Research Article

Influence of Indole-3-Butyric Acid on Rooting Efficacy in Different Carnation (*Dianthus Caryophyllus* L.) Genotypes under Protected Condition

Prince[1]*, Arvind Mailk[2] and Vivek Beniwal[1]

[1]Department of Horticulture, CCS Haryana Agricultural University, Hisar- 125004, Haryana, India
[2]Ram Dhan Singh Seed Farm, CCS Haryana Agricultural University, Hisar- 125004, Haryana, India

Abstract

A study on the effect of Indole-3-butyric acid (IBA) on fifteen genotypes of carnation (Dianthus caryophyllus L.) was conducted at Centre for Quality Planting Material, RDS Seed Farm, CCS HAU, Hisar, Haryana. The study revealed that among the Fifteen genotypes experimented, the highest per cent of rooting was recorded in the genotype Guadina (91.33 %) whereas, the lowest rooting per cent was recorded in the genotype IIHR (44.66 %). As for the concentration of IBA used, 500 ppm resulted in the maximum rooting percentage (72.48%) as compared to that in 200 ppm concentration. Similar tendency of superiority was observed for days for root initiation, number of roots per cutting and length of roots, wherein the genotype Beltico took the least number of days for root initiation (15.83 days) and highest number of roots (18.01) per cutting followed by Golem (16.87).

Keywords: Carnation, genotype, Indole-3-butyric acid, rooting per cent, root length

***Correspondence**
Author: Prince
Email: prince.hau@gmail.com

Introduction

The demand for ornamental flowers is ever increasing in international and domestic market with the improvement in standard of living and quality of life. Among the cut flowers, carnation is preferred by growers to rose and chrysanthemum it has long vase life. In India, carnation is grown in and around Delhi, Chandigarh, Maharashtra, Punjab, Himachal Pradesh, Karnataka, Tamil Nadu and Andhra Pradesh. The most suitable climate for commercial carnation flower production in India prevails in the Nilgiris and Kodaikanal of Tamil Nadu and parts of Himachal Pradesh. Commercially, carnation is vegetatively propagated through soft wood cuttings. Carnation cuttings can be propagated around the year by maintaining the temperature at 18-22^{o}C with 75-80% relative humidity inside the polyhouse. Rooting in cuttings is obtained in 25-30 days after propagation with manual misting in a polythene chamber [5]. These cuttings are made from the soft green succulent new growth of the plant. 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 would relatively increase the rooting success. Among different factors governing root development, rooting hormone plays very important role, it encourage the plant to induce rooting process. 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 many ornamental crops. Exogenous auxin application improves rooting efficiency and quality of stem cuttings, while IBA and NAA stimulate adventitious rooting in cuttings [7]. Indole Butyric Acid (IBA) and Naphthalene Acetic Acid (NAA) have been found significant affect on the root development process in plants. Amin and Hashim (1992) reported that treating "Spider" chrysanthemum cuttings with IAA and IBA at concentrations 0, 100, 200, 300 or 400 ppm significantly increased the number of roots compared with non- treated cuttings [2]. Debasis (2000) found that soaking "Super White" *Chrysanthemum indicum* cuttings with NAA at concentration of 2000 ppm significantly increased the growth of the roots, germination percentage and the number of roots [9]. Ranpise *et al*. (2004), studied the effect of different levels of IBA on rooting, growth and flower yield of chrysanthemum cv. Sonali Tara and reported maximum survival percentage with IBA at 2000ppm followed by1000ppm IBA [18]. Khewale *et al*. (2005) studied the influence of different concentrations of IBA and media on root parameters in propagation of carnation cv. Gaudina and recorded highest percentage of rooting with IBA at 125ppm [15]. Grewal *et al*. (2005), studied the effect of IBA and NAA on rooting of chrysanthemum terminal cuttings and indicated that cuttings with IBA at 400ppm performed well with respect to percentage of rooting [10]. Panahi and Morteza (2000), studied the effect of auxins on rooting and flowering of carnation cultivars (*Dianthus caryophyllus* L.) and recorded highest number of roots per cutting with

IBA at 100ppm. Hence, the present study was designed to standardise the appropriate concentration of IBA for rooting in carnation cuttings under protected condition [17].

