

## Effect of variety and pruning of umbel on yield and quality of carrot seed

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**Abstract:** The study was carried out to investigate the effect of variety and umbel pruning on quality seed production of carrot using three varieties viz. Brasilia Agroflora, Prima Agroflora, New Kuroda, and four different pruning level of umbel viz. control (keep all umbels), only primary umbels, only secondary umbels, and primary & secondary umbels. The two-factor experiment was laid out in RCBD with three replications. Different variety and umbel pruning showed highly significant influence on all most all the parameters studied. The highest seed yield (1222.75 kg/ha) and quality of seed (germination 85.43% and seed vigour index 11.06) were obtained from Brasilia Agroflora, while the lowest seed yield (1140.75 kg/ha) and quality of seed (germination 79.33% and seed vigour index 10.85) from New Kuroda. The primary & secondary umbels produced the highest seed yield (1341.37 kg/ha), while the lowest seed yield (1013.23 kg/ha) from only secondary umbels. The highest quality of seed (germination 89.57% and vigour index 11.39) exhibited only primary umbels whereas, the lowest (76.39%; 10.48) from control (keep all umbels). In case of combined effects, the highest seed yield (1379.55 kg/ha) was produced from Brasilia Agroflora with primary & secondary umbels, while the lowest from New Kuroda with only secondary umbels (967.79 kg/ha). Considering the quality, the highest germination (92.11%) and vigour index (11.52) obtained from Brasilia Agroflora with only primary umbels while the lowest (70.56%; 10.39) from New Kuroda with control (keep all umbels).

**Key words:** Carrot, variety, umbel prunings, yield, quality seed.

### Introduction

Variety is an important factor for seed production. In Bangladesh, there is no recommended variety of carrot. Most of the seed companies of the world produce carrot seeds to suit their own climatic conditions and if the seeds are used without adaptability test, the growers may face economic losses. In this case, varieties selection plays an important role in carrot seed production. There is a vast scope for increasing the yield of carrot per hectare by using seeds of high yielding varieties. Many countries have developed good quality high yielding varieties even through introduction. Carrot is grown in Bangladesh during winter season. It usually requires relatively low temperature for flowering. The climatic condition of Bangladesh is not suitable enough for the production of seeds of most of the high yielding exotic varieties. Almost entire production of carrot in Bangladesh is based upon imported seeds. The imported seeds are relatively expensive which are not always available in time for sowing. Hence, cultivation of good quality carrot becomes an uncertainty every year. To boost up carrot production in the country timely supply of quality seed in desired quantity should be ensured, which is possible only by improving local seed production technology. The genetic information on yield and yield contributing characters of the crop species should be assessed for its improvement.

Umbel pruning and umbel order are important factors for the quality of carrot seed (Pereira *et al.*, 2008 and Amjad *et al.*, 2005). It has mentionable effect on carrot seed characteristics especially on seed size and weight. There are three types of umbel of carrot such as primary, secondary and tertiary. Umbel pruning is done mainly for balancing and influencing the nutrients and hormones. As a result of umbel pruning the existing umbels face less competition for nutrients and hormones. More nutrients and hormones are transported to the flowers and they produce bigger, heavier and healthy seeds. The seeds become more vigorous and viable. As the seeds become more vigorous; they show a remarkable germination percentage. With the above perspective, the present study was undertaken to find out the suitable variety and umbel pruning on yield and quality of carrot 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 umbel keeping, viz., control (keep all umbels), only primary umbels, only secondary umbels, and primary & secondary umbels were maintained. The unit plot size was 1m×1m. Date of seedlings transplanting: 1 December'10. Date of harvesting: 7 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 on 15 September, 2010. The 75 days old plants were transplanted 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 most of all the parameters under study. The highest plant height (132.71 cm) was measured in Brasilia Agroflora, while New Kuroda showed the lowest (113.68 cm). This might be due to genetical phenomena of these varieties. The results are in agreement with Sharma *et al.* (1990). Maximum days required for 50% flowering (81.41) was noted in Brasilia Agroflora whereas, Prima Agroflora took 79.17 days. The maximum time required (12.70 days) from 50% flowering to fruit set

