International Journal of Agricultural and Applied Sciences, December 2023, 4(2): 86-93
https://www.agetds.com/ijaas
ISSN: 2582-8053
https://doi.org/10.52804/ijaas2023.4211

Research Article

OPEN ACCESS

Impact of delaying harvesting dates for sugar beet varieties under recent environmental changes

Dalia Ibrahim El-Geddawy*, Karam Abd El-Sadek Abd Elsalam and Ibrahim Abd ElBaki Abd Elateef
Sugar Crops Research Institute, Agricultural Research Center, Egypt
**Corresponding author e-mail: elgeddawydaliascientific@gmail.com*
(Received: 21/08/2023; Revised: 29/09/2023; Accepted: 05/11/2023; Published: 20/12/2023)

ABSTRACT
The present study was conducted at Experimental Sennuris District in Fayoum Governorate, Egypt (latitude of $29^0 24' 26''$N and longitude of $30^0 52' 00''$E) to investigate the effect of harvest dates on some sugar beet varieties concerning their yield and quality. Two successive field experiments were carried out in the 2020/2021 and 2021/2022. A randomized complete block split plots were assigned for the four harvesting dates (mid-February, 1st week of March, mid-March and 1st week of April), i.e. at the age of 180, 195, 210 and 225 days after sowing. The sub-plots were occupied by the four sugar beet varieties i.e. (Faraida, Jampol, Fantazja and Melodia). The obtained results revealed that there were significant differences among the four studied harvesting dates concerning root length, diameter and weight as well as root yield in both seasons. The highest values were obtained by delaying the harvesting up to 225 days from sowing. Concerning the quality traits, neither the harvesting date nor the varieties affected sucrose, purity (QZ), sodium, potassium, α-amino N and sugar recovery percentages in both seasons. However, the upper mid-harvesting date i.e. age of 195 days from sowing recorded the lower significant impurities and SLM percentages in the 1st season only.
Keywords: Sugar beet, harvesting dates, varieties, quality and quantity traits.

INTRODUCTION

Sugar beet crop has become the main source of sugar production in Egypt since 2012 beside sugarcane (Sugar Crops Council, 2022). Climatic changes in meteorological factors such as day and night temperature, day length, wind speed and relative humidity affect sugar beet germination, growth translocation and storage of sugar in tap roots.

Maho and Skenderasi (2020) and Mall, *et. al.* (2021) indicated that climatic changes will result in an increment in the mean temperature in many regions of the globe, where the agriculture and rural areas will be more affected by those changes. Modifying sowing and/or harvesting dates is one of the methods to adapt plants to new environmental changes (Curcic *et. al.*, 2018).

Many researchers mentioned that harvesting dates had distinguished effects on the yield and quality characteristics of sugar beet. Many studies were conducted in Egypt in different locations during the period from 2011-2021. The results of those studies showed that delaying the harvesting date up to 120 days from sowing enhanced root yield, sugar and extractable sugar content. They added that root fresh weight /plant, root and sugar yields/fed were significantly increased according to Shalaby *et. al.*, (2011), Hanan and Yasin (2013) and El-Bakary (2021). Moreover, Al-Sayed *et. al.*, (2012) recorded an increase in root dimensions in terms of root length and diameter as affected by delaying harvesting from 180 up to 210 days from sowing. Shalaby *et. al.* (2011) reported that increasing sugar beet plant age at harvesting from 180 to 210 days from sowing, decreased root sodium and potassium contents significantly. Likewise, Nagib *et. al.* (2018) found that beets harvested at an older age (210 days after sowing) surpassed those harvested one month earlier in all studied traits i.e. impurities percentage (Na and K), sugar recovery percentage and root yield/fed (ton), except loss in sugar yield/fed and α-amino- N%. In the same context, Awad, *et. al.* (2015) and Sorour, *et. al.* (2020) pointed out that increasing sugar beet plant age to harvesting from 165, 180, 195 and 210 days caused a positive and significant increase in sucrose% and purity%. El-Bakary (2021) stated that harvesting of sugar beet after 210 days from sowing was the proper age to obtain the highest mean values of root fresh weight/plant, sucrose, extractable sugar beet quality index percentages as well as root and sugar yields/fed. On the contrary, Farweez, *et. al.* (2022) found that the early crushing season in mid-February was the best time for sugar beet manufacturing, which can be recommended for smart sugar

manufacturing in Egypt to combat climate change. They found that harvesting beets in mid-February reduced Na and α-amino-N in sugar beet juice. Meanwhile, the highest sucrose and QZ% were recorded.

