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## Response of cuttings of different carnation (*Dianthus Caryophyllus* L.) cultivars to rooting hormones

**Aman Singh, Deepanshu and Pramod Kumar**

**Abstract**

The experiment entitled Response of cuttings of different carnation (*Dianthus caryophyllus* L.) cultivars to rooting hormones was conducted at Department of Horticulture, Naini Agricultural Institute, SHUATS, Prayagraj during November to March, 2019-20. Experiment was laid out in a FRBD having 3 cultivars and 7 rooting hormone concentrations consisting of 21 treatments with three replications. The results revealed that among the varieties studied, variety Liberty recorded maximum rooting percentage (89.5%), Plant height (81.9 cm.), No. of leaves per plant (128.7), No. of shoots per plant (5.3), Minimum Days to flower bud initiation (116.3), Minimum Days to flower bud opening (19.9), Flower diameter (6.8 cm.), Vase life (7.1) and No. of cut flower stalks per plant (9.8). The data on different concentrations of rooting hormones studied revealed that concentration of IBA @ 400ppm (R<sub>2</sub>) was superior compared to the other treatments with respect to Maximum rooting percentage (97.4%), Plant height (85.1 cm.), No. of leaves per plant (130.1), No. of shoots per plant (5.4), Minimum Days to flower bud initiation (115.2), Minimum Days to flower bud opening (17.2), Flower diameter (8.0 cm.), Vase life (8.1) and No. of cut flower stalks per plant (11.0). Interaction data revealed that treatment T<sub>3</sub> (V<sub>1</sub>R<sub>2</sub>) Liberty + IBA @ 400ppm recorded maximum rooting percentage (98.5%), Plant height (85.5 cm.), No. of leaves per plant (130.2), No. of shoots per plant (5.4), Minimum Days to flower bud initiation (115.1), Minimum Days to flower bud opening (17.6), Flower diameter (8.3 cm.), Vase life (8.1) and No. of cut flower stalks per plant (11.1).

**Keywords:** Carnation, cultivars, rooting hormones, IBA

**Introduction**

Carnation (*Dianthus caryophyllus* L) belongs to the family Caryophyllaceae having diploid chromosome number 2n=30. It is grown in several parts of the world and is believed to be the native of Mediterranean region. The generic name *Dianthus* comes from the writings of Theophrastus who lived about 300 B.C. He proposed that the word "*Dianthus*" came from the Greek words: "dios" means divine (God): "anthos" means lower, that is "the flower of the Gods". Linnaeus chose the species name "caryophyllus" after the genus of Clove, as the fragrance from Carnation is reminiscent of clove. The variety William Sim produced in 1938-39 by William Sim of North Berwick, Marine was the greatest contribution to the present Carnation industry. From that one red flowered plant, there have been mutations to several variegated forms like white, pink, orange, etc. Carnation is an important lower crop having great commercial value as a cut flower due to its excellent keeping quality, wide array of color and forms. Carnation, apart from producing cut flowers can also become useful in gardening for bedding, edging. Borders, pots and rock gardens (Dole and Wilkins, 2005) <sup>[1]</sup>. From medicinal point of view, Carnation flowers are considered to be cardiotoxic, diaphoretic and alexiteric (Shiragur *et al.* 2004) <sup>[4]</sup>.

It is commercially grown in many countries like Columbia, Kenya, Canary Island, Italy, Spain, Holland, U.S.A, etc. In India, sim carnations are being cultivated in many cities like Nasik, Pune, Bengaluru, Ludhiana, Solan and Shimla etc.

Carnations require sufficient amount of light and proper ventilation to produce high quality flowers and therefore design and orientation of greenhouse are of greater importance. Though there are different types of greenhouses, naturally ventilated Polyhouses are preferred in mild climate in which temperature is reduced by ventilation (Ryagi *et al.* 2007) <sup>[3]</sup>.

