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EFFECT OF GROWING MEDIA AND GIBBERELLIC ACID ON GROWTH AND YIELD OF CARNATION (*DIANTHUS CARYOPHYLLUS* L.) *CV.* WHITE LIBERTY

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Abstract

An experiment was carried out to study the "Effect of growing media and Gibberellic Acid on growth and yield of Carnation (*Dianthus caryophyllus* L.) *cv.* White Liberty" at Kairacombai (village), Kotagiri (Taluk), The Nilgiris (district) during 2019 to 2020. The experiment was conducted by using different growing media combination *viz.,* M_1 - Garden soil : sand : Farm yard manure @1:1:1, M_2 - Garden soil : sand : vermicompost @1:1:1, M_3 - Garden soil : sand : coir pith @1:1:1, M_4 - Garden soil : sand : leaf mould @1:1:1 along with foliar application of Gibberellic Acid (GA_3) in three different concentration *viz.,* 100, 200 and 300 ppm at 40, 80, 120 and 160 days after planting in RBD. Results revealed that among the various vegetative parameters assessed maximum plant height (38.39 cm, 57.42 cm and 110.52 cm), maximum number of leaves (69.36, 104.69 and 148.58), increased leaf length (9.46 cm, 12.93 cm and 14.96 cm), number of shoots (5.27, 6.73 and 8.37), internodal length (3.90 cm, 5.16 cm and 6.94 cm) and number of internodes (5.16, 11.69 and 14.83) have been recorded maximum in the treatment T_6 (Garden soil: Sand: vermicompost @ 1:1:1) along with foliar application of Gibberellic Acid GA_3 @ 300 ppm. In the same way yield parameters such as flower yield plant^{-1} (11.02), flower yield per plot (198.36) and flower yield per m^2 (396.72) were performed best in the treatment T_6 with the application of Garden soil : Sand :Vermicompost @ 1:1:1 along with foliar application of GA_3 @ 300 ppm respectively than other treatments.

Key words: Carnation, Growing media, Gibberellic Acid.

Introduction

Flowers are the auspicious creation of God to beautify the surroundings they symbolize beauty, peace, purity and they give us a unique way to share the love within people. Flowers play a cardinal role in human behavior and bring tranquility and peace of mind to the people (Singh, 2006). A decade after liberalization in India floriculture industries took giant steps in the export arena which gave a dynamic shift from intensive subsistence production to commercial production of cut flowers. Among the cut flowers of the domestic and international markets, Carnation (*Dianthus caryophyllus* L.) originated from tracts of Mediterranean region substitutes all commercial flowers of a nosegay by its attractive shape and color, this made Carnation gain greater importance next to Rose. Various technologies have been formatted in order to boost up the productivity, nutrient management along with some horticultural techniques under protected environment conditions has brought a greater significance in maximizing the growth, yield and quality of the flower crops. Application of organic amendments like farm yard manure, vermicompost, coir pith and leaf mould as a growing media improves the soil texture, soil porosity, and water retention capacity and maintains a congenial microbial population in which it increases the soil nutrition and at the same time it reduces the use of inorganic fertilizers. In this study, an attempt is made to find out the effect of growing media and Gibberellic Acid (GA_3) on the performance of Carnation and to find out the best treatment combination for maximizing the growth and yield of Carnation.

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Materials and Methods

The present study entitled "Effect of growing media and Gibberellic Acid on growth, flowering, yield and quality of Carnation (*Dianthus caryophyllus* L.) *cv.* White Liberty" was carried out at Kairacombai (village), Kotagiri (Taluk), The Nilgiris (district) during 2019 to 2020. The experiment was laid out in randomized block design

