Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(5): 953-957
Received: 26-07-2019
Accepted: 27-08-2019

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Effect of the different rooting media and IBA concentrations on survival percentage and root parameters of carnation (*Dianthus caryophyllus*) cuttings CV. Gaudina

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Abstract
The present experiment was conducted to study the effect of different rooting media and IBA concentrations on rooting of carnation cuttings cv. Gaudina under semi-climate controlled greenhouse conditions, during 2017-2018 and the experiment was conducted in Completely Randomized Design (CRD). All the rooting media and IBA concentrations studied recorded superior rooting parameters over control. Among the rooting media studied, cocopeat + river sand (1:1) and among the IBA concentration, 200 ppm IBA was found the best. Within the interaction treatments, the best combination was found with the cocopeat + river sand (1:1) rooting media with 200 ppm IBA concentration which recorded highest survival percentage of cuttings (93.33%), rooting percentage (93.33%), number of primary roots per cutting (6.93) and longest root length (69.47 mm).

Keywords: Auxins, cocopeat, floriculture, plant growth regulators

Introduction
The demand for ornamental flowers is ever increasing in the international and domestic market with the improvement in standard of living and quality of life. Carnation (*Dianthus caryophyllus*) belongs to *Caryophyllaceae* family and is a native of the Mediterranean region (Salehi, 2006) [19]. It is a valuable flower crop which has great commercial value as a cut flower because of its excellent keeping quality, a wide range of colors and forms, ability to withstand long-distance transport and high rehydration capacity (Pralhad, 2009) [14]. It ranks next only to rose and *Chrysanthemum* in global floriculture trade (Sanyat *et al.* 2006) [21]. Carnations are vegetatively propagated by mainly soft wood cuttings. These cuttings are made from the soft green succulent new growth of the plant. Year-round propagation can be done in carnation inside the polyhouse provided temperature is maintained at approximately 20 ºC and 75-80 per cent relative humidity (Chadha, 2001) [5].

The growth and development of carnation plants is affected by the different types of factors. Among these different factors, the vital factor which plays a major role in quality production and rooting of cuttings of carnation is rooting media. For proper growth, a rooting media must provide four functions: supply nutrients, provide water, permit gaseous exchange to and from the roots and should also provide support to the plants. River sand, vermiculite, perlite, cocopeat, sphagnum moss, etc. and their different combinations are being used as rooting media for carnation cuttings. The type of rooting medium up to some extent determines the nature of roots produced in the cutting (Nanda and Kochhar, 1985) [12]. Plant growth regulators like auxins play an important role in improvement in rooting of cuttings. Mostly used auxins are IBA and NAA. The promoting effect of IBA on rooting is because of its conversion to IAA in plant tissue. Hence, the study was conducted to standardize the media and optimum dose of IBA for better rooting of carnation cuttings.

Materials and Methods
The study was conducted during 2017-18 at Centre for Quality Planting Material, CCSHAU, Hisar, Haryana. In present investigation terminal cuttings having 10 – 15 cm length with 2-4 pairs of leaves of standard type of carnation cv. Gaudina were used. Rooting media used were river sand, cocopeat, vermicompost + cocopeat + river sand (1:1:1), vermicompost + cocopeat (1:1), vermicompost + river sand (1:1), cocopeat + river sand (1:1) and cocopeat + vermiculite + perlite (3:1:1). The growth hormone used was Indole Butyric Acid (IBA) with three different concentrations 0 (control), 100 and 200 ppm. Terminal ends of cuttings were dipped in IBA solution for 5 minutes. The treated cuttings were planted in protrays kept in semi-climate

controlled greenhouse nursery. The cuttings were watered regularly with rosecan to maintain the media in moist condition. To maintain the optimum temperature and humidity, cooling (fan and pad) and fogging system were operated in semi-climate controlled greenhouse as and when required. Protrays of 40 x 20 cm size with 50 plugs in each protray were filled with different media. The experiment was laid out in Completely Randomized Design (CRD) with total 21 treatments having 3 replications each and 10 cuttings planted per replication. Biometric observations recorded were survival percentage of cuttings after one month of planting and other observations like rooting percentage, number of primary roots per cutting and root length (mm) were recorded at appropriate time after planting of cuttings. For recording the observations, five representative plants were selected randomly in each replication and average was worked out and the data were statistically analysed using sas version 9.4 (Panse and Sukhatme, 1985) [13].

