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Original Research Paper

Influence of inorganic nutrients on growth, flowering and quality of *Dendrobium* cv. Singapore white

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ABSTRACT

***Dendrobium* orchid cv. Singapore White is cultivated commercially for cut flower purpose. The performance of this orchid in response to the different nutrient concentrations was evaluated under the agro-climatic conditions of Kodagu during 2017-2020. Twelve nutrient doses were applied as foliar sprays at weekly intervals to study their effect on vegetative growth, flower production and quality parameters of the cut flowers. Plant height, number of leaves plant^{-1}, leaf area, number of pseudobulbs plant^{-1}, number of spikes plant^{-1} year^{-1}, number of flowers spike^{-1} and spike length varied significantly with the nutrient doses. Foliar spray of 30:20:20 NPK 0.1% at weekly intervals recorded the maximum plant height of 53.21cm, number of spikes plant^{-1}year^{-1} (10.01) with spike length of 44.43 cm and 16.20 flower spike^{-1}.**

Key words: Cut flower production, *Dendrobium,* Nutrients, Orchid and Quality

INTRODUCTION

Dendrobium orchid cv. Singapore White is an epiphyte belonging to the family Orchidaceae. It produces long spikes bearing attractive white flowers and is commercially cultivated for cut flower purpose. Globally orchids are traded as cut flowers and potted plants and are estimated to comprise of about 10% of the total cut flower trade (De *et al*., 2014). Indian orchid trade registered an increased trend of import value of orchids as compared export value during 2013-2014 to 2018-2019. According to De (2020) the highest import of orchids was recorded in 2013-2014 (Rs. 3425.76 lakh) followed by 2015-2016 (Rs. 2985.19 lacs) and 2018-2019 (Rs. 2321.84 lakh). Commercial cultivation of orchids in India has lot of scope to meet the demand for orchid cut flowers thereby reducing our dependence on imported flowers.

In India, states such as Kerala, Tamil Nadu, Karnataka, and Maharashtra are commercially cultivating *Dendrobium* orchids for cut flower production. This species comprises of 90% of the orchids in commercial cultivation (Rajeevan and Shobhana,1993). Similarly, in Karnataka, *Dendrobium* cultivation has been taken up in a cluster mode under Kanflora Society (Hegde, 2017). Kodagu, in Karnataka harbours about 75 species of native orchids and has conducive climatic conditions for commercial cultivation of orchids (Rao,1998). Among the exotic orchids, *Phalaenopsis, Dendrobium* and *Oncidium* are grown by orchid enthusiasts in this region. There is a lot of potential for commercial cultivation of orchids in this region.

Orchid plants receive water and nutrition from rainfall, air, breakdown of humus accumulated in the crevices of tree trunks and bird droppings in its natural habitats (Naik *et al*., 2009). For commercial cultivation orchid plants have to be provided with inorganic nutrients through foliar sprays for proper growth and development. Frequent application of diluted fertilisers to cater to the nutrient absorption and storage capacity is the general norm. Considering these facts, the present study was conducted to identify the

optimum nutrient regime for *Dendrobium* orchids to realise higher cut flower yield of superior quality under Kodagu conditions.

