

Effect of sowing dates on the growth and yield of carrot

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Abstract: An experiment was conducted at the USDA Alliums project Field Laboratory of Horticulture Farm, Bangladesh Agricultural University, Mymensingh during the period from 25 October 2015 to 20 May 2016 to investigate the effect of sowing dates on the growth and yield of carrot. The experimental treatments were five different sowing dates (25 October 2015, 15 November 2015, 5 December 2015, 30 December 2015, 10 February 2016) and two varieties BA (Brasilia Agroflora) and PA (Prima Agroflora) their constituted 10 treatments. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. All the treatments had the significant effect on the growth and development of carrot. The sowing date 15 November 2015 with the variety BA produced the highest (8.50 t/ha) root yield and the sowing date 10 February 2016 with variety PA gave the lowest (2.56 t/ha) root yield.

Key words: Sowing dates, growth, yield, carrot.

Introduction

The carrot (*Daucus carota*) is a root vegetable and easy to grow in sandy soil. Carrot is a domesticated form of the wild carrot. Carrot (*Daucus carota*), native to Europe and southwestern Asia, the plant probably originated in Persia and was originally cultivated for its leaves and seeds. Nowadays, the most commonly eaten part of the plant is the tap root, although the greens leaves are sometimes eaten as well. It is mainly a cold climatic crop but it can also be grown in a relatively higher temperature without much difficulty. According to Barnes (1939), 15.6°C to 21.1°C temperature is the best for its growth and development. In Bangladesh, it is grown during the winter season when the temperature ranges from 11.7°C to 28.9°C (Alim, 1974). It grows a rosette of leaves in the spring and summer while building up the stout taproot. Fast-growing varieties mature within three months of sowing the seed, while slower-maturing varieties are harvested in autumn and winter. The roots contain high quantities of alpha and beta carotene, and are a good source of vitamin K and vitamin B6. The Food and Agriculture Organization of the United Nations (FAO) reports that world production of carrots and turnips (these plants are combined by the FAO for reporting purposes) for calendar year 2013 was 37.2 million ton. Almost half were grown in China. Carrots are widely used in many cuisines, especially in preparation of salads, and carrot salads are a tradition in many regional cuisines. The area under carrot cultivation was 81312 thousand hectare with total production of 3389663 thousand tones in the world (FAO, 2006). In Bangladesh in the year 2011-2012, the area under carrot cultivation was 1564 hectares, total production was 13136 metric tones in Bangladesh (BBS, 2012). Sowing time is an important factor for quality root and seed production of carrot. The different sowing time of carrot have a significant effect on growth and yield due to availability of proper environmental factor. Usually low temperature is required for flowering. Proper sowing date is also an important key factor for its flowering. Moreover, its seed production is greatly influenced by temperature. Late sowing increases percent of root splitting, root firmness, contents of dry matter. Improper sowing date also reduces the respiratory quotient. Quality of root depends on the harvesting time under Bangladesh condition. Variety is also an important factor for carrot production. In our country there is no quality seed variety of carrot. Low yielding variety produces low yield and there will be economic loss. Selection of high yielding variety can bring a better yield. Varietal selection is the pre

condition for expected yield. Many countries have produced high yielding variety. The present experiment was conducted with the varieties PA (Prima Agroflora) and BA (Brasilia, Agroflora), they were imported from USA. Under this circumstances, the present study was undertaken with the aim of investigating the effects of sowing dates on the growth and yield of the two varieties of carrot. It is hoped that the information gathered from the result of the experiment would be helpful for the grower to increase the production and quality of carrot by sowing at proper time.

Materials and Methods

The working area was at the USDA-Alliums project Field Laboratory, Horticulture Farm of Bangladesh Agricultural University, Mymensingh. The land was medium high, soil was sandy loam type and pH was 6.7. Double factor experiment was consisted by two varieties (PA and BA) and five sowing dates (25 October 2015, 15 November 2015, 5 December 2015, 30 December 2015, 10 February 2016). The experiment was laid out in RCBD with 3 replications. Treatments were randomly assigned in the plots. Randomly ten plants were selected for data collection from each unit plot. Manuring was started from land preparation. Cow dung, Urea, TSP (Triple Super Phosphate) and MoP (Muriate of Potash) were applied @ 10 tons, 150 kg, 105 kg and 175 kg per hectare respectively. The total quantity of cow dung was applied during land preparation. Half of the recommended quantity of Urea, total quantity of TSP and half of MP were applied as top dressing after 30 days and the remaining halves of Urea and MP after 45 days of seed sowing. Intercultural operations were done as and when necessary. The harvesting was started after 45 days of sowing for each date of sowing and final harvesting was done at 100 days after sowing. Data were collected and recorded on different parameters of plants growth, development, quality and yield. The collected data were analyzed statistically. The means for all treatments were calculated and the analysis of variance for all of the characters were performed by F variance test. The significance of difference of difference between the pairs of mean was separated by LSD at 1% level of probability.

