. These results may be due to the genetic differences among varieties. The results of the present investigation are in line with those of El-Sheikh *et al.* (2009), Aly *et al.* (2012) and Mekdad and Rady (2016). They reported that significant differences regarding purity among cultivars.

Table 8. Purity % of sugar beet varieties as affected by harvesting age in 2014/2015 and 2015/2016

varieties	2014/2015				Mean	2015/2016				Mean
	Harvest age (days from sowing)					Harvest age (days from sowing)				
	180	195	210	225		180	195	210	225	
Misribel	77.83	84.99	88.97	85.33	84.28	84.90	83.57	91.43	82.40	85.58
Halawa	76.73	89.33	91.30	85.13	85.63	84.50	83.93	94.41	83.73	86.64
Husam	87.97	78.43	93.27	87.43	86.77	83.97	88.77	89.79	84.57	86.77
Natora	80.70	79.43	89.37	90.43	84.98	83.75	85.23	93.17	83.93	86.52
Habiba	78.70	88.12	88.27	89.33	86.11	84.90	83.98	89.42	84.67	85.74
Mean	80.39	84.06	90.23	87.53		84.40	85.10	91.64	83.86	
LSD at 0.05 level for										
Harvesting age (A)					2.15					3.43
Varieties (B)					2.41					NS
A x B					4.65					6.69

The results also showed that purity % was significantly affected by the interaction between the studied factors. Purity % of Misrible and Natora varieties were significantly increased by delaying harvesting age from 195

to 210 days, but Habiba variety have insignificant difference. In general, the highest purity% (93.27 and 94.41) were obtained from Husam and Halawa varieties, when harvested at 210- days age in the 1st and 2nd seasons, respectively.

6.Sugar loss to molasses percentage

The obtained data in Table 9 indicated that sugar loss to molasses percentage was significantly affected by harvesting age. Lowest values (1.194 % and 1.289 %) were recorded when plants harvested at ages of 195 and 210 days, in the first and second seasons, respectively. These results are in harmony with those obtained by Aly *et al.* (2011). They found that late harvest date at 205 days from sowing caused significant reduction in sugar loss to molasses%.

Data showed that differences among the tested sugar beet varieties in sugar in sugar loss to molasses percentage were insignificant.

Table 9. Sugar loss to molasses % of sugar beet varieties as affected by harvesting age in 2014/2015 and 2015/2016.

varieties	2014/2015				Mean	2015/2016				Mean
	Harvest age (days from sowing)					Harvest age (days from sowing)				
	180	195	210	225		180	195	210	225	
Misribel	1.133	1.203	1.500	1.677	1.378	1.410	2.143	1.457	1.313	1.581
Halawa	1.270	1.007	1.503	1.650	1.358	1.107	2.137	1.197	1.457	1.474
Husam	1.177	1.370	1.560	1.677	1.446	2.033	1.537	0.920	1.417	1.477
Natora	1.297	1.080	1.580	1.673	1.407	2.097	1.700	1.373	1.410	1.645
Habiba	1.160	1.310	1.610	1.680	1.440	1.273	2.123	1.497	1.567	1.615
Mean	1.207	1.194	1.551	1.671		1.584	1.928	1.289	1.433	
LSD at 0.05 level for										
Harvest age (A)					0.109					0.233
Varieties (B)					NS					NS
A x B					0.226					0.522

In respect to the effect of the interaction between sugar beet varieties and harvesting age was significant on this trait. The beet varieties did not behave the same under the four harvesting ages.

7. Extractable sugar percentage

Collected data in Table 10 show that increasing harvesting age from 180 to 225 days significantly affected the extractable sugar percentage in both seasons. Delaying harvesting date up to 210 days significantly increased the extractable sugar %. different extents. On the contrary, delaying harvest from 210 up to 225 days' age was significantly and insignificantly reduced Extractable sugar % in the 1st and 2nd seasons, respectively. Al-Jbawi, (2000), Aly *et al.* (2011) and Al - Sayed *et al.* (2012). They found that harvest date effects on extraction sugar percentage was highly significant.

The interaction effect between harvesting age and varieties was significant in both seasons. This significant effect revealed that sugar beet varieties does not behave the same under the studied harvesting dates.

Table 10. Extractable sugar % of sugar beet varieties as affected by harvesting age in 2014/2015 and 2015/2016

varieties	2014/2015				Mean	2015/2016				Mean
	Harvest age (days from sowing)					Harvest age (days from sowing)				
	180	195	210	225		180	195	210	225	
Misribel	10.43	14.26	16.37	12.79	13.46	13.10	12.82	13.91	13.06	13.23
Halawa	11.00	15.96	16.40	13.12	14.12	13.09	12.09	13.45	14.01	13.16
Husam	10.09	15.83	15.64	14.39	13.99	12.63	13.36	14.78	13.12	13.46
Natora	10.34	15.25	15.29	13.86	13.68	12.30	12.63	13.43	14.14	13.13
Habiba	10.51	14.39	15.86	14.79	13.89	12.40	12.64	13.33	13.94	13.08
Mean	10.47	15.14	15.91	13.79		12.71	12.71	13.78	13.65	
L.S.D. at 0.05 level for										
Harvest age (A)					0.619					0.577
Varieties (B)					NS					NS
A x B					1.430					1.366

8. Extractability percentage

Data in Table 11: show that harvesting ages significantly affected the extractability percentage of the studied beet varieties. Harvesting at 195 and 210 days, age recorded the highest mean values, whereas 180 and 195 days, age recorded the lowest values, in the first and second seasons, respectively. These data are in partial agreement with those obtained by Aly *et al.* (2011) They found that extractability was significantly affected by plant age at harvest.