with a plant spacing of about 15 cm x 15 cm containing 18 plants experimental per plot. The treatment details are ., T_1 - Garden soil : Sand : Farm yard manure@ 1:1:1 + 100 ppm of GA_3, T_2 - Garden soil : Sand : Farm yard manure @ 1:1:1 + 200 ppm of GA_3, T_3 - Garden soil : Sand : Farm yard manure @ 1:1:1 + 300 ppm of GA_3, T_4 - Garden soil : Sand : vermicompost @ 1:1:1 + 100 ppm of GA_3, T_5 - Garden soil : Sand : vermicompost @ 1:1:1 + 200 ppm of GA_3, T_6 - Garden soil : Sand : vermicompost @ 1:1:1 + 300 ppm of GA_3, T_7 - Garden soil : Sand : coirpith @ 1:1:1 + 100 ppm of GA_3, T_8 - Garden soil : Sand : coirpith @ 1:1:1 + 200 ppm of GA_3, T_9 - Garden soil : Sand : coirpith @ 1:1:1 + 300 ppm of GA_3, T_{10} - Garden soil : Sand : leaf mould @ 1:1:1 + 100 ppm of GA_3, T_{11} - Garden soil : Sand : leaf mould @ 1:1:1 + 200 ppm of GA_3, T_{12} - Garden soil : Sand : leaf mould @ 1:1:1 + 300 ppm of GA_3, T_{13} - Garden soil + Sand. table 1.

Three replications were maintained for each treatment. Thirty days old seedlings were transplanted and planted in the raised beds of a polyhouse at a shallow depth with part of the root zone exposed. The optimum temperature inside the polyhouse was maintained at 20-23^{0}C during day time and 13- 15^{0}C during night time. Relative humidity was maintained at 60- 80% during the growth of the plants till harvest. The recommended dose of fertilizers was given along with the drip irrigation as per the schedule. Intercultural practices were done for quality flowers. Netting was done in order to get flowers with long straight stalks. The plants were supported with the help of iron rods at both sides of the bed with 3 m distance. Pinching was done in four weeks after planting in order to break apical dominance and to ensure the maximum number of branches which lead to increased flower yield and quality. Disbudding was done by removing axillary buds. Foliar application of Gibberellic Acid (GA_3) was given according to the treatment schedule @ 100 ppm, 200 ppm and 300 ppm at 40, 80, 120 and 160 days after planting Days after planting.

Table 1: Treatment details.

T_1	Garden soil : Sand : Farm yard manure @ 1:1:1 + GA_3 @100 ppm
T_2	Garden soil : Sand : Farm yard manure @ 1:1:1 + GA_3 @ 200 ppm
T_3	Garden soil : Sand : Farm yard manure @ 1:1:1 + GA_3 @300 ppm
T_4	Garden soil : Sand : vermicompost @ 1:1:1 + GA_3 @100 ppm
T_5	Garden soil : Sand : vermicompost @ 1:1:1 + GA_3 @ 200 ppm
T_6	Garden soil : Sand : vermicompost @ 1:1:1 + GA_3 @300 ppm
T_7	Garden soil : Sand : coirpith @ 1:1:1 + GA_3 @100 ppm
T_8	Garden soil : Sand : coirpith @ 1:1:1 + GA_3 @ 200 ppm
T_9	Garden soil : Sand : coirpith @ 1:1:1 + GA_3 @300 ppm
T_{10}	Garden soil : Sand : leaf mould @ 1:1:1 + GA_3 @100 ppm
T_{11}	Garden soil : Sand : leaf mould @ 1:1:1 + GA_3 @ 200 ppm
T_{12}	Garden soil : Sand : leaf mould @ 1:1:1 + GA_3 @300 ppm
T_{13}	Garden soil : Sand - Control

The observations on vegetative characters such as plant height (cm), number of leaves, leaf length (cm), number of shoots, internodal length (cm) and number of internodes were recorded at 45, 90 and 120 Days After Planting and yield parameters such as flower yield plant^{-1}, flower yield plot^{-1} and flower yield per m^2. The data on various parameters were analyzed statistically as per the procedure suggested by Panse and Sukhatme (1978).

