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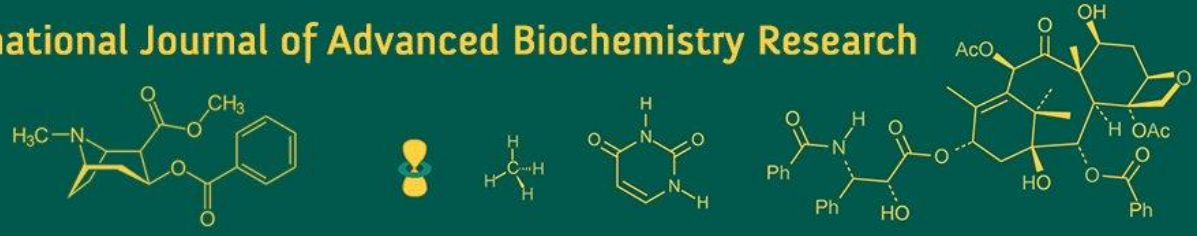

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AJ Bhandari
Floriculture and Landscape Architecture, Polytechnic in Horticulture, Navsari Agricultural University, Paria, Gujarat, India

SL Chawla
Professor, Department of Floriculture and Landscape Architecture, NAU, Navsari, Gujarat, India

TR Ahlawat
Director of Research, Navsari Agricultural University, Navsari, Gujarat, India

HF Patel
Polytechnic in Horticulture, Navsari Agricultural University, Paria, Gujarat, India

AI Makawana
Polytechnic in Horticulture, Navsari Agricultural University, Paria, Gujarat, India

JH Gohil
Agriculture Experimental Station, Navsari Agricultural University, Paria, Gujarat, India

Corresponding Author:
AJ Bhandari
Floriculture and Landscape Architecture, Polytechnic in Horticulture, Navsari Agricultural University, Paria, Gujarat, India

Effect of different nutrient solutions in *Dendrobium* on flower quality and yield of orchid under polyhouse

AJ Bhandari, SL Chawla, TR Ahlawat, HF Patel, AI Makawana and JH Gohil

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Abstract
The present investigation entitled "Nutrient Management in *Dendrobium* Orchid Under NV Polyhouse Condition" was conducted at Floriculture Research Farm, Navsari Agricultural University, Navsari, Gujarat, during October 20, 2020 to October 19, 2022. The flowering parameters were analysed with Completely Randomized Design (CRD). There were nine treatments and 3 repetition. There are different nutrients which used in the experiment likewise, N, P, K, Ca, Mg, S, Fe, Mn, Zn, Cu, B, Ni and Mo and made treatments as T_1: Solution P, T_2: Solution P + S, T_3: Solution P + M_1, T_4: Solution P + S + M_1, T_5: Solution P + M_1 + M_2, T_6: Solution P + S + M_1 + M_2, T_7: Solution P + S + M_1 + M_2 *(*Fortnightly*)*, T_8: Solution D (Drenching) and T_9: T_7 + T_8. The flowering parameters were influenced significantly by different levels of macro and micronutrients. The maximum spike length, rachis length, floret size and number of spikes per plant were found in T_6. Thus, the present findings that i.e. N: 200 mg/l weekly spray while, P:50 mg/l, K: 200 mg/l, Ca and Fe: 100 mg/l, each of Mg, Mn, Zn: 50 mg/l, S: 232.3 mg/l, Cu: 10 mg/l, B: 25 mg/l and Ni, Mo: 5 mg/l (each) at every 15 days interval spray enhanced flowering and yield of *Dendrobium* orchid under polyhouse.

Keywords: Orchids, *Dendrobium*, nutrients, polyhouse, nitrogen, phosphorus, potassium

Introduction
The *Dendrobium* plant having a distinctive appearance, it has sympodial growth habit, epiphytic in nature and it has bulb or cane like structure with thick green leaves. These orchids grow quickly throughout the summer and are dormant during winter. Among seventeen essential nutrient elements, nine are classified as macronutrients or major nutrients (C, H, O, N, P, K, Ca, Mg and S). Carbon, H and O constitute 90-95 percentage of the plant's dry matter weight and are supplied to the plant through CO_2 and H_2O. However, N is dependent on other nutrients also for its effectiveness (Hew and Yong, 2004) [4]. For example, to activate and synthesize nitrate reductase, K is required. Deficiencies of both N and P can affect photosynthesis of the plants. Chloroplasts develop in the presence of nitrogen. Green leaf cells' chloroplasts contain up to 75% of the total organic nitrogen. (Marschner, 2003) [9]. Again, fertigation offers significant fertilizer usage savings and lowers leaching losses (Kumar *et al*., 2017) [5].
Further, there is lack of adequate information on management like, planting, nutrient management, handling *etc*, which are important factor in yield and flowering quality of *Dendrobium* spike. Besides, application of nutrients in optimum proportion, quantity is the key factors in regulating growth and flowering in cut flower production of *Dendrobium* orchid therefore, this experiment entitled "NUTRIENT MANAGEMENT IN *Dendrobium* ORCHID UNDER POLYHOUSE"