Data revealed that there was insignificant difference among varieties in extractability percentage these results were true in both growing seasons.

Regarding the interaction effect between the studied two factors on extractability percentage, it is clear that the extractability percentages of the tested varieties were not in the same line with the studied harvesting ages .

9.Root yield

Data given in Table 12: reveal that delaying harvest ages from 180 to 195, 210 and 225 days significantly increase root yield. This increments amounted 2.190, 3.772 and 6.697 ton/fad with harvest at age of 195, 210 and 225 days over harvest at 180 days in the first season and 1.908, 5.797and 8.109 ton/fad in the second season, respectively. The increases in root yield by delaying harvest date is due to the increase in root length (Table 2) and root diameter (Table 3). These results are in agreement with those obtained by El-Sheikh *et al.* (2009), Mahmoud *et al.* (2008), Mohamed and Yasin (2013) and Mekdad and Rady (2016). They noted that beet variety of BTS 301 significantly exceeded Amina variety for root yield over two seasons.

Data also showed that the examined varieties varied significantly in root yield. The highest mean values of root yield. (38.698 and 33.972 ton/fad) were scored by Misribel variety followed by Husam (33.326 and 30.548 ton/Fad), while the lowest mean values of root yield (28.622 and 28.113 Ton/Fad.) were obtained with Natora variety in the first and second seasons, respectively. The superiority of Misribel may be due to its better root traits (Tables 2 and 3).

These results are in line with those obtained by Shalaby *et al.* (2011), Aly *et al.* (2012), Al-Labody *et al* (2012) and Kaloi *et al.* (2014). They noted that all sugar beet varieties showed different behavior with respect to root yield.

Table 11. Extractability % of sugar beet varieties as affected by harvesting age in 2014/2015 and 2015/2016

varieties	2014/2015				Mean	2015/2016				Mean
	Harvest age (days from sowing)					Harvest age (days from sowing)				
	180	195	210	225		180	195	210	225	
Misribel	85.71	88.76	88.63	84.57	86.92	86.74	82.31	87.05	87.22	85.83
Halawa	85.42	90.87	88.63	85.33	87.56	88.41	81.51	88.23	87.18	86.33
Husam	84.90	88.93	87.83	86.35	87.00	82.67	86.21	90.68	86.65	86.55
Natora	84.46	90.09	87.51	85.89	86.99	81. 90	84.58	87.18	87.59	85.31
Habiba	85.67	88.25	87.72	86.61	87.06	86.67	82.28	86.37	86.56	85.47
Mean	85.23	89.38	88.06	85.75		85.28	83.38	87.90	87.04	
LSD at 0.05 level for										
Harvest age (A)					1.71					1.78
Varieties (B)					NS					NS
A x B					2.280					3.64

Table 12. Root yield ton/fad of sugar beet varieties as affected by harvesting age in 2014/2015 and 2015/2016

varieties	2014/2015				Mean	2015/2016				Mean
	Harvest age (days from sowing)					Harvest age (days from sowing)				
	180	195	210	225		180	195	210	225	
Misribel	34.015	35.180	42.024	43.574	38.698	29.784	30.207	37.648	38.251	33.972
Halawa	28.282	29.696	30.215	33.744	30.484	22.860	24.161	32.418	33.806	28.311
Husam	30.444	31.653	33.807	37.400	33.326	27.792	30.551	31.356	32.491	30.548
Natora	25.658	28.967	28.494	31.370	28.622	24.419	25.822	28.275	33.934	28.113
Habiba	28.058	31.911	30.773	33.584	31.149	24.828	28.480	28.968	31.743	28.504
Mean	29.291	31.481	33.063	35.988		25.936	27.844	31.733	34.045	
LSD at 0.05 level for										
Harvest age (A)					2.051					2.098
Varieties (B)					2.293					2.346
A x B					4.587					4.691

The effect of the interaction between harvesting age and varieties was significant. In the second season, root yield of Misribel and Halawa varieties were significantly increased by delaying harvesting date from 195 to 210 days, but this was not true in the case of the other varieties. In general, the highest root yield (43.574 and 38.251 ton/fad) was produced by Misribel variety when harvested at 225 days' age in 1st and 2nd seasons, respectively.

