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INFLUENCE OF PLANTING DATES AND STORAGE PERIOD ON ROOT ROT INFECTION AND SOME TECHNOLOGICAL CHARACTERISTICS OF SUGAR BEET PLANT

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ABSTRACT

The objective of this work was to study the effect of beet post-harvest storage under bare field condition for two, four, six, eight, ten and 12 days (before manufacturing) of beet sowing under four sowing dates *i.e.* August, September, October and November on root rot diseases, root weight, and chemical composition. Therefore, two field trials were carried out at Tamia district, Al-Fayoum Governorate during 2017/18 and 2018/19 seasons. Harvest was implemented (after 180 days from sowing dates) during mid February, March, April and May as corresponding to each sowing dates.

The obtained results revealed:

No infection observed in beet stored for four days in Aug. and Sep. sowing dates and for two days in Oct. and Nov. followed by gradual infection of root rot up to 12 days. Moreover, October sowing exhibited the highest average root wt., while, the lowest root rot diseases infection, highest TSS, sucrose, impurities (Na, K and α-Amino N), sugar lost to molasses, extracted sugar (recovery) and extractability were of August sowing.

Delaying beet delivery (storage) to process for two days insignificantly affected the reduction of root wt., however, a continuous delay of beet increased the root wt. loss to reach its maximum values after 12 days. TSS, sucrose, extracted sugar and extractability values were increased with time elapsed up to six days and dropped drastically after that. Similarity, continuous and gradual increase in beet impurities and sugar lost to molasses as time elapsed after harvest up to 12 days.

Further, the negative changes detected in all studied traits and root rot injuries as well with the delayed of beet process after harvest were more pronounce with the delaying of sowing dates (Oct. and Nov.) and harvest during Apr. and May. Whereas, early sowing (Aug. and Sep.) exhibited a vice versa trend.

Moreover, increase in root rot disease infection, the reduction in average root wt. and various quality attributes by delaying beet

manufacturing led to a shortage in root yield, sucrose percentage delivered to the factory and consequently a decrease in farmer income in addition, difficult in slicing freshness roots and increase in sugar lost to molasses during process.

Key Words: Sugar beet, Sowing dates, Beet post-harvest storage, Root rot diseases, Chemical composition

INTRODUCTION

Sugar beet (*Beta vulgaris* L., Fam: Chenopodiacea) is one of the most important sugar crops in the world and provides about 40% of the world sugar production and represents the second source after sugar cane. Sugar beet has been introduced into Egypt since 1982 to share sugar cane in fulfilling the increase requirements of sugar consumers. Nowadays, sugar beet occupied the first in sugar production. Cultivation area was expanded to cover about 600 thousand feddan (Fed:4200m^2) distributed among nineteen governorates in southern delta and middle Egypt.

Soil borne diseases are still a major threat to sugar beet cultivation in Egypt and all over the world because of the wide host range of the pathogens and their strong survival ability in the soil **(Mousa *et al.*, 2006 and Bokor 2007)**. Many of these pathogens *i.e. Rhizoctonia solani, Macrophomina phaseolina, Sclerotioum rolfsii and Fusarium* spp. **(Husseien, Manal, 2005)** cause post harvest losses in storage piles **(Jacobsen, 2006)** which increase post harvest respiration rate, sucrose losses, impurities and invert accumulation **(Klotz and Campbell, 2009; Campbell *et al.*, 2011 and Liebe *et al.*, 2016)**. The elevated respiration rates not only imply an increase in sucrose loss but also may cause an increase in pile temperature, which increases respiration rate and facilitates the development of storage rots **(Campbell and Klotz, 2006)**.

Numerous studies have discussed the dates of beet cultivation and its impact on productivity and quality attributes. Such as **Nikpanah *et al.* (2015), Al Jbawi and Al Zubi (2016), Gobarah *et al.* (2019) and Kumar *et al.* (2019)** who illustrated that early and late sowing decreased sugar beet root, sugar and leaf yields and increased impurities contents, while, October sowing maximized beet productivity and quality attributes.

Sometimes, sugar beet roots are stored in large exposed piles after harvest remaining in field for many days before manufacturing. During storage, respiration, rotting, invert sugar accumulation and physical deterioration affected greatly roots weight and quality **(Campbell and Klotz, 2006 and Al Jbawi *et al.*, 2015)**. **Hassan *et al.* (2011), Campbell**

and Fugate (2016) and Mohamed *et al.* (2017) revealed that the increase in time elapse between harvesting and processing exhibited to gradual increase in pol%, α-Amino N, Na and K contents as well as sugar recovery% of sugar beet. Meantime, roots and recoverable sugar yields were decreased. **Al Jbawi *et al.* (2015), Al Jbawi and Al Zubi (2016) and Mohamed *et al.* (2017)** showed that prolonging storage period of harvested roots leads to high and gradual increment in the total soluble solids (brix %), sucrose %, and root weight loss% (23.5, 11.3, and 9.6%), respectively.