Material and Methods

The experiment was carried out at Centre for Quality Planting Material, RDS Seed Farm, CCS HAU, Hisar, Haryana during 2016-17, to study the effect of rooting hormone viz., Indole butyric acid on rooting success in different carnation genotypes. In the experiment, terminal cuttings of fifteen genotypes of carnation viz., Friday (T_1), Irene (T_2), Aicardii (T_3), Gaudina (T_4), Ambrose (T_5), White Liberty (T_6), Jureno (T_7), Baltico (T_8), Bizet (T_9), Tasmon (T_{10}), Gwen (T_{11}), Harvey (T_{12}), Golem (T_{13}), Eskino (T_{14}) and IIHR (T_{15}) were treated with 200 ppm and 500 ppm IBA (Indole butyric acid) and were recorded for their rooting success. The experiment was laid out in Completely Randomized Design, with three replications. The basal portion of the cuttings was dipped in Indole butyric acid for 10 minutes. Treated cuttings were planted in protrays containing coir pith as the media. Under each replication, 25 cuttings were planted. Temperature was maintained at 18-25°C, and relative humidity at 80-85% within a polyhouse. Observations were recorded on different root characteristics of the cuttings every two days once to be precise. The cuttings were picked randomly, and days from planting to formation of root initials were considered as days taken for rooting. Per cent rooting was determined by counting the number of rooted cuttings per replication and dividing this by the total number of cuttings per replication. For number of roots per cutting, all the roots originating from the cuttings were counted, and, the total number of roots was divided by the total number of rooted cuttings. All roots produced per replication were collected and their length was measured; the sum of the length was divided by the total number of rooted cuttings to calculate average root length.

Results and Discussion

Rooting Percentage (%)

The investigation on the effect of IBA on rooting of different carnation (*Dianthus caryophyllus* L.) genotypes showed significant difference for rooting per cent. Data presented in **Table 1** shows that the significantly highest rooting per cent was recorded in T_4 (91.33 %) followed by T_7 (83.33 %), whereas, the lowest rooting per cent was recorded in T_{15} (44.66 %). Similar results were obtained by Renuka *et al*. (2015) w. r. t. rooting percent which revealed that IBA appeared to have wide range of root enhancing ability in carnation [19].

Table 1 Effect of IBA at 200 ppm and 500 ppm on rooting per cent in different genotypes of carnation

Genotypes	IBA		Mean
	200 ppm	500 ppm	
T_1	80.00	84.00	82.00
T_2	72.00	86.66	79.33
T_3	61.33	65.33	63.33
T_4	89.33	93.33	91.33
T_5	62.66	73.33	68.00
T_6	78.66	76.66	77.66
T_7	80.00	86.66	83.33
T_8	61.33	76.00	68.66
T_9	57.33	74.66	66.00
T_{10}	62.66	76.00	69.33
T_{11}	70.66	72.00	71.33
T_{12}	49.33	53.33	51.33
T_{13}	76.00	77.33	76.66
T_{14}	68.00	45.33	56.66
T_{15}	42.66	46.66	44.66
Mean	67.46	72.48	
CD at 5%	Genotype = 5.26	IBA= 1.92	Interaction= 3.44

As for the concentration of IBA used, 500 ppm resulted in the maximum rooting percentage (72.48%) as compared to that in 200 ppm concentration and these results Confirmatory with Grewal *et al.* (2005) in chrysanthemum [10]. Interaction between genotypes and auxin was found significant and maximum rooting

percentage was recorded in IBA 500 ppm (93.33%) which was followed by IBA 500 ppm (86.66) in T_4 and T_7 respectively. Similar results were reported by Gupta *et al.* (2005), in bougainvillea cv. Pallavi [11].

Root Initiation

The data in **Table 2** reveals that T_8 took the least number of days for root initiation (15.83 days) which was at par with T_{13} (16.83 days) and T_1 (17.16 days). On the other hand, highest number of days for root initiation was recorded in T_{12} (25.00 days). This may be due to the fact that the varietal response to exogenous application of IBA depends on the capacity of the individual genotypes to readily transport them to the sites of utilization where they initiate the formation of adventitious roots [6]. Effects of IBA on root initiation were in accordance to the findings of Grewal *et al*. (2005) in chrysanthemum [10].

Auxin treatment significantly reduces the time-to-rooting and early rooting was recorded with the 500 ppm IBA (20.60 days) over 200 ppm (22.53 days). This might be due to the internal auxin amount is not enough for root induction of cuttings. It has been reported that auxin existence is necessary for induction of the root starter cells [12]. Similar findings have been reported by Bharathy *et al.* (2004) in case of carnation and by Kazankaya *et al.* (2005) in case of other cultivars of rose [4, 14]. Interaction between genotypes and auxin is found non-significant.

