Effect of foliar application of growth regulators on growth and flower yield of *Tabernaemontana divaricata* (L.)

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ABSTRACT

Tabernaemontana divaricata (L.) (Crape jasmine) is a commercial important loose flower suitable for year round production in India. Application of growth regulators can increase its ability to produce more flowers. Hence, a field experiment was conducted in a farmer's field at Manarpalyam village of Selam district, Tamilnadu during 2020-2021 to study the effect of foliar application of regulators on growth and flower yield. Randomized Block Design was adopted with nine treatments in three replications. Treatment comprise of four plant growth regulator (NAA (@ 100 and 150ppm, GA_3 @ 75 and 150ppm, MH @ 500 and 750ppm, CCC (@ 500 and 750ppm) and water spray as control. Data pertaining to growth and yield parameters were recorded at periodical intervals. Among the growth regulators NAA and GA_3 significantly enhanced all the growth parameters however, application of growth retardants MH and CCC reduced certain growth parameters like plant height, internodal length, plant spread, leaf area. All other growth and yield parameters *viz.*, primary branches, secondary branches, number of leaves, stem girth, DMP, weight of hundred flowers, single flower weight, and number of flowers/plant/day were significantly increased due to all the treatments. Application of GA_3 @ 150ppm recorded the maximum values in all growth and yield parameters. The highest flower yield (11.75 g/plant/day, 70.52 g/plot/day, and 39.18kg/ha/day) was recorded in GA_3@150ppm followed by the next best treatment GA_3@75ppm. It could be concluded that foliar application GA_3@150ppm on 60, 120 and 180 days after planting can improve the flower yield up to 11.75t/ha/year.

Key Words : *Tabernaemontana divaricata*, Crape jasmine, GA_3, NAA, MH, CCC, Growth papameters, Yield Parameters

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1.INTRODUCTION

The area under commercial flower production is increasing every year as the consumption and demand for loose flowers is constantly increasing during past ten years. During 2019-2020 in India, flower crops are cultivated in an area of 307000ha with a production of 694 million cut flowers and 2300 Mt of loose flowers (Agricultural Statistics at a glance, 2020). Recently, along with major loose flowers viz., jasmines, chrysanthemeum, tuberose, crossandra, coxcomb, and rose, which are traditionally cultivated, Crape jasmine (*Tabernaemontana divaricata*) is also finding a place in market. Crape jasmine *is* an evergreen shrub containing large, glossy dark green leaves, white fragrant 5-petaled tubular flowers is being cultivated as loose flower. It is gaining commercial importance in landscape industry also. When compared with jasmine, the crape jasmine is hardy, low input crop with high productivity and self life. Hence, they are used as alternate loose flowers during off season production.

Crape jasmine is maintained as a perennial flower crop by annual pruning. The growth regulation plays a major role in its cultivation. Application of appropriate growth regulators can make the plant bear flowering throughout the year. Growth regulators are defined as organic compounds other than nutrients, which in small amounts can promote, inhibit or modify any physiological process in plants. Use of plant growth regulators in floriculture includes regulation of plant growth, flowering propagation, stress tolerance, shelf life, and yield enhancement (Chandra Sekhar, 2020). Application of both growth regulators like NAA and GA_3 or growth retardants like CCC and MH might have a definite influence on the morphology and physiology of plants towards enhancing flower yield (*Gul et al.,* 2006). Growth and flowering responses of flower crops to plant growth regulators have been studied to enhance number of flowers and also to hasten or delay flowering as required by the grower (Cathey, 1980). Effects of these chemicals

vary with the plant species, dose, method of application, frequency of application, season and various other factors, which influence the uptake, and translocation of the chemical. The research work done on the influence of these growth regulators on growth and flowering of crape jasmine was not enough to define a package of practice to recommend to farmers. The present study was carried out with the objective of finding the influence of foliar application of regulators on growth and flower yield of crape jasmine.

