

Published with Open Access at **Journal BiNET**

Vol. 29, Issue 02: 2456-2471

**Journal of Bioscience and Agriculture Research**Journal Home: [www.journalbinet.com/jbar-journal.html](http://www.journalbinet.com/jbar-journal.html)

## Effect of planting dates on the growth and yield of five varieties of sugarbeet (*Beta vulgaris L.*)

**Deapika Rani Das**

Horticulture department, Bangladesh Agricultural University, Mymensingh, Bangladesh,

✉ For any information: [deapika.cd@gmail.com](mailto:deapika.cd@gmail.com) (Das, DR)

Article received: 24.05.2022; Revised: 27.07.2022; First published online: 30 August, 2022

### ABSTRACT

An experiment was carried out at the Horticulture Farm, Bangladesh Agricultural University, Mymensingh, from November 2014 to April 2015, to study the effect of planting dates on the growth and yield of five varieties of sugarbeet (*Beta vulgaris L.*). The experiment consisted of two planting dates such as 16 November and 30 November and five varieties, viz., Serenada, Aranka, Belleza, Danicia, and Natura. The experiment was laid out in a Randomized Complete Block Design with three replications. Observations were made on yield and different plant characters, e.g., plant height, number of leaves/plants, root length, fresh weight of root/plant, root yield/plot, root yield/ha, fresh weight of leaves/plant, leaf yield/plot, leaf yield/ha, dry weight of root/plant, dry weight of leaves/plant, root diameter and total soluble solids (TSS). The results showed that planting dates significantly affected yield and all the plant characters of sugarbeet under study. The higher root yield (27.69, 32.10 and 32.71 t ha<sup>-1</sup>) and the higher leaf yield (13.61, 25.728 and 26.93 t ha<sup>-1</sup>) were recorded from 16 November planting at 90, 120 and 150 DAP, respectively. The root yield and leaf yield decreased gradually after planting on 16 November. The effect of varieties significantly influenced the growth and yield of sugarbeet. The higher root yield (25.14, 39.68 and 41.96 t ha<sup>-1</sup>) and leaf yield (17.56, 30.12 and 31.64 t ha<sup>-1</sup>) were found in the variety Serenada at 90, 120 and 150 DAP, respectively. The lower root yield (17.20, 21.24 and 24.81 t ha<sup>-1</sup>) and leaf yield (4.74, 17.83 and 18.73 t ha<sup>-1</sup>) were obtained from the variety Danicia at 90, 120, and 150 DAP, respectively. The combined effect of planting dates and variety significantly affected growth and yield. Serenada variety gave the maximum root yield (31.63, 41.43 and 45.14 t ha<sup>-1</sup>) and leaf yield (21.6, 30.20, and 31.94 t ha<sup>-1</sup>) with 16 November planting at 90, 120, 150 DAP, respectively. The minimum root yield (10.24, 20.36 and 24.08 t ha<sup>-1</sup>) and leaf yield (2.4, 17.41 and 18.07 t ha<sup>-1</sup>) with 30 November planting at 90, 120 and 150 DAP, respectively were obtained from the variety Danicia. The results indicated that all the varieties gave a higher yield on 16 November planting than the planting on 30 November and the Serenada variety gave the highest yield among the varieties.

**Key Words:** Biennial root crop, Line sowing, Sugarbeet, Serenada, Aranka, Belleza, Danicia and Natura

**Cite Article:** Das, D. R. (2022). Effect of planting dates on the growth and yield of five varieties of sugarbeet (*Beta vulgaris L.*). Journal of Bioscience and Agriculture Research, 29(02), 2456-2471.

**Crossref:** <https://doi.org/10.18801/jbar.290222.298>



Article distributed under terms of a Creative Common Attribution 4.0 International License.

## I. Introduction

Sugarbeet (*Beta vulgaris* L.) is a temperate climate biennial root crop and species of agricultural importance in the Beta genus. Sugarbeet constitutes 45% of world sugar production. It is a crop cultivated for the production of sugar and potentially, for the production of energy, bio-ethanol (Rinaldi et al., 2006). Sugarbeet ranks second to sugarcane in terms of the world's sugar production. Sugarbeet is a temperate crop, generally grown in Europe, North America and temperate zones of Asia. Russia, France, USA, Germany, Ukraine, Turkey, Poland, China, UK and Egypt are the major sugarbeet-producing countries of the world which produced 47.6, 37.2, 26.2, 25.0, 18.7, 16.1, 11.6, 10.7, 8.5 and 7.4 million tons sugarbeet, respectively (FAO, 2010). A serving of one sugarbeet weighing 100g contains 42.68 kilocalories of energy, 8g of carbohydrates, 2g of fiber and 1g of protein (Song et al., 2010). Sugarbeet is a short-duration crop compared to sugarcane. It takes 5-6 months to get maturity, while sugarcane takes 12-14 months. In Bangladesh, the amount of sugar produced from sugarcane is not sufficient to meet the demand of the country. The total demand for sugar in Bangladesh is 1.8 million metric tons, whereas the average production is only 0.8 million metric tons. To fulfill the requirements, the country needs to import 1.3 million metric tons of sugar which are costly for a country like ours. Additional 0.4 million metric tons of sugar remain in need (BSRI, 2010). So, moving towards an alternative crop to produce more sugar yearly is very important. In Bangladesh, different varieties/lines such as Shubhra, Cauvery, C-Green, EB-0513, EB-0616, EB-0617, EB-0618, EB-0621, EB-0625, EB-0626, EB-0809 and Indus are already being used by Bangladesh Sugarcane Research Institute (BSRI), Bangladesh Agricultural Research Institute (BARI) and Bangladesh Rural Advancement Committee (BRAC) with the view to find out the optimum planting date and suitable variety/line(s) of sugarbeet for growing under the agro-climatic context of the country. The suitable time for growing sugarbeet in Bangladesh is the Rabi season (Anonymous, 2005). Generally planting date of sugarbeet varies with the climate of the region and the variety used. Therefore, the planting date is the most crucial factor affecting the yield of this crop to a great extent. Substantial yield increase of sugarbeet can be achieved by planting the crop at the proper time, which may vary from variety to variety (Abo-Salama et al., 2000). The planting time of sugarbeet at any location is decided by the prevailing temperature and the optimum temperature ranges between 15-25°C for germination, 21-35°C for growth and development and 15-18°C for maturation (Ustimenko-Barumovsky, 1983). Identification of variety/line and specific planting dates is essential for obtaining the economic yield of the crop.

## II. Materials and Methods

### Sources of sowing ingredients

The seed of five varieties was collected from Denmark. Seeds were sown on two dates viz. 16 November, 2014 and 30 November, 2014. The seeds were sown in lines where the distance between two lines was 25 cm and seed to seed 20 cm.

### Treatments of the experiment

#### Factor A: Planting dates

- a) 16 November 2014 (P<sub>1</sub>)
- b) 30 November 2014 (P<sub>2</sub>)

#### Factor B: Variety

- a) Serenada (V<sub>1</sub>),
- b) Aranka (V<sub>2</sub>),
- c) Belleza (V<sub>3</sub>),
- d) Danicia (V<sub>4</sub>) and
- e) Natura (V<sub>5</sub>)

### Design and layout of the experiment

The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The size of each plot was 2m<sup>2</sup> (2.0m x 1.0 m). The total number of plots was 30; each replication was divided into 10-unit plots. The distance between plots was 0.5 m, while the distance between two blocks was 0.5 m.

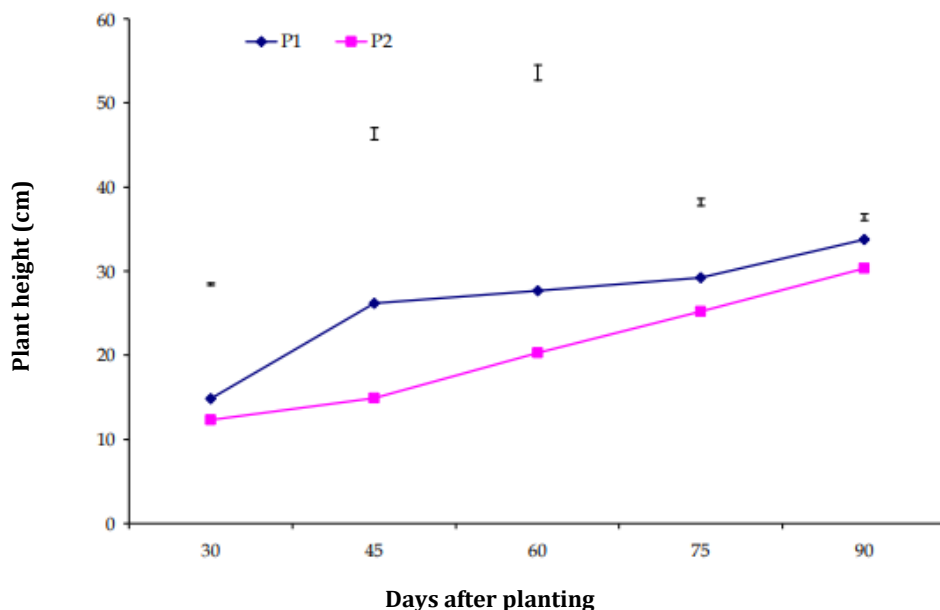
### Statistical analysis

All the collected data were analyzed statistically following the analysis of variance (ANOVA) technique and the significance of mean differences was measured by Duncan's Multiple Range Test (DMRT) as described by Gomez and Gomez (1984) using a computer-operated programmer named MSTAT-C (Gomez et al., 1984).