The objective of this work was to study the effect of beet post-harvest delaying periods up to twelve days (before manufacturing) of beet sowing under four sowing dates on root rot diseases severity, root weight and chemical composition.

MATERIAL AND METHODS

Two field trials were carried out at Al-Assal farm, Tamia distract, Al-Fayoum Governorate during 2017/18 and 2018/19 seasons. To study the effect of post harvest storage under bare field condition for two, four, six, eight, ten and 12 days of beet sowing in four dates *i.e.* August, September, October and November plantations using Hussam variety. Therefore, a split plot design with four replications was performed in both seasons. Sowing dates was carried out on the second week of August, September, October and November during 2017 and 2018. Sowing dates were allocated in the main plots, whereas, beet storage was adopted in the sub plots. Plot area was 21 m^2, including five rows, distances between and within rows 60 and 20 cm, respectively. All agricultural practices including hoeing, thinning, fertilization were done as recommended for insured optimum production.

Therefore, harvest was implemented (after 180 days from sowing dates) during mid February, March, April and May as corresponding to each sowing dates. Selected uniform 100 roots cleaned and free from disease were obtained from each plot (each replicate) for each sowing dates. Tops were removed, roots were stored into seven identical small piles in a bare field condition. Root rot disease severity was estimated for each sample before and after storing according to the scale devised by **Engelkes and Windels (1996)** using the scaling graduation from 0-7 grades as follows:

0 = no visible lesions.
1 = arrested lesions at point of inoculation.
2 = less than 5% shallow, dry rot canker.

3 = 5 to 24 % deep, dry rot canker.
4 = 25 to 49 % extensive rot.
5 = 50 to 89 % rot extensive into interior root.
6 = 90 to less than 100 %.
7 = 100 % dead plants.

Further, samples from each pile (10 roots) were weighted and periodically before and after storing for two, four, six, eight, ten and 12 days to determine the following traits:

1. Total Soluble Solids (TSS) was determined using hand refractometer.
2. Sucrose percentage (Pol %) was polarimeterically determined according to the method of **Le-Docte (1927)**.
3. Impurities: Sodium (Na) and Potassium (K) mg/100g beet were determined using the Flame photometer according to **A.O.A.C (2005)**, α-amino nitrogen / 100g beet was determined according to **Carruthers *et al.* (1962)**.
4. Sugar lost to molasses, extracted sugar percentage (rendement or recovery) and extractability were calculated according to the following formulas:

- Sugar lost to molasses (SLM%) = 0.14 (V1 + V2) + 0.25 (V3) + 0.50 **(Devillers, 1988)**.
- Extracted sugar % = Pol % - SLM% - 0.6 **(Dexter, *et al.*, 1967)**.
- Extractability % = Extracted sugar % / Pol%

Where: V1 = Sodium, V2 = Potassium, V3 = α-amino nitrogen, V4 = Pol%

The collected data were statistically analyzed according to **Snedecor and Cochran (1981),** after transfer the percentage data to Arc-Sin units. Treatment means were compared using L.S.D at 5% level of probability.

RESULTS AND DISCUSSION

Meteorological data during storage period:

Average meteorological data of 2018 and 2019 during storage period from 14th day up to 28th (15 days) for Feb., March, April and May Table (1) indicated that maximum and minimum day temperature increased obviously from Feb. 20.1°C to reach 38.1°C for May and the same attitude have been observed for minimum temperature (from 10.4°C to 22.8°C). The same trend was also detected for day long /hours, where day long was increased gradually from Feb. (11.18 h) to May (13.42 h), meantime, during April and May the sun shines most days long, but during Feb. and March most of the day are cloudy. With regard to relative humidity, it decreased clearly from 44.4% for Feb. to 22.1% for May.