10.Sugar yield

Data presented in Table 13 show that delaying sugar beet harvest to 195,210 and 225-days resulted in increasing sugar yield by 0.325, 0. 415 and 0.687 ton/fad as compared with harvest at age of 180 days in the first season, corresponding to 0.117, 0.585 and 0.0754 ton/fad in the second season, respectively. The increase in sugar yield by delaying harvest date is due to the increase in sucrose, percentage and root yield which reflected on sugar yield as a final product. These results are in line with those recorded by Al -Sayed *et al.* (2012); Hemayati, *et al* (2012) and Mohamed and Yasin (2013). They reported that delaying harvesting date from 180 to 195 and 210 days significantly increased sugar yield.

Table 13. Sugar yield (Tons/fad.) of sugar beet varieties as affected by harvesting age in 2014/2015 and 2015/2016

varieties	2014/2015				Mean	2015/2016				Mean
	Harvest age (days from sowing)					Harvest age (days from sowing)				
	180	195	210	225		180	195	210	225	
Misribel	2.920	3.122	3.725	3.689	3.364	2.460	2.606	3.414	3.318	2.950
Halawa	2.414	2.698	2.678	2.880	2.668	2.034	2.413	2.525	2.779	2.438
Husam	2.584	2.816	2.970	3.230	2.900	2.407	2.514	2.706	2.814	2.610
Natora	2.167	2.610	2.493	2.694	2.491	2.118	2.124	2.462	2.951	2.414
Habiba	2.404	2.816	2.698	2.932	2.712	2.020	1.970	2.860	2.950	2.450
Mean	2.498	2.813	2.913	3.085		2.208	2.325	2.793	2.962	
LSD at 0.05 level for										
Harvest age (A)					0.165					0.167
Varieties (B)					0.207					0.209
A x B					0.414					0.418

Also data showed that the tested sugar beet varieties differed significantly in sugar yield. Misribel variety produced 0.696,0.464, 0.873 and 0.652 ton/fad in the first season, and 0.512, 0.340, 0.536 and 0.500 ton/fad in the second season, higher than those obtained from Halawa, Husam, Natora and Habiba varieties, respectively. This superiority of Misribel variety in sugar yield could be attributed to the increase in extractable sugar and root yield/fad. (Tables 10 and 12). These results are in agreement with those found by Mahmoud *et al* (2008); Al-Labody *et al* (2012); Kaloi, *et al.* (2014) and Mekdad and El-Sherif (2016). They reported that the two sugar beet varieties differed significantly in mean of sugar yield (ton/fad).

In respect to the effect of the interaction between varieties and harvesting age was significant on this trait. Sugar beet varieties did not behave the same under the four harvesting ages. Sugar yield of Misribel variety was significantly increased by delaying harvesting date from 195 to 210 days but this was not the case with the other four varieties. Generally, the highest sugar yield (3.725 and 3.414 Tons/Fad.) was recorded by harvesting Misribel variety at age of 210 days in 1st and 2nd seasons, respectively.

CONCLUSION

The optimum harvesting age for all tested sugar beet varieties was 225 days, except for Misrbel variety, it gave the highest root and sugar yields at age of 210 days. Generally, under the conditions of the present work in Toshka, the results suggest that harvesting Misribel sugar beet variety at age of 210 days is recommended to give best quality as well as highest root and sugar yields.

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إمكانية زراعة و انتاج بنجر السكر فى منطقة توشكى 1 .تحديد العمر الامثل للحصاد

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هذا هو العمل البحثى الأول الذى يتناول محصول بنجر السكر فى منطقة توشكى و يستهدف إمكانية زراعته وإنتاجته بالمنطقه. و قد تم لهذه الدراسة تنفيذ تجربتين حقليتين بالمزرعة التجريبية لشركة جنوب الوادى للتنمية بتوشكى (دائرة عرض 22,49° شمالاً و خط طول 28,58 ° شرقاً, و بإرتفاع 188 م فوق سطح البحر) محافظة أسوان, مصر العليا خلال موسمى 2015/2014 و 2016/2015 لتحديد العمر الأمثل لحصاد (180, 195, 210, 225 يوماً) خمسة أصناف من بنجر السكرأربعة منها عديد الأجنة وهى مسرابل, حلاوة, حسام, و حبيبة, بالاضافة الى صنف وحيد الجنين وهو ناتورا. و قد أستخدم تصميم تجربة عاملية فى قطاعات كاملة العشوائية فى ثلاثة مكررات. أظهرت النتائج أن تأخير الحصاد حتى عمر 225 يوماً أدى الى زيادة معنوية فى طول و قطر الجذور و النسبة المئوية للسكروز و النسبة المئوية للنقاوه و النسبة المئوية للسكر المستخلص و النسبة المئوية للأستخلاص و أيضا حاصلى الجذور و السكر , كما تأثرت نسبة الشوائب معنوياً بتأخير عمر النباتات عند الحصاد من 180 وحتى 225 يوماً. أظهرت النتائج فروقا معنوية بين الأصناف المختبرة فى صفات طول الجذور و حاصلى الجذور والسكروالنسبة المئوية للسكروز و النقاوه و الشوائب. تشير نتائج هذه الدراسة الى إمكانية التوصية بزراعة الصنف مسرابل و حصاده بعد 210 يوماً من الزراعة للحصول على أفضل صفات جوده و اعلى محصول من الجذور و السكر تحت ظروف منطقة الدراسة.