Results and Discussion

Survival percentage of cuttings

The data in table 1 shows that survival percentage of cuttings in protrays significantly increased with the different rooting media and also with the increase in concentration of IBA. Among the rooting media, highest survival percentage of cuttings (86.78%) was observed in cocopeat + river sand (1:1) media, which might be because of that the river sand provides the mechanical support to the plant and coco peat which has good water holding capacity and nutrient supply that might have supported for increased survival percentage of cuttings. Among the different IBA concentrations, 200 ppm IBA recorded highest survival percentage of cuttings (84.71%) and it was least (76.57%) in 0 ppm IBA. Among the interaction of rooting media and IBA concentration, the best combination was observed with cocopeat + river sand (1:1) with 200 ppm of IBA (93.33%), while it was least in control (60.33). Similar results were obtained by Barreto and Nookaraju (2007) [1] as they observed the effect of auxin types on rooting and acclimatization of grapevine as affected by different media and reported that plantlets when planted in coco-peat in combination with sand showed highest acclimatization and highest survival percentage. The results are also in confirmatory with the studies of Ranpise *et al.* (2004) [17], who recorded significantly highest survival percentage (96.47) with higher concentration of IBA at 30 days of planting in *Chrysanthemum* cv. Sonali Tara.

Table 1: Effect of different rooting media and IBA concentrations on survival percentage of cuttings after one month of planting in protrays in carnation cv. Gaudina

Rooting media	Concentration of IBA (ppm)			Mean
	0	100	200	
River sand (Control)	60.33	66.67	80.33	69.11
Coco peat	80.33	81.33	83.33	81.66
Vermicompost + Cocopeat + River sand (1:1:1)	76.67	80.33	81.66	79.55
Vermicompost + Cocopeat(1:1)	80.33	83.33	86.67	83.44
Vermicompost + River sand (1:1)	80.33	80.33	84.33	81.66
Cocopeat + River sand (1:1)	80.33	86.67	93.33	86.78
Cocopeat + Vermiculite + Perlite (3:1:1)	77.67	78.67	83.33	79.89
Mean	76.57	79.62	84.71	
C.D. at 5%	Media	Concentration of IBA	Media x Concentration of IBA	
	2.62	1.71	4.54	

Similar findings were obtained by Gurjar and Patle (2007) [9] in pomegranate, Renuka and Sekhar (2015) [18] in carnation and Bhandari (2014) [2] in hibiscus.

Rooting percentage

The data in Table 2 shows the significant effect of different rooting media and the concentration of IBA on the rooting percentage of carnation cuttings. The maximum rooting percentage of carnation cuttings (84.44%) was found in the cocopeat + river sand (1:1).

Table 2: Effect of different rooting media and IBA concentrations on rooting percentage of cuttings at the time of transplanting in carnation cv. Gaudina

Rooting media	Concentration of IBA (ppm)			Mean
	0	100	200	
River sand (Control)	43.33	46.67	50.33	46.78
Coco peat	56.67	60.33	66.67	61.22
Vermicompost + Cocopeat + River sand (1:1:1)	76.67	76.67	80.33	77.89
Vermicompost + Cocopeat(1:1)	76.67	80.33	83.33	80.11
Vermicompost + River sand (1:1)	66.67	73.33	76.67	72.22
Cocopeat + River sand (1:1)	76.67	83.33	93.33	84.44
Cocopeat + Vermiculite + Perlite (3:1:1)	63.33	66.67	73.33	67.78
Mean	65.72	69.62	74.86	
C.D. at 5%	Media	Concentration of IBA	Media x Concentration of IBA	
	2.24	1.46	3.87	