Table (1): Average meteorological data* during storage period from 14th up to 28th day (15 days)

Sowing dates	Max. Temp.	Min. Temp.	Relative Humidity %	Day long/h	Wind (km/h)	Sun Shines
February	20.1	10.4	44.4	11.18	18.8	Mostly cloudy
March	24.6	13.2	50.4	12.03	19.9	Partly cloudy-sunny
April	28.2	15.7	34.7	13.04	20.9	Most sunny
May	38.1	22.8	22.1	13.42	19.1	Most sunny

- **average 2018 and 2019 years**

Disease Severity of Root Rot

Average data (Table 2) indicated that sowing dates significantly affected the level of disease severity in beet roots. Whereas, sowing in November exhibited the highest percentage of root rot disease incidence followed by October sowing in both seasons, nevertheless, August sowing showed the lowest root rot disease incidence in the two seasons (Table 2). Worth to mention that, root rot disease infection caused a great reduction in both average root wt. and root sugar content as mentioned after especially in October and November plantation. In this connection, **Khalil (2007) and Ghatak *et al.* (2015)** illustrated that sowing date play an important role for decreasing soil borne diseases.

Regarding delay in manufacturing beet after harvest, data in Table (2) stated that no infection in root stored for two days from harvest in both season followed by a gradual and significant increase in disease severity incidence to reach 10.18% and 8.34% infected roots after stored for 12 days in the first and second seasons, respectively. These findings gave evidence that the high injuries cause a serious impact on the productivity and quality of sugar beet (**Al Jbawi *et al.*, 2015)**.

The interaction between the two factors was significantly affected root rot disease severity in both seasons. The first time root rot disease infection appeared after root store for six days in August and September sowing, then a gradually, significant and moderate increase have been detected till beet stored for 12 days. Otherwise, October and November plantation showed that beet stored for two days was free from infection then a gradually and obvious increase in disease severity take place to reach 12.17 % and 11.35% in the first season and 9.48% and 10.16% in the second season corresponding delay in beet process for 12 days after harvest. These results may be due to the rise of soil and pile temperature that encourages the multiplication and spread of root rot diseases. **Campbell and Klotz (2006)** reported that the elevated respiration rates not only imply an increase in sucrose loss but also may cause an increase in pile temperature, which increases respiration rate and facilitates the development of storage rots. Further, many of these pathogens cause post harvest losses in storage piles **(Jacobsen, 2006)** which increase post harvest respiration rate, sucrose losses, impurities and invert accumulation **(Campbell *et al.*, 2011)**.

Table (2): The effect of sowing dates and storage period on disease severity during 2017/18 and 2018/ 19 seasons.

	Days after harvest							Mean
	0	2	4	6	8	10	12	
2017/ 2018								
Aug.	0.00	0.00	0.00	2.73	4.48	6.49	8.12	3.12
Sept.	0.00	0.00	0.00	3.14	5.10	7.57	9.07	3.55
Oct.	0.00	0.00	1.44	4.18	6.09	8.54	12.17	4.63
Nov.	0.00	0.00	1.91	5.08	7.18	9.41	11.35	4.99
Mean	0.00	0.00	0.84	3.78	5.71	8.11	10.18	4.07
L.S.D. 0.05	S= 0.17			P= 0.09		SxP= 0.17		
2018/ 2019								
Aug.	0.00	0.00	0.00	2.47	3.81	5.11	6.50	2.56
Sept.	0.00	0.00	0.00	2.81	4.52	5.78	7.21	2.90
Oct.	0.00	0.00	1.33	3.87	5.78	7.56	9.48	4.00
Nov.	0.00	0.00	1.54	4.48	6.47	8.18	10.16	4.40
Mean	0.00	0.00	0.72	3.41	5.15	6.66	8.34	3.47
L.S.D. 0.05	S= 0.03			P= 0.03		SxP= 0.06		
S= Sowing date, P= Post harvest, SxP= Interaction								

We conclude from these results, any of sowing date even August sowing gave a satisfying average root wt. where, the weather during sowing date were suitable for growing beet, in addition to, free of soil borne diseases. Moreover, the reduction in average root wt. and various quality attribute by delaying beet process leads to a decrease in root yield, sucrose percentage delivered to the factory and consequently a decrease in farmer income in addition, difficult in slicing freshness roots and increase in sugar lost to molasses during process.

Average Root Weight / g:

Average over a period of 12 days after harvest and prior to milling Table (3) indicated that average root wt. (g) differed significantly among the four sowing dates. Where, the highest root wt. was detected for October sowing in both seasons, however, August sowing showed the lowest root wt. in the two seasons. Data also cleared the same trend have been recorded for average root wt. at harvest day (zero day) before stored beet. These findings are in agreement with many workers and recently with **Kumar *et al.* (2019)** who stated that among twelve different dates of sowing, the highest roots yield and quality attributes were observed on October sowing compared to the rest of treatments. Worth to mentioned, it is detected that any of sowing date even August sowing gave a satisfying average root wt. where, the weather during sowing date were suitable for growing beet, in addition to free of diseases severity.

