

## RESPONSE OF NUTRITION ON GROWTH AND FLOWERING OF *Dendrobium* ORCHIDS UNDER EASTERN HIMALAYAN REGION

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**ABSTRACT:** A study on response of nutrition on growth and flowering of *Dendrobium* orchids under low cost poly house at Instructional farm, Department of Floriculture, College of Horticulture & Forestry, Pasighat, Arunachal Pradesh was conducted during April 2011 to March 2012. Three levels of nutrient mixtures (NPK 19:19:19) viz. 2g/l, 4g/l and 8g/l with commercial micronutrient mixture at 0.2 per cent and four varieties namely, TSG, Sonia, Thongchai Gold and Singapore White were selected for their evaluation. Significant response of nutrition, varieties and their interaction was observed. Cultivar Singapore White showed maximum plant height (65.09cm), number of leaves per cane (10.40), leaf length (19.75cm), cane girth (16.68mm) and minimum internodal space (4.82cm), while, highest number of canes per clump (6.93) and leaf width (6.19cm) was observed with cultivars Sonia and TSG, respectively. Earliness in flowering (93.45 days), increased flower diameter (8.12cm), number of florets per spike (13.57), number of spikes per plant per year (3.24) and fresh weight of spikes (34.07g) was associated with cultivar Sonia. However, cultivar TSG showed increased spike length (45.65cm) and rachis length (30.81cm). Higher dose of nutrition (8g/l) enhanced growth and flowering characters of all varieties as compared to lower dose. In interaction, significant response was noticed with higher dose of nutrition in cultivar Sonia, TSG and Singapore White, respectively.

**Keywords :** *Dendrobium*, polyhouse, nutrition, growth, flowering.

Orchids are the most fascinating and beautiful flowers in flora kingdom and exhibit a wide range of diversity in form, size, colour and texture of flower. Orchids are perennial in habit, flowers are expensive, have long vase life and propagated through tissue culture for commercial cultivation. Now-a-days, *Dendrobium* orchids are being used extensively as potted plants for interior scaping of hotels and restaurants due to their floriferousness, wide range of colour, shape and sizes, year round availability and long flowering life of several weeks to months. In India, tropical orchid particularly *Dendrobium* has become very popular and is grown under low cost poly houses. Production of *Dendrobium* cultivars is now of great interest in Pasighat as a potential cut-flower having long vase life and requires less effort for crop production with minimal attention. Water soluble fertilizers play an important role for better growth and development of orchid. Due to slow growth habit, orchid plants require less nutrients in efficient composition. During period of rapid growth, the plant can accept and use larger amounts of fertilizers, but

less frequent and more dilute applications are appropriate, when growth is slower. Thus, use of correct composition of nutrient mixture produces best vegetative growth and good quality flower spikes (Higaki and Imamura, 8). Also, foliar feeding is more effective for the orchids. Therefore, the study was undertaken to determine the effect of graded level of nutrient mixture on growth and flowering of orchid varieties.

### MATERIALS AND METHODS

The study was carried out at Instructional Farm, Department of Floriculture, College of Horticulture & Forestry, Central Agricultural University, Pasighat, Arunachal Pradesh from April 2011 to March 2012. Arunachal Pradesh comes under humid-per humid eco-system under Eastern Himalayan Region. Pasighat town, headquarter of East Siang District is situated at an altitude of 155 metres above mean sea level and is lying between 27° 43' and 29° 20' North latitudes and 94° 42' and 95° 35' East latitudes. It has warm and humid climate with distinct rainy season spread over 5 months from May to September. Three