MATERIALS AND METHODS

The present investigations to study the effect of inorganic nutrients on growth and flowering of orchids, *Dendrobium* cv. Singapore White was conducted during 2017-2020 at the Central Horticultural Experiment Station of ICAR- Indian Institute of Horticultural Research, located in Chetalli in Kodagu district of Karnataka. Chetalli is located between 12^0 37' North latitude and 75^0 83' East longitude at an elevation of 1050 m above MSL, with temperature ranging from 19^0C to 32^0C and relative humidity from 55- 90%. Hardened tissue cultured plants were planted in 8" plastic pots in a medium comprising of broken tile bits, chopped coconut husk and charcoal in 1:1:1 ratio (v/v) and was housed in a naturally ventilated polyhouse. The experiment comprised of twelve different ratios of NPK *viz*., T_1: 10:10:10 NPK @ 0.1% ;T_2: 10:20:10 NPK @ 0.1% ; T_3:10:10:20 NPK @ 0.1%; T_4:10:20:20 NPK @ 0.1% ; T_5:20:10:10 NPK @ 0.1% ; T_6: 20:20:10 NPK @ 0.1% ; T_7:20:10:20 NPK @ 0.1% ; T_8:20:20:20 NPK @ 0.1% ; T_9: 30:10:10 NPK @ 0.1% ;T_{10}:30:20:10 NPK @ 0.1% ; T_{11}:30:10:20 NPK @ 0.1% and T_{12}: 30:20:20 NPK @ 0.1%. The nutrients were applied at weekly intervals as foliar sprays. The experiment was laid out in completely randomized design (CRD) with three replications and ten plants per replication. The observations were recorded for three consecutive years on plant height, number of leaves plant^{-1}, leaf area, number of pseudobulbs plant^{-1}, internodal length, girth of pseudobulbs number of spikes plant^{-1} year^{-1}, number of flowers spike^{-1}, spike length, flower size, pedicel length and vase life of cut flowers. Data recorded for the vegetative and floral parameters over the three-year period was pooled and analysed using the OPSTAT statistical package (Sheoran *et al*., 1998).

RESULTS AND DISCUSSION

Among the vegetative parameters presented in Table 1, plant height, number of leaves plant^{-1}, leaf area and number of pseudobulbs plant^{-1} varied significantly among the treatments. Foliar spray of 30:20:20 NPK @ 0.1% (T_{12}) at weekly intervals recorded the maximum plant height of 53.21 cm and was at par with treatments T_2:10:20:10 NPK@0.1% (53.11 cm); T_3:10:10:20 NPK @ 0.1%; (52.41 cm), T_9: 30:10:10 NPK @ 0.1% (50.71 cm) and T_{11}:30:10:20 NPK @ 0.1% (49.43 cm). The results are in accordance with the findings of Bichsel *et al*. (2008) who found that an increase in nitrogen was found to have a favourable effect on plant height in *Dendrobium* hybrids. This is also corroborated by the findings of Anitha and Kannan (2015a) in *Dendrobium* orchid cv. Earsakul. The minimum plant height (43.80 cm) was recorded in treatment T_8:20:20:20 NPK @ 0.1%. Weekly foliar application of T_{10}:30:20:10 NPK @ 0.1% recorded the maximum number of leaves plant^{-1} (47.82) and was at par with treatments T_4:10:20:20 NPK @ 0.1% (46.44); T_{11}:30:10:20 NPK @ 0.1% (46.02) and T_{12}:30:20:20 NPK @ 0.1% (44.72). Application of higher levels of nitrogen was found to significantly increase the total chlorophyll content in *Dendrobium* orchid cv. Earsakul according to Anitha and Kannan (2015b). The number of leaves affects the photosynthetic efficiency of the plant and this is in accordance with the findings of Wang (1996) in *Phalaenopsis*. The minimum number of leaves plant^{-1} (25.05) was recorded in treatment T_7:20:10:20 NPK @ 0.1%. Foliar spray of T_2:10:20:10 NPK @ 0.1% recorded the maximum leaf area (48.40 cm^2) whereas, minimum leaf area (30.75 cm^2) was recorded in treatment T_5: 20:10:10 NPK @ 0.1%. The treatment T_4:10:20:20 NPK @ 0.1% recorded the maximum number of pseudobulbs plant^{-1} (9.10) and was at par with T_{12}:30:20:20 NPK @ 0.1% (8.89), whereas application of T_3:10:10:20 NPK @ 0.1% resulted in the minimum number of pseudobulbs plant^{-1} (6.63). Improved vegetative growth of the plants may be attributed to the increase in the photosynthetic capacity of the plants. This is in corroboration with the findings of Sailo, *et al.* (2014) that though the leaves are the source of photosynthates for inflorescence development, the pseudobulb is responsible for the redistribution of assimilates from the leaves. There is substantial mobilisation of carbohydrate to the inflorescence through the pseudobulb. The internodal length and girth of pseudobulbs did not vary significantly with the treatments.

