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Infulence of Varying Levels of Foliar Nutrients on Flower Quality and Yield of *Dendrobium* Orchid Cv. Sonia-17

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ABSTRACT

The present investigation was carried out at orchidorium, Regional Horticultural Research and Extension Centre, University of Horticultural Sciences campus, GKVK, Bengaluru during September 2015 to June 2017. The results indicated a significant influence of the treatments on different flower quality and yield parameters. Treatment 2:6:2 (T_9) NPK ratio produced longer spike length (56.31 cm), rachis length (42.65 cm), number of florets per spike (10.87), diameter of floret (9.42 cm), spike weight (34.75 g) and spike girth (4.04 mm) and it was on par with treatments 2:6:1 (T_8) NPK ratio and 3:6:2 (T_{13}) NPK ratio and lowest was observed in control (T_1). Highest number of spike per plant (3.07) was recorded in T_9- 2:6:2 and it was on par with treatment T_8 - (2:6:1) (2.87).However, it was registered lowest spike per plant was noticed in control (T_1).

Key words: *Foliar nutrient, Dendrobium.*

INTRODUCTION

Orchids are highly valued as cut flowers in commercial floriculture owing to the wide range of colors, shapes, sizes and fragrance they display, with a long vase life being an added advantage. Belonging to the second largest genus of orchids, most *Dendrobium* species are epiphytic and are from subtropical and tropical regions. *Dendrobium* is a popular genus for cut flower production. Many growers in the states of Kerala, Tamil Nadu, coastal Karnataka and Andhra Pradesh are cultivating *Dendrobiums* on a commercial scale. *Dendrobiums* occupy nearly 90 per cent of the area under orchid cultivation in Kerala due to the easy management practices and plant material availability[10]. In Karnataka, a number of farmers have taken up *Dendrobium* orchid cultivation, under the guidance of Kanflora[4]. Considering the large area under *Dendrobium* cultivation, and the fact that there is a decline in the yield and quality of the spikes during the cooler months of winter, it was found essential to sustain the yield and quality of the flowers round the year for commercial production.

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Poole and Sheehan[9] have identified the critical factors affecting orchid mineral nutrition *viz*., the medium, the degree of decomposition of organic materials and the age of the plants. According to Hew and Yong[5] more information pertaining to mineral nutrition of orchid plants at different stages is needed for formulating a practical fertilizer programme for tropical orchid cultivation. The optimum NPK ratio for *Dendrobium Pompadour* has been identified as 1.5:1.5:1[9,5]. This ratio could not however give optimum yield and spike quality over a long period of time in commercial cultivation. Therefore a study was conducted to sustain the growth and yield of the *Dendrobium* orchid through application of different levels of NPK as foliar nutrition.

MATERIAL AND METHODS

The experiment was conducted to study the effect of varying levels of NPK on growth and yield of *Dendrobium* orchid cv. Sonia-17 under naturally ventilated polyhouse at Regional Horticultural Research and Extension Centre, University of Horticultural Sciences campus, GKVK, Bengaluru during September 2015 to June 2017. The experiment was laid out in a Completely Randomized Design comprising thirteen treatments (three levels of N, two levels of P and two levels of K) replicated thrice. The number of pots per treatment was twenty. Two year-old plants of *Dendrobium* Sonia- 17 in earthen pots were placed on iron benches and 50 per cent shade was provided using green agro shade nets. All the plants were given as foliar spray of 19:19:19 water soluble fertilizer @ 0.2 per cent and additional requirement of nutrient levels were supplement through urea (46%), orthophosphoric acid (61%) and potassium sulphate (50%). Urea was used as the source of nitrogen, Orthophosphoric acid was used as the source of phosphorous and potassium sulphate used as the source of potassium and were supplied throughout the growth period using water soluble fertilizers at 15 days interval through foliar spray throughout the experiment from September 2015 to May 2017. The treatment comprising of foliar nutrients at various N: P: K levels are as follows.