levels of nutrient mixtures (NPK 19:19:19) viz. 2g/l, 4g/l and 8g/l with commercial micronutrient mixture at 0.2 per cent and four varieties namely, TSG, Sonia, Thongchai Gold and Singapore White were selected for their evaluation. The experiment was laid out in factorial randomized complete block design (FRCBD) with three replications. Six month old tissue cultured plants were planted on block of coconut fibre of size 30cm x 30cm and placed on raised platform and were used as an experimental materials. Offshoots were planted on four corners of the coconut fibre block inside low cost polyhouse with top and sides were covered by 50 per cent black coloured UV stabilized shade net. The day temperature prevailing during crop period ranged from 21.2-32.6°C and night temperature ranged from 11.6-24.1°C, respectively. The relative humidity ranged from 63.6-75.8 per cent. The average rainfall during the crop period was 2787mm. Nutrient mixtures with micronutrients were sprayed at fortnightly interval and standard package of practices were followed. Normally, ground water was used for irrigation and preparation of nutrient mixtures. The pH and EC of the irrigation water and nutrient solution were kept at 6.0 and below 0.6 dS per metre. Observations on various vegetative characters like plant height, number of leaves per cane, internodal space, leaf length, leaf breadth, cane girth; flowering characters like total number of flowering canes per clump, number of florets per spike, days to harvest of spikes, spike length, rachis length, flower diameter, fresh weight of spike and yield components like number of spikes per plant per year were recorded and collected data were pooled and analysed statistically (Panse and Sukhatme, 10).

## RESULTS AND DISCUSSION

### Effect of nutrition and variety on growth parameters

Increasing level of nutrients significantly affected the vegetative and flowering characters of orchid varieties. The data pertaining to vegetative characters clearly indicate significant differences among the treatments (Table 1). Highest plant height was associated with cultivar Singapore White (65.09cm) followed by TSG (61.94cm) which was on par with Sonia (60.06cm). However, the lowest plant height was noticed with cultivar Thongchai Gold (52.57cm). This might be due to genotypic differences between the cultivars and responded differently. Wide range of variability for plant height among the varieties is mainly due to genetic nature, growing situation and environmental conditions of the plant. These findings are in accordance with the report of Roychowdhury et

al. (12) in *Dendrobium* orchids and Thomas and Lekha Rani (15) in monopodial orchids.

Increasing level of nutrients had significant response on plant height. Nutrient mixture (NPK 19:19:19) at 8g/l showed maximum plant height (75.58cm) followed by nutrient mixture at 4g/l (60.09cm). Maximum plant height might be due to efficient fertigation during rapid growth and better translocation of nutrients from back bulbs to younger shoots during the course of development (Nair *et al.*, 9). The maximum vegetative growth with increasing levels of nutrient might be due to the fact that nitrogen is a constituent of protein which helps in division and enlargement of cell, thereby, enhancing plant growth (Sharma *et al.*, 14). The interaction effect of cultivars and nutrition also showed significant response in plant height. Significant interaction was found for plant height and associated with  $N_3V_3$  (90.66 cm) followed by  $N_1V_3$  (80.72 cm) and  $N_2V_2$  (71.46 cm). These results are in close conformity with the findings that plant growth increased with higher concentrations of nutrients in *Dendrobium nobile* (Dematte and Graziano, 7).

Maximum number of leaves per cane was recorded with cultivar Singapore White (10.40) followed by Thongchai Gold (9.85) and TSG (7.87), respectively. Nutrient mixture (NPK 19:19:19) at 8g/l showed highest number of leaves per cane (11.29) followed by nutrient mixture at 4g/l (9.08), respectively. Adequate application of nutrient mixture resulted in vigorous vegetative growth of the plant and imparted green colour to the foliage which favoured photosynthetic activity of the plant and greater synthesis of carbohydrate in the leaves (Agarwal *et al.*, 1) in marigold. Significant interaction was found for number of leaves per cane and associated with  $N_3V_4$  (13.63) followed by  $N_2V_4$  (10.97) which was on par with  $N_3V_1$  (10.65),  $N_1V_3$  (10.57) and  $N_2V_2$  (10.30), respectively. Whereas, internodal space was reduced in cultivar Singapore White (4.82mm) which was on par with Thongchai Gold (4.84mm). Nutrient mixture at 8g/l recorded least internodal space (5.42mm) which was on par with nutrient mixture at 4g/l (5.73mm), respectively. However, significant interaction for internodal space with  $N_3V_3$  (4.67mm) which was on par with  $N_3V_2$  (4.70mm),  $N_2V_3$  (4.72mm),  $N_3V_1$  (4.82mm),  $N_2V_4$  (4.99mm) and  $N_3V_4$  (5.10mm), respectively, was associated. Arumugam and Jawaharlal (3) reported that coconut fibre as growing medium showed positive results for plant height, number of shoots per plant, early flowering, spike length and number of florets per spike in *Dendrobium* 'Sonia-17'. This clearly indicates that orchids require a

