

Effect of variety and age of stecklings on yield and quality of carrot seed

M.A. Malek, M. Sikder¹ and D. Mohammed²

Department of Horticulture, Patuakhali Science and Technology University, Patuakhali, ¹Metal Agro Limited, Salna, Gazipur, ²Public Relations and Publications Section, Bangladesh Agricultural University, Mymensingh

Abstract: An experiment was conducted to study the effect of variety and age of stecklings on quality seed production of carrot. Using three varieties viz. Brasilia Agroflora, Prima Agroflora, New Kuroda and four different age levels of stecklings viz. 65, 72, 79, 86 days of stecklings. The two-factor experiment was laid out in RCBD with three replications. Different variety and age of stecklings showed highly significant influence all most all the parameters studied. The highest seed yield (1329.83 kg/ha) was recorded from Brasilia Agroflora and the quality of seed (germination 81.23% and seed vigour index 10.81) was produced from the same variety, while the lowest seed yield (1292.58 kg/ha) and germination (77.92%) were obtained from New Kuroda. The 72 days age of stecklings was recorded the highest seed yield (1401.21 kg/ha) and the quality of seed (germination 88.42% and seed vigour index 11.13) were produced from the same age, while the lowest seed yield (1231.42 kg/ha) and germination (71.94%) were obtained from 86 days age of stecklings. In case of combined effect, the highest seed yield (1420.63 kg/ha) was obtained from Brasilia Agroflora with 72 days age of stecklings and that of the lowest (1201.60 kg/ha) from New Kuroda with 86 days age of stecklings.

Key words: Carrot, variety, age of stecklings, yield, quality seed

Introduction

Carrot is an important root crop from nutritional point of view. It plays a vital role to protect the blindness of children providing vitamin A. In Bangladesh, there is no recommended variety of carrot for seed production. Many countries have developed good quality high yielding varieties through introduction. For the development of suitable varieties, it is essential to evaluate the characters of the available germplasm properly and conserve the collected materials for future use. Almost entire production of carrot in Bangladesh depends on imported seeds. These are relatively expensive which are not always available in time for sowing. So, cultivation of good quality carrot falls in an uncertainty. This situation also restricts its production. To save the foreign currency and increase carrot production, timely supply of quality seed in desired quantity should be ensured. This is possible through the improvement of seed production. Hence, the genetic information of different varieties on yield, yield contributing characters and quality of carrot seed producing species are to be assessed for its improvement. Again, age of stecklings are considered as another important factor in proper flowering, fruiting and maximizing viable seed production in plant. It is generally uprooted before on-set of their reproductive phase and then replanted after cutting a part of their fleshy roots to avoid vertical degeneration and to ensure quality seed production. Age of uprooted plants (stecklings) has influence on the yield and quality of seed. The extents of root cuts also influence the growth of stecklings and thus on seed yield and quality (Kanwar, 1984; Singh *et al.*, 1981). This information need thorough study to standardize the cultural practices for quality carrot seed production. Sharfuddin and Siddique (1985) indicated that radish plants should be uprooted when they are well developed before transplanting. Rashid (1976) suggested that the carrot plants should be uprooted before flowering and pruned leaving 2.5 to 5.0 cm shoot and 5.0 to 7.5 cm root. So, it is essential to know the optimum age of stecklings for maximizing the quality yield of carrot. Therefore, the present study was designed to establish the suitable variety and optimum age of stecklings for maximizing the yield and quality of onion seed.

Materials and Methods

The experiment was conducted at Horticulture Farm, Bangladesh Agricultural University, Mymensingh during October, 2010 to June, 2011. The treatments of the experiment consisting of three varieties of carrot viz. Brasilia Agroflora, Prima Agroflora and New Kuroda, and four different age viz. 65, 72, 79 and 86 days of stecklings were used. The unit plot size was 1m×1m. Date of stecklings transplanting: 4 times from 5 December'10 to 1 week interval. Date of harvesting: 10 April to 10 May, 2011. The selected land was medium high and the texture of soil was clay loam. The two-factor experiment was laid out RCBD with three replications. The experimental plot was prepared by good tillage and fertilized with recommended doses of manure and fertilizers. The seeds of varieties were collected from USDA-Alliums project, Department of Horticulture, BAU, Mymensingh. All intercultural operations were done as and when needed. Seeds were sown uniformly in rows. Transplanting was done at 1 October'10 to 1 week interval as per treatment in the main field. The matured umbels were harvested in several installments, when the umbel turned into grayish in colour. Seeds were then collected by hand rubbing, cleaned and dried until they reached safe moisture level (8-10%).