Table (3): The effect of sowing dates and storage period on average root weight, total soluble solids and sucrose (Pol%) during 2017/18 and 2018/19 seasons

	Days after harvest (2017/18)							Mean	Days after harvest (2018/19)							Mean
	0	2	4	6	8	10	12		0	2	4	6	8	10	12	
Average root weight (g)																
Aug.	936	935	933	927	918	905	887	918.71	985	983	981	976	972	953	924	967.71
Sept.	1029	1028	1024	1015	996	981	960	1004.71	1017	1015	1011	1006	995	977	946	995.29
Oct.	1041	1038	1030	1017	1010	988	944	1009.71	1210	1207	1201	1191	1180	1149	1089	1175.29
Nov.	1017	1013	1005	986	976	927	883	972.43	1114	1109	1103	1090	1067	1035	975	1070.43
Mean	1003.25	1003.50	998.00	986.25	975.00	950.25	918.50	976.39	1081.50	1078.50	1074.00	1065.75	1053.50	1028.50	983.50	1052.18
L.S.D . 0.05	S= 3.95			P= 6.56		SxP= 13.12			S= 5.78			P= 7.43		SxP= 14.37		
Total Soluble Solids (TSS)																
Aug.	21.90	22.05	22.49	22.72	23.20	23.43	23.28	22.72	21.65	21.96	22.43	22.77	22.95	22.58	22.48	22.40
Sept.	21.18	21.51	21.76	22.05	22.65	22.87	22.81	22.12	20.75	21.09	21.83	22.32	24.15	24.56	24.35	22.72
Oct.	20.86	21.12	21.67	22.05	22.91	23.05	22.41	22.01	19.90	20.25	20.87	21.25	21.22	20.74	18.91	20.49
Nov.	20.45	20.96	21.58	22.23	20.75	18.35	16.76	20.15	19.83	20.21	21.79	22.38	21.89	19.21	17.28	20.37
Mean	21.10	21.41	21.88	22.26	22.38	21.93	21.32	21.75	20.53	20.88	21.73	22.18	22.55	21.77	20.76	21.49
L.S.D . 0.05	S= 0.25			P= 0.30		SxP= 0.60			S= 0.33			P= 0.39		SxP= 0.77		
Sucrose (Pol%)																
Aug.	18.74	18.71	19.24	19.64	19.05	18.39	16.25	18.57	18.54	18.71	19.02	19.17	18.83	18.57	16.86	18.53
Sept.	18.13	18.35	18.67	18.79	18.07	17.35	16.27	17.95	17.91	18.05	18.56	18.39	18.03	17.45	16.95	17.91
Oct.	17.86	18.05	18.09	17.62	17.38	16.51	15.34	17.26	17.51	17.68	17.56	18.01	17.36	16.94	15.91	17.29
Nov.	16.71	17.08	17.13	16.92	16.15	15.23	13.09	16.04	16.83	16.97	17.04	16.75	16.44	16.05	12.36	16.06
Mean	17.86	18.05	18.28	18.24	17.66	16.87	15.24	17.46	17.70	17.85	18.05	18.08	17.67	17.24	15.52	17.44
L.S.D . 0.05	S= 0.14			P= 0.20		SxP= 0.40			S= 0.16			P= 0.24		SxP= 0.47		
S= Sowing date, P= Post harvest, SxP= Interaction																

Average root wt. (g) over sowing dates was decreased gradually and significantly as time elapsed between harvesting and manufacturing in both seasons. Data Table (3) cleared that delaying beet delivery for two days insignificantly affected root wt. reduction, however, a continuous delay of beet increased the root wt. loss to reach its maximum values after 12 days was 8.45% (from 1003.25 to 918.5g) and 9.06% (from 1081.5 to 983.5g) for both seasons, respectively **(Al Jbawi *et al.*, 2015; Al Jbawi and Al Zubi, 2016 and El-Syiad *et al.*, 2016)**.