2. MATERIALS AND METHODS

A field experiment was carried out in the Manarpalyam village of Selam district, Tamilnadu during 2020-2021 to study the effect of foliar application of regulators on growth and flower yield of crape jasmine. The experiment was laid in Randomized Block Design with nine treatments and three replications. The rooted cuttings of *T.divaricata* Cv. Meenampalli local obtained from a farmer's field were planted in plots of 3m x 6m dimension in a spacing of 1.5m X 2m for assessing their growth and yield performance. Standard package of practices were adopted throughout the experiment to grow a healthy crop. Totally nine treatment comprise of four plant growth regulator at two concentrations each viz., NAA (@ 100ppm and 150ppm), GA_3 (@ 75ppm and 150ppm), MH (@ 500ppm and 750ppm), and CCC (@ 500ppm and 750ppm) along with water spray control. As per the treatment schedule, foliar applications of growth regulator treatments were applied on 60, 120 and 180 days after planting. The plant protection measures were adopted to control weeds, pest and diseases. The plant bushes are pruned at 50cm height from the ground level. Harvesting of flower was done during evening hours by plucking the unopened flower buds. Initially harvesting was done once in two days. At peak flowering season harvesting was done every day. Four plants were randomly selected at each plot in all the three replications and were tagged for recording the non-destructive parameters. Data pertaining

to growth and yield parameters were recorded at periodical intervals. The data recorded were subjected to statistical analysis by adopting the standard procedure (Panse and Sukhatme, 1967). The critical differences were worked out at 5% probability significance.

3. RESULTS AND DISCUSSION

3.1.Growth parameters

Application of foliar growth regulator treatments significantly influenced the growth parameters of crape jasmine. Among them, NAA and GA_3 significantly enhanced all the growth parameters when compared to control treatment, however, application of growth retardants MH and CCC significantly reduced certain growth parameters like plant height, internodal length, plant spread, and leaf area. The maximum plant height (148.22cm) recorded in GA_3 @ 150ppm (T4) was 4 per cent higher than the plant height observed in control (Table 1). However, T8 (CCC @ 750 ppm) recorded the least plant height which is 3 per cent less than the control. The T4 was followed by application of GA_3 @ 75ppm (T3). There was 10 per cent increment in intermodal length observed between the best treatment GA_3 @ 150ppm (T4) and control. Compared to control, 8 per cent reduction in intermodal length was observed in T8 (CCC @ 750 ppm). In line with the present results, Navale *et al*.(2010) also found reduction in plant height, suppression of internodal length, and reduction in lateral shoots due to the foliar application of CCC and Maleic Hydrazide have retarded in chrysanthemum. Compared to control, the plant spread (70.67cm) and leaf area (30.24cm^2) observed in T4 (GA_3 @ 150ppm) was 6 per cent higher and in T8 (CCC @ 750 ppm) the plant spread (63.85cm) and leaf area (27.04cm^2) were 5 per cent declined. Enhancement in plant height and intermodal length observed due to the application of GA_3 and NAA treatments might be due to the fact that GA_3 can influence plant growth by its effect on cell elongation (Sekhar *et al.*, 2020). Role of GA_3 in inter-nodal

elongation was already observed by Hooley (1994). Reduction in plant height and intermodal length observed in treatments with CCC and MH might be due to the inhibitory role of these growth retardants in cell division at meristematic shoots. Suppression in cell enlargement and division might have seized the terminal growth (Gowda,1990) ; Aswath *et al.*1994).

The growth parameters *viz.*, primary branches, secondary branches, number of leaves, stem girth, and DMP were significantly increased due to application of all the growth regulator treatments including retardants (Table 1). Application of GA_3 @ 150ppm (T4) has enhanced 18 per cent primary branches leading to 24 per cent enhancement in secondary branches (20.56 /plant) when compared to control (16.56 /plant). Elongation of inter-nodal length due to the application of GA_3 and NAA could be the reason for increase in plant height accommodating production of more internodes on main axis that lead to increased number of lateral buds from where primary branches originate. A similar result was observed by Rameshkumar *et al.* (2010) in African marigold. Increasing the concentration of growth retardants, T6 (MH @ 750 ppm) and T8 (CCC @ 750 ppm), lead to significantly high number of branches per plant when compared to control. In general, the endogenous activities of GA and auxin overlap with respect to the regulation of cell expansion and tissue differentiation. Less number of branches observed in control plants might be due to the fact that endogenous auxin might have affected GA_3 signaling as well as GA_3 biosynthesis which is essential for cell elongation and growth differentiation (David and Naomi, 2007).