After 30 days of storage, the seeds of each treatment were placed for germination test and measure vigour index in petridishes taking 100 seeds for each treatment with blotting papers in the laboratory. The seed vigour was measured through its speed of germination. The germinated seeds were counted every day until germination was completed. An index of the speed of germination was then calculated by adding the quotients of the daily counts divided by the number of days of germination using the formula (Agrawal, 1996) as below: Seed vigour index = (No. of seed germinated at first count/No. of days required to first count) + + (No. of seed germinated at last count/No. of days to last count). Thus the seeds with higher index has faster germination rate and would be considered to be higher in vigour. Data were recorded on vegetative growth and flowering behavior, umbel characteristics, yield and quality contributing characteristics of carrot from five randomly selected plants of each plot and were analyzed statistically

by Mstac computer programme. The difference between the treatment means was adjudging by least significant difference (LSD) test.

Results and Discussion

Effect of variety: It is evident from the Table 1 that variety significantly influenced all most all of the parameters under study. The highest plant height (127.49 cm) was measured in Brasilia Agroflora, while the lowest (122.54 cm) from New Kuroda. This might be due to genetical phenomena of these varieties. The results are in agreement with Sharma *et al.* (1990). Minimum days required for 50% flowering (78.72) was noted in variety New Kuroda whereas, Brasilia Agroflora took 80.59 days. The maximum time required (12.52 days) from 50%

flowering to fruit set was found in Prima Agroflora and the minimum time (12.48 days) was required in New Kuroda. The highest number of primary umbels/plant (9.64) was recorded in Brasilia Agroflora, while the lowest (8.93) was found in New Kuroda. The highest diameter of main and primary umbel (11.04 cm & 10.85 cm) was obtained in Brasilia Agroflora, whereas the lowest in New Kuroda (10.28 cm & 10.32 cm). The highest seed yield in main and primary umbel (0.92g & 0.81g) was recorded in Brasilia Agroflora but New Kuroda demonstrated the lowest (0.86g & 0.74g) seed yield. A similar report was revealed by Cardoso (2000), who stated that seeds in the main and primary umbels were of better seed yield and quality than the seeds of secondary umbel.

Table 1. Effect of variety on growth, yield contributing characters, yield and quality of carrot seed

Variety	Plant height (cm)	Days to 50% flowering	Days required for fruit set	Primary umbels/ plant	Diameter of main umbel (cm)	Diameter of primary umbel (cm)	Yield of main umbel (g)	Yield of primary umbel (g)	Seed yield/ plant (g)	Seed yield/ ha (kg)	1000-seed weight (g)	Germination % of seed	Seed Vigor Index
Brasilia Agroflora	127.49	80.59	12.49	9.64	11.04	10.85	0.92	0.81	8.34	1329.83	1.11	81.23	10.81
Prima Agroflora	124.58	79.97	12.52	9.17	10.79	10.57	0.89	0.78	8.14	1301.52	1.08	79.68	10.72
New Kuroda	122.54	78.72	12.48	8.93	10.28	10.32	0.86	0.74	8.03	1292.58	1.03	77.92	10.66
LSD at 5%	2.824	1.232	0.786	0.382	0.404	0.362	0.045	0.026	0.108	22.85	0.026	1.093	0.074
LSD at 1%	3.789	1.652	1.053	0.512	0.543	0.486	0.061	0.035	0.145	30.66	0.035	1.466	0.099
Level of significance	**	*	NS	**	**	*	*	**	**	**	**	**	**

* Significance at 5% level, ** Significance at 1% level, NS: Not Significance

Table 2. Effect of age of stecklings on growth, yield contributing characters, yield and quality of carrot seed

Age of stecklings	Plant height (cm)	Days to 50% flowering	Days required for fruit set	Primary umbels/ plant	Diameter of main umbel (cm)	Diameter of primary umbel (cm)	Yield of main umbel (g)	Yield of primary umbel (g)	Seed yield/ plant (g)	Seed yield/ ha (kg)	1000-seed weight (g)	Germination % of seed	Seed Vigor Index
65 days of stecklings	126.57	84.26	11.58	9.75	11.12	10.81	0.90	0.77	8.31	1329.12	1.11	81.46	10.81
72 days of stecklings	136.14	80.32	12.50	11.04	11.83	11.13	1.08	0.97	8.77	1401.21	1.20	88.42	11.13
79 days of stecklings	120.19	78.23	12.62	8.48	10.32	10.36	0.81	0.70	7.96	1270.13	1.02	76.63	10.54
86 days of stecklings	116.58	76.22	13.28	7.71	9.55	10.02	0.77	0.66	7.64	1231.42	0.96	71.94	10.44
LSD at 1%	4.375	1.908	1.218	0.591	0.626	0.561	0.070	0.041	0.167	35.40	0.041	1.693	0.115
Level of significance	**	**	**	**	**	**	**	**	**	**	**	**	**