well drained media with sufficient moisture retention capacity which favours the faster growth.

Highest number of cane per clump was recorded with cultivar Sonia (6.93) which was on par with Thongchai Gold (6.22) and TSG (6.22). Nutrition also responded significantly for enhancing number of cane per clump. Higher level of nutrient mixture at 8g/l showed increased number of cane per clump (7.23) followed by nutrient mixture at 2g/l (5.77), respectively. These results corroborate with the findings of Barman *et al.*(5) in *Cymbidium*. However, significant interaction for number of cane per clump with N<sub>2</sub>V<sub>2</sub> (8.13) which were on par with N<sub>3</sub>V<sub>1</sub> (7.43) and N<sub>1</sub>V<sub>3</sub> (7.28), respectively, was associated. Extended length of leaf was associated with cultivar Singapore White

(19.75cm) followed by Sonia (18.38cm) and Thongchai Gold (45.96cm). Higher level of nutrient mixture at 8g/l showed increased length of leaf (19.19cm) followed by nutrient mixture at 4g/l (17.44cm). Significant interaction was associated with N<sub>3</sub>V<sub>4</sub> (21.75cm) followed by N<sub>2</sub>V<sub>2</sub> (20.14 cm) which was on par with N<sub>3</sub>V<sub>3</sub> (19.82cm), respectively. Whereas, increased breadth of leaf was noted with cultivar TSG (6.19 cm) followed by Thongchai Gold (5.85 cm) and Sonia (4.89cm). Higher level of nutrient mixture at 8g/l showed increased breadth of leaf (5.93 cm) followed by nutrient mixture at 4g/l (5.38 cm), respectively. Significant interaction for breadth of leaf with N<sub>3</sub>V<sub>1</sub> (6.49cm) which was on par with N<sub>1</sub>V<sub>3</sub> (6.52cm) and N<sub>1</sub>V<sub>2</sub> (6.33 cm), respectively, was noticed. Increased cane girth was noticed with cultivar Singapore White