### III. Results

#### Effect of planting dates on yield and yield contributing characters of sugarbeet

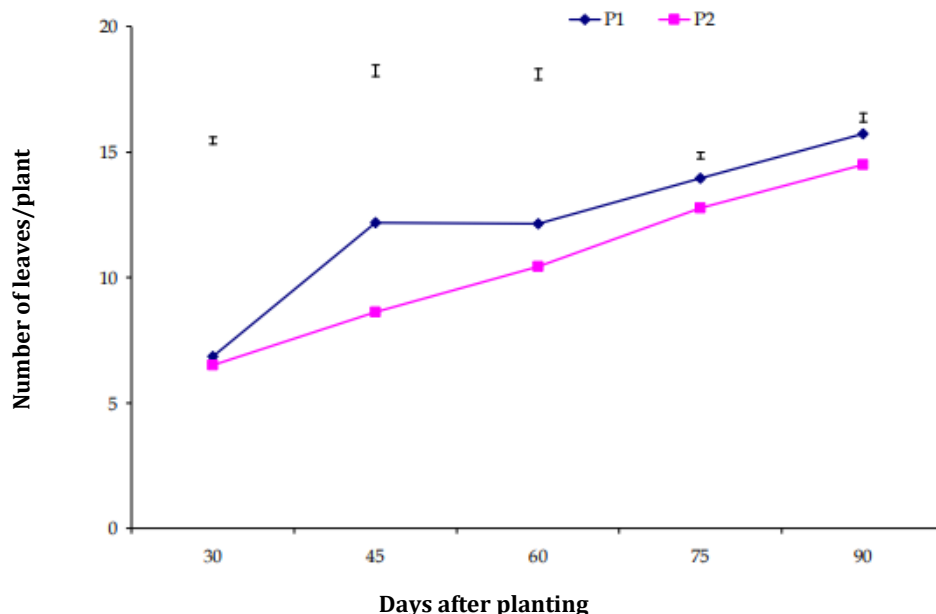
**Plant height:** Plant height showed a significant response to planting dates. Plant height was recorded at 30, 45, 60, 75 and 90 DAP. The result showed that the highest plant height (33.75 cm) was recorded on 16 November planting and the lowest value (30.31 cm) on 30 November planting at 90 DAP (Figure 01).



**Figure 01. Effect of planting date on plant height (cm) at different DAP.**

The vertical bars represent LSD values at 1% level of probability. P<sub>1</sub>=16 November, P<sub>2</sub>= 30 November

**Number of leaves/plants:** Planting dates exerted a significant effect on the number of leaves per plant in this study. Several leaves were recorded at 30, 45, 60, 75 and 90 DAP. The result indicates that the highest number of leaves (15.72) was recorded on 16 November planting and the lowest value (14.49) on 30 November planting at 90 DAP (Figure 02).



**Figure 02. Effect of planting date on the number of leaves/plant at different DAP.**

The vertical bars represent LSD values at 1% level of probability. P<sub>1</sub>=16 November, P<sub>2</sub>=30 November

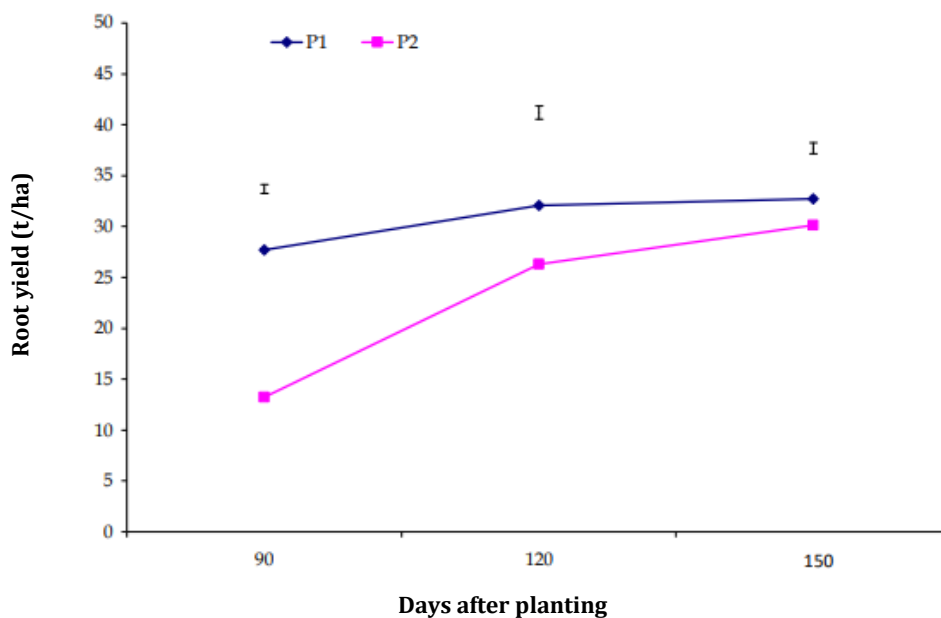
**Root length:** Root length showed a significant variation due to planting dates. In the first harvest, at 90 DAP the results revealed that the higher root length (12.32 cm) was recorded on 16 November planting and the lower value (9.89 cm) on 30 November planting. In the second harvest, at 120 DAP

the results showed that the higher root length (12.70 cm) was recorded on 16 November planting and the lower value (11.11 cm) on 30 November planting. In the final harvest, at 150 DAP the results showed that the higher root length (14.05 cm) was recorded on 16 November planting and the lower value (12.14 cm) on 30 November planting (Table 01).

**Fresh weight of root/plant:** Planting dates exerted a significant effect on the fresh weight of root per plant in this study. The fresh root weight per plant was recorded at 90, 120 and 150 DAP. The result indicates that the higher fresh weight of root/plant (138.47 g) was recorded on 16 November planting and the lower value (66.04g) on 30 November planting in the first harvest. In the second harvest, the higher fresh weight of root/plant (160.49 g) was recorded on 16 November planting and the lower value (131.53 g) on 30 November. Finally, the higher fresh weight of root/plant (163.55 g) was recorded on 16 November planting and the lower value (150.63 g) on 30 November planting in the final harvest (Table 01).

**Root yield/plot:** Root yield per plot showed a significant variation due to planting dates. Root yield per plot was recorded at 90, 120 and 150 DAP. The result indicates that the higher root yield per plot (5.54 kg) was recorded on 16 November planting and the lower value (2.64 kg) on 30 November planting in the first harvest. In the second harvest, the higher root yield per plot (6.42 kg) was recorded on 16 November planting and the lower value (5.26 kg) on 30 November. The higher root yield per plot (6.54 kg) was recorded on 16 November planting and the lower value (6.03 kg) on 30 November planting in the final harvest (Table 01).

**Root yield:** Planting dates exerted a significant effect on root yield in this study. Root yield was recorded at 90, 120 and 150 DAP. The result indicates that the higher root yield (27.69 t ha<sup>-1</sup>) was recorded on 16 November planting and the lower value (13.21 t ha<sup>-1</sup>) on 30 November planting in the first harvest. In the second harvest, the higher root yield (32.10 t ha<sup>-1</sup>) was recorded on 16 November planting and the lower value (26.31 t ha<sup>-1</sup>) on 30 November. Finally, the higher root yield (32.71 t ha<sup>-1</sup>) was recorded on 16 November planting and the lower value (30.13 t ha<sup>-1</sup>) on 30 November planting in the final harvest (Figure 03).



**Figure 03. Effect of planting date on root yield (t/ha) at different DAP.**

The vertical bars represent LSD values at 1% level of probability. P<sub>1</sub>=16 November, P<sub>2</sub>=30 November

**Dry weight of root/plant:** Planting dates exerted a significant effect on the dry weight of root per plant in this study. The result indicates the higher dry weight of root/plant (19.73 g) on 16 November planting and the lower value (8.83 g) on 30 November planting in the first harvest. The higher dry weight of root/plant (19.36 g) on 16 November planting and the lower value (14.33 g) on 30 November planting in the second harvest. The higher dry weight of root/Plant (22.24 g) on 16 November planting and the lower value (16.19 g) on 30 November planting in final harvest (Table 01).

**Table 01. Effect of planting date on root length, fresh wt. of root/plant, root yield/plot, dry wt. of root/plant of sugarbeet on different days after planting**

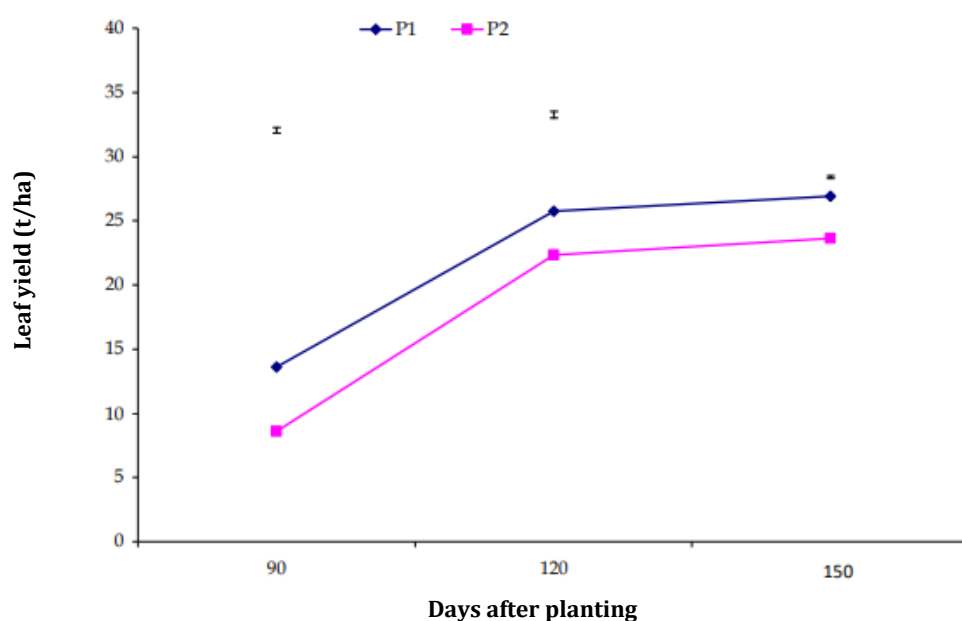
Planting date	Root length at different DAP			Fresh wt. of root/plant (g) at DAP			Root yield/plot (kg) at DAP			Dry wt. of root/plant (g) at DAP		
	90	120	150	90	120	150	90	120	150	90	120	150
P <sub>1</sub>	12.32	12.70	14.05	138.47	160.49	163.55	5.54	6.42	6.54	19.73	19.38	22.24
P <sub>2</sub>	9.89	11.11	12.14	66.04	131.53	150.63	2.64	5.26	6.03	8.83	14.33	16.19
LSD <sub>0.05</sub>	0.24	0.73	0.49	2.96	3.19	1.66	0.10	0.13	0.14	0.94	0.41	0.59
LSD <sub>0.01</sub>	0.33	1.00	0.67	4.06	4.43	2.27	0.13	0.17	0.19	1.29	0.56	0.81
Level of significance	**	**	**	**	**	**	**	**	**	**	**	**