The results were in confirmatory with the reports of Thomas *et al.* (2003) [26] in carnation cv. Mixed Super Chaubaud; Singh *et al.* (2002) [24] and Renuka and Sekhar (2015) [18] in carnation. As the cocopeat + river sand contain adequate organic matter that improves the soil structure, enables to retain moisture and variety of micro-organisms which support root growth, which might have contributed for maximum percentage of rooting. The maximum rooting percentage was observed with 200 ppm IBA (74.86%) while it was found minimum with 0 ppm IBA (65.72%). Among the interaction

treatments, the highest rooting percentage was found in cocopeat + river sand with 200 ppm IBA (93.33%) while it was found minimum in control (43.33%), which was found statistically at par in control with 100 ppm IBA (46.67%). Auxins help to increase the cell division by increasing the level of endogenous cytokinin which results in the induction of more number of root primordia. Exogenous application of auxins will hasten the process of root initiation. These results are in accordance with the findings of Bose *et al.* (2002) [4], Copes and Mandel (2000) [6], Prince *et al.* (2017) [15] and Singh *et al.* (2006) [25] in carnation. Among the interaction, the best rooting percentage was found in cocopeat + river sand (1:1) with 200 ppm IBA (93.33%). Khewale *et al.* (2005) [10] and Gowda *et al.* (2017) [8] reported the similar result for different concentrations of IBA and media on different root parameters in propagation of carnation and recorded highest percentage of rooting with IBA.

Number of primary roots per cutting

The data in Table 3 indicates that rooting media and IBA concentration has significantly increased the number of primary roots per cutting of carnation. Significant differences were recorded among different rooting media on number of roots per cutting. Among the media, highest number of roots per cutting (5.16) was recorded in cocopeat + river sand (1:1), which was found at par with vermicompost + cocopeat + river sand (1:1:1) (5.02) and the lowest number of roots per cutting (3.33) was found in the river sand alone. This might be due to the fact that coco peat can retain moisture up to nine times of its own volume while maintaining excellent air-filled porosity, providing vital oxygen to the roots. The combination of river sand and coco peat might have provided a suitable environment for development of more number of roots. The results were in confirmatory with Thomas *et al.* (2003) [26]. Cuttings treated with 200 ppm IBA recorded highest number of roots per cutting (5.67), while least number of roots per cutting was found with 0 ppm IBA (3.13). The interaction between rooting media and IBA concentration was significant for number of roots per cutting. Cocopeat + river sand (1:1) with 200 ppm IBA recorded the highest number of roots per cutting (6.93). This might be due to that IBA is more resistant to oxidation and it is very effective as root promoter and IBA retained near the site of application, hence it is one of the best rooting stimulator (Weaver, 1972) [27].

Table 3: Effect of different rooting media and IBA concentrations on number of primary roots per cutting at the time of transplanting in carnation cv. Gaudina

Rooting media	Concentration of IBA (ppm)			Mean
	0	100	200	
River sand (Control)	2.07	3.27	4.67	3.33
Coco peat	2.20	2.27	6.60	3.69
Vermicompost + Cocopeat + River sand (1:1:1)	4.47	5.13	5.47	5.02
Vermicompost + Cocopeat(1:1)	3.60	5.00	5.47	4.69
Vermicompost + River sand (1:1)	3.60	4.27	4.80	4.22
Cocopeat + River sand (1:1)	3.20	5.33	6.93	5.16
Cocopeat + Vermiculite + Perlite (3:1:1)	2.80	4.33	5.73	4.29
Mean	3.13	4.23	5.67	
C.D. at 5%	Media	Concentration of IBA	Media x Concentration of IBA	
	0.30	0.20	0.53	

The results are in confirmatory with the reports of Samananda *et al.* (1972) [20] they reported that IBA increased the number of roots in stem cuttings of *Chrysanthemum*. Sidhu and Singh (2002) [24] also reported that IBA at 250 ppm recorded highest number of roots per cutting in *Chrysanthemum*. These results were in confirmatory with Mahale *et al.* (2002) [11], Bharathy *et al.* (2003) [3], Ghofrani *et al.* (2013) [7] in carnation and Shiva and Nair (2009) [22] in hibiscus.

Root length (mm)

Root length (mm) significantly differs with the rooting media and the concentration of IBA as shown in Table 4. Among the media, maximum root length (67.87 mm) was observed in the cocopeat + river sand (1:1) and minimum root length (33.08 mm) was observed in the river sand alone.