Concerning sugar beet varieties and their response to harvesting date, Hanan and Yasin (2013) indicated that the evaluated sugar beet varieties significantly differed in quality traits including impurities, purity and sugar loss in molasses percentages and root length and diameter. Also, Shalaby, *et. al.* (2011) reported that sugar beet varieties varied significantly in sucrose percentage, root and sugar yields/fed), Na and K percentage. On the other hand, Sorour, *et. al.* (2020) noticed that beet varieties had different responses to harvesting delay. They showed that Ravel surpassed the other varieties in beet sucrose and juice purity %. On the other hand, Oscar poly variety had the lowest mean values at different harvesting ages.

This experiment aimed to find out the influence of prolonged age at which the tested sugar beet varieties can be harvested to obtain the maximum root and sugar yields/fed as well as quality characteristics.

MATERIALS AND METHODS

The present study was carried out in the Experimental Sennuris District in Fayoum governorate, Egypt (latitude of $29^0 24' 26''$ N and longitude of $30^0 52' 00''$ E). The seeds were sown on the 15th of September in 2020/2021 and 2021/2022 seasons. The objective of this work was to record the impact of delaying harvesting dates on the quantity and quality of four sugar beet varieties: two multi-germ ones namely Faraida and Melodia, and two mono-germ ones called Jampol and Fantazja, which were harvested in four dates (mid-February, 1st week of March, mid-March and 1st week of April i.e., harvesting was done at ages of 180, 195, 210 and 225 days after sowing. Seeds were sown on September 15th in both seasons. The soil type was clayey (43.8 clay %) with pH 7.9 and EC 3.13 dS/m. A randomized complete block design in a split-plot arrangement was employed with three replicates to lay out 16 treatments, where the main plots were occupied by the four harvest dates. Meanwhile, the subplot was occupied by the four sugar beet varieties. The basic experimental unit area was 21 m^2 (1/400 fed), including 6 ridges of 50 cm width and 7 m long. All recommended agricultural practices for growing sugar beet were followed.

The recorded data:

The climatic conditions during the period of study

These data were obtained from the Central Lab. for Agricultural Climate, Agricultural Research Center, and Ministry of Agriculture and Land Reclamation in both seasons. The average climatic factors during the study are represented in Table (1).

At harvest, five plants were collected randomly from the inner ridges of each plot to determine the following traits:

1. Root length (cm).
2. Root diameter (cm).
3. Root fresh weight/plant (kg).
4. Root yield/fed (ton):

At the four harvesting times, roots from each plot were collected, cleaned, and weighed in kilograms/plot and converted into tons.

Quality parameters

All of the following quality parameters were determined at the Laboratories of Fayoum Sugar Company according to the method of McGinnus (1971):

1. Sucrose percentage (S) was determined through an Automatic Sugar Polarimetric according to McGinnus (1971).

Table 1. Average climatic conditions during 2020-2021 and 2021-2022

Average of months	2020-2021				Average of months	2021-2022			
	Minimum Temperature (°C)	Maximum Temperature (°C)	Wind Speed (m/s)	Sunshine Duration (Hours)		Minimum Temperature (°C)	Maximum Temperature (°C)	Wind Speed (m/s)	Sunshine Duration (Hours)
September ¶(2020)	21.9	37.5	4.2	12.1	September¶ (2021)	19.9	34.5	3.9	12.0
October	19.4	26.3	3.4	11.5	October	17.7	31.1	3.5	11.4
November	14.1	20.9	2.7	10.7	November	15.3	27.6	2.4	10.6
December	10.4	22.3	2.3	10.2	December	8.8	19.6	2.6	10.2
January (2021)	8.2	21.7	2.5	10.4	January (2022)	4.8	16.9	2.5	8.3
February	8.0	21.6	2.6	11.0	February	6.4	19.0	2.6	11.0
March	9.4	23.7	3.2	11.9	March	7.7	22.2	3	11.9
April	12.0	29.9	3.5	12.8	April	14.5	32.4	3.5	14.5
Average of 1st season	12.9	25.4	3	11.3	Average of 2nd season	11.8	23	3	11.2
¶average of 2 weeks									