Nutrients sprayed at different levels					
Treatments	**NPK levels**	**19:19:19**	**N (g)**	**P (ml)**	**K (g)**
T_1	1:1:1(control)	2 g	-	-	-
T_2	1:4:1	2 g	-	1.90	-
T_3	1:4:2	2 g	-	1.90	0.76
T_4	1:6:1	2 g	-	3.15	-
T_5	1:6:2	2 g	-	3.15	0.76
T_6	2:4:1	2 g	0.83	1.90	-
T_7	2:4:2	2 g	0.83	1.90	0.76
T_8	2:6:1	2 g	0.83	3.15	-
T_9	2:6:2	2 g	0.83	3.15	0.76
T_{10}	3:4:1	2 g	1.67	1.90	-
T_{11}	3:4:2	2 g	1.67	1.90	0.76
T_{12}	3:6:1	2 g	1.67	3.15	-
T_{13}	3:6:2	2 g	1.67	3.15	0.76

Five plants were selected at randomly in each treatment of replications for the purpose of recording observations on various parameters of growth and yield. The mean value of the data was worked out for the purpose of statistical computation (analysis).

RESULTS AND DISCUSSION

The experimental results revealed a significant influence of the nutritional treatments on the different vegetative and yield parameters. The data pertaining to the spike length, rachis length, number of florets per spike, diameter of floret, spike weight, spike girth and spike yield per plant at different stages of crop growth are presented in tables from 1 to 7.

Spike length is one of the qualitative character which determines the prices in the domestic and international market. The data with respect to spike length as influenced by different treatments are furnished in Table-1. At 3 and 6 MAT, NPK level of 2:6:2 (T_9) produced significantly maximum spike length (50.25 cm and 52.58 cm respectively) and it was on par with 3:6:2 (T_{13}) (49.22 cm and 52.09 cm respectively) which were superior to other treatments studied. However, it was registered minimum in control (30.25 cm and 32.25 cm respectively). On the other hand at 9, 12, 15, 18 and 21 months after treatment, significantly maximum spike length was recorded in 2:6:2 NPK level (T_9) (53.66, 55.93, 56.31, 55.05 and 53.05 cm respectively) and it was on par with T_8 and T_{13}. Whereas, minimum length of spike was recorded in (T_1) control (35.52, 40.55, 38.42, 40.05 and 38.83 cm respectively). The increased nutrient availability from phosphorus and potassium might have increased the various endogenous hormonal levels in the plant tissue, which ultimately increased the spike length. The findings were coated by earlier author by Nair *et al.*[8].

Increased uptake level of nitrogen, phosphorus and potassium resulted in increased spike length might be due to accumulation of relatively more starch and sugar which were synthesized in the plant body, which ultimately helps to form carbohydrate and translocation of starch in *Dendrobium* orchid. Similar findings was quoted by Kabir *et al.*[6] in *Dendrobium* orchid. Balanced dose of nitrogen, phosphorus and potassium seemed to have increased the vegetative growth, favorable for the synthesis of peptide bond, protein and carbohydrate metabolism that are essential for quality flower development by Kumar *et al.*[7] in *Dendrobium* orchid.

At higher levels of nutrient application, there was significant increase in spike length which might be higher nutrient absorption in plants. Nutrients could have supported better storage and transfer of energy which influence on cell division and cell enlargement. This variation might have played a positive role in increasing the spike length. These results are in conformity with the reports of Anitha and Kannan[2] in *Dendrobium* orchid.

Significant results were obtained with respect to rachis length in different treatments of *Dendrobium* cv. Sonia-17 are illustrated in table. 2. Longest rachis length (38.58 cm, 39.26 cm, 41.60 cm, 44.36 cm, 42.65 cm, 42.24 cm and 41.32 cm at 3, 6, 9, 12, 15, 18 and 21 MAT respectively) was recorded in NPK @ 2:6:2 (T_9) and it was statically on par with treatment 3:6:2 (T_{13}) followed by 2:6:1 (T_8) and shortest length of rachis was recorded in control. This can be attributed to higher nutrient uptake in plants which enhance the production of food materials which subsequently increase the rachis length. The findings were coated by earlier authors by Nair *et al.*[8], Kumar *et al.*[7] and Anitha and Kannan[2] in *Dendrobium* orchid.