P<sub>1</sub> = 16 November, P<sub>2</sub> = 30 November; \*\* = Significant at 1% level of probability

**Fresh weight of leaves/ plant:** The fresh weight of leaves/plants showed significant variation due to planting dates. In the first harvest, at 90 DAP the results revealed that the higher value of the fresh weight of leaves/plant (64.04 g) was recorded on 16 November planting and the lower value (42.92 g) on 30 November planting. In the second harvest, at 120 DAP the results recorded that the higher fresh weight of leaves/plant (128.64 g) was recorded on 16 November planting and the lower value (111.574 g) on 30 November planting. In the final harvest, at 150 DAP the results recorded that the higher fresh weight of leaves/plant (134.64 g) was recorded on 16 November planting and the lower value (118.12 g) on 30 November planting (Table 02).

**Leaf yield/plot:** Leaf yield/plot showed significant variation due to planting dates. In the first harvest, at 90 DAP the results revealed that the higher leaf yield/plot (2.72 kg) was recorded on 16 November planting and the lower value (1.72 kg) on 30 November planting. In the second harvest, at 120 DAP the results recorded that the higher leaf yield/ plot (5.146 kg) was recorded on 16 November planting and the lower value (4.464 kg) on 30 November planting. In the final harvest, at 150 DAP the results recorded that the higher leaf yield/plot (5.39 kg) was recorded on 16 November planting and the lower value (4.73 kg) on 30 November planting (Table 02).

**Leaf yield:** Leaf yield showed significant variation due to planting dates. In the first harvest, at 90 DAP the results revealed that the higher value of leaf yield (13.61 t ha<sup>-1</sup>) was recorded on 16 November planting and the lower value (8.59 t ha<sup>-1</sup>) on 30 November planting. In the second harvest, at 120 DAP the results recorded that the higher leaf yield (25.728 t ha<sup>-1</sup>) was recorded on 16 November planting and the lower value (22.314 t ha<sup>-1</sup>) on 30 November planting. In the final harvest, at 150 DAP the results recorded that the higher leaf yield (26.93 t ha<sup>-1</sup>) was recorded on 16 November planting and the lower value (23.62 t ha<sup>-1</sup>) on 30 November planting (Figure 04).

**Figure 04. Main effect of planting date on leaf yield (t/ha) at different DAP.**

The vertical bars represent LSD values at 1% level of probability. P<sub>1</sub>=16 November, P<sub>2</sub>=30 November

**Table 02. Effect of planting date on fresh wt. of leaves/plant, leaf yield/plot, dry wt. of leaves/plant of sugarbeet on different days after planting**

Planting date	Fresh wt. of leaves/plant (g) at DAP			Leaf yield/plot (kg) at DAP			Dry wt. of leaves/plant (g) at DAP		
	90	120	150	90	120	150	90	120	150
	P <sub>1</sub>	68.04	128.64	134.64	2.72	5.146	5.39	8.68	9.45
P <sub>2</sub>	42.92	111.57	118.12	1.72	4.464	4.73	6.99	7.57	8.94
LSD <sub>0.05</sub>	0.56	3.08	2.84	0.24	0.12	0.08	0.08	0.38	0.73
LSD <sub>0.01</sub>	0.72	4.23	3.89	0.33	0.16	0.11	0.11	0.52	1.00
Level of significance	**	**	**	**	**	**	**	**	**

P<sub>1</sub> = 16 November, P<sub>2</sub> = 30 November; \*\* = Significant at 1% level of probability

**Dry weight of leaves/plant:** A significant effect on the dry weight of leaves per plant was observed in this study. The result showed the higher dry weight of leaves/plant (8.68 g) on 16 November planting and the lower value (6.99 g) on 30 November planting in the first harvest. The higher dry weight of leaves/plant (9.45 g) on 16 November planting and the lower value (7.57 g) on 30 November planting in the second harvest. The higher dry weight of root/plant (10.84 g) on 16 November planting and the lower value (8.94 g) on 30 November planting in final harvest (Table 02).

**Root diameter:** Root diameter showed a significant variation due to planting dates. In the first harvest, at 90 DAP the results revealed that the higher upper portion (5.37cm), the middle portion (4.12 cm), the lower portion (1.29 cm) were recorded on 16 November planting, and the upper portion (3.94 cm), the middle portion (2.86 cm), the lower portion (1.29 cm) on 30 November planting. In the second harvest, at 120 DAP the results showed that the higher upper portion (6.04 cm), the middle portion (4.79 cm), and the lower portion (1.37 cm) were recorded on 16 November planting, and the lower upper portion (5.95 cm), the middle portion (4.58 cm) and lower portion (1.25 cm) on 30 November planting. In the final harvest, at 150 DAP the results showed that the higher upper portion (6.50 cm), the middle portion (5.19cm), and the lower portion (1.41 cm) were recorded on 16 November planting and the lower upper portion (6.11 cm), the middle portion (4.96 cm), and lower portion (1.29 cm) on 30 November planting (Table 03).

**Table 03. Effect of planting date on root diameter and TSS of sugarbeet on different days after planting.**

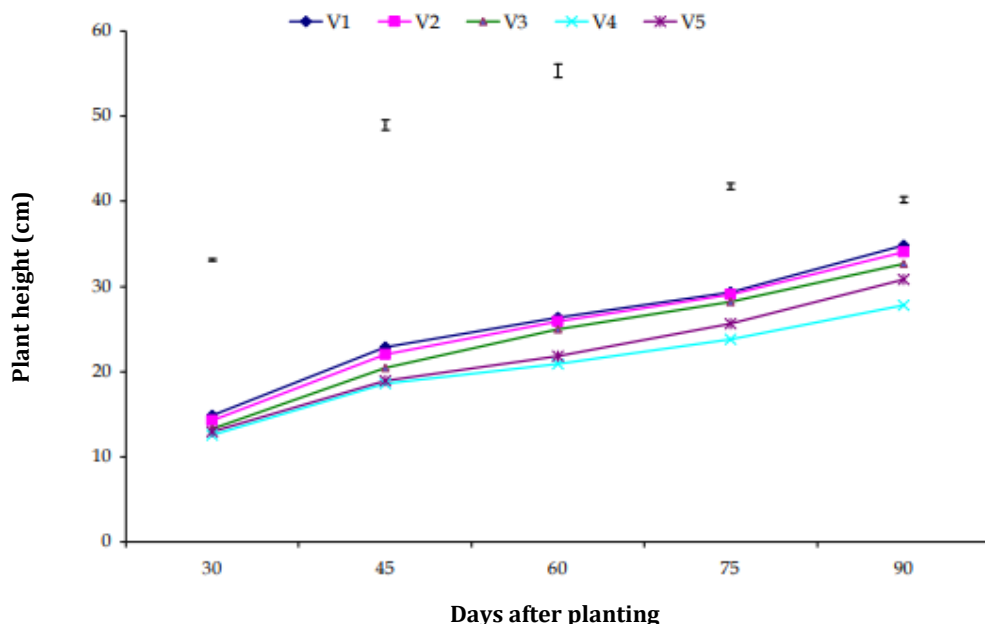
Planting date	Root diameter (cm) at DAP									TSS (% Brix) at DAP		
	90			120			150			90	120	150
	Upper portion	Middle portion	Lower portion	Upper portion	Middle portion	Lower portion	Upper portion	Middle portion	Lower portion			
P <sub>1</sub>	5.37	4.12	1.29	6.04	4.79	1.37	6.50	5.19	1.41	20.76	23.36	23.70
P <sub>2</sub>	3.94	2.86	1.19	5.95	4.58	1.25	6.11	4.96	1.29	20.48	21.59	21.99
LSD <sub>0.05</sub>	0.29	0.23	0.05	0.28	0.13	0.12	0.07	0.06	0.06	0.18	0.36	0.12
LSD <sub>0.01</sub>	0.40	0.32	0.08	0.38	0.18	0.17	0.10	0.08	0.08	0.25	0.50	0.17
Level of significance	**	**	NS	NS	**	NS	**	**	**	NS	**	**

P<sub>1</sub> = 16 November, P<sub>2</sub> = 30 November, \*\* = Significant at 1% level of probability, NS = Non-significant 4.1.13 Total soluble solid

Planting dates exerted a significant effect on total soluble solids (TSS) in this study. The result indicates the higher TSS (20.76%) on 16 November planting and the lower value (20.48%) on 30 November planting in the first harvest. The higher TSS (23.36%) on 16 November planting and the lower value (21.59 %) on 30 November planting in the second harvest. The higher TSS (23.70%) on 16 November planting and the lower value (21.99%) on 30 November planting in final harvest (Table 03).