Commercial carnation is propagated through cuttings. Although, they have a tendency to root well under normal conditions, a little intervention with the use of growth regulators i.e. rooting hormones and appropriate media relatively increase the rooting success. The plant bio-system has its own inventory of plant growth promoting chemicals, nevertheless, endogenous application of PGR's have been reported to improve rooting percentage and root characters in

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many flower crops. Indole butyric acid (IBA) and Naphthalene Acetic Acid (NAA) have been found to positively affect the rooting phenomena in plants.

IBA and NAA are most commonly used auxins (Kaviarase and Selvaraj 2016) [2] Naphthalene acetic acid, commonly abbreviated NAA, is an organic compound with the formula  $C_{10}H_7CH_2CO_2H$ . NAA is a plant hormone in the Auxin family and is an ingredient in many commercial postharvest horticultural products as has been reported to modify plant growth and lower yield in carnation including significant increase in plant height, number of leaves and nodes, internodes height, shoot and root dry weight, flower diameters and number of petals.

### Materials and method

A study entitled Response of cuttings of different carnation (*Dianthus caryophyllus* L.) cultivars to rooting hormones was carried out in the Department of Horticulture, Naini Agricultural Institute, Sam Hligginbottom University of Agriculture, Technology and Sciences during 2019-2020. The experiment includes three cultivars of carnation viz., Liberty, Gwen and Gaudina in three replications with application of different concentrations of growth regulators: Indole-3-butyric acid (IBA) and Naphthalene Acetic Acid (NAA) with a total of twenty one treatments.

Herbaceous terminal cuttings of different carnation cultivars were treated with different concentrations of IBA and NAA. The basal portion of herbaceous cuttings were dipped in rooting hormone solution for 10 minutes and then planted in pro-trays. After month of planting in pro-trays, the rooted cuttings were planted in naturally ventilated polyhouse and various observations on vegetative and floral parameters were recorded.

#### Factor A= Varieties      Factor B = Plant growth regulators

V<sub>1</sub> – Liberty

V<sub>2</sub> – Gwen

V<sub>3</sub> – Gaudina

R<sub>0</sub> – control

R<sub>1</sub> – IBA @ 200ppm

R<sub>2</sub> – IBA @ 400ppm

R<sub>3</sub> – IBA @ 600ppm

R<sub>4</sub> – NAA @ 200ppm

R<sub>5</sub> – NAA @ 400ppm

R<sub>6</sub> – NAA @ 600ppm

### Treatment details

Symbols	Treatment combination	
T <sub>1</sub>	V <sub>1</sub> R <sub>0</sub>	Liberty + control
T <sub>2</sub>	V <sub>1</sub> R <sub>1</sub>	Liberty + IBA @ 200 PPM
T <sub>3</sub>	V <sub>1</sub> R <sub>2</sub>	Liberty + IBA @ 400 PPM
T <sub>4</sub>	V <sub>1</sub> R <sub>3</sub>	Liberty + IBA @ 600 PPM
T <sub>5</sub>	V <sub>1</sub> R <sub>4</sub>	Liberty + NAA @ 200 PPM
T <sub>6</sub>	V <sub>1</sub> R <sub>5</sub>	Liberty + NAA @ 400 PPM
T <sub>7</sub>	V <sub>1</sub> R <sub>6</sub>	Liberty + NAA @ 600 PPM
T <sub>8</sub>	V <sub>2</sub> R <sub>0</sub>	Gwen + control
T <sub>9</sub>	V <sub>2</sub> R <sub>1</sub>	Gwen + IBA @ 200 PPM
T <sub>10</sub>	V <sub>2</sub> R <sub>2</sub>	Gwen + IBA @ 400 PPM
T <sub>11</sub>	V <sub>2</sub> R <sub>3</sub>	Gwen + IBA @ 600 PPM
T <sub>12</sub>	V <sub>2</sub> R <sub>4</sub>	Gwen + NAA @ 200 PPM
T <sub>13</sub>	V <sub>2</sub> R <sub>5</sub>	Gwen + NAA @ 400 PPM
T <sub>14</sub>	V <sub>2</sub> R <sub>6</sub>	Gwen + NAA @ 600 PPM
T <sub>15</sub>	V <sub>3</sub> R <sub>0</sub>	Gaudina + control
T <sub>16</sub>	V <sub>3</sub> R <sub>1</sub>	Gaudina + IBA @ 200 PPM
T <sub>17</sub>	V <sub>3</sub> R <sub>2</sub>	Gaudina + IBA @ 400 PPM
T <sub>18</sub>	V <sub>3</sub> R <sub>3</sub>	Gaudina + IBA @ 600 PPM
T <sub>19</sub>	V <sub>3</sub> R <sub>4</sub>	Gaudina + NAA @ 200 PPM
T <sub>20</sub>	V <sub>3</sub> R <sub>5</sub>	Gaudina + NAA @ 400 PPM
T <sub>21</sub>	V <sub>3</sub> R <sub>6</sub>	Gaudina + NAA @ 600 PPM