Table 2 Effect of IBA at 200 ppm and 500 ppm on days taken for root initiation in different genotypes of carnation

Treatment	IBA		Mean
	200 ppm	500 ppm	
T_1	18.00	16.33	17.16
T_2	22.00	20.66	21.33
T_3	24.66	23.00	23.83
T_4	25.66	23.00	24.33
T_5	22.66	20.33	21.50
T_6	24.33	22.33	23.33
T_7	24.00	21.66	22.83
T_8	16.66	15.00	15.83
T_9	22.66	19.66	21.16
T_{10}	24.33	23.00	23.66
T_{11}	25.66	22.66	24.16
T_{12}	25.33	24.66	25.00
T_{13}	17.66	16.00	16.83
T_{14}	23.00	21.00	22.00
T_{15}	21.33	19.66	20.50
Mean	22.53	20.60	
CD at 5%	Genotype = 2.50	IBA= 0.91	Interaction= NS

Number of roots / cutting

There was a significant effect of genotype on the number of roots per cuttings (**Table 3**). Maximum numbers of roots (18.01) were observed in T_8 which was at par with T_{13} (16.87) and T_1 (16.69). Variation in rooting characteristics of different genotypes may be attributed to their genetic characteristics or variation in auxin and carbohydrate content in cuttings, due to which some plants root profusely while others fail to root [1, 13, 3].

IBA significantly increased the number of roots per cutting and found maximum (13.84) in 500 ppm IBA. The more number of roots obtained with the application of growth chemicals clearly reflects that they not only initiate rooting but also help in subsequent rapid growth of roots in numerical strength. The effect of auxins has been reported to enhance rooting through the translocation of carbohydrates and other nutrients to the rooting zone [16].

Root Length

Table 4 shows that the average root length was significantly highest in T_8 (12.81 cm) which was on par with T_{13} (12.49 cm) and T_1 (12.15 cm), while 500 ppm IBA resulted in the longest root (11.44 cm) over 200 ppm (11.00 cm). The earliness in rooting may have resulted in the formation of longer roots. Production of adventitious roots in plants through cell division, multiplication and specialization is also controlled by plant growth substances especially auxins

[8]. This implies that treating stem cuttings with auxins can increase the root length and number of roots. Interaction of the genotype and auxin was found non-significant.

Table 3 Effect of IBA at 200 ppm and 500 ppm on number of roots / cutting in different genotypes of carnation

Treatment	IBA		Mean
	200 ppm	500 ppm	
T_1	16.20	17.183	16.69
T_2	14.58	15.17	14.87
T_3	14.20	14.46	14.33
T_4	13.56	14.92	14.24
T_5	13.06	13.71	13.38
T_6	11.73	13.86	12.80
T_7	12.44	12.60	12.52
T_8	17.26	18.76	18.01
T_9	11.16	12.03	11.60
T_{10}	12.06	12.28	12.17
T_{11}	12.19	12.85	12.52
T_{12}	10.23	10.90	10.56
T_{13}	16.74	17.00	16.87
T_{14}	11.53	9.99	10.76
T_{15}	10.96	11.96	11.46
Mean	13.19	13.84	
CD at 5%	Genotype = 1.47	IBA= 0.53	Interaction= NS

Table 4 Effect of IBA at 200 ppm and 500 ppm on Root Length (cm) in different genotypes of carnation

Treatment	IBA		Mean
	200 ppm	500 ppm	
T_1	11.66	12.63	12.15
T_2	10.66	11.43	11.04
T_3	11.31	11.55	11.43
T_4	11.38	11.99	11.69
T_5	11.06	10.56	10.81
T_6	11.56	10.50	11.03
T_7	10.93	11.63	11.28
T_8	12.70	12.93	12.81
T_9	10.76	11.00	10.88
T_{10}	10.80	11.55	11.17
T_{11}	10.39	11.09	10.74
T_{12}	9.16	10.40	9.78
T_{13}	12.22	12.76	12.49
T_{14}	10.10	10.78	10.44
T_{15}	10.35	10.77	10.56
Mean	11.00	11.44	
CD at 5%	Genotype = 1.13	IBA= 0.41	Interaction= NS

References

[1] Abbas, H., Jaskani, M. J., Hussain, Z. and Asif, M. 2006. Response of rose cuttings against root promoting hormones during spring and autumn. Int. J. Biol. Biotechnol. 3(1): 201-204.