**Table 1: Effect of nutrition and variety on growth parameters of Dendrobium orchid.**

Treatment	Plant height (cm)	No. of leaves/cane	Internodal space (mm)	Total No. of cane/clump	Length of leaf (cm)	Breadth of leaf (cm)	Cane girth (mm)
<b>Nutrition</b>							
N <sub>1</sub> (2g/l)	44.08	6.58	5.43	5.77	15.58	4.82	14.33
N <sub>2</sub> (4g/l)	60.09	9.08	5.87	5.63	17.44	5.38	16.06
N <sub>3</sub> (8g/l)	75.58	11.29	5.42	7.23	19.19	5.93	17.68
<b>Mean</b>	<b>59.92</b>	<b>8.98</b>	<b>5.57</b>	<b>6.21</b>	<b>17.40</b>	<b>5.38</b>	<b>16.02</b>
<b>CD (P=0.05)</b>	<b>1.71</b>	<b>0.37</b>	<b>0.35</b>	<b>0.50</b>	<b>0.66</b>	<b>0.28</b>	<b>0.31</b>
<b>Variety</b>							
V <sub>1</sub> (TSG)	61.94	7.87	6.42	6.22	15.53	6.19	16.59
V <sub>2</sub> (Sonia)	60.06	7.80	6.21	6.93	18.38	4.89	14.86
V <sub>3</sub> (Thongchai Gold)	52.57	9.85	4.84	6.22	15.96	5.85	15.96
V <sub>4</sub> (Singapore White)	65.09	10.40	4.82	5.49	19.75	4.56	16.68
<b>Mean</b>	<b>59.92</b>	<b>8.98</b>	<b>5.57</b>	<b>6.21</b>	<b>17.40</b>	<b>5.38</b>	<b>16.02</b>
<b>CD (P=0.05)</b>	<b>1.98</b>	<b>0.43</b>	<b>0.40</b>	<b>0.58</b>	<b>0.76</b>	<b>0.32</b>	<b>0.35</b>
<b>Interaction</b>							
N <sub>1</sub> V <sub>1</sub>	41.83	4.80	6.55	5.63	13.62	5.73	14.64
N <sub>1</sub> V <sub>2</sub>	63.26	8.23	6.92	5.75	15.96	6.33	16.45
N <sub>1</sub> V <sub>3</sub>	80.72	10.57	5.80	7.28	17.02	6.52	18.69
N <sub>1</sub> V <sub>4</sub>	49.66	5.83	5.73	6.70	16.61	4.46	13.57
N <sub>2</sub> V <sub>1</sub>	59.06	7.27	6.92	5.95	18.38	4.86	14.69
N <sub>2</sub> V <sub>2</sub>	71.46	10.30	5.97	8.13	20.14	5.36	16.32
N <sub>2</sub> V <sub>3</sub>	44.83	7.93	4.72	5.40	14.42	5.19	13.85
N <sub>2</sub> V <sub>4</sub>	53.40	10.97	4.99	5.83	15.59	5.88	16.38
N <sub>3</sub> V <sub>1</sub>	59.48	10.65	4.82	7.43	17.86	6.49	17.65
N <sub>3</sub> V <sub>2</sub>	39.99	7.73	4.70	5.41	17.67	3.89	15.26
N <sub>3</sub> V <sub>3</sub>	64.62	9.83	4.67	4.99	19.82	4.46	16.71
N <sub>3</sub> V <sub>4</sub>	90.66	13.63	5.10	6.08	21.75	5.34	18.07
<b>Mean</b>	<b>59.92</b>	<b>8.98</b>	<b>5.57</b>	<b>6.21</b>	<b>17.40</b>	<b>5.38</b>	<b>16.02</b>
<b>CD (P=0.05)</b>	<b>3.42</b>	<b>0.75</b>	<b>0.70</b>	<b>1.01</b>	<b>1.32</b>	<b>0.56</b>	<b>0.61</b>

(6.93 mm) which was on par with Thongchai Gold (6.22 mm) and TSG (6.22 mm). Higher level of nutrient mixture at 8g/l showed increased number of cane per clump (7.23mm) followed by nutrient mixture at 2g/l (5.77mm). However, significant interaction for cane girth with  $N_2V_2$  (8.13 mm) which were on par with  $N_3V_1$  (7.43 mm) and  $N_1V_3$  (7.28 mm), respectively, was associated.

### Effect of nutrition and variety on flowering parameters

The data presented in Table 2 indicated that cultivars and increasing dose of nutrients significantly affected the flowering characters. Increased fresh weight of spike was recorded with cultivar Sonia (34.07g) followed by TSG (33.23g) and Singapore

White (31.11g), whereas, cultivar Thongchai Gold showed reduced fresh weight of spike (28.39g). Higher level of nutrient mixture at 8g/l produced maximum fresh weight of spike (33.72g) followed by nutrient mixture at 4g/l (31.65g), respectively. However, significant interaction for fresh weight of spike with  $N_2V_2$  (36.16g) which was on par with  $N_1V_3$  (35.72) was associated. Highest spike length was recorded with cultivar TSG (45.65cm) followed by Singapore White (43.54cm) and Sonia (39.41cm). Higher level of nutrient mixture at 8g/l showed maximum spike length (52.43cm) followed by nutrient mixture at 4g/l (40.34cm), respectively, while, significant interaction was associated with  $N_3V_4$  (65.72cm) followed by  $N_2V_2$  (53.93cm) which was on par with  $N_1V_3$  (53.83cm), respectively. The application of nutrient at