Number of florets per spike is one of the important qualitative character and plays an important role in extending vase life of cut flowers. Significant differences were recorded in different nutrient levels during the entire crop growth period and presented in table. 3. Among nutrient levels, the increased number of florets per spike was recorded in 2:6:2 NPK level (T_9) and it was on par with treatment T_{13} (3:6:2) (9.13, 9.53, 9.67, 10.53, 10.87, 10.07, 9.47 and 9.07, 9.40, 9.53, 10.40, 10.40, 9.47 9.33 at 3, 6, 9, 12, 15, 18 and 21 MAT respectively) and lower number of florets was recorded in control. Increase in number of florets could be attributed to optimum levels of balanced NPK application which helped in better assimilation of carbohydrates and build up of new cells for more number of florets in *Dendrobium* orchid by Kumar *et al.*[7].

Increase in number of florets per spike at higher dosage of phosphorous and potash supplied through foliar application might have positive linear relationship with production of longer stem which inturn to improving the production of more number of florets per spike. Similar results were observed by Nair *et al.*[8], and Anitha and Kannan[2] in *Dendrobium* orchid.

Different nutrient levels had significant effect on diameter of floret are furnished in table-4. Results clearly indicated that, floret diameter increased significantly during the crop growth period. Maximum diameter of floret was observed in 2:6:2 NPK level (T_9) (9.16 cm, 9.21 cm, 9.02 cm, 9.26, 9.42, 9.32 and 9.20 cm at 3, 6, 9, 12, 15, 18 and 21 MAT respectively) and minimum (7.25 cm, 7.48 cm, 7.35 cm, 7.92 cm, 8.08 cm, 8.02 cm ,7.76 cm) was observed in (T_1) control at 3, 6, 9, 12, 15, 18 and 21 MAT respectively. Increased level of phosphorus and potassium resulted in increased diameter of floret in *Dendrobium* was reported by Nair *et al.*[8]. Balanced dose of NPK nutrients have favorable for the synthesis of peptide bond, protein and carbohydrate metabolism that are essential for bigger flower diameter in *Dendrobium* by Kumar *et al.*[7].

Increased uptake level of nitrogen, phosphorus and potassium dose resulted in increased diameter of floret might be due to accumulation of more starch and sugar which were synthesized in the plant body which ultimately, helps to translocation of starch resulting good quality flowers in *Dendrobium* orchid. Similar findings of Kumar *et al.*[7] and Anitha and Kannan[2] in *Dendrobium* orchid.

Spike weight was significantly influenced by different nutrient levels are presented in table-5. Among the treatments, maximum spike weight of 28.68 g, 29.44g, 29.97 g, 32.07, 34.75, 34.07 and 31.02 g was recorded in NPK mixture 2:6:2 (T_9) at 3, 6, 9, 12, 15, 18 and 21 MAT respectively and it was statistically on par with the treatments of 3:6:2 and 2:6:1.Whereas, minimum weight of spike was noticed in control (T_1). Increase in spike length is positively associated with increase in spike weight. This variation in spike weight might be due to higher uptake of NPK nutrients results in the synthesis of amino acids, ADP, ATP and co-enzymes. These results were supported in *Dendrobium* orchid by Kumar *et al.*[7] and Anitha and Kannan[2].