[2] Amin, K.A. and Hashim, H.A. 1992. Effect of two types of plant auxin on rooting of cuttings of chrysanthemum (Chrysanthemum morifolium). Third Scientific Conference of Technical Education. Agricultural Research, 477 -487.

[3] Akhtar, M.S., Khan, M.A., Atif-Riaz. and Adnan-Younis. 2002. Response of different rose species to different root promoting hormones. Pak. J. Agri. Sci. 39(4): 297-299.
[4] Bharathy, P.V., Sonawane, P.C., Sasnu, A. 2004. Effect of plant growth regulators, type of cutting and season on rooting of carnation (Dianthus caryophyllus L.) cuttings. Ind. J. Hort. 61:338-341.
[5] Chadha, K.L. 2001. In: Handbook of Horticulture, pp.548-54.
[6] Cibele, T. Da Costa, Marcia R. De Almeida, Carolina M. Ruedell, Joseli Schwambach, Felipe S. Maraschin, and Arthur G. Fett-Neto. 2013. When stress and development go hand in hand: main hormonal controls of adventitious rooting in cuttings. Frontiers in Plant Science 4: 133.
[7] Copes, D.L. and Mandel, N.L. 2000. Effects of IBA and NAA treatments on rooting Douglas-fir stem cuttings. New Forests, 20(3): 249-257.
[8] Davis, D.T. and Hassig, B.E. 1990. Chemical control of adventitious root formation in cuttings. Plant Growth Regulation Society of America. 18: pp 1-17.
[9] Debasis, C. 2000. Retrieval of a new colored chrysanthemum through organ ogenenesis from sartorial chimera. National Botanical Research Institute, India: 1060-1070.
[10] Grewal, H.S., Ramesh, K. and Rupinder, C. 2005. Effect of IBA and NAA on rooting of chrysanthemum (Dendranthema grandiflora Tzevlev) terminal cuttings. Orna. Hort. 8(3): 230-232.
[11] Gupta, V.N., Banerjee, B.K. and Datta, S.K. 2005. Studies on regeneration of bougainvillea by stem cuttings with the aid of auxins under intermittent mist. J. Orna. Hort. 8(1): 65-69.
[12] Hartmann, H.T., Kester, D.E., Davies, F.T., Geneve, R.L. 2002. Plant Propagation: Principles and Practices, Prentice Hall, New Delhi, India.
[13] Hussain, H. and Khan, M.A. 2004. Effect of growth regulators on stem cuttings of Rosa bourbonaina and Rosa gruss-an-teplitz. Int. J. Agri. Biol. 6(5): 931-932.
[14] Kazankaya, A., Yoruk, E., Dogan, A. 2005. Effect of IBA on rooting of Rosa canina hardwood cuttings from Lake Van Region, Turkey. Acta Horticulturae. 690:153-158.
[15] Khewale, A.P., Golliwar, V.J., Poinkar, M.S., Jibhakate, S.B. and Athavale, M.P. 2005. Influence of different concentrations of IBA and media on root parameters in the propagation of carnation cv. Gaudina. J. of Soils & Crops. 15(2): 406-410.
[16] Middleton, W., Jarvis, B.C. and Booth, A. 1980. The role of leaves in auxin and boron depending rooting of stem cuttings of Phaseolus aureus Roxb. New Phytologist. 84(2): 251-259.
[17] Panahi, R. and Khoushkhoui Morteza. 2000. Effects of auxins on rooting and flowering of two cultivars of carnation (Dianthus caryophyllus L.). Iranian J. Hort. Sci. Techn. 1(3-4): 91-108.
[18] Ranpise, S.A., Bharmal, V.S. and Darwade, R.T. 2004. Effect of different levels of indole butyric acid (IBA) on rooting, growth and flower yield of chrysanthemum cv. Sonali Tara. J. Orn. Hort. 7(3-4): 331-337.
[19] Renuka, K., Chandrashekar, K., Pratap, M. and Narendra Reddy. 2015. Effect of plant growth regulators on rooting of carnation (Dianthus caryophyllus L.) cuttings of different cultivars under poly house conditions. J. Soils & Crops. 25(2): 266-270.

Publication History
Received 10th Aug 2017
Revised 28th Aug 2017
Accepted 04th Sep 2017
Online 30th Sep 2017