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PERFORMANCE OF DIFFERENT CARROT GENOTYPES AND IMPACT OF GA_3 ON SEED PRODUCTION POTENTIAL OF BU CARROT 1

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ABSTRACT

Two field experiments were conducted in the Horticultural Research Farm of Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh during November 2017 to May 2018. In the first experiment, the varietal performance of the carrot genotypes namely BU Carrot 1, New Kuroda, Chantanany Kuroda, Sin Kuroda and Kuroda-35 were studied. The second experiment was undertaken to find out the effect of different concentrations of GA_3 (0, 100, 200, 300 ppm) on the seed yield of BU carrot 1. The BU Carrot 1 showed the highest root yield (25.8 t ha^{-1}) followed by New Kuroda (22.7 t ha^{-1}). The highest seed yield (1243.0 kg ha^{-1}) was obtained in the treatment sprayed with 200 ppm $GA_{3,}$ which was significantly higher from those of 300 ppm of GA_3 (774 kg ha^{-1}) treatment. The findings showed that BU Carrot1 had higher performance of yield compared to other genotypes and it provided the highest seed yield with the foliar application of GA_3 at 200 ppm concentration.

Keywords: Carrot genotypes, root yield, seed yield, GA_3

Introduction

The umbelliferous vegetable carrot (*Daucus carota* L.) belongs to the family Apiaceae. It is a rich source of carotene and mostly grown in temperate and boreal regions (Rubatzky *et al.* 1999 a). Carrot is one of the most important β-carotene rich root crops with excellent source of iron and contains good quantities of vitamin B, C, and rich in sugar (Yawalker 1985). The average yield of carrot in Bangladesh is 35.0 t ha^{-1} but yield in developed countries ranges from 42.7 to 54.2 t ha^{-1} (Rashid and Shakur 1986). Unavailability of quality seed is the main constraint of carrot production in Bangladesh. The imported seeds are relatively expensive which are not always available in time for sowing. To boost up carrot production in the country and timely supply of quality seeds in desire quantity must be ensured by producing carrot seed locally.

Globerson (1972) reported that soaking carrot roots in 100 ppm GA_3 or spraying young foliage developed from a planted root gave higher seed yield. Spraying and soaking in GA_3 produced high percentage of flower in non-flowering cultivars. Joshi and Singh (1982) investigated the effects of foliar spray of GA_3 on seed production of carrot at different concentrations. Mangal *et al*. (1980) reported that the GA_3 at 50-250 mg/L was beneficial for seed production of cauliflower. Foliar application of gibberellic acid increases shoots to root ratio. Considering the above facts and observation, the present study was undertaken to find out the seed production capability of newly developed BU Carrot 1 compared to some other genotypes and to know the effect of GA_3 on the BU Carrot 1.

Materials and Methods

The field experiments were carried out in the Horticultural Research farm of Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh during November 2017 to May 2018. The study site is located in the middle of Bangladesh which occupied 25°25′ North latitude and 89°5′ East longitude. The area has sub-tropical climate characterized by three distinct seasons; the monsoon or rainy season (May to October), the winter or dry season (November to February) and the pre-monsoon or hot season (March to April). The mean maximum and minimum temperatures, relative humidity and rainfall are 36.0 and 12.7 °C, 65.8% and 237.6 cm, respectively.

Cultivation of the carrot genotypes: Five genotypes of carrot namely BU Carrot 1, New Kuroda, Chanfany

Kuroda, Sin Kuroda and Kuroda-35 were cultivated in the first experiment. In the second experiment only BU Carrot 1 was cultivated followed by application of GA_3 at 0, 100, 200, 300 ppm concentrations. The seeds were then soaked in water for 24 hours in order to facilitate germination. Then seeds were air dried before sowing and placed at a depth of 1 to 2 cm. Manures and fertilizers were applied to the fertilizer recommendation guide (cow dung 10 t, urea 120 kg, TSP 120 kg and MP 180 kg ha^{-1}) (FRG 2012). 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 MOP were applied at the time of final land preparation. Rest halves of MOP was applied at time of 20 and 30 days after seed sowing .Urea was top dressed in three equal splits at 40, 60, and 80 days seed sowing. Irrigation, weeding and other intercultural operations were done whenever necessary.