Results and Discussion

Shoot length: The length of the longest shoot was significantly influenced by the date of planting. At final harvest, the tallest shoot (48.18 cm) was obtained from the second sowing (Nov. 15) crop by 42.77 cm and the shortest shoot length was obtained in case of sowing at

Feb. 10 (29.89 cm) (Table 1). The variety BA significantly produced the taller plants (41.74 cm) compared to BA variety (36.79 cm) (Table 2). Significant combined effect of variety and sowing dates on shoot length was also observed showing the highest shoot length (11.76 cm) in BA variety sown on Nov. 15 and the lowest shoot length (28.69 cm) in BA variety planted on Feb. 10. At different

dates of harvest, it was observed that the length of shoot comparatively decreased as the continued irrespective of the sowing dates (Table 3). Favorable soil moisture and temperature is necessary for proper plant growth are stated by Sharma and Parashar (1980) and Haque and Bhuiya (1999).

Table 1. Effect of sowing dates on yield and yield contributing characters of carrot

Sowing date	Shoot Length (cm)	Number of leaves /plant	Root Length (cm)	Root diameter (cm)	Cracking %	Total weight (g)	Shoot weight (g)	Shoot dry weight (g)	Root weight (g)	Root dry weight (g)	Yield (kg/plot)	Yield (t/ha)
P ₁	41.66	7.51	6.90	1.96	3.33	57.94	36.31	6.05	21.63	4.32	27.60	5.52
P ₂	48.18	7.98	6.75	1.49	3.75	67.63	50.33	8.39	17.17	3.60	34.42	6.88
P ₃	42.77	10.00	9.71	2.81	3.75	47.85	23.18	5.15	7.60	2.47	25.15	5.03
P ₄	33.79	6.84	7.68	0.85	3.75	39.92	21.47	4.02	5.92	2.00	19.82	3.96
P ₅	29.89	8.03	6.30	0.81	2.00	23.88	18.77	3.50	5.06	1.75	14.75	2.95
LSD _{0.05}	0.69	0.24	0.09	0.10	0.11	1.86	1.46	0.63	0.64	0.41	1.49	0.29
LSD _{0.01}	0.95	0.33	0.13	0.14	0.15	2.55	1.99	0.86	0.87	0.57	2.04	0.41
Level of sig.	**	**	**	**	**	**	**	**	**	**	**	**

** = Significant at 1% level of probability, P₁ =25 October 2015, P₂ =15 November, 2015, P₃ =5 December 2015, P₄ =30 December 2015, P₅ =10 February 2016

Number of leaves: When sowing date and variety changes, it significantly affects on number of leaves (Appendix III). The maximum number of leaves (10) was recorded from the third sowing (Dec. 5). The minimum number of leaves was 6.84 that had been sown in 30 December (Table 1). The lower number (7.81) of leaves was observed in PA variety compared to BA (8.34) variety

(Table 2). Combination between sowing date and variety had also significant effect on yield of carrot. It was observed that plants sowing on 5 December (11.76) produces highest number of leaves on BA variety and the lowest number of leaves produced at 30 December (7.07) on PA variety (Table 3). Similar experimented was stated by Maurya and Singh (1985).

