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Studies on the effect of different growth regulators and spray intervals on growth and flowering of Dendrobium cv. "Singapore white".

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Introduction

Orchids (*Orchid spp.*) are the most beautiful flowers of god's creation and they symbolize love, mystery, beauty and luxury. Orchid belongs to the family *Orchidaceae*, the largest and the most diverse family of flowering plants consisting of 35,000 species under 880 genera (Kumar and Sheela, 2007). Among cut flowers, orchids occupy 6th position in the world market with their incredible range of diversity in flower shape, size and colour of the flower.

India is recognized as a significant producer of orchids in the world. Nearly 1,300 species of orchids are found in India which constitutes almost 10 per cent of the world orchid flora with Himalayas as their main home (Medhi and Chakrabarthi, 2009). In India, growing of orchids commercially was not organized however, the orchids are popular with the professionals & hobbyists for their highly fascinating beautiful

flowers which are bestowed with long lasting properties. The orchid cultivation is fast emerging as an absorbing & rewarding vocation besides being an admirable antidote to the otherwise busy routine life. Apart from this, orchids have curative and aphrodisiac properties. Prospects of an increasing consumer demand, buoyant world market have promoted the status of orchid growing to an industry in our country in the past two decades. Orchid trade is still in infancy

due to the lack of knowledge on the varieties suitable for commercial production and export. Moreover, research work on the evaluation of commercial hybrids and varieties for suitability to our condition is very limited.

Hybrids of Dendrobium, Cymbidium, Phalaenopsis, Vanda and many other genera have been taken to cut flower trade (Premananda and Reeta, 2014). Dendrobiums are tropical orchids and are the second largest genus of the orchid family with more than 1000 species. Greenhouse technology is utilized for growing Dendrobium orchids, as they require less light intensity, low temperature and high humidity. In the present scenario beside production of cut flowers, orchids also have great potential as potted ornamentals. Many of the Indian species, north eastern Himalayan species in particular are suitable for their direct use as high value potted novelty. Unfortunately, this still remains a gray area and suffers from lack of attention and realization of its tremendous potential. Among the different genus *Aerides, Arachnanthe, Bulbophyllum, Calanthe, Coelogyne, Cymbidium, Dendrobium, Phaius, Phalaenopsis, Pleione, Rhyncostyles* and *Vanda* were found to possess the desirable characteristics as potted plants.

Plant growth regulators or plant regulators are the organic chemical compounds which modify or regulate physiological process in an appreciable measure in plants when used in small concentrations. They are readily absorbed and move rapidly through tissues when applied to different parts of the plant (Dutta and Ramdas, 1998). Growth regulators have been found effective in terms of overall growth of the plants, flowering duration, floriferousness and ultimate quality of the cut blooms. Earlier workers reported the positive influence of GA_3 (Gibberellic acid) on the growth parameters like shoot length, internodal length etc. (Niranjan and Muthuswamy,1975), and flowering parameters like early flowering longer stalk, enhanced flowering period, increased yield per unit area , longer vase life (Sadanand,2000) while BA (Benzyladenine) increased the number of basal shoots, flower number, flower longevity and vase life (Prasanth et al,2006)and also their combination on growth and flowering (Mondal and Mitra,2017).

Since not much of research work is done on these lines on pot grown orchids in semi- arid tropics of this region, the present experiment is conducted with the objective of assessing the performance of pot grown dendrobium orchids under the influence of different growth regulators with frequency of applications in terms of growth and floral attributes with the following objectives

Materials and methods

The lab experiment was laid out as Factorial Completely Randomized Design (FCRD) and replicated four times which was conducted at College of Horticulture, Mojerla, Hyderabad. For the experiment The tissue culture plants were procured from the firm ‘Florence Flora’ from Pune. *Dendrobium* orchid

Hybrid "Singapore white" a popular hybrid which belongs to Dendrobium species .The plants are sympodial in growth with bright green leaves. Petals are creamish white in color with little greenish tinge at base.

The plants were raised in sturdy plastic pots with perforations at the bottom and sides. The pots are 5 inches diameter × 4 inches tall tapering to 4 inches at bottom. The pots with holes on all sides of the pot promoted good drainage, humidity and aeration for the plants.

The treatments under growing medium for orchids in the present experiment consisted of usage of charcoal and brick pieces and their growth regulator combinations. The orchid pot media with charcoal and brick pieces were filled in individual orchid pots in different combinations as per the treatments. The eight month old Dendrobium orchid plants of "Singapore white" were planted in the pots.

