



Effect of Different Sowing Dates on Quantity and Quality of Some Promising Sugar Beet (*Beta vulgaris* L.) Varieties under North Delta, Condition

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MANY agronomic practices must be need modified to maximize quantity and quality of sugar beet crop. Two field experiments were sconducted at Belkas town, Dakahlia Governorate, Egypt, near Dakahlia Sugar Company, during two successive winter seasons 2014/2015 and 2015/2016. A comparative study was conducted to assess the performance and stability of four multigermsugar beet varieties (*Beeta vulgaris* L.), i.e. Dema-Poly, Pleno, Glloria and Ras-Poly in relation to three sowing dates, i.e. 1st September, 1st October and 1st November as well as their interaction to select the superior varieties in respect to highest yield and quality with suitable both early and late swing dates. A split-plot design with four replications was used. Results of study revealed that different sowing dates have significant effect on all beet characters. Sowing sugar beet plants at 1st October was significantly associated with the highest yields of root and sugar as well as quality traits in terms of sucrose (S%), purity % and recoverable sugar (R S%). On the other hand, leaf area index (LAI) and top yield ton/fed (fed= 4200m²) significantly decreased with delayed sowing dates. Sowing sugar beet plants at 1st September associated with maximum total soluble solids (T.S.S%) and impurities content, i.e. Na %, K %, α -amino N % as well as sucrose loss to molasses (SLM %) compared with late sowing date. Also, results clearly showed that the variances due to sugar beet varieties were significantly in all studied traits. Ras-Poly variety recorded the highest values of root dimension (cm), root fresh weight (gm/plant), root yield (RY) ton/fed, white sugar yield (WSY) ton/fed, sucrose %, purity % and recoverable sugar (RS%) followed by Dema-poly and Glloria in a descending order in both seasons. While, Glloria variety produced the maximum LAI and top yield (TY) ton/fed. The highest values of impurities content, i.e. Na %, K %, and α -amino-N %, as well as sucrose loss to molasses (SLM%) were recorded with planting Pleno variety on 1st September. Generally, sowing Ras-poly variety at the optimum date on 1st October produced the highest root, white sugar yields and lowest impurities content followed by Dema-poly and Glloria. While, the highest values of LAI and top yield ton/fed were obtained when Glloria variety planted on early date followed by Pleno variety under studied environmental conditions

Keywords: Organic-inorganic fertilizers, Bio-fertilizer, Integrated nutrients, Nutrients balance, Nutrient management.

Introduction

Sugar beet (*Beta vulgaris* L.) ranks the second important sugar crop after sugar cane, producing annually about 40% of total sugar production all over the world and have readily adaptable to different environmental factors including climate

(El-Hag et al., 2015). Egypt produces about 2.305 million ton of sugar (1.100, 1.050, and 0.155 million ton from sugar cane, sugar beet and sweet sorghum, respectively) and consumes about 3.100 million ton (74.35%), that means about 0.795 million ton sugar (25.65%) is important annually from foreign countries (C.C.S.C., 2017).

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There was a gap between sugar production and consumption due to steady increases in the population (2.5% annually) as well as the change of sugar consumption patterns.

Increasing sugar beet cultivated area and sugar production per unit area are considered the important national target to minimize the gap between sugar production and consumption. The importance of this crop is not only from its ability to grow in wide range of soils (saline, alkaline and calcareous soils) but also sugar beet plants could be successful cultivated in the newly reclaimed soils without competition with other traditional winter crops due to its tolerance to salinity and ability to produce high root and sugar yields under stress conditions and its low requirement of water compared with sugar cane.

In Egypt, the total cultivated area of sugar beet reached about 193405ha with total production 10.04 million ton. Most of these areas are cultivated at Dakahlia and Kafer El-Sheikh Governorates. While the total cultivated area in the world reached about 4.5 million ha with total production 250.91 million ton (FAO, 2017).

The composition of sugar beet is mainly affected by cultivation methods such as N application, varieties, sowing dates and population density (Sogut & Arioglu, 2004). Sowing date is one of the most important factors in crop management affecting crop yield and other agronomic traits.

Many studies have shown that all quantitatively and qualitatively inherited traits can significantly vary depending upon environmental conditions as well as cultivation practices such as sowing time (Salmasi et al., 2006). Sowing date has a key role in sugar beet growth, yield and root juice quality and influenced by previous crop, climatic condition, cultivars, etc. (Kandil et al., 2004).