Materials and Methods
The experiment was carried out in natural ventilated polyhouse at Floriculture Research Farm ASPEE College of Horticulture, Navsari Agricultural University, Navsari, Gujarat. Six years old plants of *Dendrobium* orchid var. Sonia 17 were carefully replanted on freshly cut and washed coconut husk media under naturally ventilated polyhouse. Preparation of different spray solutions made from different chemicals and prepare stock solution of 10000 mg/l and take 50 ml of stock solution for N and K and add make the volume 2.5 lit. by

For the P solution take 10 ml of stock solution and make it 2 lit by adding of water in it and spray according to treatments. Likewise, other solutions were prepared and spray.

The present experiment consisted of following nutrient solution treatments along with their methods and time of applications.

T_1: Solution P
T_2: Solution P + S
T_3: Solution P + M_1
T_4: Solution P + S + M_1
T_5: Solution P + M_1 + M_2
T_6: Solution P + S + M_1 + M_2
T_7: Solution P + S + M_1 + M_2 (Fortnightly)
T_8: Solution D (Drenching)
T_9: T_7 + T_8

Treatment details

Looking to the basic nutrient requirement of orchid, total five nutrient solutions (P, S, M_1, M_2 and D) were prepared by using different chemical compounds. The pH of each solution was adjusted to 6.5 and then applied alone or in combination as per treatments. Moreover, nutrient contents in each solution along with their concentrations are given in Table 1.

During the experimentation, the methods followed for different nutrient solutions application and their time of application are given here:

Treatments	Time and methods of application
T_1	Foliar spray of solution P was done at weekly interval (7-8 days) after establishment of experimental plants.
T_2, T_3, T_4, T_5 and T_6	Solution P was foliar sprayed at weekly interval whereas, remaining solutions of individual treatments were foliar sprayed at fortnight interval (15-16 days).
T_7	Foliar spay of all the solutions (P, S, M_1 and M_2) were done at fortnight interval (15-16 days).
T_8	Solution D was applied by drenching @ 50 mL/plant at fortnight interval (15-16 days).
T_9	P, S, M_1 and M_2 solutions were foliar sprayed and solution D was applied by drenching @ 50 ml/plant at fortnight interval (15-16 days).

Table 1: Nutrient concentration as per treatment

Sr. No.	Treatments	Nutrients (mg/l)												
		N	P	K	S	Ca	Mg	Fe	Mn	Zn	Cu	Ni	B	Mo
1	T_1: Solution P	200	50	200	80	50	-	-	-	-	-	-	-	-
2	T_2: Solution P + S	200	50	200	146	100	50	-	-	-	-	-	-	-
3	T_3: Solution P + M_1	200	50	200	166.5	50	-	100	50	50	10	5	-	-
4	T_4: Solution P + S + M_1	200	50	200	232.3	100	50	100	50	50	10	5	-	-
5	T_5: Solution P + M_1 + M_2	200	50	200	166.5	50	-	100	50	50	10	5	25	5
6	T_6: Solution P + S + M_1 + M_2	200	50	200	232.3	100	50	100	50	50	10	5	25	5
7	T_7: Solution P + S + M_1 + M_2 (Fortnightly)	200	50	200	232.3	100	50	100	50	50	10	5	25	5
8	T_8: Solution D (Drenching)	40	10	40	44	40	20	2	1	1	0.2	0.1	0.25	0.05
9	T_9:	T_7 + T_8												

The observation parameters such as spike length, rachis length, flower size, number of flowers per spike, longevity of spike, number of spikes per plant, vase life and water uptake.

3. Results and Discussion

The flowering and spike quality of orchids are determined by the parameters such as spike length, rachis length, floret size, number of florets per spike, longevity of spike and vase life. Plants respond differently to stimuli but, in general, nutritional greatly affect the sensitivity of the major flowering mechanism (De *et al*., 2018) [2]. In the present study also, nutrients of different macro and micronutrient ratios applied had significant effect on the yield and quality parameters of the spike and it is discussed below.

3.1 Spike Length

The data from Table 2 revealed that, the maximum spike length (40.49 cm) was recorded with the foliar application of T_6 treatment and minimum spike length (34.98 cm) was observed in treatment T_8. The foliar application of macro and micro elements increase spike length may be due to the production of healthy shoots which acts as an important source of mineral reserve for the subsequent development of inflorescence, similar findings by Pradeep *et al*. (2014) [14] in gladiolus, Patnaik *et al*. (2017) [13] and Saud *et al*. (2016) [16] in *Dendrobium*.