### Results and discussion

Observations were recorded with respect to vegetative, flowering, flower quality, and yield parameter during the growing period of crop.

Maximum rooting percentage is found in variety Liberty (89.5%), followed by variety Gwen (88.9%) and the minimum is variety Gaudina (87.8%). Due to different concentrations of PGR Rooting percentage was found maximum (97.4%) is recorded in R<sub>2</sub> (IBA@ 400 ppm) followed by (94.3%) in R<sub>1</sub> (IBA@ 200 ppm) and the minimum (80.9%) in R<sub>0</sub> (Control). Interaction data revealed T<sub>3</sub> (V<sub>1</sub>R<sub>2</sub>) Liberty+ IBA@400ppm is recorded with maximum Rooting percentage (98.5%) followed by T<sub>10</sub> (V<sub>2</sub>R<sub>2</sub>) Gwen + IBA@400ppm is recorded with rooting percentage (97.3%) and the minimum (80.3%) is recorded in T<sub>15</sub> (V<sub>3</sub>R<sub>0</sub>) Gaudina + Control.

Maximum plant height at 120 DAP is found in variety Liberty (81.9 cm.), followed by variety Gwen (81.6 cm.) and the minimum is variety Gaudina (81.2 cm.). Due to different concentrations of PGR plant height was found maximum (85.1 cm.) is recorded in R<sub>2</sub> (IBA@ 400 ppm) followed by (83.9 cm.) in R<sub>1</sub> (IBA@ 200 ppm) and the minimum (77.9 cm.) in R<sub>0</sub> water spray (Control). Interaction data revealed T<sub>3</sub> (V<sub>1</sub>R<sub>2</sub>) Liberty + IBA@400ppm is recorded with maximum plant height (85.5 cm.) followed by T<sub>10</sub> (V<sub>2</sub>R<sub>2</sub>) Gwen + IBA@400ppm is recorded with plant height (85.0 cm.) and the minimum (77.5 cm.) is recorded in T<sub>15</sub> (V<sub>3</sub>R<sub>0</sub>) Gaudina + Control.

Maximum Number of leaves per plant at 120 DAP is found in variety Liberty (128.7), followed by variety Gwen (128.5) and the minimum is variety Gaudina (128.4). Due to different concentrations of PGR Number of leaves per plant was found maximum (130.1) is recorded in R<sub>2</sub> (IBA@ 400 ppm) followed by (129.7) in R<sub>1</sub> (IBA@ 200 ppm) and the minimum (126.9) in R<sub>0</sub> (Control). Interaction data revealed T<sub>3</sub> (V<sub>1</sub>R<sub>2</sub>) Liberty + IBA@400ppm is recorded with maximum Number of leaves per plant (130.2) followed by T<sub>10</sub> (V<sub>2</sub>R<sub>2</sub>) Gwen + IBA@400ppm is recorded with Number of leaves per plant (130.0) and the minimum (126.8) is recorded in T<sub>15</sub> (V<sub>3</sub>R<sub>0</sub>) Gaudina + Control.