The early sowing of sugar beet during October gave higher beet as well as higher sugar content than late sowing (Amin et al., 1989). On the other hand, Hammad et al. (1981) observed that sugar beet sown in November gave highest root yield and low chances of insect pest infestation. Ramazan (2002) concluded that early planting of sugar beet has best germination and high root and sugar yields than the late planting affected due to low temperature. Malec (1992) in Poland

demonstrated that early sowing of sugar beet led to higher crop yield but inferior quality and lower sugar content.

In this concern, Refay (2010) showed that total soluble solids (T.S.S.) and total sugar percent (S%) were significantly affected by planting dates, sowing beet at 15 October recorded the highest values of sucrose percent, sugar purity percentage and sugar yield. On the other hand, Azzazy (1998) showed that none of the studied characters was significantly affected by the two sowing dates except top yield. A delay in sowing results in losses of root weight, root yield and sugar yield, but percentage of dry matter was significantly increased (Kolble & Petzold, 2002; Sogut & Arioglu, 2004; Nikpanah et al., 2010; Al-Jbawi et al., 2015). Leilah et al. (2005) concluded that sowing sugar beet on first of October produced the highest values of length, diameter and fresh weight of roots, purity percentage as well as root, top and sugar yields ha⁻¹. Maralian et al. (2008) found that sowing date had a significant effect on sugar beet yield and its quality. They added that the optimum sowing date in 20 April that maximum yield and quality observed on this treatment. Petkeviciene (2009) indicated that at early sowing the stand density of sugar beet plants was by 3.3% lower compared with the average (99.900 plants/ha). He added, one week delay in sowing reduced roots by 4.7ton ha⁻¹ and white sugar 0.9ton ha⁻¹ and increased alpha amino nitrogen content in roots by 2.58mg 100g⁻¹. Nikpanah et al. (2015) tested three sowing dates (1 July, 20 July and 13 August) and three levels of nitrogen (25% less than optimum, optimum and 25% higher than optimal) on sugar beet production and growth index, they showed that with early sowing and increase nitrogen level maximum leaf area index and dry matter accumulation increased.

In general, both early and late sowing decreased sugar beet root, sugar and leaf yields and increased impurities contents (Somayeh et al., 2012; Hoosin et al., 2015; Illkaee et al., 2016; Al-Jbawi & Al-Zubi, 2016). Also, Kumar et al. (2019) revealed that among of 12 different dates of sowing, higher yield and yield attributes were observed in sowing at October 1st fortnight compared to the rest of the treatments.

All sugar beet genotypes cultivated in Egypt are important from foreign countries, so it is preferable to evaluate them under the Egyptian

condition to select the superior varieties in respect to yield and quality traits. Sugar beet varieties differed significantly in all studied traits (Mahmoud et al., 1999; Osman et al., 2003; El-Sheikh et al., 2009; Mohamed et al., 2012; Mohamed & Yasin, 2013; Nofal et al., 2016).

In this concern, Gobarah & Mekki (2005) found that Top cultivar gave the highest yields of root, sugar and recoverable sugar, while Ras Poly variety showed more sucrose% (S%), recoverable sugar % (RS%) as well as juice purity % than Kawemira and Top varieties. Enan et al. (2009) revealed that Farida variety gave a significant increase for sugar yield, T.S.S. %, sucrose % and purity %, while, it recorded the lowest values of impurities content, i.e. Na, K and Alpha-amino N. Shalaby et al. (2011) and Okasha & Mubarak (2018) suggested that sugar beet varieties significantly in root fresh weight, sucrose % and yields of root and sugar fed⁻¹ with increasing distance between hills from 15 to 25cm. Awad et al. (2014) evaluate six sugar beet cultivars under three harvesting date, they revealed that superiority of Dema-Poly variety in root weight, root yield, recoverable sugar yield ton/fed, sucrose %, sugar recovery % and purity % when it was harvested after 215 days from sowing.

Also, Kaloi et al. (2014) reported that all sugar beet varieties showed different behavior with respect to beet yield and sugar recovery. They added that, maximum beet yield was produced by SDPAK03/06 variety followed by California, Magnolia and SDPAK 09/07, while the varieties California, Magnolia, SDPAK03/04 and SDPAK09/07 performed best with regard to beet yield and sugar recovery %. Moreover, Hanaa et al. (2016) showed that, cultivar Farida gave the highest values of root fresh, root and sugar yields, sucrose %, T.S.S % and purity % compared with Sultan and Samba cultivars.