**Table 2: Effect of nutrition and variety on flowering parameters of Dendrobium orchid.**

Treatment	Fresh weight of spike (g)	Spike length (cm)	Rachis length (cm)	Flower diameter (cm)	No. of florets/spike	Days to harvest spike	No. of spikes/plant/year
<b>Nutrition</b>							
$N_1$ (2g/l)	29.80	28.04	19.29	6.55	7.96	166.59	1.92
$N_2$ (4g/l)	31.65	40.34	29.69	6.95	11.17	157.66	2.87
$N_3$ (8g/l)	33.72	52.43	38.24	7.96	15.99	150.44	3.22
<b>Mean</b>	<b>31.72</b>	<b>40.27</b>	<b>29.07</b>	<b>7.15</b>	<b>11.71</b>	<b>158.23</b>	<b>2.67</b>
<b>CD (P=0.05)</b>	<b>0.44</b>	<b>1.15</b>	<b>1.23</b>	<b>0.37</b>	<b>0.50</b>	<b>0.87</b>	<b>0.20</b>
<b>Variety</b>							
$V_1$ (TSG)	33.23	45.65	30.81	7.99	10.30	95.88	3.11
$V_2$ (Sonia)	34.07	39.41	29.14	8.12	13.57	93.45	3.24
$V_3$ (Thongchai Gold)	28.39	32.56	23.80	6.08	10.44	213.52	2.19
$V_4$ (Singapore White)	31.11	43.54	32.54	6.43	12.52	230.07	2.12
<b>Mean</b>	<b>31.72</b>	<b>40.27</b>	<b>29.07</b>	<b>7.15</b>	<b>11.71</b>	<b>158.23</b>	<b>2.67</b>
<b>CD (P=0.05)</b>	<b>0.51</b>	<b>1.33</b>	<b>1.41</b>	<b>0.43</b>	<b>0.58</b>	<b>1.00</b>	<b>0.2</b>
<b>Interaction</b>							
$N_1V_1$	31.22	35.64	20.93	7.29	7.55	98.52	2.37
$N_1V_2$	33.04	47.48	34.25	7.57	10.31	96.04	3.27
$N_1V_3$	35.72	53.83	37.25	9.12	13.04	93.07	3.70
$N_1V_4$	31.26	28.89	20.93	7.46	9.02	96.80	2.60
$N_2V_1$	34.80	35.42	26.29	7.91	12.29	92.48	3.40
$N_2V_2$	36.16	53.93	40.20	8.98	19.40	91.08	3.73
$N_2V_3$	26.68	26.06	19.70	5.61	8.49	223.89	1.37
$N_2V_4$	27.76	35.38	25.68	5.84	10.69	210.59	2.47
$N_3V_1$	30.73	36.25	26.03	6.81	12.15	206.08	2.73
$N_3V_2$	30.03	21.59	15.61	5.84	6.78	247.13	1.33
$N_3V_3$	30.99	43.06	32.56	6.49	11.39	231.53	2.33
$N_3V_4$	32.29	65.72	49.47	6.95	19.39	211.53	2.70
<b>Mean</b>	<b>31.72</b>	<b>40.27</b>	<b>29.07</b>	<b>7.15</b>	<b>11.71</b>	<b>158.23</b>	<b>2.67</b>