** Significance at 1% level

Brasilia Agroflora gave the highest seed yield/plant, and yield/ha (8.34g & 1329.83 kg) followed by Prima Agroflora (8.14g & 1301.52 kg) whereas it was the lowest (8.03g & 1292.58 kg) in New Kuroda (Table 1). This might be due to the fact that the variety Brasilia Agroflora had a good genetic potential which enhanced more cell division and cell elongation resulting best performance. This result agrees with Mohanty (1998). Mohanty and Prusti (2001) reported that seed yields vary with the cultivars. This might be due to higher umbel size, number of flower/umbel, number of seeds/ umbel and 1000-seed weight. Maximum 1000-seed weight (1.11g) was recorded in Brasilia Agroflora, while New Kuroda gave the minimum (1.03g). Malik *et al.* (1993) found 1000-seed weight of carrot 0.96g. This result is in an agreement with this finding. The highest quality of seed (germination 81.23% and vigour index 10.81) was exhibited in Brasilia Agroflora followed by Prima Agroflora (79.68% & 10.72). The lowest quality of seed (germination 77.92% and

vigour index 10.66) was observed in New Kuroda variety. This might be due to higher thousand seed weight which enhanced the speed of germination. This result is in agreement with the findings of Shantha *et al.* (1998). They found 80.2 % seed germination in carrot seed from primary umbel.

Effect of age of stecklings: Significant variation was observed all of the parameters under study (Table 2). The highest plant height (136.14 cm) was measured in 72 days age of stecklings, while 86 days age of stecklings showed the lowest (116.58 cm). The results are agreement with Sharma *et al.* (1990). Minimum days required for 50% flowering (76.22) was noted in 65 days age of stecklings, while 65 days age took 84.26 days. The maximum days required (112.28 days) from 50% flowering to fruit set was found in 86 days age of stecklings and the minimum time (11.58 days) from 65 days age of stecklings. The highest number of primary umbels/plant (11.04) was recorded in 72 days age of stecklings, while the lowest

(7.71) in 86 days age of stecklings. The highest diameter of main and primary umbel (11.83 cm & 11.13 cm) were found in 72 days age of stecklings whereas, the lowest (9.55 cm & 10.02 cm) in 86 days (Table 2). The highest seed yield in main and primary umbel (1.08g & 0.97g) was observed in 72 days age of stecklings followed by 65 days (0.90g & 0.77g) while 86 days age of stecklings demonstrated the lowest (0.77g & 0.66g) seed yield. The 72 days age of steckling gave the highest seed yield/plant and yield/ha (8.77g & 1401.21 kg) followed by 65 days age of stecklings (8.31g & 1329.12 kg) whereas it

was the lowest (7.64g & 1231.42 kg) in 86 days. This might be due to higher umbel size, number of flower/umbel, number of seeds/umbel and 1000-seed weight. The highest 1000-seed weight (1.20g) was recorded in 72 days age of stecklings, while 86 days occurred the lowest (0.96g). The highest quality of seed (germination 88.42% and vigour index 11.13) was exhibited in 72 days age of stecklings, while the lowest (71.94% & 10.44) was observed in 86 days (Table 2). This might be due to higher thousand seed weight which enhanced the speed of germination.

Table 3. Combined effect of variety and age of stecklings on growth, yield contributing characters, yield and quality of carrot seed