2. Purity percentage (QZ) was determined as follows:
Juice purity percentage (Qz) = ZB / Pol x100
ZB = Pol - [impurities + 0.29]
Where:
ZB = corrected sugar content or extractable white sugar (% / beet).
Pol = Gross sugar percentage
3. Sodium (Na) and Potassium (K) (mill-equivalent 100 g-1 beet) were determined in the digested solution by using the Flame photometer according to the method described by Brown & Lilliand (1964).
4. α-amino N percentage was also determined by using double beam filter photometry using the blue number method according to Sheikh, 1997.
5. Impurities percentage = 0.343 (Na + K) + 0.094 (α amino-N).
6. Sugar recovery percentage = (S - 0.29) - [0.343(Na + K) + 0.094 (α amino-N)], where S is sucrose percentage.
7. SLM percentage = 0.343(K+ Na) + 0.094(α amino-N) - 0.31.
Impurities percentage, Sugar recovery percentage (SR), and Sucrose loss to molasses percentage (SLM) were calculated according to Harvey and Dotton (1993).
The obtained data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the split-plot design as published by Gomez and Gomez (1984) using the MSTAT-c statistical package. The least significant difference (LSD) was used to test the differences between treatment means at a 5 % level of probability.

RESULTS AND DISCUSSION

Among quantity and quality traits of sugar beet crops that may be affected by climatic changes, root length and diameter, root weight per plant, and root and sugar yields/fed, were assessed in the present work. It was found that delaying harvesting up to 225 days after sowing, led to significant increases in the 1st four previously mentioned characters in both seasons as shown in Tables (2-5). Harvesting beets at the age of 225 days increased root length by 4.96 and 7.5 cm compared to those harvested earlier at the age of 180 days, in the 1st and 2nd seasons, respectively. A gradual increase was recorded in root length as the harvesting date was delayed from 180, 195, 210 and 225 days from sowing, where plant tap roots continued their growth. The same observation was noticed with root diameter. The latest harvesting date significantly increased root diameter by 6.98 and 3.9 cm compared to the earliest one, in the 1st and 2nd seasons, successively. Accordingly, the previous increments in root length and diameter were positively reflected on both root fresh weight and root yield/fed, where significant increments in root weight/plant amounted to 900 and 816.7 kg, corresponding to 28.4 and 33.6 tons of roots/fed were gained, in the 1st and 2nd season, consecutively, as harvesting was delayed from 180 to 225 days. The results showed that the evaluated sugar beet varieties were insignificantly different in their root length and diameter, in both seasons. However, they varied significantly in root fresh weight/plant and root yield/fed, in the 2nd season only, where Melodia surpassed each of Faraida, Jampol and Fantazja varieties in root weight/plant by 200.0, 120.9 and 104.2 g, respectively, which led to 4.0, 2.6 and 1.2 tons of roots/fed.
Tables (6-13) show the effect of delaying harvesting dates with different varieties on some chemical traits. Neither the harvesting date nor the varieties affected sucrose, purity (QZ), sodium, potassium, α-amino N and sugar recovery percentages in both seasons. However, the industrial characteristics i.e. impurities and sugar loss in molasses percentages were affected by the harvesting date. The upper mid-harvesting age (195 days from sowing) in the 1st season recorded the lower significant impurities and SLM percentages as compared to the early age (180 days from sowing) by 0.26 % for both traits. Meanwhile, no significant differences were between the other harvesting dates concerning impurities and SLM percentage. In the 2nd season, the latest harvesting date i.e. age of 225 days from sowing recorded the highest significant impurities as compared to the other harvesting dates. The number of increments were 0.76, 0.73 and 0.70 % for the ages 180, 195 and 210, respectively. The upper mid-age and the latest one recorded the highest SLM percentages without significant effect between them. The recorded SLM percentage at the age of 195 days from sowing was 2.96% with an increment amounting to 0.20 and 0.24% compared to the age of 180 and 210 days from sowing.