Two sets of the pots were maintained by spraying growth regulators at monthly intervals and spraying at bi-monthly intervals under green coloured shadenet The plants were staked with thin bamboo sticks. The surroundings of the plants were kept moist by frequently damping the paths, stages, benches and floor of the shadenets. Depending upon the climatic conditions, frequency of watering was manipulated. Watering was done to roots without wetting the leaves manually with rose can. In summer watering was done daily, while in winter watering was done at an interval of 2-3 days. Since the water holding capacity of the media also differed in individual treatments, watering frequency was judged accordingly.

Plant height (cm):

The vegetative growth of Dendrobium hybrid "Singapore white" was significantly influenced by different Growth regulators and number of applications (Table 1). The plant height was recorded highest in the treatment combination of GA_3 100 ppm +BA 100 ppm (G_7) with (30.83 cm) and regarding number of applications, monthly applications were maximum with (29.12 cm) significant influence was not recorded in case of interaction with the plant growth regulators and number of applications. In the present study the application of $GA_3$100ppm+BA 100ppm resulted in maximum plant height and the increase in plant height may be attributed to the effect of GA_3 on cellular processes by stimulating cell elongation, lengthening cells caused increased growth and influence of benzyle Adenine on cell division and formation of meristematic growth (Staurt and Jones,1997).

Stem girth (nm):

Growth regulators consisting of GA_3 100 ppm (G_3) alone increased the stem girth (5.22 mm respectively) and among the number of applications, monthly applications recorded the highest stem girth (5.00 mm) as compared to bi-monthly

applications. The interaction effect did not show the significant difference between the growth regulators and the number of applications. The above findings are in agreement with the previous work of Suvarna laxmi Palei *et al*., 2016) in African marigold.

Number of leaves^{-1}:

The treatment combination of GA_3 100 ppm +BA 100 ppm (G_7) increased the number of leaves plant^{-1} (18.17) followed by GA_3 400 ppm (16.17) and among the number of applications, monthly applications was superior with (15.48). There was no interaction between the the growth regulators and the number of applications. The increase in number of leaves per plant with the application of GA_3 100ppm+BA 100ppm(G_7) might be due to enhanced cell division, cell enlargement and promotion of protein synthesis with GA_3 application exogenously. The above findings are in agreement with the previous work of Suvalaxmi Palei *et al*., (2016) in African marigold.

Leaf area (cm^2):

The treatment combination of GA_3 100 ppm +BA 100 ppm (G_7) increased the leaf area (55.13 cm^2) followed by GA_3 400 ppm (53.60 cm^2) and significant difference noticed, among the number of applications, monthly applications was (52.82 cm^2). there was no significant difference noticed, in case of interaction of growth regulators and the number of applications. Among all the treatments M_7-GA_3 100ppm+BA 100ppm recorded the maximum leaf area and since Gibberellic acid might have played a major role in plant growth and development which in turn might have contributed to leaf expansion .

The above findings are in agreement with the previous work of Pal and Choudhury (1998) in gladiolus cv. hunting song (Kumar *et al*., 2003).

Number of shoots:

The treatment combination of GA_3 100 ppm +BA 100 ppm (G_7) increased the leaf area (5.83) followed by GA_3 400 ppm (5.67) and significant difference noticed, among the number of applications, monthly applications was (4.86). Significant difference was noticed, in GA_3 100 ppm +BA 100 ppm (G_7) with 6.33 at monthly applications. Enhanced shoot production was promoted due to the application of GA_3 100ppm+BA 100ppm in “Singapore white” was observed in this study. Cytokinins and Gibberillins are known to promote cell division and elongation (Wismer,1994 and Salisbury& Ross,1996). The enhanced shoot production may be considered

as a result of the ability of cytokinin (BA) to promote lateral bud development by disrupting the apical dominance acting in opposition to auxin.

The above findings are in agreement with the previous work of Kirad *et al*., 2001 in gladiolus, Wankhede *et al*. (2002) in tuberose and Singh *et al*. (2008) Benny *et al* (2017) in carnation.

Effect of Vegetative parameters in *Dendrobium* as influenced by different plant Growth regulators and number of spraying intervals and their interaction