Data Table (3) also cleared that any factors (sowing dates and delaying beet manufacturing) or the interaction between both factors had a significant effect on root wt. loss during 2017/18 and 2018/19 seasons, but the rate of reduction as beet delivery delaying is more pronounced as sowing dates delaying from August to November in both seasons. The rate of reduction in root wt. after 12 days after harvesting and prior to manufacturing recorded 5.24, 6.71, 9.32 and 13.18% corresponding to Aug. Sep., Oct and Nov. sowing dates in the first season, while, it was, 6.19, 6.98, 10.00 and 12.48% in the second season (Table 3). The reduction in average root wt. may be attributed to the effect of various metrological data specially the effect of maximum and minimum temperatures, relative humidity and day length (Table 1). In addition to diseases severity which are responsible for considerable losses in root weight as shown in Table (2). The obtained results are in accordance with those reviewed by **Campbell and Klotz (2006) and Jacobsen (2006)** who found that elevated respiration rates may cause an increase in pile temperature and facilitates the development of storage rots.

Based on, the reduction in average root wt. by delaying beet manufacturing leads to a decrease in root yield delivered to the factory and consequently a decrease in farmer income in addition, difficult in slicing freshness roots during process.

Total Soluble Solids (TSS) and Pol. (Sucrose %):

Average data Table (3) cleared that sowing date significantly affected root TSS and sucrose in both seasons. Sowing in August exhibited to the highest root content of TSS and sucrose in both seasons then followed by a gradual decrease in those traits, meantime, November cultivation recorded the lowest values. Data also Table (3) cleared that the reduction in TSS and sucrose traits was more pronounced as sowing date delaying from August to November in both seasons, whereas, the harvest time of each sowing carried out during February, March, April and May, where, gradual rise in temperatures (Table 1), and consequently a reduction in beet efficiency of sugar synthesis and sugar accumulation, meantime, an increase in diseases severity in exchange for delaying planting dates have been recorded (Table 2). These findings are partly in the same line with those reported by **Campbell and Klotz (2006), Gobarah *et al.* (2019) and Kumar *et al.* (2019).**

Delaying beet roots over a period of two, four, six, eight, ten and 12 days after harvest and prior to manufacturing in Table (3) showed that apparent increase in TSS values with time elapsed up to eight days after beet harvest in both seasons and then dropped to reach 21.32 and 20.76 % after 12 days as compared by TSS value at harvest day (zero days) 21.10 and 20.53% in both seasons. The increase of TSS values are apparent (not true) due to water evaporation loss (dryness) during storage or / and sucrose conversion. Similar trend was also reported by **Al Jbawi and Al Zubi (2016)**.

Sucrose % behaved similarly as TSS where a significant increase in its value have been detected with storage beet after harvest up to six days in both season then followed by a sharp loss to reach 14.67% (from 17.86 to 15.24) and 12.32% (17.70 to 15.52) after 12 days as compared by harvest day (zero day). The increase in sucrose during the first six days may be apparently due to water loss dryness of root, however the reduction observed after that may be due to sucrose conversion and the effect of diseases severity which attack roots during storage and used sucrose in its growth and spread of diseases severity as shown in Table (2). The losses result from beet respiration and microorganisms that decompose part of sucrose to produce invert sugar **(Al Jbawi and Al Zubi, 2016 and Abd El-Rahman *et al.*, 2019)**.

Regarding the interaction between sowing dates and storage period data in Table (3) illustrated that TSS was still increasing by delaying beet processing up to 12 days for sowing dates during August, September and October (harvest was carried out during February, March and April), however, TSS values for November sowing was increased with delaying beet processing up to eight days and then these values were decreased corresponding beet delaying after ten and 12 days prior to harvest.

On the other side, sucrose was still increased in the first season with storage up to six for Aug. and Sept. sowing dates and four days for Oct. and Nov. sowing dates, whereas, in the second season, sucrose increased up to six days for Aug. and Oct. sowing dates and 4 days for Sept. and Nov. sowing dates, therefore, sucrose was decreased obviously as compared with beet not stored, these findings were supported by **Al Jbawi and Al Zubi (2016) and Abd El-Rahman *et al.* (2019)**.

Impurities and sugar lost to molasses:

Sowing dates significantly influenced beet impurities *i.e.* K, Na and α-amino nitrogen mg/ 100 g beets in both seasons. In the both seasons, August planting exhibited the highest contents of beet K, Na and α-amino nitrogen (Table 4) as compared with other sowing dates, except K was the highest in September sowing dates. These findings may be attributed that August plantation during harvest time (February) where the weather condition was more favorable for beet growth.