Table 4: Effect of different rooting media and IBA concentrations on length of longest root (mm) at the time of transplanting in carnation cv. Gaudina

Rooting media	Concentration of IBA (ppm)			Mean
	0	100	200	
River sand (Control)	29.73	34.23	35.27	33.08
Coco peat	35.40	55.20	63.60	51.40
Vermicompost + Cocopeat + River sand (1:1:1)	47.00	48.13	63.87	53.00
Vermicompost + Cocopeat(1:1)	35.60	55.67	65.73	52.33
Vermicompost + River sand (1:1)	37.00	50.07	58.23	48.43
Cocopeat + River sand (1:1)	66.20	67.93	69.47	67.87
Cocopeat + Vermiculite + Perlite (3:1:1)	34.07	39.53	57.33	43.64
Mean	40.71	50.11	59.07	
C.D. at 5%	Media	Concentration of IBA	Media x Concentration of IBA	
	2.09	1.37	3.62	

This might be because of the fact that river sand provides nutrients and drains off excess water and coco peat provide maximum pore space and aeration which might have supported maximum length of longest root. Results were confirmatory with Thomas *et al.* (2003) [26] in carnation. Singh *et al.* (2002) [24] also recorded the maximum length of longest root with coco peat in carnation. There was significant difference in the root length with the increase in concentration

of IBA. Carnation cuttings treated with 200 ppm IBA recorded the maximum root length (59.07 mm), while it was found minimum (40.71 mm) with 0 ppm IBA. It appears likely that auxins initiate synthesis of structural proteins involved in the formation of adventitious root. The results are in confirmatory with the reports of Ramtin *et al.* (2011) [16] in *Poinsettia pulcherrima* L. and Ghofrani *et al.* (2013) [7] and Singh *et al*. (2006) [25] in carnation.

The best combination of media and IBA concentration observed for maximum root length (69.47 mm) was cocopeat + river sand (1:1) with 200 ppm IBA, which was at par with cocopeat + river sand (1:1) rooting media with 0 ppm IBA (66.20 mm) and with 100 ppm IBA (67.93 mm) cocopeat + river sand. Similar results were reported by Khewale *et al*. (2005) [10] in carnation cv. Gaudina and concluded that cocopeat in combination with IBA at 125 ppm was found to be the best over other media treatments regarding number of roots per cutting.

Conclusion

It can be concluded from above results that among the different rooting media studied, the media comprised of cocopeat + river sand (1:1) and among the different concentrations of IBA, 200 ppm IBA was recorded best for survival percentage of cuttings, rooting percentage, number of primary roots per cutting and root length (mm). Within the interaction treatments, the best combination for all these parameters was found with the cocopeat + river sand (1:1) rooting media and 200 ppm IBA concentration.

Hence the proper knowledge of rooting medium regarding their physio-chemical properties and behavior is a necessity for better rooting of carnation. The treatment of carnation cuttings with IBA significantly improves the rooting parameters and hence the standardization of optimum dose of IBA for carnation cuttings is an important aspect of research because there are a lot of contradictions regarding the optimum concentration of different auxins. Hence this research is very helpful to students, researchers and farmers for selecting best rooting media and optimum dose of IBA for the better rooting of carnation cuttings.

Acknowledgement

With sincerity and immense pleasure, I feel great pride and privilege to express profound sense of gratitude and heartiest indebtedness to my guide Dr. Arvind Malik, Assistant Professor, Department of Horticulture, Chaudhary Charan Singh Haryana Agricultural University, Hisar for his untiring guidance, positive suggestion and self-dedication enable me to complete this study, without which the very existence of this research work would have been impossible.