was found in Brasilia Agroflora and the minimum time (12.44 days) from New Kuroda (Table 1). The highest number of primary umbels/plant (7.38) was recorded in Brasilia Agroflora, while the lowest (7.23) in New Kuroda. The highest number of secondary umbels/plant (9.44) was recorded in Brasilia Agroflora and the lowest (9.11) from New Kuroda. The highest diameter of primary and secondary umbel (8.35 cm & 5.19 cm) were found in Brasilia Agroflora whereas, the lowest in New Kuroda (8.03 cm & 4.96 cm). Maximum seed yield in primary and secondary umbel (0.69g & 0.31g) were observed in Brasilia Agroflora, while New Kuroda demonstrated the lowest (0.62g & 0.28g) seed yield. A similar report was revealed by Cardoso (2000), who stated that seeds in the 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	Secondary umbels/plant	Diameter of primary umbel (cm)	Diameter of secondary umbel (cm)	Yield of primary umbel (g)	Yield of secondary umbel (g)	Seed yield/plant (g)	Seed yield/ha (kg)	Germination % of seed	Seed Vigor Index
Brasilia Agroflora	132.71	81.41	12.70	7.38	9.44	8.35	5.19	0.69	0.31	7.75	1222.75	85.43	11.06
Prima Agroflora	122.68	79.17	12.63	7.33	9.31	8.21	5.09	0.67	0.29	7.42	1182.65	83.15	10.98
New Kuroda	113.68	79.29	12.44	7.23	9.11	8.03	4.96	0.62	0.28	7.14	1140.75	79.33	10.85
LSD at 5%	2.368	1.646	0.182	0.117	0.230	0.155	0.123	0.026	0.026	0.151	11.04	1.673	0.105
LSD at 1%	3.177	2.208	0.244	0.157	0.309	0.208	0.165	0.035	0.035	0.202	14.81	2.245	0.141
Level of sig.	**	*	*	*	*	**	**	**	**	**	**	**	**

\* Significance at 5% level, \*\* Significance at 1% level

Brasilia Agroflora exhibited the highest seed yield/plant, and yield/ha (7.75g & 1222.75 kg) followed by Prima Agroflora (7.42g & 1182.65 kg) whereas it was the lowest (7.14g & 1140.75 kg) in New Kuroda. 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 and number of seeds/umbel. The highest quality of seed (germination 85.43% and vigour index 11.06) were exhibited in Brasilia Agroflora followed by Prima Agroflora (83.15% & 10.98) and the lowest (79.33% & 10.85) was observed in New Kuroda. 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 form primary umbel.

**Effect of umbel pruning:** Significant variations were observed of all the parameters under study (Table 2). The highest plant height (127.04 cm) was measured in case of only secondary umbel whereas, control (keep all umbels) showed the lowest (119.24 cm). The results are agreement with Sharma *et al.* (1990). Maximum days required for 50% flowering (84.89 days) was noted in control (keep all umbels) but Primary & secondary umbel took minimum (76.20 days). The maximum days required (13.44 days) from 50% flowering to fruit set was found in Primary & secondary umbel and the minimum time (11.48 days) was

recorded in control (keep all umbels). Maximum number of primary umbels/plant (9.98) was recorded in only primary umbels, while the minimum (9.62) was found in the control (keep all umbels). The highest number of secondary umbels/plant (13.07) was found in only secondary umbels, while the lowest (11.73) from control (keep all umbels). The highest diameter of primary umbel (11.50 cm) was found in only primary umbel whereas, the lowest in control (keep all umbels) (10.40 cm). The highest diameter of secondary umbel (7.14 cm) was found in only secondary umbel while the lowest in control (keep all umbels) (6.39 cm) (Table 2).