Maximum Number of shoots per plant at 120 DAP is found in variety Liberty (5.3), followed by variety Gwen (5.3) and the minimum is variety Gaudina (5.2). Due to different concentrations of PGR Number of shoots per plant was found maximum (5.4) is recorded in R<sub>2</sub> (IBA@ 400 ppm) followed by (5.3) in R<sub>1</sub> (IBA@ 200 ppm) and the minimum (5.2) in R<sub>0</sub> (Control). Interaction data revealed T<sub>3</sub> (V<sub>1</sub>R<sub>2</sub>) Liberty + IBA@400ppm is recorded with maximum Number of shoots per plant (5.4) followed by T<sub>10</sub> (V<sub>2</sub>R<sub>2</sub>) Gwen + IBA@400ppm is recorded with Number of shoots per plant (5.4) and the minimum (5.1) is recorded in T<sub>15</sub> (V<sub>3</sub>R<sub>0</sub>) Gaudina + Control.

Minimum Days to flower bud initiation is found in variety Liberty (116.3) followed by variety Gwen (116.4) and the maximum is variety Gaudina (116.6). Due to different concentrations of PGR Days to flower bud initiation was found maximum (115.2) is recorded in R<sub>2</sub> (IBA@ 400 ppm) followed by (115.5) in R<sub>1</sub> (IBA@ 200 ppm) and the maximum (118.0) in R<sub>0</sub> (Control). Interaction data revealed T<sub>3</sub> (V<sub>1</sub>R<sub>2</sub>) Liberty + IBA@400ppm is recorded with minimum Days to flower bud initiation (115.1) followed by T<sub>10</sub> (V<sub>2</sub>R<sub>2</sub>) Gwen + IBA@400ppm is recorded with Days to flower bud initiation (115.2) and the maximum (118.3) is recorded in T<sub>15</sub> (V<sub>3</sub>R<sub>0</sub>) Gaudina + Control.

Minimum Days to flower bud opening is found in variety Liberty (19.9) followed by variety Gwen (20.3) and the

maximum is variety Gaudina (20.5). Due to different concentrations of PGR Days to flower bud opening was found minimum (17.9) is recorded in R<sub>2</sub> (IBA@ 400 ppm) followed by (18.5) in R<sub>1</sub> (IBA@ 200 ppm) and the maximum (23.0) in R<sub>0</sub> (Control). Interaction data revealed T<sub>3</sub> (V<sub>1</sub>R<sub>2</sub>) Liberty + IBA@400ppm is recorded with Days to flower bud opening (17.6) followed by T<sub>10</sub> (V<sub>2</sub>R<sub>2</sub>) Gwen + IBA@400ppm is recorded with Days to flower bud opening (17.9) and the maximum (23.2) is recorded in T<sub>15</sub> (V<sub>3</sub>R<sub>0</sub>) Gaudina + Control. Maximum Flower diameter is found in variety Liberty (6.8 cm.) followed by variety Gwen (6.6 cm.) and the minimum is variety Gaudina (6.5 cm.). Due to different concentrations of Flower diameter was found maximum (8.0 cm.) is recorded in R<sub>2</sub> (IBA@ 400 ppm) followed by (7.6 cm.) in R<sub>1</sub> (IBA@ 200 ppm) and the minimum (5.3 cm.) in R<sub>0</sub> (Control). Interaction data revealed T<sub>3</sub> (V<sub>1</sub>R<sub>2</sub>) Liberty + IBA@400ppm is recorded with Flower diameter (8.3 cm.) followed by T<sub>10</sub> (V<sub>2</sub>R<sub>2</sub>) Gwen + IBA@400ppm is recorded Flower diameter (8.0 cm.) and the minimum (5.2 cm.) is recorded in T<sub>15</sub> (V<sub>3</sub>R<sub>0</sub>) Gaudina + Control.