Experimental design and application of GA_3: The experiments were conducted in Randomized Complete Block Design with three replications. In the first experiment, the genotypes were comprised as treatments. The plots were raised by 19 cm from the ground level. The unit plot size was 2.0 ×1.0 m having row to row and plant spacing of 25 cm and 40 cm, respectively. In the second experiment, four different concentrations of GA_3 (0, 100, 200 and 300 ppm) were considered as treatment. The unit plot size was 1.5 × 1.2 m having row to row and plant spacing of 25 cm and 40 cm, respectively. Different concentrations of GA_3 were sprayed on 20, 30 and 40 days old plants with hand sprayer.

Data collection: At flower initiation in the first experiment, five carrot roots of each genotype were selected randomly and the length, breadth, weight, periphery, core breath, branching habit and root yield were measured. At harvest in the second experiment, five plants of the BU Carrot 1 were randomly selected and the number of umbel $plant^{-1}$ was counted. Then umbel diameter and periphery were measured and numbers of seeds $umbel^{-1}$ were counted. Seed yield $umbel^{-1}$, $plant^{-1}$ and ha^{-1} were noted. Weight of 1000 seed and germination percentage were estimated.

Data analysis: Data were analyzed by analysis of variance and the mean values were separated by Tukey HSD posthoc statistic. All the analyses were performed using IBM SPSS 21.1 software.

Results and Discussion

Remarkable variations were observed in the root weight, length, breadth, periphery, and core breadth, branching and root yield of the studied carrot genotypes (Table 1). The highest weight (116.2 g) was recorded from genotype BU Carrot-1 followed by New Kuroda (102.2 g). The lowest carrot weight was observed in Kuroda-35 (70.9 g). The highest carrot length was noted in BU Carrot-1(18.2 cm) followed by New Kuroda (16.55cm). The genotype Kuroda-35 showed the lowest carrot length (14.20 cm). The maximum carrot breath was recorded in BU Carrot-1 (4.0 cm) followed by New Kuroda (3.5 cm). The minimum carrot breath was found in Koroda-35 (3.00 cm). The largest periphery (12.7 cm) was measured in BU Carrot-1 followed by New Kuroda (10.9 cm) and Chantanany Kuroda (10.1 cm). On the contrary, the smallest periphery was found in Kuroda-35 (9.4 cm). The largest core breadth was found in BU Carrot-1(1.0 cm) and followed by New Kuroda (0.7 cm). The lowest core breadth was recorded in Kuroda-35 (0.5 cm). New Kuroda (1.1 %) and Kuroda-35 (1.13 %) showed statistically similar and higher branching. Minimum branches were noticed in BU

Table 1. Performance of different carrot genotypes when tested for seed production

Varietal characteristics	Carrot genotypes				
	BU Carrot- 1	New Kuroda	Chantanany Kuroda	Sin Kuroda	Kuroda-35
Root weight (g)	116.2 ±1.3 a	102.2 ±4.0 b	78.5±1.3 c	74.8±7.4 c	70.9±4.0 c
Root length (cm)	18.2±0.4 a	16.6±0.7 b	15.2±0.4 c	14.9±0.6 cd	14.2±0.3 d
Root breadth (cm)	4.0±0.2 a	3.5 ±0.2 b	3.2±0.1 bc	3.1±0.1 c	3.0±0.1 c
Root periphery (cm)	12.7±0.7 a	10.9±0.5 b	10.1±0.3 bc	9.7±0.3 c	9.4±0.3 c
Core breath (cm)	1.0±0.1 a	0.7±0.1 b	0.6±0.1 bc	0.6±0.1 c	0.5±0.1 c
Branching habit (%)	0.5±0.1 b	1.1±0.1 a	0.7±0.2 b	0.7±0.2 b	1.1±0.2 a
Root yield (t/ha)	25.8±0.3 a	22.7±0.9 b	17.4±0.3	16.6±1.6 c	15.8±0.9 c

Means within a column followed by the same letter(s) are not significantly different by Tukey posthoc statistic at $p \leq 0.05$.