All the treatments were differed significantly with respect to the spike girth during the entire period of experiment are presented in table-6. Highest spike girth of (3.89 mm, 3.91 mm, 3.95 mm, 3.98 mm, 4.04 mm, 4.00 mm and 4.10 mm at 3, 6, 9, 12, 15, 18 and 21 MAT respectively) was recorded in treatment 2:6:2 NPK level (T_9) and minimum girth of spike (2.96 mm, 3.10 mm, 3.18 mm, 3.12 mm, 3.24 mm, 3.27 mm and 3.32 mm) was recorded in control at 3, 6, 9, 12, 15, 18 and 21 MAT respectively months after treatment. Optimum dosage of nutrients could have supported better storage and transfer of energy which influence on cell division and cell enlargement, ultimately it leads to biological and metabolism changes in plants. These results are in accordance with the findings of Anitha and Kannan[2] in *Dendrobium* orchid.

The data on spike yield per plant in *Dendrobium* as influenced by treatments are presented in table 7. Number of spike per plant recorded at 3, 6 and 9 MAT had found significant effect on different levels of nutrients. Maximum number of spike per plant (1.60, 2.00 and 2.20 respectively) was recorded in T_9- 2:6:2 and it was on par with treatment T_8 - (2:6:1) (1.40, 1.93 and 2.13 respectively).However, it was registered minimum yield of 0.87, 1.20 and 1.07 spikes per plant was noticed in control (T_1). Significantly highest cut flower yield of 2.60, 2.87, 3.07 and 2.80 was recorded in 2:6:2 (T_9) which is at par with the treatment (T_8) 2:6:1 (2.54, 2.80, 2.87 and 2.60 respectively). While, lowest flower yield per plant was recorded in control (T_1) at 12, 15, 18 and 21 months after treatment.

It can be concluded from the above study that increasing the levels of phosphorus and potassium in the foliar spray given to *Dendrobium* orchids can result in better flower

quality and higher yield almost throughout the growing season. Treatment T_9-2:6:2 and T_8-2:6:1 NPK ratios which were highly profitable for the farmers for commercial cultivation.

Table 1: Effect of varying nutrient levels on plant height of *Dendrobium* orchid cv. Sonia-17

Treatments NPK levels	Spike length (cm) at different months after treatment							
	3 MAT	6 MAT	9 MAT	12 MAT	15 MAT	18 MAT	21 MAT	Mean
T_1: 1:1:1 (Control)	30.25	32.25	35.52	40.55	38.42	40.05	38.83	36.55
T_2- 1:4:1	39.28	40.35	40.68	43.02	44.92	42.22	41.82	41.75
T_3- 1:4:2	40.87	41.04	40.92	42.12	47.12	45.08	43.75	42.98
T_4- 1:6:1	42.62	41.25	42.38	45.02	47.70	46.74	46.04	44.53
T_5- 1:6:2	44.67	43.30	45.54	46.54	50.23	48.26	48.03	46.65
T_6- 2:4:1	45.29	48.22	47.88	50.31	50.14	49.88	49.22	48.70
T_7- 2:4:2	47.40	48.62	48.76	49.96	52.80	50.20	49.76	49.64
T_8- 2:6:1	49.08	51.65	51.70	53.71	53.85	53.96	52.21	52.30
T_9- 2:6:2	50.25	52.58	53.66	55.93	56.31	55.05	53.05	53.83
T_{10}- 3:4:1	45.34	45.84	44.74	46.87	49.28	47.42	46.75	46.60
T_{11}- 3:4:2	46.62	47.13	47.13	48.54	50.05	49.38	48.65	48.21
T_{12}- 3:6:1	47.78	50.01	49.24	51.16	52.07	53.10	51.18	50.64
T_{13}- 3:6:2	49.22	52.09	51.56	53.76	53.12	52.94	51.95	52.09
S.Em ±	1.32	1.21	0.92	0.70	1.02	0.54	0.81	
C.D.@ 5%	3.84	3.50	2.67	2.05	2.97	1.56	2.35	

Control (19:19:19 @ 2gm/L 1:1:1) MAT-months after treatment

Table 2: Effect of varying nutrient levels on rachis length of *Dendrobium* orchid cv. Sonia-17