**Effect of varieties on yield and yield contributing characters of sugarbeet**

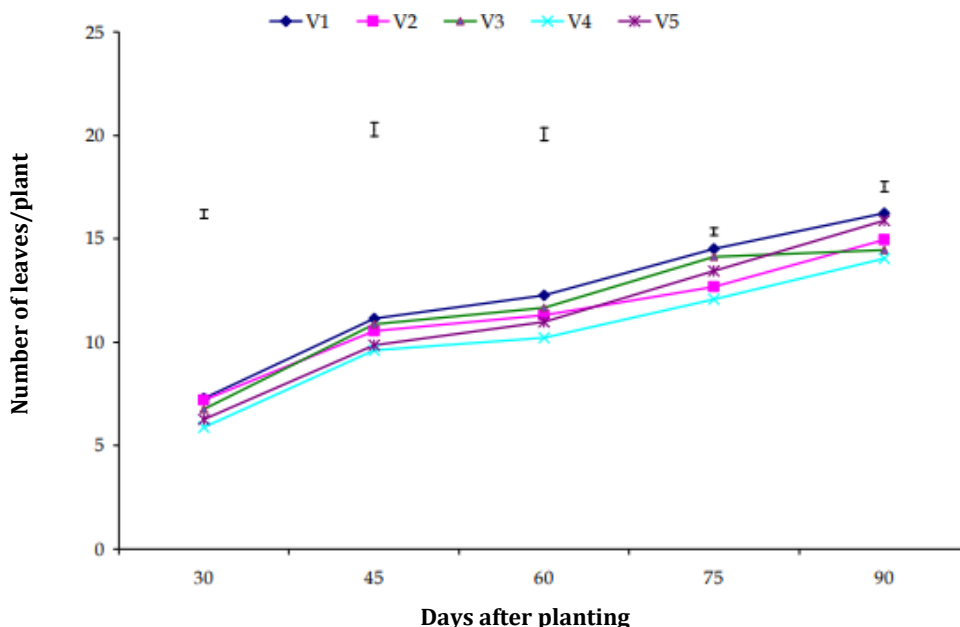
**Plant height:** Plant height showed a significant variation due to different varieties. Plant height was recorded at 30, 45, 60, 75 and 90 DAP. The result showed that the highest plant height (34.85 cm) was recorded in Serenada and the lowest value (27.78 cm) in Danicia at 90 DAP (Figure 05).



**Figure 05. Main effect of variety on plant height (cm) at different DAP.**

The vertical bars represent LSD values at 1% level of probability. V<sub>1</sub>=Serenada, V<sub>2</sub>=Aranka, V<sub>3</sub>=Belleza, V<sub>4</sub>= Dancia, V<sub>5</sub>=Natura.

**Number of leaves per plant:** Variety exerted a significant effect on the number of leaves per plant in this study. A number of leaves were recorded at 30, 45, 60, 75 and 90 DAP. The result indicates that the highest number of leaves (16.24) was recorded in Serenada and the lowest value (14.04) in Danicia at 90 DAP (Figure 06).



**Figure 06. Main effect of variety on number of leaves/plant at different DAP.**

The vertical bars represent LSD values at 1% level of probability. V<sub>1</sub>=Serenada, V<sub>2</sub>=Aranka, V<sub>3</sub>=Belleza, V<sub>4</sub>= Dancia, V<sub>5</sub>=Natura.

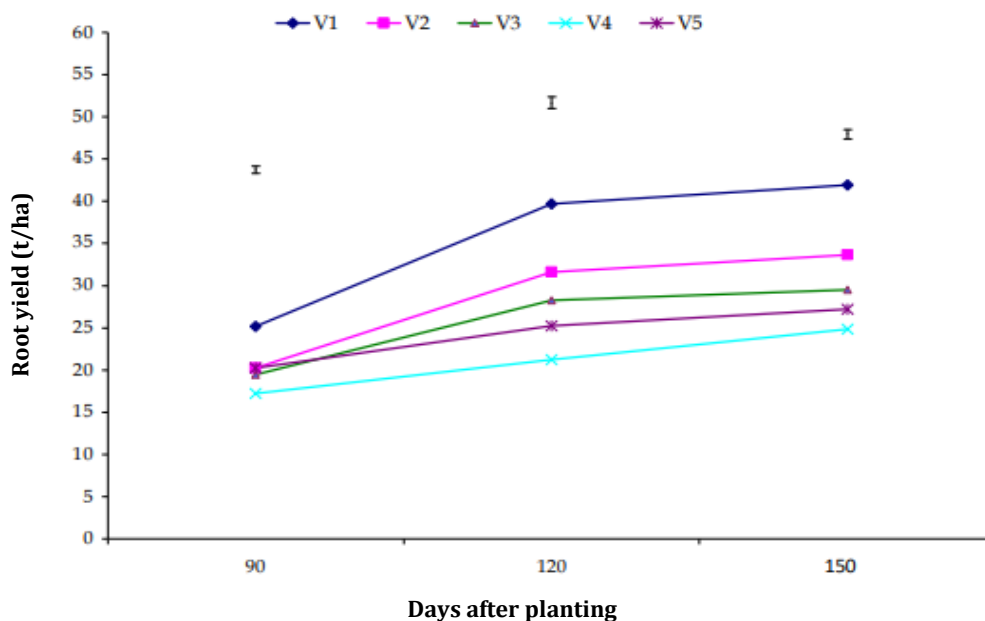
**Root length:** Root length showed a significant variation due to variety. In the first harvest, at 90 DAP the results revealed that the highest root (12.44 cm) was recorded in Serenada and the lowest value (9.38 cm) in Danicia. In the second harvest, at 120 DAP the results showed that the highest root (15.45 cm) was recorded in Serenada and the lowest value (10.32 cm) in Danicia. In the final harvest, at 120

DAP the results showed that the highest root (17.18 cm) was recorded in Serenada and the lowest value (10.89 cm) in Danicia (Table 04).

**Fresh weight of root per plant:** Variety significantly affected the fresh weight of root per plant in this study. The fresh root weight per plant was recorded at 90, 120 and 150 DAP. The result indicates that the highest fresh weight of root/plant (125.67 g) was recorded in Serenada and the lowest value (86.00 g) in Danicia in the first harvest. In the second harvest, the highest fresh weight of root/plant (198.40 g) was reported in Serenada and the lowest value (106.20 g) was reported in Danicia. In the final harvest, the highest fresh weight of root/plant (209.80 g) was reported in Serenada and the lowest value (124.09 g) was reported in Danicia (Table 04).

**Root yield/plot:** Root yield/plot showed a significant variation due to variety. Root yield per plot was recorded at 90, 120 and 150 DAP. The result indicates that the highest root yield/plot (5.03 kg) was recorded in Serenada and the lowest value (3.44 kg) in Danicia in the first harvest. In the second harvest, the highest root yield/plot (7.94 kg) was reported in Serenada and the lowest value (4.25 kg) was reported in Danicia. In the final harvest, the highest root yield/plot (8.40 kg) was reported in Serenada and the lowest value (4.97 kg) was reported in Danicia (Table 04).

**Root yield:** Variety significantly affected root yield in this study. Root yield was recorded at 90, 120 and 150 DAP. The result indicates that the highest root yield (25.14 t ha<sup>-1</sup>) was recorded in Serenada and the lowest value (17.20 t ha<sup>-1</sup>) in Danicia in the first harvest. In the second harvest, the highest root yield (39.68 t ha<sup>-1</sup>) was reported in Serenada and lowest value (21.24 t ha<sup>-1</sup>) was reported in Danicia. In the final harvest, the highest root yield (41.96 t ha<sup>-1</sup>) was reported in Serenada and the lowest value (24.81 t ha<sup>-1</sup>) was reported in Danicia (Figure 07).



**Figure 07. Main effect of variety on root yield (t/ha) at different DAP.**

The vertical bars represent LSD values at 1% level of probability. V<sub>1</sub>=Serenada, V<sub>2</sub>=Aranka, V<sub>3</sub>=Belleza, V<sub>4</sub>= Danicia, V<sub>5</sub>=Natura.

**Dry weight of root/plant:** Variety exerted a significant effect on the dry weight of root per plant in this study. The result indicates the highest dry weight of root/plant (17.30 g) in Serenada and the lowest value (11.05 g) in Danicia in the first harvest. The highest dry weight of root/plant (19.97 g) in Serenada and the lowest value (13.17 g) in Danicia in the second harvest. The highest dry weight of root/plant (22.69 g) in Serenada and the lowest value (15.83 g) in Danicia in final harvest (Table 04).

**Fresh weight of leaves/plant:** The fresh weight of leaves/plants showed significant variation due to variety. In the first harvest, at 90 DAP the results revealed that Serenada produced the highest fresh weight of leaves/plant (87.77 g) and Danicia produced the lowest value (23.67 g). In the second harvest, at 120 DAP the results recorded that Serenada produced the highest fresh weight of leaves/plant (150.60 g) and Danicia produced the lowest value (89.14 g). In the final harvest, at 150



DAP the results recorded that Serenada produced the highest fresh weight of leaves/plant (158.18 g) and Danicia produced the lowest value (93.63 g) (Table 05).