Table 2. Effect of variety on yield and yield contributing characters of carrot

Variety	Shoot Length (cm)	Number of leaves /plant	Root Length (cm)	Root diameter (cm)	Cracking %	Total weight (g)	Shoot weight (g)	Shoot dry weight (g)	Root weight (g)	Root dry weight (g)	Yield (kg/plot)	Yield (t/ha)
V ₁	41.74	7.81	7.42	1.16	3.17	40.62	26.89	4.75	8.43	1.62	21.11	4.22
V ₂	36.79	8.34	7.51	2.00	3.47	54.27	33.13	6.09	14.52	4.03	27.59	5.52
LSD _{0.05}	0.44	0.15	0.06	0.06	0.07	1.18	0.92	0.39	0.40	0.26	0.94	0.19
LSD _{0.01}	0.59	0.21	0.08	0.09	0.09	1.61	1.26	0.54	0.55	0.36	1.29	0.26
Level of sign.	**	**	**	**	**	**	**	**	**	**	**	**

** = Significant at 1% level of probability, V₁ = PA, V₂ = BA.

Table 3. Combined effects of sowing date and variety on yield and yield contributing characters of carrot

Treatment combination	Shoot Length (cm)	Number of leaves /plant	Root Length (cm)	Root diameter (cm)	Cracking %	Total weight (g)	Shoot weight (g)	Shoot dry weight (g)	Root weight (g)	Root dry weight (g)	Yield/plot (kg)	Yield (t/ha)
P ₁ V ₁	43.84	7.95	7.08	2.03	3.33	33.08	21.09	3.31	11.83	1.36	26.20	5.24
P ₁ V ₂	39.48	7.07	6.73	1.89	3.33	82.80	51.54	8.80	31.44	7.29	29.00	5.80
P ₂ V ₁	50.08	8.15	6.64	1.32	3.33	67.05	53.57	8.66	13.15	2.32	26.33	5.27
P ₂ V ₂	46.28	7.82	6.85	1.66	4.17	68.22	47.10	8.13	21.18	4.88	42.50	8.50
P ₃ V ₁	48.50	8.24	8.47	0.95	4.17	44.20	21.42	4.77	7.33	1.93	22.43	4.49
P ₃ V ₂	37.05	11.76	10.94	4.66	3.33	51.50	24.93	5.53	7.87	3.00	27.87	5.57
P ₄ V ₁	35.15	6.74	8.03	0.74	3.33	37.42	19.93	3.70	5.50	1.33	17.77	3.55
P ₄ V ₂	32.42	6.95	7.33	0.96	4.17	42.42	23.00	4.33	6.33	2.67	21.87	4.37
P ₅ V ₁	31.10	7.96	6.87	0.79	1.67	21.33	18.43	3.33	4.33	1.17	12.80	2.56
P ₅ V ₂	28.69	8.10	5.72	0.84	2.33	26.43	19.10	3.67	5.78	2.33	16.70	3.34
LSD _{0.05}	0.98	0.34	0.13	0.14	0.15	2.63	2.06	0.89	0.89	0.58	2.11	0.42
LSD _{0.01}	1.34	0.47	0.18	0.19	0.21	3.60	2.82	1.22	1.23	0.80	2.89	0.58
Level of sign.	**	**	**	**	**	**	**	**	**	**	**	**

** = Significant at 1% level of probability, P₁ = 25 October 2015, P₂ = 15 November 2015, P₃ = 5 December 2015, P₄ = 30 December 2015, P₅ = 10 February 2016

Root length: Various sowing dates produced significantly different length of modified roots in carrot. Largest root length (9.71 cm) was found at the plants sown on 5

December and the smallest root length was plants that had been sown on 10 February (6.30 cm) (Table 1). Longer root was observed in variety BA (7.51 cm) compared to

variety PA (7.42 cm) (Table 2). The length of roots increased and then decreased at different harvesting time in respect of sowing date. Effect of combination between sowing date and variety showed that except December 5, other four sowing dates produced significantly longer roots. Carrot seeds sowing at December 5 with variety BA produced longest root (10.94 cm) where sowing at 10 February with BA variety produced smallest root (5.72 cm) (Table 3).

Root diameter: Root diameter exhibits significant variation with different sowing dates. The highest diameter was 2.81 cm at sowing on 5 December and lowest was 0.81 cm at sowing on 10 February. The biggest root diameter resulted from the variety BA (2.00 cm) which was greater than the variety PA (1.16 cm) (Table 2). In case of variety and sowing date combination, the sowing date December 5 and variety BA gave the highest root diameter (4.66 cm) compared to the other treatments. The sowing date 30 December and variety PA produced the lowest root diameter (0.74 cm). Late sowing showed smaller root diameter (Table 3).