Combinations Variety x age of stecklings	Plant height (cm)	Days to 50% flowering	Days required for fruit set	Primary umbels/plant	Diameter of main umbel (cm)	Diameter of primary umbel (cm)	Yield of main umbel (g)	Yield of primary umbel (g)	Seed yield/plant (g)	Seed yield/ha (kg)	1000-seed weight (g)	Germination % of seed	Seed Vigor Index
Brasilia Agroflora x 65 days of stecklings	129.52	85.62	11.54	10.33	11.41	10.96	0.92	0.81	8.52	1362.97	1.14	82.31	10.90
Brasilia Agroflora x 72 days of stecklings	141.76	81.18	12.52	11.41	12.07	11.47	1.13	1.02	8.91	1420.63	1.24	91.19	11.26
Brasilia Agroflora x 79 days of stecklings	122.23	78.70	12.60	8.78	10.70	10.54	0.83	0.72	7.98	1275.23	1.04	78.03	10.61
Brasilia Agroflora x 86 days of stecklings	116.46	76.88	13.31	8.02	9.98	10.42	0.78	0.68	7.95	1260.47	1.01	73.38	10.47
Prima Agroflora x 65 days of stecklings	126.32	83.77	11.75	9.46	11.09	10.79	0.92	0.77	8.27	1317.70	1.11	81.25	10.79
Prima Agroflora x 72 days of stecklings	134.53	80.78	12.46	11.18	12.08	10.76	1.09	0.99	8.75	1406.67	1.19	88.54	11.12
Prima Agroflora x 79 days of stecklings	120.32	78.00	12.64	8.35	10.19	10.47	0.80	0.71	7.82	1249.50	1.03	77.29	10.54
Prima Agroflora x 86 days of stecklings	117.13	77.32	13.22	7.69	9.81	10.27	0.76	0.67	7.71	1232.20	0.99	71.65	10.43
New Kuroda x 65 days of stecklings	123.87	83.40	11.45	9.45	10.87	10.68	0.86	0.73	8.14	1306.70	1.08	80.81	10.74
New Kuroda x 72 days of stecklings	132.18	79.01	12.54	10.53	11.33	11.17	1.01	0.90	8.64	1376.33	1.17	85.53	11.01
New Kuroda x 79 days of stecklings	118.02	77.99	12.63	8.30	10.08	10.05	0.79	0.69	8.09	1285.67	1.00	74.56	10.47
New Kuroda x 86 days of stecklings	116.14	74.46	13.30	7.42	8.86	9.36	0.76	0.63	7.26	1201.60	0.89	70.79	10.43
LSD at 1%	7.578	3.305	2.110	1.024	1.085	0.972	0.122	0.070	0.290	61.31	0.070	2.933	0.199
Level of significance	**	**	**	**	**	**	**	**	**	**	**	**	**

** Significance at 1% level

Combined effect of variety and age of stecklings: Highly significant variations were observed for all the parameters under study due to combined effects of variety and age of stecklings (Table 3). The highest plant height (141.76 cm) was recorded in treatment combination of Brasilia Agroflora with 72 days old stecklings treatment while the lowest (116.14 cm) in New Kuroda with 86 days. The longest days to 50% flowering (85.62 days) were required in the combination of Brasilia Agroflora with 65 days old stecklings while the shortest period (74.46 days) from New Kuroda with 86 days. The highest time required (13.30 days) from 50% flowering to fruit set was found in New Kuroda with 86 days old steckling and the lowest time (11.54 days) in the variety of New Kuroda with 65 days old steckling. The highest number of primary umbels/plant (11.41) was recorded in Brasilia Agroflora with 72 days age of stecklings while the lowest (4.42) in New Kuroda with 86 days. The highest diameter of main and primary umbel (12.07 cm & 11.47 cm) was found in Brasilia Agroflora with 72 days age of stecklings whereas the lowest in New Kuroda with 86 days (8.86 cm & 9.36 cm) (Table 3). The maximum seed yield in main and primary umbel (1.13g & 1.02g) was observed in Brasilia Agroflora with 72 days age of stecklings while New Kuroda with 86 days demonstrated the lowest seed yield (0.76g & 0.63g). Brasilia Agroflora with 72 days age of stecklings obtained

the highest seed yield/plant and yield/ha (8.91g & 1420.63 kg) whereas it was the lowest (7.26g & 1201.60 kg) in New Kuroda with 86 days (Table 3). This might be due to higher umbel size, number of flower/umbel, number of seeds/umbel and 1000-seed weight. Maximum 1000-seed weight (1.24g) was recorded in Brasilia Agroflora with 72 days age of stecklings while the New Kuroda with 86 days age of stecklings gave the minimum weight (0.89g). The highest quality of seed (germination 91.19% and vigour index 11.26) was exhibited in Brasilia Agroflora with 72 days age of stecklings, while the lowest (70.79% & 10.43) was observed in New Kuroda variety with 86 days age of stecklings (Table 3). This might be due to higher 1000-seed weight which enhanced the speed of germination.

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