Maximum Vase life is found in variety Liberty (7.1) followed by variety Gwen (7.0) and the minimum is variety Gaudina (6.9). Due to different concentrations of Vase life was found maximum (8.1) is recorded in R<sub>2</sub> (IBA@ 400 ppm) followed by (7.9) in R<sub>1</sub> (IBA@ 200 ppm) and the minimum (5.9) in R<sub>0</sub> (Control). Interaction data revealed T<sub>3</sub> (V<sub>1</sub>R<sub>2</sub>) Liberty + IBA@400ppm is recorded with Vase life (8.1) followed by T<sub>10</sub> (V<sub>2</sub>R<sub>2</sub>) Gwen + IBA@400ppm is recorded Vase life (8.1) and the minimum (5.7) is recorded in T<sub>15</sub> (V<sub>3</sub>R<sub>0</sub>) Gaudina + Control.

Maximum No. of cut flower stalks per plant is found in variety Liberty (9.8) followed by variety Gwen (9.6) and the minimum is variety Gaudina (9.5). Due to different concentrations of No. of cut flower stalks per plant was found maximum (11.0) is recorded in R<sub>2</sub> (IBA@ 400 ppm) followed by (10.6) in R<sub>1</sub> (IBA@ 200 ppm) and the minimum (8.3) in R<sub>0</sub> (Control). Interaction data revealed T<sub>3</sub> (V<sub>1</sub>R<sub>2</sub>) Liberty + IBA@400ppm is recorded with No. of cut flower stalks per plant (11.1) followed by T<sub>10</sub> (V<sub>2</sub>R<sub>2</sub>) Gwen + IBA@400ppm is recorded No. of cut flower stalks per plant (11.0) and the minimum (8.2) is recorded in T<sub>15</sub> (V<sub>3</sub>R<sub>0</sub>) Gaudina + Control.

Table 1: Growth parameters

Level of PGR	Rooting Percentage (%)				Plant Height (Cm.)				Number of Leaves				Number of Shoots			
	Cultivar				Cultivar				Cultivar				Cultivar			
	V <sub>1</sub>	V <sub>2</sub>	V <sub>3</sub>	MEAN (R)	V <sub>1</sub>	V <sub>2</sub>	V <sub>3</sub>	MEAN (R)	V <sub>1</sub>	V <sub>2</sub>	V <sub>3</sub>	MEAN (R)	V <sub>1</sub>	V <sub>2</sub>	V <sub>3</sub>	MEAN (R)
R <sub>0</sub>	81.5	80.9	80.3	80.9	78.2	77.9	77.5	77.9	127.0	126.9	126.8	126.9	5.2	5.2	5.1	5.2
R <sub>1</sub>	95.4	94.4	93.1	94.3	84.2	83.9	83.6	83.9	129.8	129.7	129.5	129.7	5.3	5.3	5.3	5.3
R <sub>2</sub>	98.5	97.3	96.4	97.4	85.5	85.0	84.7	85.1	130.2	130.0	129.9	130.1	5.4	5.4	5.4	5.4
R <sub>3</sub>	92.1	91.8	90.4	91.4	83.3	83.0	82.6	82.9	129.2	129.1	128.8	129.1	5.3	5.3	5.3	5.3
R <sub>4</sub>	83.9	83.1	82.1	83.0	79.5	79.1	78.7	79.1	127.6	127.5	127.3	127.5	5.2	5.2	5.2	5.2
R <sub>5</sub>	86.1	85.6	84.3	85.3	80.8	80.3	79.9	80.3	128.1	128.0	127.8	127.9	5.2	5.2	5.2	5.2
R <sub>6</sub>	89.3	88.6	87.5	88.5	82.0	81.67	81.1	81.6	128.6	128.4	128.3	128.5	5.3	5.3	5.2	5.3
Mean V	89.5	88.8	87.7		81.9	81.6	81.2		128.7	128.5	128.4		5.3	5.3	5.2	
Comparison	F test	C.D.	SE(d)		F test	C.D.	SE(d)		F test	C.D.	SE(d)		F test	C.D.	SE(d)	
Due to varieties	S	0.032	0.016		S	0.031	0.015		S	0.034	0.017		S	0.029	0.014	
Due to hormone	S	0.021	0.010		S	0.020	0.010		S	0.022	0.011		S	0.011	0.009	
Interaction	S	0.056	0.028		S	0.054	0.027		S	0.059	0.029		S	0.043	0.025	