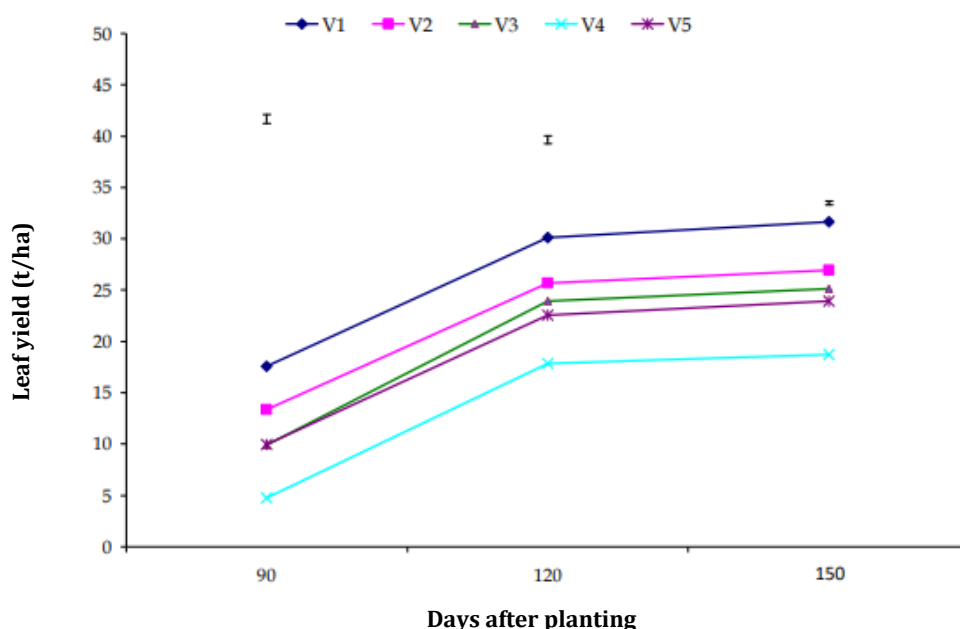
**Table 04. Effect of variety on root length, fresh wt. of root/plant, root yield/plot, dry wt. of root/plant of sugarbeet on different days after planting**

Planting date	Root length (cm) at DAP			Fresh wt. of root/plant (g) at DAP			Root yield/plot (kg) at DAP			Dry wt. of root/plant (g) at DAP		
	90	120	150	90	120	150	90	120	150	90	120	150
V <sub>1</sub>	12.44	15.45	17.18	125.67	198.40	209.80	5.03	7.94	8.40	17.30	19.97	22.69
V <sub>2</sub>	11.40	11.72	13.07	101.17	158.00	168.09	4.05	6.32	6.72	15.82	16.95	19.47
V <sub>3</sub>	11.34	11.50	12.28	97.14	141.17	147.59	3.89	5.65	5.91	12.78	16.76	18.51
V <sub>4</sub>	9.38	10.32	10.89	86.00	106.20	124.04	3.44	4.25	4.97	11.05	13.17	15.83
V <sub>5</sub>	10.99	11.02	12.07	101.30	126.30	135.96	4.05	5.05	5.44	14.46	17.44	19.60
LSD <sub>0.05</sub>	0.38	1.16	0.77	4.69	5.04	2.63	0.15	0.20	0.22	1.50	0.65	0.94
LSD <sub>0.01</sub>	0.53	1.59	1.06	6.42	6.90	3.60	0.21	0.28	0.31	2.05	0.89	1.29
Level of significance	**	**	**	**	**	**	**	**	**	**	**	**

V<sub>1</sub> = Serenada, V<sub>2</sub> = Aranka, V<sub>3</sub> = Belleza, V<sub>4</sub> = Danicia, V<sub>5</sub> = Natura; \*\* = Significant at 1% level of probability

**Leaf yield/plot:** Leaf yield/plot showed significant variation due to variety. In the first harvest, at 90 DAP the results revealed that Serenada produced the highest leaf yield/plot (3.51 kg) and Danicia produced the lowest value (0.95 kg). In the second harvest, at 120 DAP the results recorded that Serenada produced the highest leaf yield/plot (6.03 kg) and Danicia produced the lowest value (3.57 kg). In the final harvest, at 150 DAP the results recorded that Serenada produced the highest leaf yield/plot (6.33 kg) and Danicia produced the lowest value (3.75 kg) (Table 05).

**Leaf yield:** Leaf yield showed significant variation due to variety. In the first harvest, at 90 DAP the results revealed that Serenada produced the highest leaf yield (17.56 t ha<sup>-1</sup>) and Danicia produced the lowest value (4.74 t ha<sup>-1</sup>). In the second harvest, at 120 DAP the results recorded that Serenada produced the highest leaf yield (30.12 t ha<sup>-1</sup>) and Danicia produced the lowest value (17.83 t ha<sup>-1</sup>). In the final harvest, at 150 DAP the results recorded that Serenada produced the highest leaf yield (31.64 t ha<sup>-1</sup>) and Danicia produced the lowest value (18.73 t ha<sup>-1</sup>) (Figure 08).



**Figure 08. Main effect of variety on leaf yield (t/ha) at different DAP.**

Vertical bars represent LSD values at 1% level of probability. V<sub>1</sub>=Serenada, V<sub>2</sub>=Aranka, V<sub>3</sub>=Belleza, V<sub>4</sub>= Danicia, V<sub>5</sub>=Natura.

**Dry weight of leaves/plant:** A significant effect of variety on the dry weight of leaves per plant was observed in this study. The result showed the highest dry weight of leaves/plant (9.38 g) in Serenada and the lowest value (5.28 g) in Danicia in the first harvest. The highest dry weight of leaves/plant

(9.60 g) in Serenada and the lowest value (6.67 g) in Danicia in the second harvest. The highest dry weight of leaves/plant (11.53 g) in Serenada and the lowest value (8.01 g) in Danicia in final harvest (Table 05).

**Table 05. Effect of variety on fresh wt. of leaves/plant, leaf yield/plot, dry wt. of leaves/plant of sugarbeet on different days after planting**

Planting date	Fresh wt. of leaves/plant (g) at DAP			Leaf yield/plot (kg) at DAP			Dry wt. of leaves/plant (g) at DAP		
	90	120	150	90	120	150	90	120	150
V <sub>1</sub>	87.77	150.60	158.18	3.51	6.03	6.33	9.38	9.60	11.53
V <sub>2</sub>	66.77	128.30	134.78	2.68	5.13	5.40	8.83	8.50	10.00
V <sub>3</sub>	49.54	119.70	125.67	1.98	4.79	5.03	7.19	9.04	10.02
V <sub>4</sub>	23.67	89.14	93.63	0.95	3.57	3.75	5.28	6.67	8.01
V <sub>5</sub>	49.67	112.80	119.62	1.99	4.52	4.79	8.50	8.75	9.92
LSD <sub>0.05</sub>	0.83	4.88	4.50	0.38	0.19	0.13	0.12	0.60	1.15
LSD <sub>0.01</sub>	1.13	6.69	6.16	0.52	0.26	0.18	0.17	0.83	1.58
Level of significance	**	**	**	**	**	**	**	**	**

V<sub>1</sub> = Serenada, V<sub>2</sub> = Aranka, V<sub>3</sub> = Belleza, V<sub>4</sub> = Danicia, V<sub>5</sub> = Natura; \*\* = Significant at 1% level of probability

**Root diameter:** Root diameter showed a significant variation due to variety. In the first harvest, at 90 DAP the results revealed that the highest upper portion (5.09 cm), the middle portion (3.95 cm), the lower portion (1.62 cm) were recorded in Serenada, and the lowest upper portion (4.27cm), the middle portion (2.95 cm), the lower portion (1 cm) in Danicia. In the second harvest, at 120 DAP the results showed that Serenada produced the highest upper portion (6.69 cm), the middle portion (5.58 cm), the lower portion (1.65 cm) and Danicia produced the lowest upper portion (5.50 cm), the middle portion (3.98 cm) and lower portion (1.13 cm). In the final harvest, at 120 DAP the results showed that Serenada produced the highest upper portion (7.39 cm), the middle portion (6.25 cm), the lower portion (1.67 cm) and Danicia produced the lowest upper portion (5.60 cm), the middle portion (4.42 cm) and lower portion (1.17 cm) (Table 06).

**Total soluble solid:** Variety exerted a significant effect on total soluble solids (TSS) in this study. The result indicates the highest TSS (21.29%) in Serenada and the lowest value (20.23 %) in Danicia in the first harvest. The highest TSS (23.53%) in Serenada and the lowest value (21.86%) in Danicia in the second harvest. The highest TSS (24.00%) in Serenada and the lowest value (21.99%) in Danicia in the final harvest (Table 06).

**Table 06. Effect of variety on root diameter and TSS of sugarbeet on different days after planting**

Planting date	Root diameter (cm) at DAP									TSS (% Brix) at DAP		
	90			120			150			90	120	150
	Upper portion	Middle portion	Lower portion	Upper portion	Middle portion	Lower portion	Upper portion	Middle portion	Lower portion			
V <sub>1</sub>	5.09	3.95	1.62	6.69	5.58	1.65	7.39	6.25	1.67	21.29	23.53	24.00
V <sub>2</sub>	4.50	3.32	1.20	6.14	4.99	1.17	6.37	5.32	1.24	20.81	22.16	22.59
V <sub>3</sub>	4.64	3.47	1.25	6.04	4.64	1.35	6.11	4.84	1.38	20.31	22.18	22.95
V <sub>4</sub>	4.27	2.95	1.00	5.50	3.98	1.13	5.60	4.42	1.17	20.23	21.86	21.99
V <sub>5</sub>	4.79	3.77	1.14	5.62	4.23	1.28	6.07	4.57	1.30	20.47	22.64	22.73
LSD <sub>0.05</sub>	0.46	0.37	0.09	0.44	0.21	0.19	0.12	0.10	0.10	0.29	0.58	0.20
LSD <sub>0.01</sub>	0.63	0.50	0.12	0.60	0.28	0.27	0.16	0.13	0.13	0.40	0.79	0.27
Level of significance	NS	NS	**	**	**	*	**	**	**	**	**	**

V<sub>1</sub> = Serenada, V<sub>2</sub> = Aranka, V<sub>3</sub> = Belleza, V<sub>4</sub> = Danicia, V<sub>5</sub> = Natura; \*\* = Significant at 1% level of probability  
NS=Non significant

## Combined effect of planting dates and variety on yield and yield contributing characteristics of sugarbeet

**Plant height:** Plant height showed a significant response due to the combined effect of planting dates and variety. The highest plant height (36.47 cm) was recorded on 16 November planting with variety Serenada and the lowest value (26.93 cm) was observed on 30 November planting with Danicia variety at 90 DAP (Table 07).

**Number of leaves per plant:** The combined effect of planting dates and variety on the number of leaves/plants was significant in the study. The highest number of leaves/plant (16.60) was recorded on 16 November planting with variety Serenada and the lowest value (13.60) was observed on 30 November planting with Danicia variety at 90 DAP (Table 07).