Treatments NPK levels	Rachis length (cm) at different months after treatment							
	3 MAT	6 MAT	9 MAT	12 MAT	15 MAT	18 MAT	21 MAT	Mean
T_1: 1:1:1 (Control)	22.40	23.85	25.12	27.41	30.16	30.20	28.76	26.84
T_2- 1:4:1	23.55	24.84	27.08	28.08	31.28	32.54	30.05	28.20
T_3- 1:4:2	25.16	27.53	28.04	29.24	32.16	34.26	31.32	29.67
T_4- 1:6:1	28.12	26.78	29.12	32.22	34.13	34.93	33.76	31.29
T_5- 1:6:2	30.20	29.18	29.75	33.08	38.42	37.98	35.95	33.50
T_6- 2:4:1	31.45	32.73	32.84	37.16	37.29	38.22	37.42	35.30
T_7- 2:4:2	33.72	34.25	34.98	37.58	38.78	39.45	38.24	36.71
T_8- 2:6:1	36.74	38.04	38.41	40.70	40.10	40.20	40.58	39.25
T_9- 2:6:2	38.58	39.26	41.60	44.36	42.65	42.24	41.32	41.43
T_{10}- 3:4:1	30.67	30.67	31.34	35.02	37.06	37.86	36.48	34.15
T_{11}- 3:4:2	32.16	33.69	35.16	36.84	37.84	39.60	37.24	36.07
T_{12}- 3:6:1	36.08	36.34	36.87	38.32	39.25	40.55	39.80	38.17
T_{13}- 3:6:2	37.10	37.12	39.02	42.16	40.86	39.42	40.03	39.38
S.Em ±	0.90	0.85	0.66	0.97	0.78	0.85	0.60	
C.D.@ 5%	2.62	2.46	1.92	2.83	2.27	2.47	1.73	

Control (19:19:19 @ 2gm/L 1:1:1) MAT-months after treatment

Table 3: Effect of varying nutrient levels on number of florets of *Dendrobium* orchid cv. Sonia-17

Treatments NPK levels	Number of florets per spike at different months after treatment							
	3 MAT	6 MAT	9 MAT	12 MAT	15 MAT	18 MAT	21 MAT	Mean
T_1: 1:1:1 (Control)	6.20	6.80	6.53	7.20	7.93	7.33	7.13	7.01
T_2- 1:4:1	6.87	7.20	7.27	7.87	8.20	7.53	7.57	7.50
T_3- 1:4:2	7.00	7.27	7.13	7.47	8.53	7.80	7.67	7.55
T_4- 1:6:1	7.20	7.33	7.40	8.07	8.33	8.27	8.20	7.82
T_5- 1:6:2	7.40	7.53	7.53	8.33	9.13	8.43	8.33	8.09
T_6- 2:4:1	7.27	8.33	8.33	9.20	9.20	8.80	8.60	8.53
T_7- 2:4:2	8.00	8.60	8.73	9.93	10.00	8.93	8.93	9.01
T_8- 2:6:1	8.33	9.13	8.80	10.27	10.07	9.27	9.20	9.29
T_9- 2:6:2	9.13	9.53	9.67	10.53	10.87	10.07	9.47	9.89
T_{10}- 3:4:1	7.40	7.87	7.73	8.13	8.73	8.40	8.07	8.04
T_{11}- 3:4:2	7.80	8.13	8.40	9.00	8.93	9.20	8.80	8.60
T_{12}- 3:6:1	8.27	9.20	9.07	9.33	10.13	9.07	9.00	9.15
T_{13}- 3:6:2	9.07	9.40	9.53	10.40	10.40	9.47	9.33	9.65
S.Em ±	0.30	0.34	0.21	0.42	0.38	0.34	0.37	
C.D.@ 5%	0.87	0.98	0.61	1.22	1.10	1.00	1.07	

Control (19:19:19 @ 2gm/L 1:1:1) MAT-months after treatment

Table 4: Effect of varying nutrient levels on diameter of floret of *Dendrobium* orchid cv. Sonia-17