Maximum seed yield in primary umbel (1.01g) was observed in only primary umbels but control (keep all umbels) demonstrated the minimum (0.75g) seed yield. The highest seed yield in secondary umbel (0.49g) was observed in only secondary umbels, while control (keep all umbels) demonstrated the lowest (0.32g) seed yield. Primary & secondary umbels recorded the highest seed yield/plant and yield/ha (8.39g & 11341.37 kg) followed by control (keep all umbels) (7.74g & 1233.22 kg) whereas, it was the lowest (6.47g & 1013.23 kg) in only secondary umbels (Table 2). This might be due to higher umbel size, number of flower/umbel and number of seeds/umbel. The highest quality of seed (germination 89.57% and vigour index 11.39) were exhibited in only primary umbels followed by primary & secondary umbels (82.59% & 10.81) while the lowest (76.39% & 10.48) was observed in control (keep all umbels). This might be due to higher thousand seed weight which enhanced the speed of germination.

**Table 2.** Effect of umbel pruning on growth, yield contributing characters, yield and quality of carrot seed

Keeping of umbels	Plant height (cm)	Days to 50% flowering	Days required for fruit set	Primary umbels/plant	Secondary umbels/plant	Diameter of primary umbel (cm)	Diameter of secondary umbel (cm)	Yield of primary umbel (g)	Yield of secondary umbel (g)	Seed yield/plant (g)	Seed yield/ha (kg)	Germination % of seed	Seed Vigor Index
Control (keep all umbels)	119.24	84.89	11.48	9.62	11.73	10.40	6.39	0.75	0.32	7.74	1233.22	76.39	10.48
Only primary umbel	123.18	81.23	12.59	9.98	0.00	11.50	0.00	1.01	0.00	7.14	1140.38	89.57	11.39
Only secondary umbel	127.04	77.52	12.84	0.00	13.07	0.00	7.14	0.00	0.49	6.47	1013.23	81.97	11.17
Primary & secondary umbel	122.64	76.20	13.44	9.64	12.36	10.88	6.80	0.88	0.38	8.39	1341.37	82.59	10.81
LSD at 1%	3.669	2.550	0.281	0.182	0.356	0.240	0.191	0.041	0.041	0.233	17.11	2.593	0.162
Level of significance	**	**	**	**	**	**	**	**	**	**	**	**	**

\*\* Significance at 1% level

**Combined effect of variety and umbel pruning:** Highly significant variations were observed for all the parameters under study due to combined effect of variety and umbel pruning (Table 3). The highest plant height (138.16 cm) was observed in treatment combination of Brasilia Agroflora with only secondary umbels while the lowest (109.21 cm) was found in New Kuroda with control (keep all umbels). The longest days to 50% flowering (86.84

days) was required in the combination of Brasilia Agroflora with control (keep all umbels) while the shortest period (75.19 days) from New Kuroda with primary & secondary umbels. The highest time required (13.62 days) from 50% flowering to fruit set was found in New Kuroda with primary & secondary umbels and the lowest time (11.01 days) was required in the variety New Kuroda with control (keep all umbels).

**Table 3.** Combined effect of variety and umbel pruning on growth, yield contributing characters, yield and quality of carrot seed