**Table 07. The combined effect of planting date and variety on plant height and number of leaves/plants on different days after planting**

Treatment combination	Plant height (cm) at different DAP					Number of leaves/plants at different DAP				
	30	45	60	75	90	30	45	60	75	90
P <sub>1</sub> V <sub>1</sub>	16.53	28.80	30.60	31.47	36.47	7.33	13.07	13.00	15.07	16.60
P <sub>1</sub> V <sub>2</sub>	15.87	28.47	29.93	31.30	36.43	7.27	12.53	12.33	12.87	15.67
P <sub>1</sub> V <sub>3</sub>	14.40	25.93	28.60	29.83	33.27	6.73	12.87	12.53	14.87	15.27
P <sub>1</sub> V <sub>4</sub>	13.53	23.60	24.00	25.47	28.63	6.27	11.20	11.33	12.73	14.47
P <sub>1</sub> V <sub>5</sub>	13.87	24.20	25.27	27.93	33.93	6.60	11.27	11.47	14.27	16.60
P <sub>2</sub> V <sub>1</sub>	13.20	16.87	22.13	27.10	33.23	7.20	9.20	11.53	13.93	15.87
P <sub>2</sub> V <sub>2</sub>	12.60	15.60	21.80	26.80	31.63	7.10	8.53	10.27	12.47	14.20
P <sub>2</sub> V <sub>3</sub>	12.20	14.93	21.27	26.53	32.00	6.80	8.87	10.80	13.40	13.67
P <sub>2</sub> V <sub>4</sub>	11.56	13.60	17.80	22.10	26.93	5.50	8.00	9.07	11.40	13.60
P <sub>2</sub> V <sub>5</sub>	12.00	13.67	18.40	23.37	27.73	5.95	8.47	10.47	12.60	15.13
LSD <sub>0.05</sub>	0.25	1.18	1.56	0.76	0.67	0.33	0.54	0.53	0.29	0.40
LSD <sub>0.01</sub>	0.34	1.62	2.14	1.04	0.91	0.46	0.74	0.72	0.40	0.55
Level of significance	**	**	*	*	**	**	**	**	**	**

V<sub>1</sub> = Serenada, V<sub>2</sub> = Aranka, V<sub>3</sub> = Belleza, V<sub>4</sub> = Danicia, V<sub>5</sub> = Natura; \*\* = Significant at 1% level of probability

**Root length:** A significant variation in root length was observed due to the combined effect of planting dates and variety. In the first harvest, at 90 DAP the highest root length (13.40 cm) was recorded in the combined between 16 November planting and the Serenada variety. The lowest value (7.53 cm) was measured on 30 November planting with the Danicia variety. In the second harvest, at 120 DAP the highest root length (17.23 cm) was recorded in the combined between 16 November planting; and the Serenada variety. The lowest value (9.70 cm) was measured on 30 November planting with the Danicia variety. In the final harvest, at 150 DAP the highest root length (18.69 cm) was recorded in the combined between 16 November planting and the Serenada variety. The lowest value (9.89 cm) was measured on 30 November, planting with the Danicia variety (Table 08).

**Fresh weight of root/plant:** Fresh weight of root/plant showed a significant response due to the combined effect of planting dates and variety. In the first harvest, at 90 DAP the highest fresh weight of root/ plant (158.13 t ha<sup>-1</sup>) was recorded in the combined between 16 November planting and the Serenada variety. The lowest value (51.20 t ha<sup>-1</sup>) was measured on 30 November planting with the Danicia variety. In the second harvest, at 120 DAP the highest fresh weight of root/plant (207.13 t ha<sup>-1</sup>) was recorded in the combined between 16 November planting and the Serenada variety. The lowest value (101.80 t ha<sup>-1</sup>) was measured on 30 November planting with the Danicia variety. In the final harvest, at 150 DAP the highest fresh weight of root/plant (225.69 t ha<sup>-1</sup>) was recorded in the combined between 16 November planting and the Serenada variety. The lowest value (120.40 t ha<sup>-1</sup>) was measured on 30 November planting with the Danicia variety (Table 08).

**Root yield/plot:** A significant variation of root yield/plot was observed due to the combined effect of planting dates and variety. In the first harvest, at 90 DAP the highest root yield/plot (6.33 kg) was recorded in the combined between 16 November planting and the Serenada variety. The lowest value (2.05 kg) was measured on 30 November planting with the Danicia variety. In the second harvest, at 120 DAP the highest root yield/plot (8.29 kg) was recorded in the combined between 16 November

planting and the Serenada variety. The lowest value (4.07kg) was measured on 30 November planting with the Danicia variety. In the final harvest, at 150 DAP the highest root yield/plot (9.03 kg) was recorded in the combined between 16 November planting and the Serenada variety. The lowest value (4.82 kg) was measured on 30 November planting with the Danicia variety (Table 08).

**Root yield:** A significant variation in root yield was observed due to the combined effect of planting dates and variety. In the first harvest, at 90 DAP the highest root yield (31.63 t ha<sup>-1</sup>) was recorded in the combined between 16 November planting and the Serenada variety. The lowest value (10.24 t ha<sup>-1</sup>) was measured on 30 November, planting with the Danicia variety. In the second harvest, at 120 DAP the highest root yield (41.43 t ha<sup>-1</sup>) was recorded in the combined between 16 November planting and the Serenada variety. The lowest value (20.36 t ha<sup>-1</sup>) was measured on 30 November planting with the Danicia variety. In the final harvest, at 150 DAP the highest root yield (45.14 t ha<sup>-1</sup>) was recorded in the combined between 16 November planting and the Serenada variety. The lowest value (24.08 t ha<sup>-1</sup>) was measured on 30 November planting with the Danicia variety (Table 08).

**Dry weight of root/plant:** The dry weight of root/plant showed a significant response due to the combined effect of planting dates and variety. In the first harvest, at 90 DAP the highest dry weight of root/ plant (23.44 g) was recorded in the combined between 16 November planting and the Serenada variety. The lowest value (6.91 g) was measured on 30 November planting with the Danicia variety. In the second harvest, at 120 DAP the highest dry weight of root/plant (24.71 g) was recorded in the combined between 16 November planting and the Serenada variety. The lowest value (13.10 g) was measured on 30 November, planting with the Danica variety. In the final harvest, at 150 DAP the highest dry weight of root/plant (26.69 g) was recorded in the combined between 16 November planting and the Serenada variety. The lowest value (14.78 g) was measured on 30 November planting with the Danicia variety (Table 08).

**Table 08. The combined effect of planting date and variety on root length, fresh wt. of root/plant, root yield/plot, root yield, dry wt. of root/plant of sugarbeet on different days after planting.**

Treatment combination	Root length (cm) at DAP			Fresh wt. of root/plant (g) at DAP			Root yield/plot (kg) at DAP			Root yield (t/ha) at DAP			Dry wt. of root/plant (g) at DAP		
	90	120	150	90	120	150	90	120	150	90	120	150	90	120	150
P <sub>1</sub> V <sub>1</sub>	13.40	17.23	18.69	158.13	207.13	225.69	6.33	8.29	9.03	31.63	41.43	45.14	23.44	24.71	26.69
P <sub>1</sub> V <sub>2</sub>	11.67	11.53	13.47	141.67	183.73	172.59	5.67	7.35	6.90	28.33	36.75	34.52	22.90	19.41	23.47
P <sub>1</sub> V <sub>3</sub>	13.30	12.20	13.55	133.67	151.00	151.48	5.35	6.04	6.06	26.73	30.20	30.30	16.09	18.99	20.69
P <sub>1</sub> V <sub>4</sub>	11.23	10.93	11.89	120.80	110.60	127.67	4.83	4.42	5.11	24.16	22.12	25.53	15.19	13.23	16.87
P <sub>1</sub> V <sub>5</sub>	12.00	11.63	12.67	138.07	150.00	140.33	5.52	6.00	5.61	27.61	30.00	28.07	21.02	20.57	23.5
P <sub>2</sub> V <sub>1</sub>	11.47	13.67	15.66	93.20	189.67	193.90	3.73	7.59	7.76	18.64	37.93	38.78	11.15	15.22	18.69
P <sub>2</sub> V <sub>2</sub>	11.13	11.00	12.67	60.67	132.27	163.59	2.43	5.29	6.54	12.13	26.45	32.72	8.73	14.48	15.47
P <sub>2</sub> V <sub>3</sub>	9.37	10.80	11.00	60.60	131.33	143.69	2.42	5.25	5.75	12.12	26.27	28.74	9.47	14.53	16.33
P <sub>2</sub> V <sub>4</sub>	7.53	9.70	9.89	51.20	101.80	120.40	2.05	4.07	4.82	10.24	20.36	24.08	6.91	13.10	14.78
P <sub>2</sub> V <sub>5</sub>	9.97	10.40	11.47	64.53	102.60	131.59	2.58	4.10	5.26	12.91	20.52	26.32	7.90	14.31	15.69
LSD <sub>0.05</sub>	0.54	1.64	1.09	6.63	7.13	3.71	0.22	0.29	0.32	0.88	0.84	0.66	2.12	0.92	1.33
LSD <sub>0.01</sub>	0.75	2.25	1.50	9.09	9.77	5.09	0.30	0.40	0.44	1.20	1.15	0.90	2.90	1.27	1.83
Level of significance	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**

P<sub>1</sub>= 16 November, P<sub>2</sub>=30 November, V<sub>1</sub>=Serenada, V<sub>2</sub>=Aranka, V<sub>3</sub>=Belleza, V<sub>4</sub>= Danicia, V<sub>5</sub>=Natura; \*\*=Significant at 1% level of probability

**Fresh weight of leaves/plant:** A significant variation in the fresh weight of leaves/plants was observed due to the combined effect of planting dates and variety. In the first harvest, at 90 DAP the highest fresh weight of leaves/plant (108.00 g) was recorded in the combined between 16 November planting and the Serenada variety. The lowest value (12.00 g) was measured on 30 November planting with the Danicia variety. In the second harvest, at 120 DAP the highest fresh weight of leaves/plant (151.00 g) was recorded in the combined between 16 November planting and Serenada variety. The lowest value (87.07 g) was measured on 30 November planting with the Danicia variety. In the final harvest, at 150 DAP the highest fresh weight of leaves/plant (159.69 g) was recorded between 16 November planting and the Serenada variety. The lowest value (90.36 g) was measured on 30 November planting with the Danicia variety (Table 09).