The highest number of leaves (98.46/plant) recorded in GA_3 @ 150ppm (T4) was 10 per cent higher than the least number of leaves recorded in control (T9). The chlorophyll content is enhanced due to the application of all growth regulators including retardants. The highest chlorophyll content 54.62SCMAR recorded in GA_3 @ 150ppm (T4) was 50 per cent higher than

control (T9). In MH treatments also the chlorophyll content was 35 per cent higher than control. In GA_3 @ 150ppm, the DMP recorded was 19 percent higher than the control. Increase in DMP might be augmented by the increase in number of branches and leaves in GA_3 treatments that lead to increased leaf area contributed for enhanced photosynthesis and growth. Application of growth retardants also exhibited enhancement in DMP. Current results confirm that GA stimulates cell division and as opined by Ogawa *et al.* (2003). Effect of GA_3 in enhancing DMP was already reported in chrysanthemum, marigold, and China aster by Sainath *et al.* (2012) Prakash *et al.* (2015), Anuradha *et al.* (2017), and Mishra *et al.* (2018).

3.2. Flowering parameters

All growth regulators used including growth retardants significantly enhanced the flowering characters of crape jasmine. However, early flowering was observed only in NAA and GA_3 treatments. Application of MH and CCC has delayed flowering (Table 2). Earliest flowering (38 days) observed in the treatment GA_3 @ 150ppm (T4) might be due to the fact that foliar application GA_3 might have altered the composition of hormones in plant by stimulating the synthesis of endogenous GA_3 and IAA, and suppression of ABA levels (Yan-ren *et al.*, 2019). GA_3 induced early flowering in crape jasmine might be due to the ability of GA_3 in interfering with autonomous, and age pathways that affect flowering time in response to internal developmental status (Fornara *et al.* 2010). Further, GA can regulate flowering by controlling the spatial expression of floral regulatory genes (Galvao *et al.*, 2012; Jung *et al.*, 2012). The late flowering(43days) observed in CCC @ 750 ppm (T8) could be due to the influence of CCC in reducing cell number and meristematic activity in the apex when the floral stimulus for formation of flower buds arrives. Hastening of flowering due to GA_3 application was already

reported by Katkar *et al.* (2003) in China aster, Preeti *et al.* (2004) in Anthurium, and Soner and Osman (2010) in goldenrod.

The yield parameters *viz.*, weight of hundred flowers, single flower weight, and number of flowers/plant/day were significantly influenced by the growth regulator application. Application of GA_3@150ppm (T4) has enhanced 9 per cent enhancement weight of hundred flowers (148.22g) and single flower weight (0.236g) when compared to control (T9). The highest number of 49.89 flowers/plant recorded in GA_3@150ppm (T4) was 23% higher when compared to control, following to this, application of GA_3@75ppm (T3) has recorded 20% enhancement. Least number of 40.52flowers/plant was recorded in control (T9). Increase in number of flowers observed due to GA_3 application was earlier reported by Narayana Gowda (1985), Sridhar *et al.*, (2013) and Dhanasekaran (2018) in Jasmine, Amit kumar *et al.*, (2011) in African marigold, and Shinde *et al*., (2010) in chrysanthemum. Enhancement in production of flowers observed in present experiment might be due to the enhancement in growth parameters caused by alteration in hormone balance in GA_3 and NAA treatments. This condition would have lead to altering C: N ratio leading to initiate flowering stimulus in plant system. The flower yield was varied significantly due to application of all growth regulators. The highest flower yield (11.75 g/plant/day, 70.52 g/plot/day, and 39.18kg/ha/day) recorded in GA_3@150ppm (T4) was 34% higher when compared to control. The next best treatment GA_3@75ppm (T3) has recorded 29% enhancement in flower yield. The flower yield of 11.75t/ha/year estimated in GA_3@150ppm (T4) was 79% higher when compared to control. It was followed by GA_3@75ppm (T3) with 67% enhancement, NAA @ 150 ppm (T2) with 55% enhancement, and NAA @ 75 ppm (T1) with 45% enhancement when compared to control. Similar enhancement in flower yield due to the application of GA_3 was previously reported by Pancholi *et al*. (2010) in anthurium, Baghele

et al. (2016) in rose, Cherik *et al*. (2017) in gerbera and Choudhari *et al*. (2018) in chrysanthemum.