Many authors approved that environmental conditions are considered the most important limiting factors considering the production and quality of field crops (Chloupek *et. al.,* 2004; García-López *et. al.,* 2016 Pa˘cuta *et. al.,* 2021). Referring to the climatic conditions that were recorded during the growing seasons, it could be noticed that there was a decrement in the average minimum and maximum temperatures in the 2nd season (2021-2022). Meanwhile, in April 2021-2022, there were increments of 2.5 ^{0}C and 1.7 hr in the maximum temperature and day length (sunshine duration), successively, compared to those recorded in 2020-2021. Those increments were accompanied by an increment in the root length, diameter and weight and hence root and sugar yields. Those findings can be attributed to the positive influence of the previously mentioned meteorological factors in enhancing the photosynthesis process and translocation of dry matter from leaves to the storage tap roots. These results were in agreement with those of Klára *et. al.,* 2017, who mentioned that the prolonging of the vegetation period in spring by 13 days increased root yield by 10.9%. Rašovský *et. al.*, 2022 confirmed through their study that the year's weather conditions had a significant effect on all sugar beet parameters except sodium content. This fact has also confirmed that it is necessary to investigate the possibility of mitigating adverse weather condition's

effects on growing sugar beets and other crops. However, Lamiae *et. al.*, 2021 reported that the extension of the harvest date, seven and fifteen days after maturity estimated, did not affect sucrose content and the two melanogenic elements i.e. potassium and sodium. Concerning the attitude of the different varieties, Mirvat *et. al.*, 2019 reported that Ras Poly variety was in the 1st rank and produced the highest values of root length (cm), diameter (cm) and fresh weight (gm) followed by Dema Poly, Glloria and Pleno varieties in a descending order. They referred that finding to the different genetic structure for those varieties.

CONCLUSIONS

Under the recent rapid climatic changes, it is necessary to carry out further studies and reconsider many agronomical practices. In this study delaying sugar beet harvesting of the tested varieties to 225 days from sowing (1st week of April) increased root yields/fed. Meanwhile no significant difference was recorded concerning the interaction between varieties and dates of harvesting except for root traits in terms of weight and yield.

CONFLICT OF INTEREST

The author here declares that there is no conflict of interest in the publication of this article.

Table 2. Effect of harvesting date on root length (cm) of four sugar beet varieties

Sugar beet Varieties (V)	2020-2021 season					2021-2022 season				
	Age at harvesting (H) (Days after sowing)					Age at harvesting (H) (Days after sowing)				
	180	195	210	225	Mean	180	195	210	225	Mean
Faraida	32.6	34.0	35.6	38.0	35.1	33.6	34.6	37.0	38.6	36.0
Jampol	32.3	35.0	37.0	38.5	35.6	33.0	34.0	37.3	41.6	36.5
Fantazja	31.6	34.3	35.0	36.67	34.4	36.0	35.3	37.3	42.6	37.8
Melodia	35.0	34.3	35.67	36.7	34.9	32.6	37.3	37.6	42.3	37.5
Mean	32.44	34.42	35.83	37.4		33.8	35.3	37.3	41.3	

LSD at 0.05 level of significance for:

Beet variety (V)	NS	NS
Age at harvesting (H)	1.1	1.2
V x H	NS	NS

Table 3. Effect of harvesting date on root diameter (cm) of four sugar beet varieties

Sugar beet Varieties (V)	2020-2021 season					2021-2022 season				
	Age at harvesting (H) (Days after sowing)					Age at harvesting (H) (Days after sowing)				
	180	195	210	225	Mean	180	195	210	225	Mean
Faraida	11.67	12.3	16.0	18.0	14.5	12.3	12.6	13.3	17.0	14.3
Jampol	11.0	12.7	15.7	19.0	14.6	13.3	15.7	16.3	17.3	15.6
Fantazja	11.0	13.0	16.0	18.7	14.7	14.0	15.3	15.6	17.0	15.5
Melodia	12.0	13.0	15.0	18.0	14.6	13.6	16.0	17.6	17.6	16.3
Mean	11.42	12.8	15.7	18.4		13.3	14.9	16.2	17.2	

LSD at 0.05 level of significance for:

Beet variety (V)	NS	NS
Age at harvesting (H)	1.4	1.7
V x H	NS	NS

Table 4. Effect of harvesting date on root weight kg/fed of four sugar beet varieties

Sugar beet Varieties (V)	2020-2021 season					2021-2022 season				
	Age at harvesting (H) (Days after sowing)					Age at harvesting (H) (Days after sowing)				
	180	195	210	225	Mean	180	195	210	225	Mean
Faraida	916.7	983.3	1183.3	1833.3	1229.2	966.6	1016.6	1083.3	1633.3	1162.5
Jampol	750.0	933.3	1216.6	1716.6	1154.0	966.6	1033.3	1166.4	1800.0	1241.6
Fantazja	783.3	933.3	1235.3	1733.3	1170.0	966.6	1050.0	1116.6	1900.0	1258.3
Melodia	800.0	983.3	1316.6	1566.6	1166.0	1133.3	1083.3	1266.6	1966.6	1362.5
Mean	812.5	958.3	1237.5	1712.5		1008.3	1045.8	1145.8	1825.0	

LSD at 0.05 level of significance for:

Beet varieties (V)	NS	89.4
Age at harvesting (H)	105.4	122.8
V x H	NS	254.7

Table 5. Effect of harvesting date on root yield ton/fed of four sugar beet varieties

Sugar beet Varieties (V)	2020-2021 season					2021-2022 season				
	Age at harvesting (H) (Days after sowing)					Age at harvesting (H) (Days after sowing)				
	180	195	210	225	Mean	180	195	210	225	Mean
Faraida	20.0	23.3	36.6	44.6	31.2	21.0	24.0	40.3	47.3	33.2
Jampol	17.6	23.0	38.0	45.3	31.0	19.0	24.6	40.6	52.6	34.6
Fantazja	17.3	22.3	36.3	46.6	30.6	18.3	25.6	43.3	56.6	36.0
Melodia	18.6	21.3	36.6	50.6	31.8	21.6	26.6	42.3	58.0	37.2
Mean	18.4	22.5	36.9	46.8		20.0	25.3	41.6	53.6	

LSD at 0.05 level of significance for:

Beet variety (V)	NS	1.9
Age of harvesting (H)	2.00	1.6
V x H	NS	3.1

Table 6. Effect of harvesting date on sucrose percentage of four sugar beet varieties

Sugar beet Varieties (V)	2020-2021 season					2021-2022 season				
	Age at harvesting (H) (Days after sowing)					Age at harvesting (H) (Days after sowing)				
	180	195	210	225	Mean	180	195	210	225	Mean
Faraida	16.3	16.9	15.9	15.3	16.1	15.1	15.3	15.5	15.6	15.4
Jampol	16.6	16.5	16.5	17.2	16.7	15.1	14.7	15.5	15.3	15.2
Fantazja	15.3	16.8	16.3	16.1	16.1	13.9	14.3	14.2	14.9	14.3
Melodia	15.7	15.9	16.0	15.7	15.8	13.5	13.8	13.8	14.0	13.8
Mean	16.0	16.5	16.2	16.1		14.4	14.5	14.8	14.9	

LSD at 0.05 level of significance for:

Beet variety (V)	NS	NS
Age of harvesting (H)	NS	NS
V x H	NS	NS

Table 7. Effect of harvesting dates on QZ percentage of four sugar beet varieties

Sugar beet Varieties (V)	2020-2021 season					2021-2022 season				
	Age at harvesting (H) (Days after sowing)					Age at harvesting (H) (Days after sowing)				
	180	195	210	225	Mean	180	195	210	225	Mean
Faraida	87.3	85.9	86.7	89.3	87.3	89.1	89.7	88.4	89.2	89.1
Jampol	86.5	87.7	86.2	87.2	86.9	87.4	88.5	88.4	88.9	88.3
Fantazja	85.2	83.1	83.9	86.4	84.6	81.9	84.4	81.6	82.6	82.6
Melodia	85.2	87.2	86.3	86.9	86.4	80.7	81.1	81.1	80.7	80.9
Mean	86.1	85.9	85.8	87.4		84.8	85.9	84.8	85.3	

LSD at 0.05 level of significance for:

Beet variety (V)	NS	NS
Age of harvesting (H)	NS	NS
V x H	NS	NS

Table 8. Effect of harvesting date on Sodium percentage of four sugar beet varieties

Sugar beet Varieties (V)	2020-2021 season					2021-2022 season				
	Age at harvesting (H) (Days after sowing)					Age at harvesting (H) (Days after sowing)				
	180	195	210	225	Mean	180	195	210	225	Mean
Faraida	3.87	3.63	3.83	3.20	3.63	4.26	4.18	4.55	4.23	4.30
Jampol	3.92	3.30	3.80	3.76	3.69	4.94	4.26	4.56	4.84	4.65
Fantazja	4.36	4.16	4.32	4.36	4.30	6.68	6.89	6.95	6.94	6.86
Melodia	3.80	3.78	3.99	3.84	3.85	5.56	6.94	5.68	7.05	6.33
Mean	3.99	3.72	3.98	3.79		5.38	5.57	5.43	5.76	

LSD at 0.05 level of significance for:

Beet variety (V)	NS	NS
Age of harvest (H)	NS	NS
V x H	NS	NS

Table 9. Effect of harvesting date on Potassium percentage of four sugar beet varieties

Sugar beet Varieties (V)	2020-2021 season					2021-2022 season				
	Age at harvesting (H) (Days after sowing)					Age at harvesting (H) (Days after sowing)				
	180	195	210	225	Mean	180	195	210	225	Mean
Faraida	1.57	1.39	0.99	1.44	1.35	2.77	3.57	2.71	2.86	2.98
Jampol	1.60	1.40	1.69	1.43	1.53	3.13	2.56	2.47	3.39	2.88
Fantazja	2.62	2.23	2.47	1.93	2.31	3.20	4.40	3.01	3.05	3.42
Melodia	2.53	1.73	1.75	2.10	2.03	3.28	2.99	3.02	3.11	3.10
Mean	2.08	1.69	1.72	1.72		3.09	3.38	2.80	3.10	

LSD at 0.05 level of significance for:

Beet variety (V)	NS	NS
Age at harvest (H)	NS	NS
V x H	NS	NS

Table 10. Effect of harvesting date on α-amino nitrogen percentage of four sugar beet varieties

Sugar beet Varieties (V)	2020-2021 season					2021-2022 season				
	Age at harvesting (H) (Days after sowing)					Age at harvesting (H) (Days after sowing)				
	180	195	210	225	Mean	180	195	210	225	Mean
Faraida	1.82	1.53	1.50	2.04	1.72	1.60	1.87	2.26	2.12	1.96
Jampol	1.43	1.23	1.91	1.77	1.58	2.24	1.87	1.81	2.00	1.98
Fantazja	2.85	2.13	2.31	2.05	2.30	1.92	2.40	2.42	2.25	2.25
Melodia	1.39	1.13	1.45	1.59	1.39	2.13	2.26	2.03	2.32	2.19
Mean	1.87	1.50	1.79	1.86		1.97	2.10	2.13	2.17	

LSD at 0.05 level of significance for:

Beet variety (V)	NS	NS
Age at harvesting (H)	NS	NS
V x H	NS	NS

Table 11. Effect of harvesting date on impurities percentage of four sugar beet varieties

Sugar beet Varieties (V)	2020-2021 season					2021-2022 season				
	Age at harvesting (H) (Days after sowing)					Age at harvesting (H) (Days after sowing)				
	180	195	210	225	Mean	180	195	210	225	Mean
Faraida	2.04	1.87	1.79	1.78	1.87	2.56	2.83	2.70	2.63	3.09
Jampol	2.03	1.73	2.06	1.95	1.94	2.98	2.51	2.58	3.01	3.26
Fantazja	2.66	2.39	2.54	2.35	2.48	2.57	4.10	3.64	3.64	3.02
Melodia	2.30	2.00	2.10	2.18	2.14	3.26	3.62	3.17	3.70	3.24
Mean	2.25	1.99	2.13	2.06		2.68	2.71	2.74	3.44	

LSD at 0.05 level of significance for:

Beet variety (V)	NS	NS
Age at harvesting (H)	0.27	0.19
V x H	NS	NS

Table 12. Effect of harvesting date on Sugar loss in molasses percentage of four sugar beet varieties