optimum level may attributed to acceleration in development of growth and reproductive phases (Anuradha et al., 2). However, higher level of nutrient mixture might have accelerated protein synthesis, thus promoting early floral primordial development. These finding are in accordance with earlier work in *Cymbidium* (Barman et al.,5).Chang et al.(6) revealed that higher level of nutrient application accelerated the growth of flowering spikes and increased number of flowers in *Phalaenopsis*. Increased rachis length was recorded with cultivar Singapore White (32.54cm) followed by TSG (30.81cm) and Sonia (29.14cm). Higher level of nutrient mixture at 8g/l showed maximum rachis length (38.24cm) followed by nutrient mixture at 4g/l (29.69cm). Significant interaction for rachis length with  $N_3V_4$  (49.47cm) followed by  $N_2V_2$  (40.20cm) and  $N_1V_3$  (37.25cm), respectively, was associated. These results are in close conformity with the findings of Rajeevan and Swapna (11) where a combination of NPK 10:20:10 at 0.2 per cent applied twice a week produced higher number of spike, number of florets, spike length and rachis length in *Dendrobium* 'Sonia-17'. Increased flower stalk length, inflorescence length and number of flowers per stem in *Phalaenopsis* hybrid with higher nutrient concentration were also observed (Ruamrungsri et al., 13).

Cultivar Sonia recorded maximum flower diameter (8.12 cm) followed by TSG (7.99cm) and Singapore White (6.43 cm). Higher level of nutrient mixture at 8g/l showed increased flower diameter (7.96 cm) followed by nutrient mixture at 4g/l (6.95 cm). Wang (16) observed that higher concentration of nutrient responded good for obtaining healthy foliage, increased flower count and larger flowers of *Phalaenopsis* than lower concentrations. Significant interaction for flower diameter with  $N_1V_3$  (9.12cm) followed by  $N_2V_2$  (8.98cm) and  $N_2V_1$  (7.91cm), respectively, was associated. Higaki and Imamura (8) also observed that increasing the level of nutrients increases the flower size of *Vanda* 'Miss Joaquim'. Maximum number of florets per spike was noticed with cultivar Sonia (13.57) followed by Singapore White (12.52). Increasing the nutrient from 2g/l to 8g/l increased the average number of flowers per plant. Higher level of nutrient mixture at 8g/l showed increased number of floret per spike (15.99) followed by nutrient mixture at 4g/l (11.17), respectively. Increased number of florets per spike with increasing frequency of water soluble fertilizer was recorded by Barman et al. (5) in *Cymbidium*. However, significant interaction was associated with  $N_2V_2$  (19.40) which were on par with  $N_3V_4$  (19.39). Earliness in harvest of spike was noticed with cultivar Sonia (93.45 days)

followed by TSG (95.88days). However, cultivar Thongchai Gold and Singapore White recorded delayed harvest of spike (213.52 days and 230.07 days). This might be due to genotypic differences between the cultivars and responded differently. Increasing the nutrient from 2g/l to 8g/l decreased the days to harvest of spike. Higher level of nutrient mixture at 8g/l showed reduced days to harvest spike (150.44 days) followed by nutrient mixture at 4g/l (157.66 days). This might be due to increased availability of nitrogen from nutrient mixture which may induce early emergence of spike (Bankar and Mukhopadhyay, 4). Wang and Gregg (17) observed that increased fertility promoted early inflorescence emergence and blooming in *Phalaenopsis* hybrid. Higher fertilizer rates also caused a linear increase in the number of flowers, inflorescence per plant, stalk diameter, leaf number and size.

However, significant interaction for days to harvest spike with  $N_2V_2$  (91.08days) which was on par with  $N_2V_1$ (92.48days) was associated. All the cultivars and nutrient levels showed significant differences in number of spike per plant per year. Cultivar Sonia recorded highest number of spike per plant per year (3.24) which was on par with TSG (3.11). Higher level of nutrient mixture at 8g/l showed maximum number of spike per plant per year (3.22) followed by nutrient mixture at 4g/l (2.87), respectively. However, significant interaction for spike per plant per year with  $N_2V_2$  (3.73) which were on par with  $N_1V_3$  (3.70) and  $N_2V_1$  (3.40) was associated.

## CONCLUSION

It was apparent through entire investigation that cultivar Singapore White performed better in growth parameters in association with higher level of nutrient mixture, while, cultivar Sonia showed excellent in flowering parameters. Also, higher dose of nutrition (8g/l) enhanced growth and flowering characters of all cultivars as compared to lower dose. In interaction, significant response was noticed with higher dose of nutrition in cultivar Sonia, TSG and Singapore White, respectively.

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