Table (4): The effect of sowing dates and storage period on beet impurities (K, Na and α Amino N) during 2017/18 and 2018/ 19 seasons

	Days after harvest (2017/18)							Mean	Days after harvest (2018/19)							Mean
	0	2	4	6	8	10	12		0	2	4	6	8	10	12	
K mg/ 100 mg beet root																
Aug.	2.53	3.60	3.72	3.71	3.79	3.82	3.96	3.59	3.92	4.01	3.95	4.05	4.10	4.13	4.43	4.08
Sept.	3.89	3.91	3.97	3.95	4.05	4.12	4.28	4.02	3.49	3.55	3.60	3.62	3.70	3.77	3.96	3.67
Oct.	3.01	3.09	3.13	3.21	3.27	3.32	3.49	3.22	3.58	3.67	3.71	3.82	3.90	3.96	4.15	3.83
Nov.	3.46	3.58	3.66	3.67	3.81	3.94	4.15	3.75	3.23	3.36	3.35	3.45	3.55	3.69	3.93	3.51
Mean	3.22	3.55	3.52	3.64	3.73	3.80	3.97	3.65	3.56	3.65	3.65	3.74	3.81	3.89	4.12	3.77
L.S.D. 0.05	S= 0.09			P= 0.10		SxP= N.S.			S= 0.09			P= 0.11		SxP= N.S.		
Na mg/ 100 g beet root																
Aug.	2.58	2.56	2.65	2.68	2.77	2.90	3.00	2.73	2.87	2.89	2.92	2.96	3.02	3.18	3.31	3.02
Sept.	2.12	2.09	2.15	2.23	2.32	2.39	2.53	2.26	2.59	2.62	2.67	2.74	2.79	2.83	3.03	2.75
Oct.	2.28	2.33	2.37	2.41	2.49	2.62	2.74	2.46	1.96	2.01	2.01	2.06	2.24	2.27	2.40	2.14
Nov.	2.15	2.21	2.26	2.33	2.38	2.55	2.76	2.38	1.93	1.99	2.03	2.01	2.12	2.25	2.42	2.11
Mean	2.28	2.30	2.36	2.41	2.49	2.62	2.76	2.46	2.34	2.38	2.41	2.44	2.54	2.63	2.79	2.50
L.S.D. 0.05	S= 0.03			P= 0.08		SxP= N.S.			S= 0.06			P= 0.09		SxP= N.S.		
α Amino N mg/ 100 g beet root																
Aug.	2.24	2.30	2.31	2.36	2.40	2.51	2.58	2.39	2.35	2.37	2.42	2.46	2.54	2.55	2.64	2.48
Sept.	1.86	1.88	1.93	1.98	2.05	2.17	2.23	2.01	2.08	2.12	2.17	2.19	2.26	2.34	2.45	2.23
Oct.	1.92	1.94	1.99	2.02	2.20	2.28	2.39	2.11	2.02	2.04	2.10	2.15	2.33	2.37	2.53	2.22
Nov.	1.79	1.85	1.90	1.95	2.05	2.10	2.33	2.00	2.21	2.28	2.34	2.44	2.53	2.64	2.85	2.47
Mean	1.95	1.99	2.03	2.08	2.18	2.27	2.38	2.13	2.17	2.20	2.26	2.33	2.42	2.48	2.62	2.35
L.S.D. 0.05	S= 0.05			P= 0.08		SxP= N.S.			S= 0.07			P= 0.07		SxP= N.S.		
S= Sowing date, P= Post harvest, SxP= Interaction																

Because of concern about sugar lost to molasses, data Table (5) showed that sowing dates possessed substantial effect on the quantity of sugar lost to molasses in 2017/18 and 2018/19 seasons. August sowing illustrated the highest lost of sugar molasses followed by a significant reduction in the following sowing dates; meantime, this trend was true in both seasons. Such effect may be due to relatively the same effect of sowing dates on beet impurities as shown before. In this connection **Gobarah *et al.* (2019)** stated that impurities *i.e.* Na, K, α AN and sugar lost to molasses (SLM) were the highest in Sept. sowing date and decreased in Nov. and Oct. sowing dates. Moreover, **Kumar (2019)** showed that Oct. sowing recorded the highest impurities and SLM than Nov. sowing date.

Significant and gradual increase in beet impurities *i.e.* K, Na and α-amino nitrogen in both seasons and this trend was also extending to sugar lost to molasses as time elapsed after harvest and prior to processing, meantime, this increased reached the maximum after beet stored for 12 days. The detected increase in beet impurities due to delay beet process for two, four, six, eight, ten and 12 days may be concurrently to the reduction in root water content [the reduction in root wt. (Table 3)] observed previously. Simultaneously the increase in impurities reflected positively on the sugar lost to molasses where a pronounced loss sugar leak to molasses caused a big loss of sugar to the factory and reflected negatively on extracted sugar as discussed later.