Table 2: Flowering and quality parameters

Level of PGR	Days To Flower Bud Initiation				Days To Flower Bud Initiation				Flower Diameter (Cm.)				Vase Life (Days)			
	Cultivar				Cultivar				Cultivar				Cultivar			
	V <sub>1</sub>	V <sub>2</sub>	V <sub>3</sub>	MEAN (R)	V <sub>1</sub>	V <sub>2</sub>	V <sub>3</sub>	MEAN (R)	V <sub>1</sub>	V <sub>2</sub>	V <sub>3</sub>	MEAN (R)	V <sub>1</sub>	V <sub>2</sub>	V <sub>3</sub>	MEAN (R)
R <sub>0</sub>	117.7	118.0	118.3	118.0	22.9	23.0	23.2	23.0	5.5	5.3	5.2	5.3	5.9	5.9	5.7	5.9
R <sub>1</sub>	115.4	115.5	115.7	115.5	18.2	18.5	18.7	18.5	7.7	7.6	7.5	7.6	7.9	7.9	7.8	7.9
R <sub>2</sub>	115.1	115.2	115.4	115.2	17.6	17.9	18.1	17.9	8.3	8.0	7.8	8.0	8.1	8.1	8.0	8.1
R <sub>3</sub>	115.8	115.9	116.1	115.9	18.9	19.2	19.5	19.2	7.3	7.0	6.9	7.1	7.4	7.3	7.2	7.3
R <sub>4</sub>	116.9	117.1	117.2	117.1	21.7	22.8	22.9	22.5	5.9	5.8	5.7	5.8	6.3	6.2	6.1	6.2
R <sub>5</sub>	116.6	116.6	116.8	116.7	20.6	20.7	21.1	20.8	6.3	6.1	6.0	6.1	6.8	6.6	6.4	6.6
R <sub>6</sub>	116.2	116.3	116.4	116.3	19.6	19.8	20.0	19.8	6.7	6.5	6.4	6.5	7.1	7.0	6.9	7.0
Mean V	116.3	116.4	116.6		19.9	20.3	20.5		6.8	6.6	6.5		7.1	7.0	6.9	
Comparison	F test	C.D.	SE(d)		F test	C.D.	SE(d)		F test	C.D.	SE(d)		F test	C.D.	SE(d)	
Due to varieties	S	0.033	0.017		S	0.029	0.014		S	0.028	0.014		S	0.029	0.014	
Due to hormone	S	0.022	0.011		S	0.019	0.009		S	0.018	0.009		S	0.019	0.009	
Interaction	S	0.058	0.029		S	0.050	0.025		S	0.048	0.024		S	0.050	0.024	

Table 3: Yield parameters

Level of PGR	Number of cut flower stalks per plant			
	Cultivar			
	V <sub>1</sub>	V <sub>2</sub>	V <sub>3</sub>	Mean (R)
R <sub>0</sub>	8.5	8.3	8.2	8.3
R <sub>1</sub>	10.9	10.6	10.3	10.6
R <sub>2</sub>	11.1	11.0	10.9	11.0
R <sub>3</sub>	10.1	9.9	9.8	9.9
R <sub>4</sub>	8.9	8.8	8.6	8.8
R <sub>5</sub>	9.2	9.1	8.9	9.1

R <sub>6</sub>	9.6	9.5	9.3	9.5
Mean V	9.8	9.6	9.5	
Comparison	F test	CD at 5%	S.Ed.±	
Due to varieties	S	0.034	0.017	
Due to hormone	S	0.023	0.011	
Interaction	S	0.060	0.029	

### Conclusion

Based on the findings of the experiment it is concluded that the variety Liberty is superior with the interaction of growth regulator (IBA@400 ppm) with respect to the vegetative parameter (rooting percentage, Plant height, Number of leaves, Number of shoots), flowering parameters (Days taken for bud initiation and days to bud opening), quality parameter (flower diameter and vase life) and yield parameters (Number of cut flower stalks per plant per season).

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