**Leaf yield/plot:** A significant variation of leaf yield/plot was observed due to the combined effect of planting dates and variety. In the first harvest, at 90 DAP the highest leaf yield/plot (4.32 kg) was recorded in the combined between 16 November planting and the Serenada variety. The lowest value (0.48 kg) was measured on 30 November planting with the Danicia variety. In the second harvest, at 120 DAP the highest leaf yield/plot (6.04 kg) was recorded in the combined between 16 November planting and the Serenada variety. The lowest value (3.48 kg) was measured on 30 November planting with the Danicia variety. In the final harvest, at 150 DAP the highest leaf yield/plot (6.39 kg) was recorded in the combined between 16 November planting and the Serenada variety. The lowest value (3.61 kg) was measured on 30 November planting with the Danicia variety (Table 09).

**Leaf yield:** A significant variation in leaf yield was observed due to the combined effect of planting dates and variety. In the first harvest, at 90 DAP the highest leaf yield (21.60 t ha<sup>-1</sup>) was recorded in the combined between 16 November planting and the Serenada variety. The lowest value (2.40 t ha<sup>-1</sup>) was measured on 30 November planting with the Danicia variety. In the second harvest, at 120 DAP the highest leaf yield (30.20 t ha<sup>-1</sup>) was recorded in the combined between 16 November planting and the Serenada variety. The lowest value (17.41 t ha<sup>-1</sup>) was measured on 30 November planting with the Danicia variety. In the final harvest, at 150 DAP the highest leaf yield (31.94 t ha<sup>-1</sup>) was recorded in the combined between 16 November planting and the Serenada variety. The lowest value (18.07 t ha<sup>-1</sup>) was measured on 30 November planting with the Danicia variety (Table 09).

**Dry weight of leaves/plant:** A significant variation in the dry weight of leaves/plants was observed due to the combined effect of planting dates and variety. In the first harvest, at 90 DAP the highest dry weight of leaves/plant (9.54g) was recorded in the combined between 16 November planting and the Serenada variety. The lowest value (3.33 g) was measured on 30 November planting with the Danicia variety. In the second harvest, at 120 DAP the highest dry weight of leaves/plant (10.38 g) was recorded in the combined between 16 November planting and the Serenada variety. The lowest value (6.45 g) was measured on 30 November planting with the Danicia variety. In the final harvest, at 150 DAP the highest dry weight of leaves/plant (12.58 g) was recorded in the combined between 16 November planting and the Serenada variety. The lowest value (7.88 g) was measured on 30 November planting with the Danicia variety (Table 09).

**Table 09. The combined effect of planting date and variety on fresh wt. of leaves/plant, leaf yield/plot, leaf yield, dry wt. of leaves/plant of sugarbeet on different days after planting**

Treatment combination	Fresh wt. of leaves/plant (g) at DAP			Leaf yield/plot (kg) at DAP			Leaf yield (t/ha) at DAP			Dry wt. of leaves/plant (g) at DAP		
	90	120	150	90	120	150	90	120	150	90	120	150
P <sub>1</sub> V <sub>1</sub>	108.00	151.00	159.69	4.32	6.04	6.39	21.60	30.20	31.94	9.54	10.38	12.58
P <sub>1</sub> V <sub>2</sub>	82.40	147.06	153.17	3.30	5.90	6.13	16.48	29.52	30.63	8.94	9.44	10.33
P <sub>1</sub> V <sub>3</sub>	64.07	119.73	125.87	2.56	4.79	5.03	12.81	23.95	25.17	8.36	10.36	11.47
P <sub>1</sub> V <sub>4</sub>	35.33	91.20	96.90	1.41	3.65	3.88	7.07	18.24	19.38	7.22	6.88	8.14
P <sub>1</sub> V <sub>5</sub>	50.40	133.67	137.55	2.02	5.35	5.50	10.08	26.73	27.51	9.32	10.17	11.69
P <sub>2</sub> V <sub>1</sub>	67.53	150.20	156.67	2.70	6.01	6.27	13.51	30.04	31.33	9.22	8.82	10.47
P <sub>2</sub> V <sub>2</sub>	51.13	109.00	116.39	2.05	4.36	4.66	10.23	21.80	23.28	8.72	7.56	9.66
P <sub>2</sub> V <sub>3</sub>	35.00	119.67	125.47	1.40	4.79	5.02	7.00	23.93	25.09	6.02	7.72	8.56
P <sub>2</sub> V <sub>4</sub>	12.00	87.07	90.36	0.48	3.48	3.61	2.40	17.41	18.07	3.33	6.45	7.88
P <sub>2</sub> V <sub>5</sub>	48.93	91.93	101.69	1.96	3.68	4.07	9.79	18.39	20.34	7.67	7.32	8.15
LSD <sub>0.05</sub>	1.17	6.90	6.36	0.54	0.27	0.18	1.44	1.23	0.62	0.18	0.86	1.63
LSD <sub>0.01</sub>	1.61	9.46	8.71	0.74	0.37	0.25	1.97	1.69	0.86	0.24	1.18	2.24
Level of significance	**	**	**	**	**	**	**	**	**	**	**	*

P<sub>1</sub> = 16 November, P<sub>2</sub> = 30 November, and V<sub>1</sub> = Serenada, V<sub>2</sub> = Aranka, V<sub>3</sub> = Belleza, V<sub>4</sub> = Danicia, V<sub>5</sub> = Natura; \*\* = Significant at 1% level of probability.

**Root diameter:** Root diameter showed a significant variation due to the combined effect of planting dates and variety. In the first harvest, at 90 DAP the highest upper portion (5.57 cm), the middle portion (4.43 cm) and the lower portion (1.67 cm) were recorded on 16 November planting with Serenada variety. The lowest upper portion (3.47 cm), the middle portion (2.17 cm) and the lower portion (1 cm) on 30 November planting with Danicia variety. In the second harvest, at 120 DAP the

highest upper portion (6.87 cm), the middle portion (5.83 cm) and the lower portion (1.67 cm) were recorded on 16 November planting with Serenada variety. The lowest upper portion (5.43 cm), the middle portion (3.76 cm) and the lower portion (1.05 cm) on 30 November planting with Danicia variety. In the final harvest, at 150 DAP the highest upper portion (7.58 cm), the middle portion (6.50 cm) and the lower portion (1.70 cm) were recorded on 16 November planting with the Serenada variety. The lowest upper portion (5.33 cm), the middle portion (4.33 cm) and the lower portion (1.10 cm) on 30 November planting with Danicia variety (Table 10).

**Total soluble solid:** A significant variation of total soluble solids (TSS) was observed due to the combined effect of planting dates and variety. In the first harvest, at 90 DAP the highest TSS (21.29%) was recorded in the combined between 16 November planting and the Serenada variety. The lowest value (20.19 %) was measured on 30 November planting with the Danicia variety. In the second harvest, at 120 DAP the highest TSS (24.89%) was recorded in the combined between 16 November planting and the Serenada variety. The lowest value (21.15%) was measured on 30 November planting with the Danicia variety. In the final harvest, at 150 DAP the highest TSS (25.00%) was recorded in the combined between 16 November planting and the Serenada variety. The lowest value (21.30%) was measured on 30 November planting with the Danicia variety (Table 10).

**Table 10. Combined effect of planting date and variety on root diameter and TSS of sugarbeet on different days after planting**

Treatment combination	Root diameter (cm) at DAP									TSS (% Brix) at DAP		
	90			120			150			90	120	150
	Upper portion	Middle portion	Lower portion	Upper portion	Middle portion	Lower portion	Upper portion	Middle portion	Lower portion			
P <sub>1</sub> V <sub>1</sub>	5.57	4.43	1.67	6.87	5.83	1.67	7.58	6.50	1.70	21.29	24.89	25.00
P <sub>1</sub> V <sub>2</sub>	5.40	4.00	1.27	6.10	5.04	1.23	6.59	5.33	1.28	21.22	23.11	23.50
P <sub>1</sub> V <sub>3</sub>	5.40	4.10	1.30	5.97	4.43	1.47	6.22	5.00	1.50	20.39	22.82	23.89
P <sub>1</sub> V <sub>4</sub>	5.07	3.73	1.20	5.57	4.20	1.20	5.87	4.50	1.23	20.27	22.57	22.67
P <sub>1</sub> V <sub>5</sub>	5.40	4.33	1.20	5.70	4.43	1.30	6.25	4.63	1.33	20.61	23.39	23.45
P <sub>2</sub> V <sub>1</sub>	4.60	3.47	1.57	6.50	5.33	1.63	7.20	5.99	1.64	21.28	22.17	23.00
P <sub>2</sub> V <sub>2</sub>	3.60	2.63	1.13	6.17	4.93	1.10	6.15	5.30	1.20	20.39	21.21	21.67
P <sub>2</sub> V <sub>3</sub>	3.87	2.83	1.20	6.10	4.85	1.23	6.00	4.67	1.25	20.22	21.53	22.00
P <sub>2</sub> V <sub>4</sub>	3.47	2.17	1.00	5.43	3.76	1.05	5.33	4.33	1.10	20.19	21.15	21.30
P <sub>2</sub> V <sub>5</sub>	4.17	3.20	1.07	5.53	4.03	1.25	5.89	4.51	1.27	20.33	21.88	22.00
LSD <sub>0.05</sub>	0.65	0.52	0.13	0.62	0.29	0.28	0.17	0.14	0.14	0.42	0.82	0.28
LSD <sub>0.01</sub>	0.89	0.72	0.18	0.85	0.40	0.38	0.23	0.19	0.19	0.57	1.12	0.39
Level of significance	**	**	**	*	**	**	**	**	**	**	**	**

P<sub>1</sub> = 16 November, P<sub>2</sub> = 30 November; V<sub>1</sub> = Serenada, V<sub>2</sub> = Aranka, V<sub>3</sub> = Belleza, V<sub>4</sub> = Danicia, V<sub>5</sub> = Natura; \*\* = Significant at 1% level of probability