Results and Discussion

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads:

Vegetative Parameters

Vegetative parameters like plant height (cm), number of leaves, leaf length (cm), number of shoots, internodal length (cm) and number of internodes were recorded at different stages of plant growth from 45, 90 and 120 days after planting. These parameters were statistically-analyzed and presented below.

Plant height (cm)

Among the treatments studied maximum plant height (38.39 cm, 57.42 cm and 110.52 cm) were obtained in T_{-6} with the application of growing media (Garden soil : Sand : Vermicompost @ 1:1:1) along with foliar application of Gibberellic Acid (GA_3) @ 300 ppm. This may be due to the readily available nitrogen and better nutritional status from the source of vermicompost. It was similar to the findings of Renuka Gupta *et al.,* (2014) in Marigold and Ganesh (2015) in Cut Chrysanthemum. Another reason might be due to the use of growth regulator Gibberellic Acid (GA_3) which helped in the increase of plant height which was also noticed by Ali Farouq *et al*., (2018) in Carnation and Pranali Meshram *et al*., (2015) in African Marigold. This was followed by the application of growing media (Garden soil: Sand: Farm yard manure @ 1:1:1) along with Gibberellic Acid (GA_3) @ 300 ppm in the treatment T_3 with the value of 36.82 cm, 55.16 cm and 107.18 cm. Whereas, the minimum plant height (18.6cm, 28.69 cm and 67.43 cm) was recorded in the treatment T_{13} which was the control. table 2.

Number of leaves plant^{-1}

Among the treatments, the data pertaining to maximum number of leaves (69.36, 104.69 and 148.58) produced was in the treatment T_6 which was with the application of Garden soil : Sand :

Table 2: Effect of growing media and Gibberellic acid (GA_3)onplant height (cm), number of leaves per plant and leaf length (cm)in Carnation(*Dianthus caryophyllus* L.)cv. White Liberty.

Treat-ments	Plant height (cm)			Number of leaves per plant			Leaf length (cm)		
	45 days	90 days	120 days	45 days	90 days	120 days	45 days	90 days	120 days
T_1	26.74	40.92	86.59	45.50	82.74	132.14	4.96	7.05	10.05
T_2	31.45	47.79	96.62	55.63	91.03	138.76	6.55	9.30	11.90
T_3	36.82	55.16	107.18	66.02	101.70	146.47	8.95	12.19	14.38
T_4	28.28	43.21	89.93	48.88	85.03	134.32	5.50	7.81	10.67
T_5	33.27	50.46	100.28	59.28	94.84	141.58	7.48	10.55	12.98
T_6	38.39	57.42	110.52	69.36	104.69	148.58	9.46	12.93	14.96
T_7	25.18	38.70	83.24	42.13	79.62	129.96	4.90	6.31	9.42
T_8	33.02	50.02	99.94	58.99	94.01	140.92	7.06	10.04	12.54
T_9	36.34	54.97	106.94	65.98	100.96	145.89	8.54	12.04	14.17
T_{10}	23.59	36.45	79.88	38.74	77.33	127.80	4.38	5.55	8.78
T_{11}	29.87	45.49	93.27	52.27	88.04	136.51	6.03	8.56	11.29
T_{12}	34.81	52.71	103.62	62.63	97.97	143.74	8.02	11.29	13.58
T_{13}	18.6	28.69	67.43	25.84	65.95	121.15	2.92	3.48	7.36
S. ED	1.52	2.21	3.31	3.34	2.98	2.11	0.50	0.73	0.58
CD (p=0.05)	3.04	4.42	6.63	6.69	5.96	4.22	1.01	1.45	1.17

Vermicompost @ 1:1:1 along with Gibberellic Acid (GA3) @ 300 ppm table 2. This might be due to congenial microclimate that prevailed inside the polyhouse and rich nutrient status of vermicompost favoring increased growth rate of plants and the influence of plant growth regulator used at high concentration than other treatments. This was in concurrence with findings of Sendhilnathan *et al*., (2016) in English Cape Lilly, Dweepjyoti Sarkar (2018) in African Marigold. Whereas the least number of leaves (25.84, 65.95 and 121.15) were observed in T_{13}.