Factors, sowing dates and stored beets before manufacturing are behaved independently on their effect on beet impurities and sugar lost to molasses (Tables 4 and 5). Whereas, both factors were verified insignificant effect on those traits (Tables 4 and 5).

Extracted sugar and extractability percentages:

Average data indicated that August sowing exhibited the highest extracted sugar % in both seasons (Table 5) followed with a significant reduction accompanied September, October and November planting. Meantime, this trend was also recognized in the harvest day (before beet stored) in the two seasons (Table 5). These results have the same tendency as the influence of sowing dates on Sucrose %. These findings were greatly affected by the prevailing low temperature for sucrose synthesis and accumulation during growth and maturity of August sowing where harvest is carried out in the beginning of harvest season (during February month). On the contrary, especially for November sowing where harvest was carried out during May under a high temperature which affected negatively sucrose synthesis and accumulation.

Table (5): The effect of sowing dates and storage period on sugar loss to molasses, extracted sugar % and extractability during 2017/18 and 2018/ 19 seasons

	Days after harvest (2017/ 18)							Mean	Days after harvest (2018/19)							Mean
	0	2	4	6	8	10	12		0	2	4	6	8	10	12	
Sugar loss to molasses (SLM)																
Aug.	1.92	1.94	1.98	1.99	2.02	2.06	2.12	2.00	2.03	2.06	2.07	2.10	2.13	2.16	2.24	2.11
Sept.	1.81	1.80	1.84	1.89	1.90	1.95	2.01	1.89	1.87	1.90	1.92	1.94	1.92	2.01	2.09	1.95
Oct.	1.72	1.74	1.79	1.79	1.86	1.93	2.04	1.84	1.78	1.81	1.83	1.86	1.95	1.97	2.00	1.89
Nov.	1.73	1.77	1.80	1.83	1.88	1.94	2.05	1.86	1.78	1.82	1.84	1.88	1.93	1.99	2.10	1.91
Mean	1.80	1.81	1.85	1.88	1.92	1.97	2.06	1.90	1.87	1.90	1.92	1.95	1.98	2.03	2.11	1.97
L.S.D. 0.05	S= 0.03			P= 0.04		SxP= N.S.			S= 0.03			P= 0.04		SxP= N.S.		
Extracted sugar %																
Aug.	16.22	16.17	16.66	17.05	16.43	15.73	13.53	15.97	15.91	16.05	16.35	16.47	16.10	15.81	14.02	15.82
Sept.	15.72	15.95	16.23	16.30	15.57	14.80	13.58	15.45	15.44	15.55	16.04	15.88	15.51	14.74	13.79	15.28
Oct.	15.54	15.71	15.71	15.22	14.92	13.99	12.75	14.83	15.13	15.27	15.22	15.55	14.78	14.37	13.31	14.80
Nov.	14.38	14.68	14.73	14.49	13.77	12.71	10.44	13.60	14.45	14.55	14.60	14.27	13.92	13.26	9.66	13.53
Mean	15.47	15.63	15.83	15.77	15.17	14.31	12.58	14.96	15.23	15.36	15.55	15.54	15.08	14.55	12.70	14.86
L.S.D. 0.05	S= 0.16			P= 0.22		SxP= 0.45			S= 0.16			P= 0.23		SxP= 0.46		
Extractability%																
Aug.	86.56	86.44	86.61	86.82	86.26	85.53	82.93	85.88	85.79	85.80	85.96	85.91	85.48	85.13	83.13	85.31
Sept.	86.71	86.92	86.77	86.73	86.14	85.38	84.51	86.17	86.19	86.15	86.40	86.35	86.04	84.60	81.42	85.31
Oct.	87.01	87.02	86.81	86.41	85.86	84.70	83.10	85.84	86.39	86.39	86.55	86.21	85.19	84.85	83.45	85.58
Nov.	86.03	85.91	85.97	85.64	85.28	83.40	79.75	84.57	85.87	85.73	85.68	85.21	84.67	83.84	78.15	84.16
Mean	86.58	86.57	86.54	86.40	85.89	84.75	82.57	85.62	86.06	86.02	86.15	85.92	85.35	84.61	81.54	85.09
L.S.D. 0.05	S= N.S.			P= 0.49		SxP= 1.00			S= N.S.			P= 0.53		SxP= 1.06		

S= Sowing date, P= Post harvest, SxP= Interaction

Extractability trait during the four sowing dates was nearly the same as extracted sugar %, but, the differences among those sowing dates were too small to reach the level of significance in both seasons (Table 5).