Ciric (2017) found that the sugar beet production and quality depend on a successful select of promising cultivars as well as good growing conditions. Also, Kumar et al. (2019) revealed that between the two sugar beet genotypes. Cauvery recorded significantly higher yield and yield attributes than Indus. This study was carried out to evaluate the influence of sowing dates on root yield and quality traits and select the optimum variety that goes in line with both early and late sowing dates to obtain highest yield and quality of sugar beet.

Materials and Methods

Two field experiments were conducted at Belkas country, Dakahlia Governorate, near Dakahlia Sugar Company, during two successive winter seasons 2014/2015 and 2015/2016. The objective of this work was to describe yield and quality traits of four multigermsugar beet varieties (*Beeta vulgaris* L.) i.e., Dema-Poly, Pleno, Glloria and Ras-Poly in relation to three sowing dates, i.e. 1st September, 1st October and 1st November as well as their interaction. The varieties were used in this study imported from England, Holland, Germany and England countries, respectively, through the Dakaklia Sugar Company at Belkas town. Soil samples were taken at random from 0 and 30cm depth in the experimental sites before soil preparation. The soil of the experiment was clay loam texture. The chemical analyses as described by Cottenie et al. (1982) as follows: 8.28 and 8.17 pH; 1.88 and 1.93% O.M; 1.72 and 1.86 EC dsm⁻¹; 14.20 and 13.60ppm available N; 66.40 and 63.70ppm available K; 4.16 and 3.56ppm available P; 5.67 and 5.55ppm Fe; 4.14 and 4.10ppm Mn; 1.05 and 1.79ppm Zn; 2.24 and 2.56ppm Cu and 0.33 and 0.38ppm B, in the first and second seasons, respectively. A split-plot design with four replications was used. Sowing dates were allocated in the main plots and varieties were distributed in the sub plots. The sub plot area was 21m² including six ridges of 50cm width and 7m long. The previous crop was maize. Seeds of sugar beet varieties were sown in hills 20cm apart. Thinning was done at 4-leaves stage (30 days after sowing) to ensure one plant/ hill. Phosphorus at the rate of 30kg P₂O₅ fed⁻¹, in the form of calcium super phosphate (15.5% P₂O₅) was added before sowing. Nitrogen fertilizer was added at the recommended rate of 80kg N fed⁻¹, in the form of urea (46% N) in two equal doses, the first one was applied after thinning and the second one was added after 30 days later. Potassium fertilizer was added at the rate of 24kg K₂O fed⁻¹ in the form of potassium sulphate (48% K₂O) was applied before the 2nd irrigation. The other culture practices such as irrigation, weed and insect control etc, were done as recommended in the ordinary sugar beet field. At harvest time (195 days from sowing in both seasons) ten guarded plants were taken at random from each sub plot in the two seasons to determine the following traits:

Growth characters

Root dimensions in cm (length and diameter),

fresh root weight (kg), leaf area index (LAI)= Unit leaf area per plant (cm²)/ plant ground area (cm²), were measured.

Juice quality traits and impurities contents

Total soluble solids (TSS%) was measured by using digital refractometer. Sucrose percentage (S%) was determined by using Sacharometer on lead acetate extract of fresh macerated roots according to Carruthers & Oldfield (1960). Juice purity percentage (JP%) was calculated by dividing sucrose % total soluble solids using method of Silin & Silina (2011). Sodium (Na) and Potassium (K), (millequivalent 100g⁻¹ beet) were determined in the digested solution by using the Flame photometer according to the method described by Brown & Lilliand (1964), α - Amino N was also calculated by double beam filter photometry using the blue number method (Sheikh, 1997). Impurities were calculated as follows: Impurities %= 0.343 (Na+ K)+ 0.094 (α amino-N), according to Harvey & Dotton (1993). Recoverable sugar percentage (RS%), was determined to the following formula, RS%= (S%-0.29)- [0.343(Na+ K)+ 0.094 (α amino-N)] was calculated according to Harvey and Dotton (1993). Sucrose loss to molasses percentage (SLM%) was evaluated based on Harvey & Dotton (1993) as follows: SLM%= 0.343(K+ Na)+ 0.094(α amino-N)-0.31.

Yields

The plants were harvested from the four middle ridges of each sub plot to estimate the Root yield (ton/fed); Top yield (ton/fed). White sugar yield (ton/fed) was calculated according to the following equation: WSY= Root yield (ton/fed) \times recoverable sugar percentage (RS%)/ 100.