Leaf length (cm)

Treatment T_6 showed maximum leaf length (9.46cm, 12.93 cm and 14.96 cm) in which the growing media consisting of Garden soil : Sand : Vermicompost @ 1:1:1 was used along with Gibberellic Acid (GA_3) @ 300 ppm at 40, 80, 120 and 160 days after planting. It may be due to the application of an appropriate quantity of vermicompost, on account of its surplus nutritive content, it increased the beneficial soil microflora which in counter increased the leaf area. This was in line with the results reported by Bachman and Metzger (2008) and Ali Salehi Sardoei *et al*., (2014) in African Marigold. Along with that spray of Gibberellic Acid (GA_3) also increased leaf length which was in accordance with Sendhilnathan *et al*., (2017) in Gundumalliand Sharifuzzaman *et al*., (2011) in Chrysanthemum. The lesser leaf length (2.92 cm, 3.48 cm and 7.36 cm) was observed in T_{13} (Control) it may be due to the insufficient of nutrients in the media. table 2.

Number of shoots per plant

Maximum number of shoots per plant (5.27, 6.73 and 8.37) was recorded in the treatment (T_6) with application of Garden soil : Sand : Vermicompost@ 1:1:1 along with Gibberellic Acid (GA_3) @ 300 ppm sprays at 40, 80, 120 and 160 days after planting. It may be due to the application of Gibberellic Acid (GA_3) which increased the shoots and this Gibberellic Acid (GA_3) plays an important role in the growth and development of plants. Gibberellins are rather diverse group of plant substances that enhance any physiological and biochemical process in plants. These results were in accordance with the results of Pranali Meshram *et al.,* (2015) in African Marigold and Manimaran *et al.,* (2018) in Gundumalli. In control T_{13} recorded a smaller number of shoots (3.95, 4.83 and 6.04). table 3.

Internodal length per plant

The media composition of Garden soil : Sand : Vermicompost@ 1:1:1 and by foliar spray of Gibberellic Acid (GA_3) @ 300 ppm were observed in the best treatment T_6 were recorded with (3.90 cm, 5.16 cm and 6.94 cm) and the minimum internodal length was observed in T_{13} (1.58 cm, 2.63 cm and 3.63 cm). Shown in table 3. This may be due to the use of vermicompost which might have made nutrients such as nitrates, exchangeable P, K, Ca and Mg in readily available forms for plant uptake, similar variations in growing media and growth regulator was observed by Basavaraj Dalawai and Hemla Naik (2017), Ashwani Kasturi and Chandra Sekhar (2017) in Carnation.

Number of internodes per plant

Themaximum number of internodes was observed in the best treatment T_6 (5.16, 11.69 and 14.83) and the minimum number of internodes was observed in control

Table 3: Effect of growing media and Gibberellic acid (GA_3)on number of shoots, internodal length (cm) and number of internodes plant^{-1} inCarnation (*Dianthus caryophyllus* L.)cv. White Liberty