Treatments NPK levels	Diameter of floret (cm) at different months after treatment							
	3 MAT	6 MAT	9 MAT	12 MAT	15 MAT	18 MAT	21 MAT	Mean
T_1: 1:1:1 (Control)	7.25	7.48	7.35	7.92	8.08	8.02	7.76	7.69
T_2- 1:4:1	7.63	7.76	7.62	8.05	8.16	8.14	8.02	7.91
T_3- 1:4:2	8.08	8.00	7.90	8.26	8.84	8.23	7.98	8.18
T_4- 1:6:1	7.89	8.06	7.82	8.12	8.39	8.20	8.16	8.09
T_5- 1:6:2	8.15	8.22	8.34	8.32	8.56	8.56	8.40	8.36
T_6- 2:4:1	8.12	8.46	8.55	8.84	9.15	8.68	8.32	8.58
T_7- 2:4:2	8.55	8.78	8.72	9.10	9.15	8.78	8.65	8.81
T_8- 2:6:1	8.95	8.74	8.50	8.91	9.13	9.14	8.77	8.87
T_9- 2:6:2	9.16	9.21	9.02	9.26	9.42	9.32	9.20	9.22
T_{10}- 3:4:1	8.56	8.68	8.77	9.04	9.08	8.76	8.46	8.76
T_{11}- 3:4:2	8.58	8.94	8.83	9.14	9.18	8.86	8.88	8.91
T_{12}- 3:6:1	8.82	8.65	8.94	9.20	9.32	9.08	9.05	9.00
T_{13}- 3:6:2	9.06	9.12	8.98	9.18	9.25	9.21	9.12	9.13
S.Em±	0.30	0.21	0.16	0.25	0.31	0.25	0.20	
C.D.@ 5%	0.87	0.62	0.47	0.72	0.90	0.74	0.59	

Control (19:19:19 @ 2gm/L 1:1:1) MAT-months after treatment

Table 5: Effect of varying nutrient levels on spike weight of *Dendrobium* orchid cv. Sonia-17

Treatments NPK levels	Spike weight (g) at different months after treatment							
	3 MAT	6 MAT	9 MAT	12 MAT	15 MAT	18 MAT	21 MAT	Mean
T_1: 1:1:1 (Control)	18.48	19.16	18.85	20.53	23.94	20.83	20.50	20.32
T_2- 1:4:1	19.34	19.54	20.32	21.86	24.62	21.49	21.05	21.17
T_3- 1:4:2	20.03	20.12	21.15	21.43	27.39	24.06	23.65	22.54
T_4- 1:6:1	20.55	20.40	22.60	23.08	26.43	26.75	24.27	23.44
T_5- 1:6:2	21.52	21.38	23.43	24.70	28.58	28.32	26.50	24.91
T_6- 2:4:1	21.60	25.43	25.96	28.63	28.96	29.63	28.63	26.97
T_7- 2:4:2	23.55	25.75	26.70	29.60	30.92	30.84	28.20	27.93
T_8- 2:6:1	26.10	27.74	28.29	30.19	32.34	31.10	29.45	29.31
T_9- 2:6:2	28.68	29.44	29.97	32.07	34.75	34.07	31.02	31.42
T_{10}- 3:4:1	22.06	23.06	23.02	25.20	26.85	27.38	24.96	24.64
T_{11}- 3:4:2	22.72	25.23	25.40	25.98	28.21	29.32	27.72	26.36
T_{12}- 3:6:1	24.04	26.80	27.14	29.38	31.16	31.58	29.11	28.45
T_{13}- 3:6:2	26.45	27.35	28.05	30.91	32.90	32.22	29.24	29.58
S.Em ±	0.93	0.87	1.19	0.93	1.33	0.91	1.06	
C.D.@ 5%	2.70	2.52	3.46	2.71	3.87	2.64	3.09	

Control (19:19:19 @ 2gm/L 1:1:1) MAT-months after treatment

Table 6: Effect of varying nutrient levels on spike girth of *Dendrobium* orchid cv. Sonia-17