Combinations Variety x keeping of umbels	Plant height (cm)	Days to 50% flowering	Days required for fruit set	Primary umbels/plant	Secondary umbels/plant	Diameter of primary umbel (cm)	Diameter of secondary umbel (cm)	Yield of primary umbel (g)	Yield of secondary umbel (g)	Seed yield/plant (g)	Seed yield/ha (kg)	Germination % of seed	Seed Vigor Index
Brasilia Agroflora x Control (keep all umbels)	128.87	86.84	11.93	9.64	11.85	10.54	6.53	0.80	0.33	7.98	1272.64	80.36	10.55
Brasilia Agroflora x Only primary umbel	133.36	82.28	12.73	10.09	0.00	11.84	0.00	1.07	0.00	7.42	1185.31	92.11	11.52
Brasilia Agroflora x Only secondary umbel	138.16	78.78	12.85	0.00	13.35	0.00	7.29	0.00	0.52	6.94	1053.48	84.03	11.23
Brasilia Agroflora x Primary & secondary umbel	130.45	77.76	13.31	9.77	12.57	11.01	6.96	0.92	0.40	8.65	1379.55	85.21	10.92
Prima Agroflora x Control (keep all umbels)	119.63	82.85	11.51	9.63	11.76	10.41	6.42	0.78	0.32	7.73	1228.26	78.27	10.49
Prima Agroflora x Only primary umbel	121.86	80.60	12.62	10.04	0.00	11.52	0.00	1.00	0.00	7.16	1140.87	89.41	11.41
Prima Agroflora x Only secondary umbel	125.29	77.56	12.97	0.00	13.03	0.00	7.09	0.00	0.49	6.36	1018.40	81.67	11.18
Prima Agroflora x Primary & secondary umbel	123.95	75.66	13.40	9.65	12.45	10.90	6.85	0.88	0.38	8.42	1343.07	83.23	10.84
New Kuroda x Control (keep all umbels)	109.21	84.99	11.01	9.59	11.58	10.27	6.23	0.67	0.30	7.52	1198.75	70.56	10.39
New Kuroda x Only primary umbel	114.30	80.79	12.41	9.81	0.00	11.14	0.00	0.95	0.00	6.83	1094.97	87.19	11.25
New Kuroda x Only secondary umbel	117.67	76.22	12.71	0.00	12.82	0.00	7.02	0.00	0.45	6.11	967.79	80.22	11.10
New Kuroda x Primary & secondary umbel	113.53	75.19	13.62	9.49	12.06	10.72	6.59	0.85	0.35	8.12	1301.49	79.33	10.65
LSD at 1%	6.354	4.417	0.487	0.315	0.617	0.416	0.330	0.070	0.070	0.404	29.63	4.491	0.281
Level of significance	**	**	**	**	**	**	**	**	**	**	**	**	**

\*\* Significance at 1% level

The highest number of primary umbels/plant (10.09) was recorded in Brasilia Agroflora with only primary umbels while the lowest (9.59) from New Kuroda with control (keep all umbels). The highest number of secondary umbels/plant (13.35) was found in Brasilia Agroflora with only secondary umbels while the lowest (9.59) from New Kuroda with control (keep all umbels). The highest diameter of primary umbel (11.84 cm) was found in Brasilia Agroflora with only primary umbels whereas the lowest in New Kuroda with control (keep all umbels) (10.27 cm). The highest diameter of secondary umbel (7.29 cm) was found in Brasilia Agroflora with only secondary umbels whereas the lowest in New Kuroda with control (keep all umbels) (6.23 cm).

The highest seed yield in primary umbels (1.07g) was observed in Brasilia Agroflora with only primary umbels while New Kuroda with control (keep all umbels) demonstrated the lowest seed yield (0.67g). The highest

seed yield in secondary umbels (0.52g) was observed in Brasilia Agroflora with only secondary umbels while New Kuroda with control (keep all umbels) exhibited the lowest seed yield (0.30g). Brasilia Agroflora with primary & secondary umbels gave the highest seed yield/plant and yield/ha (8.65g & 1379.55 kg) whereas it was the lowest (6.11g & 967.79 kg) in New Kuroda with only secondary umbel (Table 3). This might be due to higher umbel size, number of flower/umbel and number of seeds/umbel. The highest quality of seed (germination 92.11% and vigour index 11.52) were exhibited in Brasilia Agroflora with only primary umbels while the lowest (70.56% & 10.39) was observed in New Kuroda variety with control (keep all umbels). This might be due to higher 1000-seed weight which enhanced the speed of germination.

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