Treatments	Plant height			Stem girth			Number of leaves			Leaf area			Number of shoots			Internodal length		
	N_1	N_2	Mean	N_1	N_2	Mean	N_1	N_2	Mean	N_1	N_2	Mean	N_1	N_2	Mean	N_1	N_2	Mean
G_1	22.00	22.00	22.00	4.23	3.93	4.08	12.67	12.67	12.67	55.77	47.27	51.52	3.33	4.00	3.67	3.63	4.00	3.82
G_2	27.83	24.83	26.33	4.63	3.97	4.30	15.33	14.67	15.00	52.23	52.63	52.43	5.33	5.33	5.33	6.20	6.33	6.27
G_3	29.67	27.67	28.67	5.30	5.13	5.22	15.67	13.67	14.67	55.90	47.60	51.75	6.00	5.00	5.50	5.83	6.23	6.03
G_4	32.00	29.33	30.67	5.80	4.57	5.18	18.67	13.67	16.17	56.97	50.24	53.60	6.00	5.33	5.67	7.00	5.80	6.40
G_5	28.67	24.67	26.67	4.17	3.80	3.98	13.33	11.33	12.33	44.41	44.46	44.44	3.33	3.00	3.17	4.20	3.83	4.02
G_6	31.33	24.83	28.08	4.97	3.33	4.15	13.33	13.00	13.17	45.03	42.71	43.87	3.67	3.33	3.50	4.73	3.83	4.28
G_7	32.33	29.33	30.83	5.87	4.40	5.13	19.33	17.00	18.17	59.41	50.85	55.13	6.33	4.83	5.83	7.10	5.53	6.32
Mean	29.12	26.10		5.00	4.16		15.48	13.71		52.82	47.97		4.86	4.33		5.53	5.08	
	S.Em	CD(0.05)		S.Em	CD(0.05)		S.Em	CD(0.05)		S.Em	CD(0.05)		S.Em	CD(0.05)		S.Em	CD(0.05)	
Growth regulator	1.56	4.52		0.28	0.80		0.84	2.43		1.67	4.85		0.22	0.63		0.31	0.89	
Number of applications	0.83	2.42		0.15	0.43		0.45	1.30		0.89	2.59		0.12	0.34		0.16	NS	
G × N	2.21	NS		0.80	NS		1.19	NS		2.37	NS		0.31	0.89		0.43	NS	

Intermodal length (cm):

The treatment combination of GA_3 100 ppm +BA 100 ppm (G_7) improved internodal length (6.32 cm). The significant influence was not recorded among the number of applications and also in case of interaction between growth regulators and the number of applications. The increase in intermodal length might be due to application of GA_3 and BA, which may be due to cell elongation induced by gibberellic acid and cell division promoted by cytokinins (Garder *et al* (1985)

Floral parameters:

Days to flower:

The perusal of table 2 shows that treatment G_7 (GA_3 100 ppm +BA 100 ppm) followed by G_1 (Control) took minimum days to flower (16.45 and 18.82 respectively) and significant influence was observed among the coloured shadenets, however, no influence was recorded in case of interaction effect between the growth regulators and number of applications. The above findings are in agreement with the previous works of (Sharma *et al*., 2004) in gladiolous, Suvalaxmi Palei (2016) in African marigold , Benny *et al* (2017) in carnation.

Number of spikes:

Treatment in combination with GA_3 100 ppm +BA 100 ppm increased the number of spikes per cane (1.70) among the number of applications, monthly applications (1.32) was found to be best. However remarkable significant difference was noticed between the interaction GA_3 100 ppm +BA 100 ppm with (2.33) under monthly applications gave the best all the treatments and the number of spikes. In the present study maximum number of spikes of dendrobium hybrids was recorded in the Gibberellic acid has been reported to stimulate flowering and increase the yield in ornamentals.Gibberellic acid has been found to be enhancing flower initiation in many commercial flowers. The most characteristic effects of GA_3 are increase in number of flowers, induce flowering and has enhanced apical dominance (Kumar *et al*., 2003).

The above findings are in agreement with the previous work of Pal and Choudhury (1998) in gladiolous cv. hunting song, Prakash and Jha (1998) in gladiolous cv. friendship.

Number of florets:

Number of florets per spike was recorded highest with the treatment in combination with GA_3 100 ppm +BA 100 ppm (10.33) followed by GA_3 100 ppm (7.17) Favorable effect of GA_3 might be attributed due to greater amount of carbohydrate accumulation and increase metabolic activities Similar results were earlier reported which has enhanced the flowering effect and reduced flower deformity of Phalaenopsis and Dendrobium (Chen *et al*., 1997; Sakai *et al*., 2000).

and among the number of applications, monthly applications (5.61) was found to be best. The significant difference was not noticed between the interaction between plant growth regulators and number of applications. The above findings are in agreement with the previous work of Bhattacharjee (1983) in Tiger lily, Pal and Choudhury (1998) in gladiolus cv. Hunting song. Prakash and Jha (1998) in gladiolus cv. friendship, Preeti et al. (1997) in tuberose and Singh (1999) in tuberose found highest number of floret per spike by using GA3 at 200 ppm . Similar result was also reported by Shanker *et al*. (2010) in

tuberose. Pathak *et al*. (1980) in tuberose found the maximum yield of spikes by treating with GA_3 at 200 ppm.