Table 1. Effect of inorganic nutrients on vegetative characters of *Dendrobium* cv. Singapore White

Treatments	Plant height (cm)	No. of leaves per plant	Leaf area (cm^2)	No. of pseudo-bulbs per plant	Internodal length (cm)	Girth of pseudobulbs (mm)
T_1	48.63	30.67	37.29	7.15	3.35	12.56
T_2	53.11	43.42	48.40	8.44	3.12	12.76
T_3	52.41	37.38	38.11	6.63	3.19	12.31
T_4	46.78	46.44	31.68	9.10	3.44	12.03
T_5	46.82	36.65	30.75	7.33	3.57	11.79
T_6	48.89	36.76	35.67	8.07	3.57	12.06
T_7	46.79	25.05	32.07	8.34	3.22	11.96
T_8	43.80	43.16	34.57	8.18	3.28	12.05
T_9	50.71	29.79	36.34	6.98	3.07	12.67
T_{10}	47.76	47.82	37.17	7.86	3.18	12.08
T_{11}	49.43	46.02	36.83	7.99	3.26	12.55
T_{12}	53.21	44.72	35.19	8.89	3.37	13.01
CD (P=0.05)	3.78	4.02	3.50	0.63	NS	NS

Treatment details :

T_1: 10:10:10 NPK @ 0.1% T_2: 10:20:10 NPK @ 0.1% T_3: 10:10:20 NPK @ 0.1% T_4: 10:20:20 NPK @ 0.1%

T_5: 20:10:10 NPK @ 0.1% T_6: 20:20:10 NPK @ 0.1% T_7: 20:10:20 NPK @ 0.1% T_8: 20:20:20 NPK @ 0.1%

T_9: 30:10:10 NPK @ 0.1% T_{10}: 30:20:10 NPK @ 0.1% T_{11}: 30:10:20 NPK @ 0.1% T_{12}: 30:20:20 NPK @ 0.1%

The floral traits and the vase life of cut flowers were recorded and have been presented in Table 2. The number of spikes plant^{-1}year^{-1}, number of flowers spike^{-1} and spike length varied significantly among the treatments. Maximum number of spikes plant^{-1}year^{-1} (10.01) was recorded with foliar spray of T_{12}: 30:20:20 NPK @ 0.1% and the minimum number of spikes plant^{-1}year^{-1} (7.07) were recorded with application of T_7:20:10:20 NPK 0.1%. Maximum number of flowers spike^{-1} (16.69) was recorded in treatment T_4: 10:20:20 NPK @ 0.1% and was at par with foliar application of T_{12}:30:20:20 NPK @ 0.1% (16.20) and T_3:10:10:20 NPK @ 0.1% (16.00) whereas the minimum number of flowers spike^{-1} was recorded in the treatment T_8:20:20:20 NPK @ 0.1% (10.68). Maximum spike length was recorded in the treatment T_2:10:20:10 NPK @ 0.1% (49.06 cm) and was at par with foliar application of T_5:20:10:10 NPK @ 0.1% (46.69 cm), whereas T_7:20:10:20 NPK @ 0.1% had the minimum spike length (41.28 cm). The main factors that could increase profitability of orchid cultivation is the improvement of flowering characteristics such as number of spikes produced and number of flowers per spike. This is in accordance with the findings of Wang (2004). Increase in levels of NPK in the foliar spray has played a significant role in increasing the spike length and the number of flowers per spike even while the production of flower spikes per plant has substantially increased, which is desirable for profitable commercial production. At higher levels of nutrient application, there was significant increase in spike length which might be due to

higher nutrient absorption in plants (Sudeep *et al*., 2018). Other parameters like flower size, pedicel length and vase life did not vary significantly with the treatments. This might be due to the fact that these are predominantly governed by the genetic traits. This contradicts the findings of Higaki and Imamura (1987) that increasing the level of N generally increases the flower size of Vanda 'Miss Joaquim' and addition of P and K further increases Vanda flower size.