Sugar beet Varieties (V)	2020-2021 season					2021-2022 season				
	Age at harvesting (H) (Days after sowing)					Age at harvesting (H)(Days after sowing)				
	180	195	210	225	Mean	180	195	210	225	Mean
Faraida	1.71	1.56	1.49	1.18	1.57	2.26	2.53	2.40	2.33	2.38
Jampol	1.72	1.42	1.76	1.65	1.64	2.68	2.21	2.28	2.71	2.47
Fantazja	2.36	2.09	2.24	2.05	2.18	3.27	3.80	3.34	3.34	3.44
Melodia	2.00	1.70	1.80	1.88	1.84	2.96	3.32	2.87	3.40	3.14
Mean	1.95	1.69	1.82	1.76		2.79	2.96	2.72	2.94	

LSD at 0.05 level of significance for:

Beet variety (V)	NS	NS
Age at harvesting (H)	0.26	0.18
V x H	NS	NS

Table 13. Effect of harvesting date on sugar recovery percentage of four sugar beet varieties

Sugar beet Varieties (V)	2020-2021 season					2021-2022 season				
	Age at harvesting (H) (Days after sowing)					Age at harvesting (H) (Days after sowing)				
	180	195	210	225	Mean	180	195	210	225	Mean
Faraida	14.00	14.70	13.81	13.25	13.94	12.21	12.20	12.53	12.67	12.40
Jampol	14.31	14.44	14.14	14.92	14.45	11.83	11.92	12.59	11.99	12.08
Fantazja	12.34	14.08	13.46	13.45	13.33	10.00	9.94	10.26	10.97	10.29
Melodia	12.97	13.61	13.60	13.22	13.55	9.94	9.85	10.36	10.73	10.05
Mean	13.40	14.21	13.75	13.71		10.98	10.98	11.44	11.42	
LSD at 0.05 level of significance for:										
Beet variety (V)			NS					NS		
Age of harvesting (H)			NS					NS		
V x H			NS					NS		

REFERENCES

Awad, E.M., Ahmed, O.A., and Marchelo, P.W. 2015. Evaluation of sowing date and harvest age of some sugar beet (beta vulgaris Subsp. vulgaris) cultivars under Guneid Condition, (Sudan). **3**(9), 421-424.

Brown, J.D., and Lilland, O. 1964. Rapid determination of potassium and sodium in plant material and soil extracts by flam photometry. Proceedings American Society Horticultural Science, **48**, 341-346.

Chloupek, O., Hrstkova, P., and Schweigert, P. 2004. Yield and its stability, crop diversity, adaptability and response to climate change, weather and fertilization over 75 years in the Czech Republic in comparison to some European countries. *Field Crops Research*, **85**(2-3), 167-190.

Curcic, Z., Ciric, M., Nagl, N., and Taski Ajdukovic, K. 2018. Effect of Sugar Beet Genotype, Planting and Harvesting Dates and Their Interaction on Sugar Yield. *Front Plant Sci*, **9**, 1041. DOI: 10.3389/fpls.2018.01041.

El-Bakary, H.M.Y. 2021. Yield and quality of some sugar beet varieties as affected by harvest date under EL-mania governorate condition. *Egypt. J. of Appl. Sci*., **36** (3), 107-118.

Farweez, H., El. Syiad, S.I., Mohamed, E.G.I., and Samar, H. Abd Allah. 2022. Optimal Timing of the Sugar Beet Juice Season as an Intelligent Adaptation Strategy to Climate Change in Egypt. *NVJAS*. **2** (5) 229-236.

Gobarah, Mirvat E., Hussein, M.M., Tawfik, M.M. Ahmed, Amal G., and Mohamed, Manal F. 2019. Effect of Different Sowing Dates on Quantity and Quality of Some Promising Sugar Beet (Beta vulgaris L.) Varieties under North Delta, Condition. *Egypt. J. Agron*. **41**(3), 343-354.

García-López J., Lorite, I.J., García –Ruiz, R., Ordonez, R., and Dominguez, J. 2016. Yield response of sunflower to irrigation and fertilization under semi-arid conditions. Agric. *Water Managements*. **76**, 151–162.