4. Conclusion

By comparing the growth and yield performance of all the treatments, it could be concluded that foliar application GA_3@150ppm on 60, 120 and 180 days after planting can maximize the flower yield and quality. The cumulated annual yield enhancement could around 75 per cent higher in this treatment when compared to untreated control.

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Table 1. Effect of growth regulator treatments on growth parameters of *Tabernaemontana divaricata* (L.)

Treatments	Plant height	Internodal length cm	Primary branches/ plant	Secondary branches/ plant	Leaves/ plant[1]	Plant spread	Leaf area cm[2]	Chlorophyll content (SCMR value**)	DMP (g /plant)
T1- NAA@ 100ppm	144.38	12.41	7.83	18.85	94.90	67.92	28.95	52.17	91.97
T2- NAA @ 150 ppm	145.64	12.69	8.01	19.41	96.07	68.82	29.37	46.86	94.20
T3- GA_3 @ 75 ppm	146.95	12.98	8.20	19.99	97.28	69.76	29.81	39.50	96.53
T4- GA_3 @ 150 ppm	148.22	13.26	8.38	20.56	98.46	70.67	30.24	54.62	98.78
T5- MH @ 500 ppm	140.88	11.64	7.38	17.47	92.03	65.41	27.77	49.80	86.48
T6- MH @ 750 ppm	139.55	11.35	7.65	18.30	93.75	64.45	27.32	49.22	89.79
T7- CCC @ 500 ppm	141.54	11.79	7.32	17.27	91.61	65.88	27.99	44.45	85.69
T8- CCC @ 750 ppm	138.71	11.16	7.58	18.07	93.27	63.85	27.04	42.10	88.85
T9- Control	142.95	12.10	7.09	16.56	90.12	66.89	28.47	36.12	82.84
CD (p=0.05)	**0.54**	**0.12**	**0.08**	**0.24**	**0.50**	**0.39**	**0.18**	**0.93**	**0.95**
S. ED.	**1.09**	**0.24**	**0.16**	**0.49**	**1.01**	**0.78**	**0.37**	**1.86**	**1.94**

Table 2. Effect of growth regulator treatments on flowering and yield parameters of *Tabernaemontana divaricata* (L.)

Treatments	Days taken for first flowering	Weight of hundred flowers (g)	Single flower weight (g)	No. of flowers/ Plant/ day	Flower yield per plant (g/day)	Flower yield per plot (g/day)	Estimated Flower yield (kg/ha/day)	Estimated Flower yield (t/ha/year)
T1- NAA@ 100ppm	39.58	22.75	0.228	45.89	10.48	62.90	34.94	9.55
T2- NAA @ 150 ppm	39.20	23.02	0.230	47.20	10.90	65.40	36.33	10.27
T3- GA_3 @ 75 ppm	38.44	23.29	0.233	48.56	11.33	68.00	37.77	11.02
T4- GA_3 @ 150 ppm	37.96	23.56	0.236	49.89	11.75	70.52	39.18	11.75
T5- MH @ 500 ppm	41.22	22.10	0.221	42.66	9.46	56.76	31.53	7.77
T6- MH @ 750 ppm	42.69	22.49	0.225	44.60	10.08	60.46	33.58	8.84
T7- CCC @ 500 ppm	41.94	22.01	0.220	42.19	9.31	55.87	31.04	7.51
T8- CCC @ 750 ppm	43.42	22.38	0.224	44.05	9.90	59.41	33.00	8.53
T9- Control	40.39	21.67	0.217	40.52	8.78	52.68	29.27	6.58
CD (p=0.05)	**0.31**	**0.11**	**0.001**	**0.56**	**0.18**	**1.07**	**0.59**	**0.13**
S. ED.	**0.63**	**0.23**	**0.002**	**1.14**	**0.36**	**2.17**	**1.20**	**0.27**