Spike length (cm):

Treatment in combination with GA_3 100 ppm +BA 100 ppm resulted in highest spike length of 24.67 cm and it was on par with GA_3 100 ppm (16.37 cm). Among the number of applications, monthly applications (19.91 cm) was found to be best spike length due to application of GA_3 and BA, which may be due to cell elongation induced by gibberellic acid and cell division promoted by cytokinin (Garder *et al* (1985). The result was in conformity with the results of Mondal and Mitra(2017) in cut rose var.”Buggati”.

Rachis length (cm):

Rachis length (17.83 cm) was recorded highest with the treatment consisting of plant growth regulator GA_3 100 ppm +BA 100 ppm followed by GA_3 100 ppm with (11.00 cm) and the significant influence was recorded among the number of applications, monthly applications with (11.48) and no significant difference was seen in case of interaction between plant growth regulators and number of applications. Increased in rachis length might be as a result of rapid internodes elongation due to increase cell division and cell elongation in intercalary meristem in dendrobium cv.Sonia-17. (Barman *et al*. (2014) in *Dendrobium* cv. *Thongchai gold*.

Treatments	Days to flower			Number of spikes			Number of florets			Spike length			Rachis length			Flower diameter		
	N_1	N_2	Mean	N_1	N_2	Mean	N_1	N_2	Mean	N_1	N_2	Mean	N_1	N_2	Mean	N_1	N_2	Mean
G_1	36.95	1.07	18.82	1.15	1.22	1.19	2.82	1.22	2.02	10.48	1.22	5.85	5.48	1.22	3.35	2.82	1.22	2.02
G_2	59.33	40.41	49.87	1.00	1.07	1.04	8.33	6.00	7.17	22.67	10.07	16.37	13.00	9.00	11.00	5.50	3.41	4.45
G_3	41.00	28.74	34.87	1.00	1.15	1.07	6.67	5.33	6.00	24.67	5.67	15.17	14.00	4.67	9.33	4.60	2.07	3.34
G_4	43.67	9.82	26.74	1.48	1.15	1.32	6.00	2.67	4.33	21.67	6.00	13.83	13.00	5.00	9.00	5.33	2.55	3.94
G_5	16.41	16.48	16.45	1.15	1.15	1.15	2.07	2.15	2.11	10.82	5.15	7.98	5.82	3.48	4.65	2.52	2.48	2.50
G_6	36.74	1.22	18.98	1.15	1.22	1.19	2.74	1.22	1.98	14.74	1.22	7.98	8.07	1.22	4.65	4.74	1.22	2.98
G_7	44.33	40.67	42.50	2.33	1.07	1.70	10.67	10.00	10.33	34.33	15.00	24.67	21.00	14.67	17.83	5.33	5.40	5.37
Mean	37.19	19.77		1.32	1.15		5.61	4.09		19.91	6.33		11.48	5.61		4.41	2.62	
	S.Em	CD(0.05)		S.Em	CD(0.05)		S.Em	CD(0.05)		S.Em	CD(0.05)		S.Em	CD(0.05)		S.Em	CD(0.05)	
Growth regulator	8.47	24.54		0.09	0.26		0.98	2.84		3.50	10.01		2.31	6.70		0.71	2.05	
Number of applications	4.53	13.11		0.05	0.14		0.52	1.52		1.85	5.35		1.24	3.58		0.38	1.09	
G × N	11.98	NS		0.13	0.37		1.39	NS		4.89	NS		3.27	NS		1.09	NS	

Effect of Flowering parameters in *Dendrobium* as influenced by different plant Growth regulators and number of spraying intervals and their interaction

Flower diameter (cm):

Treatment in combination with GA_3 100 ppm +BA 100 ppm resulted in highest Flower diameter of 5.37 cm and it was on par with GA_3 100 ppm (4.41 cm). Among the number of applications, monthly applications with (4.41 cm). There was no significant difference observed in case of interaction between plant growth regulators and number of applications. Application of GA_3 promoted the increase

The above findings are in agreement with the previous work of Bhattacharjee (1983b) in tiger lily, Prakash and Jha (1998) in gladiolous cv. friendship, Tiwari and Singh (2002) in tuberose, Chauhan R.V *et al* (2014) in gerbera, Suvalaxmi Palei *et al* (2016) in African marigold, Benny *et al* (2017) in carnation. diameter while BA played a major role in promoting uniform flower development avoiding deformality of orchid flowers. It has also been found to enhance flower initiation in orchids.

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