Fresh shoot weight: Considering sowing date, November 15 gave the highest shoot weight (50.33 g) Sowing at 10 February produced the lowest shoot weight (Table 1). There was significant variation on varieties. The variety BA (33.13 g) produced more shoot weight compared to PA variety (26.89 g) (Table 2). Regarding sowing date and variety combination, sowing at 15 November with variety PA resulted the highest shoot weight (53.57 g) whereas, variety PA with sowing at 10 February gave the lowest shoot weight (18.43 g) (Table 3).

Dry shoot weight: The highest shoot dry weight was in sowing at 15 November (8.39 g) and lowest shoot dry weight was in 10 February (18.77 g) (Table 1). There was significant variation of variety on dry shoot weight. The variety PA (4.75 g) produced lower shoot dry weight compared to the variety BA (6.09 g) (Table 2). There was also significant effect of combination of sowing date and variety on growth and yield of carrot. Sowing date November 15 and variety PA resulted highest dry shoot weight (8.66 g) and sowing date October 25 with variety PA produced the lowest shoot dry weight (Table 3). Similar experiment was observed by (Mack, 1970, Salter, *et al.*, 1979).

Fresh root weight: Fresh root weight per plant was significantly differed by sowing dates. Considering sowing date, October 25 produced the highest root weight (21.63 g) where the sowing date 10 February gave the lowest root weight (5.06 g) (Table 1). There was significant effect of planting dates on variety. Significant variation of variety on fresh root weight was also seen. The variety BA produced the highest root weight (14.52 g) than the variety PA (8.43 g) (Table 2). Combined effect of sowing date and variety was also significant. Combined effect of sowing dates and variety shows, the sowing on 25 October with variety BA was the highest (31.44 g) and the sowing on 10 February with the variety PA (4.33 g) gave the lowest in fresh root weight (Table 3).

Root dry weight: On the consideration of sowing date, 10 February resulted the lowest dry root weight (1.75 g) whereas 25 October resulted the highest one (4.32 g)

(Table 1). There was also significant difference of varieties for root dry weight. The variety BA gave the highest dry root weight (4.03 g) than the variety PA (1.62 g) (Table 2). Significant combined effect of sowing date and variety on growth and yield were also observed. Combination of sowing date and variety showed, sowing date 25 October with variety BA resulted highest root dry weight (7.29 g) and the sowing date 10 February with variety PA resulted the lowest root dry weight (4.33 g) (Table 3). The result of the present experiment is in full opposite agreement with that of Gadzhonov (1972)

Yield: Date of sowing, as evident from Table 1, significantly influenced the yield per hectare. The highest yield (6.88 t/ha) was obtained at 15 November and the lowest (2.95 t/ha) was found at 10 February. Yield of root was decreasing with time (Table 1). There was significant variation among the varieties. The yield of variety BA (5.52 t/ha) was greater than variety PA (4.22 t/ha) (Table 2). Combined effect of sowing date and variety was also significant. Sowing date 15 November with the variety BA resulted the maximum yield (8.50 t/ha) and Sowing date 10 February with the variety PA resulted the minimum yield (2.56 t/ha) (Table 3). Similar result was found by Bakhchevanova (1974).

Cracking percentage: Significant variation was also observed for different sowing date (Table 1). Root cracking was minimum sowing on 10 February (2.00) and maximum (3.75) was sowing on 15 November, 5 December, 30 December respectively (Table 1). The cracking percentage was higher on the variety BA (3.47) than the variety PA (3.17) (Table 2). Cracking of root varied among varieties and sowing dates. There was also significant variation between the varieties (Table 2). Combined effect of sowing dates and variety was also significant for growth and yield of carrot. Regarding combination of sowing date and variety, planting at 10 Feb. with variety PA produced lowest cracking (1.67) (Table 3). This result is fully identical with Nortje and Henrico, (1986).

Sowing date 15 November gave the highest shoot length, the highest shoot weight, the highest shoot dry weight, the highest root weight, the highest root dry weight and the highest root yield. On the comparison between the two variety BA and PA it was observed that every parameter showed better performance on the variety BA than the variety PA. Combination of sowing dates and variety it was seen that Sowing date 15 November with variety BA produced the highest yield of carrot root. Regarding all of the above characters it can be concluded that the variety BA with sowing date 15 November was the best treatment combination for better growth and yield of carrot.

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