Treat-ments	Number of shoots			Internodal length (cm)			Number of internodes per plant		
	45 days	90 days	120 days	45 days	90 days	120 days	45 days	90 days	120 days
T_1	4.33	5.53	7.09	2.61	3.65	4.83	3.64	7.66	11.68
T_2	4.68	5.99	7.64	3.14	4.31	5.72	4.21	9.39	13.03
T_3	5.15	6.59	8.20	3.73	4.97	6.67	4.99	11.14	14.42
T_4	4.43	5.69	7.28	2.79	3.88	5.11	3.83	8.24	12.11
T_5	4.85	6.19	7.84	3.34	4.56	6.06	4.47	10.03	13.49
T_6	5.27	6.73	8.37	3.90	5.16	6.94	5.16	11.69	14.83
T_7	4.23	5.34	6.92	2.43	3.44	4.51	3.46	7.12	11.23
T_8	4.80	6.14	7.82	3.31	4.52	6.01	4.40	9.92	13.46
T_9	5.11	6.50	8.19	3.70	4.95	6.63	4.95	11.12	14.40
T_{10}	4.13	5.19	6.74	2.25	3.21	4.17	3.26	6.53	10.81
T_{11}	4.54	5.85	7.45	2.97	4.09	5.42	4.03	8.80	12.58
T_{12}	4.99	6.35	8.01	3.52	4.76	6.35	4.77	10.59	13.95
T_{13}	3.95	4.83	6.04	1.58	2.63	3.63	2.95	4.85	9.52
S. ED	0.20	0.29	0.35	0.17	0.19	0.27	0.17	0.52	0.40
CD (p=0.05)	0.10	0.14	0.17	0.35	0.38	0.54	0.34	1.05	0.81

Table 4: Effect of growing media and GA3 on yield parameters of Carnation (*Dianthus caryophyllus* L.) cv. White Liberty.

Treat-ments	Number of flowers per plant	Number of flowers per plot	Number of flowres per meter square
T_1	7.06	127.08	254.16
T_2	8.48	152.64	305.28
T_3	10.23	184.14	368.28
T_4	7.51	135.18	270.36
T_5	9.11	163.98	327.96
T_6	11.02	198.36	396.72
T_7	6.62	119.16	238.32
T_8	8.94	160.92	321.84
T_9	9.98	179.64	359.28
T_{10}	6.37	114.66	229.32
T_{11}	7.99	143.82	287.64
T_{12}	9.56	172.08	344.16
T_{13}	5.52	99.36	198.72
S. ED	0.39	7.62	3.05
CD (p=0.05)	0.77	15.23	6.09

T_{13} (2.95, 4.85 and 9.52). This may be due to the incorporation of vermicompost which promoted the lush growth of plants. This was similar to the findings of Ghisewad *et al*., (2016) in Gladiolus and Vikas Kumar *et al*., (2019) in African Marigold. table 3.

Yield parameters

The number of flowers plant^{-1} (11.02), number of flowers plot^{-1} (198.36) and number of flowers per meter^2 (396.72) was produced by the plants in the treatment T_6 with the application of growing media (Garden soil : Sand : Vermicompost@ 1:1:1) along with foliar spray of Gibberellic Acid (GA_3) @ 300 ppm at 40, 80, 120 and 160 days after planting which attained the maximum yield. This was followed by the treatment T_3 with the application of growing media (Garden soil : Sand : Farm yard manure @ 1:1:1) along with foliar spray of Gibberellic Acid (GA_3) @ 300 ppm at 40, 80, 120 and 160 days after planting with the values of (10.23) number of flowers plant^{-1}, (184.14) number of flowers plot^{-1} and (368.28) number of flowers per m^2. The minimum yield (5.52 plant^{-1}, 99.36 plot^{-1} and 198.72 per meter^2) was found in the treatment T_{13} which was the control. It might have influenced the reproductive phase and induced the yield parameters. Similar finding was reported by Kaya *et al*., (2019) in Gerbera, Sendhilnathan *et al*., (2019) in Rose and Moghadam *et al*., (2012) in Lillium. table 4.

Conclusion

Based on the findings, it can be concluded that the treatment T_6 grown in the growing media consisting of Garden soil : Sand : Vermicompost @ 1:1:1 along with foliar spray of Gibberellic Acid (GA_3) @ 300 ppm at 40, 80, 120 and 160 days after planting, have served as the best treatment with respect to all growth and yield parameters. Hence it can be concluded from the study that growing media consisting of Garden soil : Sand : Vermicompost @ 1:1:1 along with Gibberellic Acid (GA_3) @ 300 ppm at 40, 80, 120 and 160 days after planting is best to obtain better growth and development of Carnations in polyhouse condition.

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