Statistical analysis

Data collected for yield and quality of sugar beet were subjected to the statistical analysis according to Snedecor & Cochran (1981) and all means were compared using LSD at 5% level of probability according to Steel & Torrie (1980).

Results and Discussion

Effect of sowing dates on growth characters

Data presented in Table 1 showed that the effect of sowing dates were significant on root dimension, root fresh weight and leaf area index (LAI) in both growing seasons, except for root length and diameter in the first season. Sowing

sugar beet on 1st October resulted in significant increase in length, diameter and fresh weight of roots compared with early or later sowing date. The increase in root dimension and weight might be attributed to the good weather condition that promoted photosynthesis and growth of sugar beet plant and hence increase root weight (Kandil et al., 2004; Leilah et al., 2005; Nikpanah et al., 2010). On the other hand, the highest values of LAI (8.75 and 8.60) were obtained with early sowing sugar beet on 1st September in the first and second seasons, respectively and gradually decreased with delay in planting. These results are in agreement with those obtained by Al-Jbawi et al. (2015), Hoosin et al. (2015) and Nikpanah et al. (2015).

Effect of sowing dates on juice quality traits and impurities contents

According to the results of Tables 2 and 3, different sowing dates significantly influenced root quality traits of sugar beet plants, i.e. TSS %, sucrose %, purity % and extractable %. Planting date on 1st October significantly increased all quality parameters as compared to early or later planting in either 1st September or 1st November. This enhancement can be related to favorable climatic conditions especially light was represented in sunny days and cool nights of late winter which are the best sugar producing and reserving in sugar beet roots. Sugar beet plants that were planted on 1st October recorded higher sugar content (S%), highest juice purity (JP%), greatest recoverable sugar percentage (RS%) and lowest total soluble solids (TSS%) followed by planting on 1st November. Leilah et al. (2005), Maralian et al. (2008) and Illkaee et al. (2016) came to similar results reporting that planting on October markedly increased sugar, purity and extractable sugar contents. They added that both early and later sowing dates decreased beet quality due to the effect of soil water content and temperature. Moreover, Salmasi et al. (2006) and El-Hag et al. (2015) observed that highly positive correlation between climatic factors and yield quality of sugar beet. Also, data in Table 3 indicated that impurities content of juice beet, i.e. sucrose loss to molasses (SLM %), Na %, K % and α -amino-N % are significantly affected by planting dates in both seasons. Sowing sugar beet early on 1st September recorded the highest values of each of the above mentioned impurities parameters, while, the lowest values were obtained from sugar beet plants sown on suitable date on 1st October followed by

planting on 1st November. This can be attributed to the fact that, plants that were planted later have spent most of their energy for storage of sugar in the roots, but the early planting has probably led to more opportunities for more suitable vegetative

growth. These results are in agreement with those obtained by Maralian et al. (2008), Refay (2010), Somayeh et al. (2012), Nikpanah et al. (2015) and Al-Jbawi & Al-Zubi (2016).

TABLE 1. Effect of sowing dates on some growth traits of sugar beet plants in 2014/2015 and 2015/2016 seasons.

Sowing dates	Root length (cm)		Root diameter (cm)		Root fresh weight (g)		LAI	
	2014/15	2015/16	2014/15	2015/16	2014/15	2015/16	2014/15	2015/16
1 st September	34.61	34.50	13.98	13.45	1116	1192	8.75	8.60
1 st October	36.10	39.50	15.40	16.10	1380	1410	8.09	8.13
1 st November	35.72	37.15	15.42	15.58	1262	1338	7.29	7.24
L.S. D at 5%	N.S.	1.13	N.S.	0.32	14.82	11.03	0.45	0.28

TABLE 2. Effect of sowing dates treatments on juice quality traits of sugar beet roots in 2014/2015 and 2015/2016 seasons.

Sowing dates	Total soluble solids %		Sucrose %		Purity %		Extractable sugar%	
	2014/15	2015/16	2014/15	2015/16	2014/15	2015/16	2014/15	2015/16
1 st September	22.60	22.26	19.62	19.70	86.83	88.53	16.08	16.22
1 st October	21.77	21.85	20.59	20.91	94.58	95.71	17.57	17.90
1 st November	22.00	22.80	20.38	20.80	92.64	91.29	17.05	17.52
L.S.D at 5%	0.25	0.30	0.19	0.31	0.46	0.40	0.08	0.11

TABLE 3. Effect of sowing dates treatments on impurities contents of sugar beet roots in 2014/2015 & 2015/ 2016 seasons