Treatments NPK levels	Spike girth (mm) at different months after treatment							
	3 MAT	6 MAT	9 MAT	12 MAT	15 MAT	18 MAT	21 MAT	Mean
T_1: 1:1:1 (Control)	2.96	3.10	3.18	3.12	3.24	3.27	3.32	3.17
T_2- 1:4:1	3.14	3.28	3.33	3.29	3.35	3.40	3.43	3.31
T_3- 1:4:2	3.42	3.36	3.42	3.43	3.47	3.51	3.48	3.44
T_4- 1:6:1	3.30	3.43	3.40	3.36	3.50	3.53	3.57	3.44
T_5- 1:6:2	3.48	3.52	3.58	3.60	3.66	3.56	3.62	3.57
T_6- 2:4:1	3.54	3.62	3.66	3.62	3.68	3.72	3.79	3.66
T_7- 2:4:2	3.62	3.68	3.77	3.73	3.75	3.79	3.83	3.73
T_8- 2:6:1	3.74	3.84	3.78	3.75	3.81	3.87	3.86	3.80
T_9- 2:6:2	3.89	3.91	3.95	3.98	4.04	4.00	4.10	3.98
T_{10}- 3:4:1	3.65	3.68	3.72	3.75	3.82	3.75	3.77	3.73
T_{11}- 3:4:2	3.74	3.71	3.80	3.73	3.85	3.87	3.84	3.79
T_{12}- 3:6:1	3.62	3.80	3.74	3.79	3.90	3.84	3.92	3.80
T_{13}- 3:6:2	3.78	3.85	3.90	3.86	3.97	3.94	3.97	3.89
S.Em ±	0.09	0.16	0.14	0.09	0.13	0.10	0.15	
C.D.@ 5%	0.25	0.47	0.41	0.27	0.39	0.28	0.43	

Control (19:19:19 @ 2gm/L 1:1:1) MAT-months after treatment

Table 7: Effect of varying nutrient levels on number of spike yield per plant of *Dendrobium* orchid cv. Sonia-17

Treatments NPK levels	Spike yield per plant at different months after treatment							
	3 MAT	6 MAT	9 MAT	12 MAT	15 MAT	18 MAT	21 MAT	Mean
T_1: 1:1:1 (Control)	0.87	1.20	1.07	1.40	1.53	1.67	1.47	**1.31**
T_2- 1:4:1	0.93	1.33	1.60	1.73	1.93	2.00	1.80	1.61
T_3- 1:4:2	1.13	1.53	1.67	1.87	1.73	1.87	1.67	1.63
T_4- 1:6:1	1.27	1.73	1.81	2.34	2.41	2.54	2.00	2.01
T_5- 1:6:2	1.40	1.80	1.93	2.00	2.07	2.33	2.13	1.95
T_6- 2:4:1	1.20	1.53	1.73	1.87	2.07	2.13	2.00	1.79
T_7- 2:4:2	1.07	1.67	1.67	1.93	2.27	2.27	2.13	1.85
T_8- 2:6:1	1.40	1.93	2.13	2.54	2.80	2.87	2.60	**2.32**
T_9- 2:6:2	1.60	2.00	2.20	2.60	2.87	3.07	2.80	**2.44**
T_{10}- 3:4:1	1.20	1.60	1.67	2.00	2.00	2.20	1.73	1.77
T_{11}- 3:4:2	1.27	1.67	1.73	2.07	2.27	2.07	1.87	1.85
T_{12}- 3:6:1	1.47	1.80	2.00	2.40	2.60	2.73	2.47	2.21
T_{13}- 3:6:2	1.47	1.87	2.07	2.47	2.73	2.87	2.53	2.28
S.Em ±	0.10	0.13	0.15	0.17	0.22	0.10	0.23	
C.D.@ 5%	0.31	0.38	0.45	0.49	0.63	0.30	0.66	

Control (19:19:19 @ 2gm/L 1:1:1) MAT-months after treatment

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