Table 2. Effect of inorganic nutrients on floral characters and vase life of *Dendrobium* cv. Singapore White

Treatments	No. of spikes plant^{-1} year^{-1}	No. of flowers / spike	Spike length (cm)	Flower size (Length-cm)	Flower size (Breadth - cm)	Pedicel length (cm)	Vase life (days)
T_1	8.26	15.23	45.52	6.78	6.65	5.60	14.38
T_2	8.70	14.43	49.06	6.90	6.73	5.78	13.11
T_3	8.80	16.00	43.80	7.00	6.92	5.75	12.13
T_4	8.03	16.69	45.40	6.91	6.93	5.83	11.67
T_5	7.77	13.87	44.43	6.86	6.94	5.84	13.24
T_6	7.90	11.48	43.59	6.90	6.93	5.30	12.38
T_7	7.07	11.10	41.28	6.57	6.82	5.61	11.82
T_8	7.59	10.68	42.89	6.47	6.89	5.71	14.51
T_9	8.15	11.92	45.98	6.93	7.10	5.81	13.84
T_{10}	7.45	11.99	45.35	6.82	7.35	5.88	13.36
T_{11}	7.11	12.25	43.74	6.40	7.12	5.86	15.29
T_{12}	10.01	16.20	46.69	6.77	6.76	5.70	12.45
CD (P=0.05)	0.83	1.32	3.22	NS	NS	NS	NS

Table 3. Correlation of vegetative and floral traits with flower spike yield as influenced by inorganic nutrient doses

Character	No. of leaves/ plant	Leaf area (cm^2)	No. of Pseudo bulbs/plant	Inter -nodal length	Pseudo-bulb girth (mm)	No. of flowers / spike	Spike length (cm)	No. of spikes / plant
Plant Height (cm)	0.059	0.628*	-0.125	-0.336	0.791**	0.491	0.626*	0.731**
No. of Leaves / plant		0.212	0.480	0.073	0.120	0.239	0.371	0.162
Leaf area (cm^2)			-0.064	-0.550	0.586*	0.110	0.667*	0.317
No. of pseudo bulbs / plant			0.224	0.043	0.084	0.140	0.084	
Internodal length					-0.436	0.174	-0.224	0.002
Pseudobulb girth (mm)						0.353	0.658*	0.674*
No. of flowers / spike							0.513	0.707*
Spike length (cm)								0.624*

* Significant at 5% level ** Significant at 1% level

Estimates of the correlation coefficients among the various characters indicated that economic characters like spike length, number of flowers spike^{-1} and spike yield were positively correlated (Table 3). Among the vegetative characters, plant height recorded highly significant positive correlation (0.731) followed by girth of pseudo stem (0.674) which was significantly and positively correlated with spike yield. The results are in accordance with the findings of Zimmerman (1990). Pseudobulbs have ability to store water, mineral and carbohydrates. The active accumulation of mineral nutrients during the period of pseudobulb development constitutes an important source of reserve for the subsequent development of the inflorescence and new shoots as reported by Hew and Ng (1996). Hence vegetative growth in sympodial orchids has a direct effect on flowering and flower quality. Significant positive correlation with the number of spikes plant^{-1} was observed for number of flowers spike^{-1} (0.707) followed by spike length (0.624). Low positive correlation with spike yield was recorded for number of leaves plant^{-1}, leaf area, number of pseudobulbs plant^{-1} and internodal length. Significant positive correlation was recorded for spike length with leaf area (0.667) followed by pseudostem girth (0.658) and plant height (0.626). Girth of pseudobulb recorded a highly significant positive correlation with plant height (0.791) and was also positively correlated with leaf area (0.586). Leaf area recorded a significant positive correlation with plant height (0.628).

It may be concluded that foliar spray of NPK in the ratio of 30:20:20 at 0.1% at weekly intervals was found to be promising, resulting in higher cut flower yield and superior quality of spikes in *Dendrobium* cv. Singapore White under the agro climatic conditions of Kodagu.

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