#### IV. Discussion

The result showed that the higher plant height (33.75 cm) and the number of leaves/plant (15.72) were recorded on 16 November planting and the lower plant height (30.31 cm) and lower number of leaves (14.49) on 30 November planting at 90 DAP. Lauer (1997) reported that early planting favors high plant establishment and provides better leaf growth, influencing the better root yield. The higher root length (12.32, 12.70 and 14.05 cm), root yield (27.69, 32.10 and 32.13 t ha<sup>-1</sup>), and leaf yield (13.61, 25.728 and 26.93 t ha<sup>-1</sup>) were recorded on 16 November planting and the lower root length (9.89, 11.11 and 12.14 cm), root yield (13.21, 26.31 and 30.13 t ha<sup>-1</sup>) and leaf yield (8.59, 22.314 and 23.62 t ha<sup>-1</sup>) on 30 November planting at 90, 120, 150 DAP, respectively. Rahman (2011) reported that the early planting date produced a higher root yield. The higher dry weight of root (22.24 g) and dry weight of leaves (10.84 g) were measured on 16 November planting and the lower dry weight of root (16.19 g) and dry weight of leaves (8.94 g) was measured on 30 November planting, respectively. The higher upper portion (6.50 cm), the middle portion (5.19 cm), the lower portion (1.41 cm) were

recorded on 16 November planting, and the lower upper portion (6.11 cm), the middle portion (4.96 cm), the lower portion (1.29 cm) on 30 November planting at 150 DAP. The previous study also supported that planting date influences both yield and yield contributing character of sugarbeet (Allam et al., 2005). The higher TSS (20.76, 23.36 and 23.70%) was recorded on 16 November planting and the lower value (20.48, 21.59 and 21.99%) on 30 November planting at 90, 120 and 150 DAP, respectively. These findings are supported by Refay (2010). The result showed that the highest plant height (3 4.85 cm) and the number of leaves (16.24) were recorded in Serenada and the lowest plant height (27.78 cm) and the number of leaves (14.04) in Danicia at 90 DAP, respectively. The highest root length (12.44, 15.45 and 17.18 cm), root yield (25.14, 39.68 and 41.96 t ha<sup>-1</sup>), leaf yield (17.56, 30.12 and 31.64 t ha<sup>-1</sup>) and TSS (21.2, 23.53 and 24.00%) was recorded in Serenada and the lowest root length (9.38, 10.32 and 10.89 cm), root yield (17.20, 21.24 and 24.81 t ha<sup>-1</sup>), leaf yield (4.74, 17.83 and 18.73 t ha<sup>-1</sup>) and TSS (20.23, 21.86 and 21.99%) in Danicia at 90, 120, 150 DAP, respectively. The highest dry weight of root (22.69 g) and dry weight of leaves (11.53 g) were measured from Serenada and the lowest dry weight of root (15.83 g) and dry weight of leaves (8.01 g) was measured from Danicia, respectively. The highest upper portion (7.39 cm), the middle portion (6.25 cm), the lower portion (1.67 cm) were recorded in Serenada and the lowest upper portion (5.60 cm), the middle portion (4.42 cm), the lower portion (1.17 cm) in Danicia at 150 DAP. The above-stated results revealed that Serenada gave the higher yield among the five varieties. It might happen due to the genetic variation among the varieties. The combined effect of planting dates and variety significantly affected most plant characters and yield. Serenada variety gave the higher root yield (31.63, 41.43 and 45.14 t ha<sup>-1</sup>) and leaf yield (21.6, 30.20 and 31.94 t ha<sup>-1</sup>) with 16 November planting at 90, 120, 150 DAP, respectively. The lower root yield (10.24, 20.36 and 24.08 t ha<sup>-1</sup>) and leaf yield (2.4, 17.41 and 18.07 t ha<sup>-1</sup>) with 30 November planting at 90, 120, 150 DAP, respectively obtained from the variety Danicia.

## V. Conclusion

Sugarbeet is mainly a temperate crop, but nowadays it grows in tropical areas. The experimental results showed that planting dates significantly affected the growth and yield of sugarbeet. The higher root yield (27.69, 32.10 and 32.71 t ha<sup>-1</sup>) and the higher leaf yield (13.61, 25.728, 26.93 t ha<sup>-1</sup>) were recorded from 16 November planting at 90, 120 and 150 DAP, respectively. The root yields and leaf yield decreased when after planting on 30 November. The varieties significantly influenced the growth and yield of sugarbeet. The highest root yield (25.14, 39.68 and 41.96 t ha<sup>-1</sup>) and leaf yield (17.56, 30.12 and 31.64 t ha<sup>-1</sup>) were found in the variety Serenada at 90, 120 and 150 DAP, respectively. The lowest root yield (17.20, 21.24 and 24.81 t ha<sup>-1</sup>) and leaf yield (4.74, 17.83 and 18.73 t ha<sup>-1</sup>) were obtained from the variety Danicia at 90, 120 and 150 DAP, respectively. Combined planting dates and variety significantly affected most plant characters and yield. Serenada variety gave the highest root yield (31.63, 41.43 and 45.14 t ha<sup>-1</sup>) and leaf yield (21.6, 30.20 and 31.94 t ha<sup>-1</sup>) with 16 November planting at 90, 120, 150 DAP, respectively. The lowest root yield (10.24, 20.36 and 24.08 t ha<sup>-1</sup>) and leaf yield (2.4, 17.41 and 18.07 t ha<sup>-1</sup>) with 30 November planting at 90, 120 and 150 DAP, respectively, were obtained from the variety Danicia. The results indicated that all the varieties gave a higher yield on 16 November planting compared to the planting on 30 November and among the varieties, Serenada gave the highest yield. This experiment was conducted in Mymensingh and during one season only. A further trial of this research work in different locations of the country is needed to recommend the result.

## Acknowledgment

The author expresses her profound appreciation and heartiest gratitude to her Supervisor, Professor Dr. Md. Azizur Rahman, Department of Horticulture, Bangladesh Agricultural University (BAU), Mymensingh, for his help, scholastic supervision, constructive criticism, intellectual guidance, continuous encouragement, and constructive suggestion.

## VI. References

- [1]. Abo-Salama, A. M. and EL Sayiad, S. I. (2000). Studies on some sugarbeet cultivars under Middle Egypt conditions: Response to sowing and harvesting dates. *Journal of Agricultural Science*, 31(1), 137-159.
- [2]. Allam, S. A. H., Mohamed, M. M., El Sayed, G. S. and Osman, A. M. H. (2005). Effect of sowing date, nitrogen fertilizer, and row spacing on yield and quality of sugarbeet crop. *Journal of Agricultural Science*, 43(1), 11-24.
- [3]. Anonymous, (2005). Tropical sugarbeet cultivation your pathway to profitability, Syngenta Bangladesh Limited, 8-11.
- [4]. BSRI (Bangladesh Sugarcane Research Institute) (2010). Annual report of 2010. Ishurdi, Pabna, Bangladesh, 1-7.
- [5]. FAO (Food and Agriculture Organization) (2010). Production Year Book. Food and Agriculture Organization, Rome, 54, 71-79.
- [6]. Gomez, K. N. and Gomez, A. A. (1984). Statistical procedures for agricultural research. John Wiley and Sons, New York, 2nd edition., 68.
- [7]. Lauer, J. G. (1997). Sugarbeet performance and interactions with sowing date, genotype, and harvest date. *Journal of Agronomy*, 26(2), 88.
- [8]. Rahman, M. K. (2011). Feasibility of sugarbeet cultivation in Bangladesh: A Review (Handbook in Bangali version). Bangladesh Sugarcane Research Institute. Ishurdi, Pabna, Bangladesh, 1-10.
- [9]. Refay, Y. A. (2010). Root yield and quality traits of three sugarbeet varieties/ lines concerning sowing date and stand densities. *World Journal of Agricultural Science*, 6(5), 589-594.
- [10]. Rinaldi, M. and Vonella, A. V. (2006). The response of autumn and spring sown sugarbeet (*Beta vulgaris L.*) to irrigation in Southern Italy: Water and radiation use efficiency. *Journal of Field Crops Research*, 95, 103-114. <https://doi.org/10.1016/j.fcr.2004.12.004>
- [11]. Song, W., Derito, C. M. and Liu, M. K. (2010). Cellular antioxidant activity of common vegetables. *Journal of Agricultural Food Chemistry*, 58(11), 6621-6629. <https://doi.org/10.1021/jf9035832>
- [12]. Ustimenko -Barumovsky, (1983). When should you sow the beet crop? *British Sugarbeet Review*, 46(1), 7-8.

### HOW TO CITE THIS ARTICLE?

Crossref: <https://doi.org/10.18801/jbar.290222.298>

#### MLA

Das, D. R. "Effect of planting dates on the growth and yield of five varieties of sugarbeet (*Beta vulgaris L.*)". *Journal of Bioscience and Agriculture Research*, 29(02), (2022): 2456-2471.

#### APA

Das, D. R. (2022). Effect of planting dates on the growth and yield of five varieties of sugarbeet (*Beta vulgaris L.*). *Journal of Bioscience and Agriculture Research*, 29(02), 2456-2471.

#### Chicago

Das, D. R. "Effect of planting dates on the growth and yield of five varieties of sugarbeet (*Beta vulgaris L.*)". *Journal of Bioscience and Agriculture Research*, 29(02), (2022): 2456-2471.

#### Harvard

Das, D. R. 2022. Effect of planting dates on the growth and yield of five varieties of sugarbeet (*Beta vulgaris L.*). *Journal of Bioscience and Agriculture Research*, 29(02), pp. 2456-2471.

#### Vancouver

Das, DR. Effect of planting dates on the growth and yield of five varieties of sugarbeet (*Beta vulgaris L.*). *Journal of Bioscience and Agriculture Research*, 2022 August, 29(02): 2456-2471.