3.2 Rachis Length

Significantly maximum rachis length (26.33 cm) was observed in treatment T_6 and it was at par (25.77 cm) with treatment T_5, while minimum rachis length (23.21 cm) was found in treatment T_7.

3.3 Floret Size

T_6 treatment recorded maximum floret size (6.10 cm) and minimum floret size (4.97 cm) in treatment T_1. The increase in the size of floret may be due to the proper accumulation of mineral nutrient at proper stage of the plant similar result were reported by Medhi (2012) [10] in *Cymbidium*, Wang and Chang (2017) [18] in *Phalanopsis* orchid and Biswas *et al*. (2021) [1] in anthurium.

3.4 Number of Florets Per Spike

The maximum number of florets per spike (11.27) was recorded in treatment T_6 and minimum number of florets per spike (7.63) was observed in treatment T_8. Similar results were found by Naik *et al*. (2013) [12] in *Cymbidium* hybrid, while Mehraj *et al*. (2014) [11], Kumar *et al*. (2015) [7] and Manisha *et al*. (2020) [8], in *Dendrobium* orchid.

3.5 Number of Spikes Per Plant

The maximum number of spikes per plant T_6 treatment (11.23) and the minimum number of spikes per plant (7.27) in treatment T_1. The foliar application of macro and micro

nutrient at proper stage, it improves the number of spikes per plant and this was confirmed with the findings of Ruchita Panda *et al*. (2019) [15] in *Phalanopsis* hybrid cv. Shagan and Kumar *et al*. (2019) in anthurium var. Xavia.

Table 2: Effect of application of nutrient on flowering and yield in *Dendrobium* orchid under polyhouse

Treatments	Spike length (cm)	Rachis length (cm)	Floret size (cm)	Number of Spikes Per Plant
T_1	35.80	24.81	4.97	7.27
T_2	36.11	24.81	5.10	8.07
T_3	36.82	24.65	5.13	8.53
T_4	37.47	24.62	5.32	9.63
T_5	39.29	25.77	5.70	10.43
T_6	40.49	26.33	6.10	11.23
T_7	35.79	23.21	5.17	7.53
T_8	34.98	23.35	5.07	7.50
T_9	35.47	23.60	5.08	7.47
S.Em±	0.34	0.44	0.06	0.13
C.D.	0.97	1.27	0.17	0.38
CV%	2.26	4.42	2.76	3.84

3.6 Longevity of Spike

The maximum longevity of spike (33.13 days) was recorded in treatment T_6 and it was at par with (31.83 days) in the treatment T_5. The results of this study are conformity with Ahmed *et al*. (2014) in *Dendrobium* orchid cv. Emma White, De *et al*. (2018) [2] in *Cymbidium* hybrid cv. White Beach Sea Green and Handaragall *et al*. (2013) [3] in anthurium cv. Tropical Red.

3.7 Vase Life

The vase life of flower was measure after harvesting the flowers. The maximum vase life (24.50 days) was recorded in treatment T_6, while minimum vase life (14.90 days) was recorded in T_7 treatment. This might be due to increased levels of nitrogen, phosphorous and potassium uptake might have decreased the water loss and helped in maintaining the water potential in a constant state which in turn might have maintained the turgidity. The results are in conformity with the findings of Shalem and Sarvanan (2020) in *Dendrobium*, Sugapriya *et al*. (2011) in *Dendrobium* and Tejaswini *et al*. (2018) [17] in anthurium flower.

3.8 Water Uptake

The data presented in table 3 was recorded maximum water uptake (33.57 ml) found in treatment T_6 and it was at par with treatment T_5 (32.40 ml) whereas minimum water uptake (26.10 ml) was recorded in treatment T_1.

Table 2: Effect of application of nutrient on flower quality and vase life in *Dendrobium* orchid under polyhouse

Treatments	Longevity of spike (days)	Vase Life (days)	Water Uptake (ml)
T_1	28.37	16.90	26.10
T_2	28.98	18.40	27.07
T_3	29.93	18.83	28.03
T_4	29.93	19.90	30.03
T_5	31.83	21.60	32.40
T_6	33.13	24.50	33.57
T_7	27.10	14.90	28.40
T_8	26.77	18.20	29.30
T_9	25.70	15.78	26.87
S.Em±	0.68	0.27	0.67
C.D.	1.96	0.80	1.93
CV%	5.76	3.64	5.68

4. Conclusion

From the present findings it can be concluded that application of N: 200 mg/l weekly spray while, P:50 mg/l, K: 200 mg/l,Ca and Fe: 100 mg/l, each of Mg, Mn, Zn: 50 mg/l, S: 232.3 mg/l, Cu: 10 mg/l, B: 25 mg/l and Ni, Mo: 5 mg/l (each) at every 15 days interval spray enhanced spike length, spike yield and flower quality of orchid.

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