Sowing dates	Impurities%		Sucrose loss to molasses		Na %		K %		α -amino-N %	
	2014/15	2015/16	2014/15	2015/16	2014/15	2015/16	2014/15	2015/16	2014/15	2015/16
1 st September	3.54	3.48	2.94	2.89	2.19	2.11	6.17	6.11	4.04	3.92
1 st October	3.03	3.01	2.44	2.41	1.72	1.78	5.38	5.32	3.20	3.14
1 st November	3.33	3.29	2.73	2.69	1.95	1.90	5.94	5.87	3.56	3.49
L.S.D at 5%	0.06	0.04	0.09	0.07	0.10	0.10	0.14	0.11	0.12	0.08

Effect of sowing dates on yield of roots, sugar and top

Sowing dates treatments exhibited significant effect on yields of roots, top and white sugar ton fed⁻¹ in both seasons (Table 4). These results in this study provided a wide range of variation in environmental conditions. Planting sugar beet on 1st October resulted in significant increase in root and white sugar yields on average 36.95, 38.10 and 6.48, 6.82ton fed⁻¹, while the lowest values 32.54, 33.47 and 5.23, 5.46ton/fed were recorded from sowing beets on 1st September in the 1st and 2nd seasons, respectively. The increase in root yield might be attributed to the good weather conditions that promoted photosynthesis and improved growth of sugar beet and hence increase root dimension and weight accordingly increase root yield. Leilah et al. (2008), Maralian et al. (2008), Refay (2010), El-Hag et al. (2015), Hoosin et al. (2015) and Kumar et al. (2019) came to similar results reporting that sowing in October markedly increased root and sugar yields compared with early or late sowing of September and November. Meanwhile, the highest top yield 16.10 and 16.80ton/fed were obtained from sowing beet plants on early date in 1st September and then it was significantly decreased with delayed sowing date. This can be attributed to early planting allows the early development of an optimal leaf surface area that is available when the environment is most suitable for maximum assimilation of energy and subsequent transfer of photosynthesis to the storage top. These results are in agreement with the finding of Nikpanah et al. (2010), Al-Jbawi et al. (2015) and Nikpanah et al. (2015).

Varietal effects on growth characters

Data presented in Table 5 showed that Ras Poly variety ranked the first one 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. This superior may be due to the genetic structure of this variety. On the other hand, Glloria variety gave a significant increase of leaf area index (LAI), however the lowest was recorded with Ras Poly in both growing seasons. In this concern, Gobarah & Mekki (2005), Refay (2010) and Mohamed et al. (2012) reported that the different between sugar beet varieties were significant in root dimension and root fresh weight.

Varietal effects on Juice quality traits and impurities contents

The collected data in Tables 6 and 7 pointed out that the differences among four examined varieties were significant with respect to juice quality traits, i.e. sucrose, total soluble solids (T.S.S.), purity and extractable sugar (E.S.) percentages (Table 6), as well as impurities contents such as, sucrose loss to molasses (S.L.M.) and Na, K, and α -amino-N (Table 7) in both seasons except T.S.S. and purity contents were insignificant in the first season. Ras Poly variety recorded the highest values of sucrose, purity and extractable sugar percentages as well as lowest T.S.S %, SLM, Na, K and α -amino-N contents in both seasons, whereas Pleno variety had the lowest sucrose, purity and extractable sugar percentages and the highest impurities content. Concerning, Ras Poly variety seem to be high juice purity due to the reduction of SLM and impurities contents. The differences between varieties used in these traits might be attributed to the differences in genetic constituents for each variety and its response to the environmental condition. These results are in line with those obtained by Gobarah & Mekki (2005), Enan et al. (2009), Shalaby et al. (2011), Mohamed & Yasin (2013), Masri & Hamza (2015) and Okasha & Mubarak (2018).

TABLE 4. Effect of sowing dates treatments on root, top and white sugar yields of sugar beet plants in 2014/2015 and 2015/2016 seasons.

Sowing dates	Root yield (RY) (ton/fed)		Top yield (TY) (ton/fed)		White sugar yield (WSY) (ton/fed)	
	2014/15	2015/16	2014/15	2015/16	2014/15	2015/16
1 st September	32.54	33.47	16.10	16.80	5.23	5.46
1 st October	36.95	38.10	14.93	15.15	6.48	6.82
1 st November	35.62	36.39	14.55	14.80	6.09	6.38
L.S.Dat 5%	0.53	0.39	0.32	0.24	0.16	0.13

TABLE 5. Effect of different varieties on some growth traits of sugar beet plants in 2014/2015 and 2015/2016 seasons.