Extracted sugar percentage significantly and gradually increased after beet stored for six days in both seasons as compared with beet harvested and not stored (control treatment). Followed by a gradual reduction in these values to reach a drastic loss level after 12 days from harvest and prior to process in both seasons (Table 5). The same attitude was also detected for extractability percentage but the reduction was significantly observed after ten days as compared with control treatment (before beet stored). These results give evidence to the negative effect of storing beet after harvest on extracted sugar which lost in molasses and hence cause great losses to sugar factory. The obtained results are in agreement with those reviewed by **Gobarah *et al.* (2019).**

The interaction between sowing dates and storing time significantly affected extracted sugar and extractability in both seasons (Table 5). A drastic reduction in both traits have been detected when beet not processed before 12 days for November sowing (harvest in May) and this reduction was decrease to reach the minimum for August plantation. Such effect may be due to the effect on temperature prevailing during harvest months as described before (Table 1).

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تأثير مواعيد الزراعة و تأخير التصنيع علي الإصابه بأعفان الجذور وبعض الصفات التكنولوجية لنبات بنجر السكر

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الهدف من هذا البحث هو دراسة تأخير توريد بنجر السكر للتصنيع لمدة 2 ، 4، 6، 8، 10 و 12 يوماً للبنجر "صنف حسام" المنزرع تحت أربعة مواعيد للزراعة هي الزراعة في شهور أغسطس وسبتمبر وأكتوبر ونوفمبرعلي متوسط وزن الجذور وصفات الجودة والإصابه بأعفان الجذور. لذلك أقيمت تجربتين حقليتين تحت ظروف محافظه الفيوم (مركز طاميه) خلال موسمي 2017 \2018 و2018 \ 2019 .

وقد تم الحصاد خلال شهور فبراير، مارس، أبريل ومايو مقابل لكل ميعاد زراعة وتوضح النتائج ما يلي:

لم يلاحظ إي إصابات بإعفان الجذور حتي 4 يوم في مواعيد الزراعة خلال شهري أغسطس وسبتمبر بينما كانت حتي يومان خلال الزراعة في شهري أكتوبر ونوفمبر. و أن إستمرار تأخير التصنيع حتي 12 يوماً أدي زيادة في نسبة الجذور المصابه بأعفان الجذور.

حققت زراعة شهر أكتوبر أعلي متوسط وزن الجذور بينما أعلي قيم للمواد الصلبه الذائبه الكلية، السكروز ، الشوائب ، السكر المستخلص ونسبة الإستخلاص قد تحقق من زراعة شهر أغسطس وكذلك أقل إصابة بأعفان الجذور.

أدي تاخير توريد البنجر للتصنيع إلي نقص غير معنوي في أوزان الجذور وقد زاد النقص في أوزان الجذور الى أقصي درجة (نقص معنوي) بتأخير التصنيع حتي 12 يوما .

وتشير النتائج أيضا زياده في قيم محتوي الجذور من المواد الصلبه الذائبه الكلية والسكروز وكذلك نسبه السكر المستخلص ونسبة الإستخلاص بتأخير توريد البنجر حتي 6 يوم وإستمرار تأخير التصنيع أدي إلي نقص شديد في هذه القيم. وبالمثل زياده مستمره وتدريجية في محتوي الجذور من الشوائب (الصيوديوم–البوتاسيوم– والفا امينو نتروجين) والسكر المفقود في المولاس مع تأخير التصنيع حتي 12 يوماً.

كما تشير النتائج إلي أن التأثير السلبي الملاحظ علي جميع الصفات تحت الدراسه والاضرار الناجمة عن الاصابات باعفان الجذور عند تاخير التصنيع بعد 2 يوم من الحصاد وكان هذا الضرر اكثر وضوحاً مع زراعات شهري أكتوبر ونوفمبر والحصاد خلال شهري أبريل ومايو بينما الزراعة المبكره (اغسطس وسبتمبر) والتي تم حصادها في شهري فبراير ومارس أدت الي نتائج عكسيه.

بناء علي ما سبق فان النقص في أوزان الجذور وصفات الجوده وإرتفاع الإصابات بأعفان الجذور يؤدي الي نقص في محصول الجذور ومحتواه من السكر المورد للتصنيع مما يؤثر علي دخل المزارع إضافه الي صعوبات في عمليات التصنيع.