Gomez, K.A. and Gomez, A.A. 1984. Statistical Procedures for Agricultural Research. 2nd Edition, John Wiley and Sons, New York, 680 p.

Hanan, Y.M. and Yasin, M.A.T. 2013. Response of some sugar beet Varieties to harvesting dates and foliar application of Boron and Zinc in sandy Soils. *Egypt. J. Agron*., **35**(2): 227-252.

Harvey, G.W., and Dotton, J.V. 1993. Root quality and processing. In: The sugar beet crop science into practice, D.A. Cooke and R.K. Scatt (Eds). Chapman and Hall, London. 571–617.

Jozefyova L., Pulkrabek, J., and Urban, J. 2004. Effect of harvest time on sugar Beet fertilized with increased nitrogen. *J. Food Agric. Environ*., **2**: 232-237.

Klára, P., Jaromir, C., Josef, P., and Jaroslav, U. 2017. Influence of sowing and harvest dates on production of two different cultivars of sugar beet. *Plant Soil Environ*. **63**(2):76-81.

Lamiae A., Wafa, T., Manar, O., Oussama, A. S. and Mbarki. M. M. 2021. Effect of Sugar Beet Harvest Date on Its Technological Quality Parameters by Exploratory Analysis. *Journal of Food Quality* 1-8.

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

Maho, A. and Skenderasi, B. 2020. The change of planting timing to sugar beet cultivars as an adaptation to climate change. *JASAE*, **16**(5): 111-123.

Mall, A. K., Misra, V, and Santeshwari S., Pathak, A.D. and Srivastava, S. 2021. Sugar Beet Cultivation in India: Prospects for Bio-Ethanol Production and Value. Added Co-Products. *Sugar Tech*, **23**(6), 1218-1234.

McGinnis, R. A. (ed.). 1982: Beet storage. In: Beet-Sugar Technology. Third Edition. Beet Sugar Development Foundation, *Denve*r. 81-99

Nagib, S.R., Abd El-Azez, Y.M. and Ali, A.M.K. 2018. Evaluation of some New Sugar Beet Varieties as Affected by Different Harvest Ages under Conditions of Minia Governorate *J. Plant Production, Mansoura Univ*., **9** (12): 1175 – 1180.

Paˇcuta V., Rašovský, M., Michalska-Klimczak, B. and Wyszyˇnski, Z. 2021. Grain Yield and Quality Traits of Durum Wheat (*Triticum durum* Desf.) Treated with Seaweed- and Humic Acid-Based Biostimulants. *Agronomy*. **11**, 1270. https://doi.org/10.3390/agronomy11071270.

Rašovský M., Paˇcuta, V., Ducsay, L. and Lenická, D. 2022. Quantity and Quality Changes in Sugar Beet (Beta vulgaris Provar. Altissima Doel) Induced by different sources of Biostimulants. *Plants*, **11**, 2222. https://doi.org/10.3390/ plants11172222.

Shalaby, N.M.E., Osman, A.M.H. and EL-Labbody, A.H., 2011. Evaluation of some sugar beet varieties as affected by harvesting dates under newly reclaimed soil, Egypt. *J. Agric. Res*., **89** (2): 605- 614.

Sorour, M.A., Mehanni, A.E. Mahmoud, Gaber, E.A. and Noha F. 2020. Sugar beet quality and juice purity of some sugar beet varieties (Beta vulgaris L.) grown in Toshka region, Egypt as effected by harvesting ages and storage conditions. **3**(3), 64-81.

Sheikh, A.R. 1997. Laboratorial Methods and their Application to Control Food and Sugar Industries Process. In: Mersa Publication, Tehran, Iran.

Yousef, M.S.H. and Abdel–Mottaleb, H.M. 2009. Effect of sowing and harvest dates on productivity of some sugar beet varieties under Sinai conditions. *J. Agric. Sci., Mansoura Univ*., **34** (9): 9543-9556.

Citation: Dalia Ibrahim El-Geddawy, Karam Abd El-Sadek Abd Elsalam and Ibrahim Abd ElBaki Abd Elateef 2023.Impact of delaying harvesting dates for sugar beet varieties under recent environmental changes. *International Journal of Agricultural and Applied Sciences*, 4(2):86-93.
https://doi.org/10.52804/ijaas2023.4211