Varieties (V)	Root length (cm)		Root diameter (cm)		Root fresh weight/plant (gm)		LAI	
	2014/15	2015/16	2014/15	2015/16	2014/15	2015/16	2014/15	2015/16
Dema-poly	37.60	39.18	14.09	14.65	1239	1390	7.45	7.62
Pleno	34.18	36.34	12.18	12.93	1098	1237	8.09	8.40
Glloria	36.98	37.15	13.80	13.74	1274	1296	8.19	8.56
Ras-Poly	39.00	39.88	15.70	16.14	1408	1430	7.11	7.42
L.S.D at 5%	0.39	0.27	0.65	0.36	8.51	6.17	0.31	0.27

TABLE 6. Effect of varieties on juice quality traits of sugar beet roots in 2014/2015 and 2015/2016 seasons.

Varieties (V)	Total soluble solids %		Sucrose %		Purity %		Extractable sugar %	
	2014/15	2015/16	2014/15	2015/16	2014/15	2015/16	2014/15	2015/16
Dema-poly	21.70	21.63	20.00	19.58	92.18	90.57	16.99	16.63
Pleno	22.22	22.87	19.48	19.60	87.67	85.74	16.18	16.42
Glloria	22.04	22.40	19.30	19.65	87.59	87.73	16.20	16.60
Ras-Poly	21.93	21.37	20.54	20.10	93.66	94.06	17.65	17.26
L.S.D at 5%	N.S	0.21	0.11	0.07	N.S	0.56	0.12	0.17

TABLE 7. Effect of varieties on impurities contents of sugar beet roots in 2014/2015 & 2015/2016 seasons.

Varieties (V)	Impurities		Sucrose loss of molasses		Na %		K %		α -amino N %	
	2014/15	2015/16	2014/15	2015/16	2014/15	2015/16	2014/15	2015/16	2014/15	2015/16
Dema-poly	3.01	2.95	2.41	2.34	1.95	1.91	5.20	5.13	2.86	2.30
Pleno	3.28	3.18	2.69	2.53	2.13	2.03	5.65	5.45	3.30	3.18
Glloria	3.12	3.05	2.54	2.45	2.00	1.98	5.40	5.23	3.11	2.98
Ras-Poly	2.89	2.84	2.29	2.24	1.87	1.81	5.00	5.00	2.49	2.18
L.S.D at 5%	0.055	0.048	0.069	0.054	0.080	0.061	0.138	0.114	0.127	0.094

Varietal effects on root, top and white sugar yields

The tabulated results in Table 8 showed that the effect of varieties on root, top and white sugar yields (ton/fed) were significant in both growing seasons. The results indicated the existence of wide genetic variability among these sugar beet genotypes. Ras Poly and Dema Poly varieties recorded the highest root yield (37.25, 39.10 and 37.90, 38.20ton/fed) and sugar yield (6.58, 6.77 and 6.44, 6.37ton/fed), while, Pleno variety scored the lowest root and sugar yields (35.00, 35.88 and 5.64, 5.87ton/fed) in the first and second seasons, respectively. This superior for Ras Poly variety may be due to the genetic structure of this variety and it had the most stable genotype for root and sugar yields. Data also cleared that Glloria variety showed more top yield than another three varieties in the two seasons. The differences among sugar beet varieties were obtained by El-Sheikh et al. (2009), Awad et al. (2014), El-Hg et al. (2015), Nofal et al. (2016) and Kumar et al. (2019).

*Effect of interaction on growth traits and yields of**root, top and white sugar*

Data in Table 9 indicated that the effect of the interaction between sowing dates and varieties was significant for root fresh weight, root yield and white sugar yield in both seasons, while LAI and top yield as well as root diameter were significant in the 2nd season only. It is worth to mention that sowing Ras Poly variety on the 1st of October gave the highest values of root diameter, root fresh, root yield and white sugar yield while, the lowest values were recorded when sowing Pleno variety in early time at 1st of September in both seasons. This results is in agreement with Kaloi et al. (2014), Hossain et al. (2015), Illkaee et al. (2016) and Al-Jbawi & Al-Zubi (2016) who found that both early and late sowing sugar beet varieties decreased root and sugar yields and increased impurities content. Also, the results clarified that the highest LAI and top yield were obtained with sowing Glloria or Pleno varieties at early time on the 1st September without significant differences between them.