Table 2. Effect of foliar application of different concentrations of GA_3 on various seed yield contributing characters of BU Carrot-1

Characters	GA_3 concentration (ppm)			
	Control	100 ppm	200 ppm	300 ppm
Umbel diameter (cm)	7.3±0.4 d	10.2±0.9 c	17.6±0.4 a	13.7±1.2 b
Umbel periphery (cm)	22.9±1.2 d	31.9±2.9 c	55.3±1.3 a	42.9±3.7 b
Number of seed umbel^{-1}	1143.0±60.6 d	1594.1± 46.3 c	2763.2±62.8 a	2142.5±186.3 b
Number of umbel plant $^{-1}$	0.8±0.1 d	1.0 ±0.0 c	1.3±0.1 a	1.1±0.0 b
Germination (%)	47.3±0.5 d	72.9±0.4 c	89.7±2.5 a	81.3±1.1 b
1000 seed weight (g)	1.5±0.0 c	2.4±0.0 b	2.9±0.0 a	2.9±0.0 a
Seed yield (g) umbel^{-1}	1.7±0.1 d	3.9±0.4 c	8.0±0.2 a	6.1±0.5 b
Seed yield (g) plant^{-1}	1.3±0.2 d	3.9±0.4 c	9.9±0.4 a	6.9±0.4 b
Seed yield (kg ha^{-1})	94.7±19.3 d	389.6±35.4 c	1243.3±96.4 a	773.8±76.5 b

Means within a column followed by the same letter(s) are not significantly different by Tukey posthoc statistic at $p \leq 0.05$.

Carrot 1 (0.5 %). The highest carrot root yield was found in BU Carrot-1 (25.8 t) followed by New Kuroda (22.7 t). The lowest carrot root yield was recorded in Kuroda-35 (15.8 t).

Due to the foliar application of different concentration of GA_3 BU Carrot 1 showed variations in umbel diameter, periphery, number of seed umbel^{-1}, number of umbel plant^{-1}, germination percentage, 1000 seed weight, seed yield umbel^{-1}, seed yield plant^{-1} and seed yield ha^{-1} (Table 2). The highest umbel diameter (17.6 cm) and periphery (55.3 cm), the highest number of seed (2763.2 umbel^{-1}) and number of umbel (1.3 plant^{-1}), the highest germination (89.7%), 1000 seed weight (2.9 g), seed yield umbel^{-1} (8.0), seed yield plant^{-1} (9.9) and seed yield ha^{-1} (1243.3 kg) were found from plants treated with 200 ppm GA_3 application, followed by the plants with 300 ppm GA_3. The lowest results were observed in control plants. It can be concluded that the umbel diameter, periphery, number of seed umbel^{-1}, number of umbel plant^{-1}, germination percentage, 1000 seed weight, seed yield umbel^{-1}, seed yield plant^{-1} and seed yield ha^{-1} gradually increased with the increase in the concentration of GA_3 up to 200 ppm and gradually decreased with the increased of GA_3 concentration. Finding of Ghoname *et al*. (2004) were almost similar when they applied 200 ppm of GA_3 as foliar spray and obtained the highest results.

It is evident from many authors that the yield performance carrot varied with genotypes, environmental factors, fertilizer application and other management practices. Malek *et al*. (2012) observed significant variations among the parameters of different genotypes of carrot and reported that the genotype *Brasilia agroflora* enumerated the highest yield (1321.5 kg ha^{-1}) and seed germination (83.2%), whereas the genotype New Kuroda had lowest yield (1193.7 kg ha^{-1}) and germination (79.4%). Application of GA_3 and its concentration plays very important role on seed production and related attributes of the plants. Mohanto *et al*. (2015) applied the GA_3 at 50 ppm, 100 ppm, 150 ppm, 200 ppm concentration on carrot and observed the highest seed yield (256.9 kg ha-1), germination (93.3%) and seed vigor index (3.2) by GA3 200 ppm treatment.

The findings of the study suggested that the BU Carrot 1 produced the highest root yield compared to New Kuroda, Chanfeny Kuroda, Sin Kuroda, Kuroda-35 and it was adopted with the climatic conditions of Bangladesh during winter. On the contrary, foliar application of GA_3 at 200 ppm concentration produced the highest seed yield. Following application of GA_3 at 200 ppm concentration, BU carrot-1 may be cultivated for root and seed production in Bangladesh.

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