References

1. Barreto MS, Nookaraju A. Effect of auxin types on *in vitro* and *ex vitro* rooting and acclimatization of grapevine as influenced by substrates. Indian Journal of Horticulture. 2007; 64(1):5-11.
2. Bhandari AJ. Effect of different growth regulators on vegetative propagation of *Hibiscus rosa sinensis* L. M. Sc. Thesis submitted to Navsari Agricultural University, Navsari, 2014.
3. Bharathy PV, Sonawane PC, Sasnu A. Effect of different planting media on rooting of cuttings in carnation (*Dianthus caryophyllus* L.). Journal of Maharashtra Agricultural University. 2003; 28(3):343-344.
4. Bose TK, Yadav LP, Pal P, Parthawarthy V. *Chrysanthemum* commercial flowers. Naya Prakashan. 2002; 1:465-468.
5. Chadha KL. Hand Book of Horticulture, Indian Council of Agricultural Research, 2001, 548-54.
6. Copes DL, Mandel NL. Effect of IBA and NAA on rooting of Douglas-fir cuttings. New forests. 2000; 20:249-257.
7. Ghofrani M, Ejraei A, Abotalebi A. Effect of IBA on rooting cuttings of carnation flowers (*Caryophillium aromaticus*) in three environments. Journal of Novel Applied Sciences. 2013; 2(4):1165-1169.
8. Gowda P, Dhananjaya MV, Kumar R. Effect of indole butyric acid on rooting of different carnation (*Dianthus caryophyllus*) genotypes. International Journal of Pure & Applied Bioscience. 2017; 5(2):1075-1080.
9. Gurjar PKS, Patle RM. Effects of rooting media and growth regulators on the rooting and growth of stem cuttings of pomegranate cv. Ganesh. Bhartiya Krishi Anusandhan Patrika. 2007; 22(1):62-66.
10. Khewale AP, Golliwar VJ, Poinkar MS, Jibhakate SB, Athavale MP. Influence of different concentrations of IBA and media on root parameters in the propagation of carnation cv. Gaudina. Journal of Soils and Crops. 2005; 15(2):406-410.
11. Mahale VG, Ashok TH, Kale RD. Vermicompost as rooting medium for carnation (*Dianthus caryophyllus* L.). Journal of Plant Biology. 2002; 29(2):175-178.
12. Nanda KK, Kochhar VK. Propagation through cuttings. In: vegetative propagation of plants. Kalyani Publishers, 1985, 123-193.
13. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers. New Delhi ICAR Publication (2nd Ed.), 1985.
14. Pralhad GC. Evaluation of carnation (*Dianthus caryophyllus* L.) varieties under greenhouse condition. M.Sc. Thesis submitted to Department of Horticulture, University of Agricultural Sciences, Dharwad, 2009.
15. Prince, Mailk A, Beniwal V. Influence of indole-3-butyric acid on rooting efficacy in different carnation (*Dianthus caryophyllus* L.) genotypes under protected Condition, Chemical Science Review and Letters. 2017; 6(23):1858-1862.
16. Ramtin A, Khalighi A, Hadavi E, Hekmati Effect of different IBA concentrations and types of cuttings on rooting and flowering *Poinsettia pulcherrima* L. International Journal of Agriculture Sciences. 2011; 1(5):303-310.
17. Ranpise SA, Bharmal VS, Dharwade RTD. Effect of different levels of Indole Butyric Acid (IBA) on rooting, growth and flower yield of *Chrysanthemum* cv. Sonali Tara. Journal of Ornamental Horticulture. 2004; 5(4):331-337.
18. Renuka K, Sekhar RC. Studies on effect of plant growth regulators on rooting of carnation (*Dianthus caryophyllus* L.) cuttings of cv. Dona under poly house conditions. Plant Archives. 2015; 14(2):1135-1137.
19. Salehi H. Can a general shoot proliferation and rooting medium be used for a number of carnation cultivars? The African Journal of Biotechnology. 2006; 5(1):25-30.
20. Samananda N, Ormrod PP, Adepe NO. Rooting of *Chrysanthemum* stem cuttings as affected by 2-chloroethyl phosphoric acid and indol butyric acid. Annals of Botany. 1972; 36:961-965.

21. Sanyat PS, Mishra RL. Carnation. In: advances in ornamental horticulture. S.K. Bhattacharjee (Ed.), Vol. 2, Pointer Publishers, Jaipur, India, 2006, 66-80.
22. Shiva KN, Nair SA. Effect of growing environment and rooting hormone on root and shoot characters of hibiscus. Indian Journal of Horticulture. 2009; 66(2):233-238.
23. Sidhu GS, Singh P. Effect of auxins on propagation in *Chrysanthemum morifolium*. National Symposium on Indian Floriculture in the New Millennium, 2002, 285-286.
24. Singh DR. Use of growth regulators in rooting of stem cutting of *Bougainvillea* var. Thimma. Journal of Ornamental Horticulture. 2002; 5(1):60-62.
25. Singh MK, Ram R, Kumar S. Effect of plant growth regulators on rooting of carnation (*Dianthus caryophyllus*) cuttings. Journal of Ornamental Horticulture. 2006; 7(2):18-20.
26. Thomas LM, Gonsalves S, Mandal T, Roychowdhury NR. Effect of different media on rooting of cuttings cv. Mixed Super Chaubaud. J Interacadamica. 2003; 7(3):262-264.
27. Weaver RJ. Plant Growth Substance in Agriculture, W. H. Freeman and Company, San Fransisco, 1972, 128.