TABLE 8. Effect of varieties on root, top and white sugar yields of sugar beet plants in 2014/2015 and 2015/2016 seasons.

Varieties (V)	Root yield (ton/fed)		Top yield (ton/fed)		White sugar yield (ton/fed)	
	2014/15	2015/16	2014/15	2015/16	2014/15	2015/16
Dema-poly	37.90	38.20	15.10	15.35	6.44	6.37
Pleno	35.00	35.88	15.74	15.90	5.64	5.87
Glloria	36.60	37.45	16.55	16.23	5.94	6.22
Ras-Poly	37.25	39.10	15.38	15.57	6.58	6.77
L.S.D at 5%	0.42	0.57	0.48	0.41	0.11	0.14

TABLE 9. The interaction effect between sowing dates and varieties on growth traits and yield in 2014/2015 and 2015/2016 seasons.

Character	LAI	Root diameter (cm)		Root fresh weight (gm)		Root yield (ton/fed)		White sugar yield (ton/fed)		Top yield (ton/fed)
		2014/15	2015/16	2014/15	2015/16	2014/15	2015/16	2014/15	2015/16	
1 st September	V1	7.54	14.83	1235	1219	35.38	35.80	5.88	6.03	16.00
	V2	8.54	14.15	1009	1145	33.95	34.45	5.44	5.57	17.30
	V3	8.93	14.80	1285	1292	37.60	38.72	6.18	6.55	17.89
	V4	6.99	15.00	1205	1245	37.45	38.33	6.11	6.52	15.73
1 st October	V1	7.08	17.00	1300	1309	38.05	38.14	6.50	6.62	15.83
	V2	8.11	14.00	1210	1259	35.10	35.70	5.78	5.86	16.77
	V3	8.26	16.30	1235	1289	36.48	37.00	6.11	6.39	16.10
	V4	6.71	18.20	1475	1510	41.09	41.68	7.17	7.42	14.97
1 st November	V1	6.60	14.38	1260	1240	39.10	39.60	6.59	6.78	15.05
	V2	7.54	13.95	1155	1189	34.30	35.80	5.72	6.01	16.00
	V3	7.11	14.10	1189	1238	35.00	35.55	5.88	6.04	15.40
	V4	6.54	16.30	1270	1296	39.45	40.88	6.76	7.09	14.63
LSD at 5%	0.96	0.65	0.18	0.16	1.64	1.42	0.25	0.19	0.87	

(*) V1: Dema-poly, V2: Pleno, V3: Glloria, V4: Ras-Poly.

Effect of interaction on quality traits and impurities content

Results presented in Table 10 pointed out that extractable sugar percentage (ES%), sucrose loss to molasses (SLM) as well as Na, K and α -amino N were significantly affected by the interaction between sowing dates and beet varieties. Sowing Ras Poly in optimum date on 1st October gave the highest ES % and lowest SLM % as well as Na, K and α -amino N because the correlation between these traits is negative (Al-Jbawi et al., 2015). On the other hand, the impurities content, i.e. Na and SLM percentages were significantly

increased with planting Pleno variety followed by Glloria variety on 1st September at both seasons, but K and α -amino N were significantly increased in the second season only. Moreover, when planting Pleno variety at early date it recorded the lowest extractable sugar percentage.

Some sugar beet genotypes have been promoted as high sugar content due to adapted for optimum sowing date. Similar results were obtained by Kaloi et al. (2014) and Hanaa et al. (2016).

TABLE 10. The interaction between sowing dates and varieties on root quality and impurities content.

Treatments (*)	Characters	Na %		K %	α -amino acid	Sucrose losses to molasses		Recoverable sugar %	
		2014/15	2015/16	2015/16	2015/16	2014/15	2015/16	2014/15	2015/16
1 st September	V1	1.91	1.98	5.80	3.08	2.73	2.67	16.61	16.85
	V2	2.09	2.14	6.44	3.34	3.01	2.94	16.00	16.08
	V3	1.90	2.00	5.90	3.18	2.60	2.71	16.40	16.91
	V4	1.92	1.90	5.58	2.98	2.58	2.54	16.34	17.01
1 st October	V1	1.88	1.89	5.64	2.85	2.65	2.55	17.09	17.35
	V2	2.00	1.90	6.12	3.01	2.86	2.73	16.44	16.39
	V3	1.91	1.95	5.81	2.95	2.79	2.63	16.71	17.28
	V4	1.87	1.85	5.48	2.87	2.49	2.45	17.49	17.80
1 st November	V1	1.92	1.87	5.86	2.83	2.58	2.60	16.85	17.08
	V2	2.00	1.97	6.09	3.05	2.87	2.78	16.67	16.78
	V3	1.95	1.90	5.96	2.92	2.70	2.66	16.80	16.97
	V4	1.90	1.89	5.67	2.88	2.61	2.56	17.10	17.32
LSD at 5%		0.12	0.08	0.13	0.10	0.13	0.11	0.22	0.18

(*) V1: Dema-poly, V2: Pleno, V3: Glloria, V4: Ras-Poly.

Conclusion

Sowing date has a key role in sugar beet growth, yield and juice quality and influenced by previous crop, climatic condition and varieties. Sowing sugar beet in different dates would extend the supplying period of root yield to sugar companies which guarantee extending working period, increasing production of sugar, eventually; it leads to minimizing the gap between sugar production and consumption.

The results of this study showed the importance of suitable sowing date and select the most stable varieties in agricultural practices in case of early or delayed sowing to maximize root and white sugar yields and improve its quality. The results of study showed that planting sugar beet cv. Ras Poly on 1st October could be recommended for maximizing sugar beet productivity and quality under the environmental condition of the present study. Generally, it can be concluded that Glloria and Ras-Poly varieties were the most suitable and highest yields of root and white sugar with early and late sowing dates, respectively.

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تأثير مواعيد الزراعة المختلفة على المحصول والجودة لبعض اصناف بنجر السكر المبشرة تحت ظروف وسط الدلتا

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اجريت تجربتين حقليتين بمركز بلقاس - محافظة الدقهلية بالقرب من مصنع الدقهلية للسكر فى موسمى 2014/2015 و2015/2016 لدراسة المقارنة لآداء أربعة اصناف من بنجر السكر وهى ديما بولى، بلينو، جلوريا، راس بولى وتأثرها بثلاثة مواعيد للزراعة هى : 1 سبتمبر، 1 اكتوبر، 1 نوفمبر وكذلك تأثير التفاعلات بينهما لإختيار أفضل الأصناف التى تتناسب مع مواعيد الزراعة المبكرة أو المتأخرة من حيث الإنتاجية وصفات جودة العصير.

استخدم تصميم القطع المنشقة مرة واحدة فى أربعة مكررات فى موسمى الزراعة وقد أحتلت مواعيد الزراعة الرئيسية ووزعت الأصناف فى القطع المنشقة.

اظهرت النتائج المتحصل عليها أن جميع صفات المحصول والجودة المدروسة تأثرت معنويا باختلاف مواعيد الزراعة. أدت الزراعة فى 1 اكتوبر إلى زيادة معنوية ملحوظة فى كلا من محصول جذور البنجر ومحصول السكر المستخلص (الأبيض) وكذلك صفات الجودة مثل نسبة السكر والنقاوة ونسبة السكر المستخلص بينما قلت معنويا نسبة الشوائب فى العصير يليها الزراعة فى 1 نوفمبر. بينما أدت الزراعة المتأخرة إلى نقص معنوى فى دليل مساحة الأوراق ومحصول العرش طن/فدان . كما اظهرت النتائج أن الزراعة المبكرة فى 1 سبتمبر أدت إلى زيادة معنوية فى نسبة الشوائب فى العصير والمتمثلة فى الصوديوم - البوتاسيوم و الفاسفامينو نيتروجين وكذلك نسبة فقد السكر فى المولاس مقارنة بالزراعات المتأخرة.

أيضا أظهرت الأصناف المدروسة إختلافات معنوية واضحة فى جميع الصفات المدروسة حيث تفوق الصنف راس بولى فى كمية المحصول من الجذور والسكر الأبيض ونسبة السكر المستخلص ونسبة النقاوة يليه الصنف ديما بولى ثم الصنف جلوريا وأخيرا جاء فى الترتيب الصنف بلينو وذلك فى موسمى الزراعة. أعطى الصنف جلوريا أعلى القيم فى دليل مساحة الأوراق ومحصول العرش طن/فدان. كما أظهرت النتائج زيادة معنوية فى نسبة الصوديوم والبوتاسيوم و الفاسفامينو نيتروجين ونسبة الشوائب عند زراعة الصنف بلينو فى 1 سبتمبر.

عموما أظهر الصنف راس بولى تفوقا واضحا فى الحصول على أعلى قيم للمحصول وصفات الجودة عند الزراعة المتأخرة يليه الصنف ديما-بولى بينما تفوق الصنف جلوريا عند زراعة مبكرا.