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Flowering and Physiological Traits of *Dendrobium* Cv. Earsakaul As Influenced by Various Nutrients and Microclimatic Conditions

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ABSTRACT
The investigation on 'Flowering and physiological traits of Dendrobium cv. Earsakul as influenced by various nutrients and micro climatic conditions" was conducted at College of Horticulture, Vellanikkara, Thrissur, Kerala from April 2011 to March 2013. The results revealed that the treatment T_6 resulted in minimum days to first flower opening (14.52). Various treatments had non significant influence on days to first flowering and days to last flower opening. Higher vase life (30.00 days) and maximum number of stomata (41.14) are recorded in T_4. The treatment combination T_3 recorded highest rate of photosynthesis (6.36 µmol CO_2 m^{-2} s^{-1}) and rate of transpiration during day time (6.56 µmol m^{-2} s^{-1}). Maximum rate of transpiration during night time was recorded in T_2 (0.26 µmol m^{-2} s^{-1}). Top ventilated polyhouse took lesser time for the days to first flower opening (252.95). Higher vase life (27.71 days), rate of photosynthesis (6.86 µmol CO_2 m^{-2} s^{-1}), transpiration rate during night (0.32 µmol m^{-2} s^{-1}) and transpiration rate during day (6.00 µmol m^{-2} s^{-1}) were recorded in plants grown under system S_2. The interaction of plant growth promoters and systems of growing had significant influence on flowering and physiological parameters.
Key words: *Dendrobium cv. Earsakul, nutrients, Piriformospora indica, micro climatic conditions, flowering and physiological traits.*

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INTRODUCTION

Among the orchid genera, *Dendrobium* is a very complex and extremely large genus widely used in the commercially cut flower production. It is the second largest genus in the family with nearly 1600 species, is one of the commercially important species. Most *Dendrobium* species are epiphytic and are from tropical and sub-tropical regions. It is a popular genus for cut flower production. Many growers in the states of Kerala, Tamil Nadu and Coastal Karnataka are cultivating *Dendrobium* 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 (Rajeevan and Sobhana, 1993). These hybrids are in the foremost position in floriculture trade especially in ornamental cut flower sprays and its capability in blooming continuously and a prolonged post-harvest life relative to other orchid hybrids (Puchooa, 2004). The type of nutrients, their quality and frequency of application play an important role on the growth and quality of flower. In orchids, growth and floral initiation is determined by the genotype and its interaction with the environmental conditions. Temperature, humidity, light and photoperiod are some of the important environmental conditions that influence growth and reproductive biology of orchids. Regulation of light intensity is essential for successful orchid culture. During plant development, the transition from vegetative to reproductive growth is triggered by a number of environmental and endogenous signals. Under controlled conditions of greenhouse, the flowers exhibit the best quality attributes required for the market. For better growth, yield and quality of the flowers, the system of growing is very important. Micro climate inside the growing system may drastically influence the growth, flowering and quality of flowers (Femina *et al.,* 2006). In most *Dendrobium* orchids, rapid vegetative

growth occurs at temperatures between 24°C and 30°C (Leonhardt, 2000). In their natural habitat, epiphytes usually meet with a greater degree of environmental stress. Fernandez (2001) reported that in *Dendrobium*, remarkable increase in plant height was noticed in treatments with 35 per cent and 50 per cent shading (both at double level) and 50 per cent single level shading. The plant height was considerably less in intense light conditions. The major constraints encountered in *Dendrobium* orchid cultivation are growing conditions, long pre blooming period and susceptibility to pest and diseases. It is envisaged that growing tropical orchids for cut flower production and potted plants will benefit from the recent advances in plant physiology and biotechnology. For the orchid industry, producing an improved hybrid, through conventional breeding or genetic engineering, is only the beginning. Optimization of the production processes and ensuring a quality product for the market is equally important. To achieve this goal, a good basic understanding of orchid physiology is essential to solve key physiological issues. However, we lack information on the some flowering and physiological aspects on tropical orchids under green house cultivation, particularly at a commercial level. This information is crucial in the optimization of the growth and yield of orchids in commercial farms. Keeping in view all these, the present investigation was taken up with the objective to study the flowering and physiological traits of *Dendrobium* cv. Earsakul as influenced by nutrients under three microclimatic conditions.

MATERIALS AND METHODS

The experiments were carried out at the orchidarium of All India Coordinated Floriculture Improvement Project (AICFIP) in the Dept. of Pomology & Floriculture, College of Horticulture, Vellanikkara, Thrissur, Kerala. Studies were conducted over a period from April 2011 to March 2013 in three types of growing systems *viz.,* two level shade house (S_1), top ventilated polyhouse (S_2) and fan and pad system (S_3). Commercially cultivated orchid hybrid variety *Dendrobium* cv. Earsakul was used for the study. Plants were grown under 50 per cent shade in two level shade house (size: 21.00 m x 6.00 m x 3.50 m x 2.00 m, top one layer shade net, lower one layer poly film 200 micron with misting system), top ventilated polyhouse (size : 21.00 m x 6.00 m x 3.50 m x 2.00 m, poly film 200 micron covering with shade net and misting system) and in 75 per cent shade in fan and pad system (size: 12.50 m x 8.00 m x 6.00 m x 4.00 m, poly film 200 micron covering, UV stabilized shade net with fan and pad for cooling system).The major nutrients $N:P_2O_5:K_2O$ at two different ratios, viz., 3 : 1 : 1 and 1 : 2 : 2 @ 0.2 per cent were applied as foliar sprays during vegetative and flowering stages, respectively. The frequency of application was weekly twice. Nutrient combinations were made using ammonium nitrate, ortho-phosphoric acid and potassium nitrate.

The treatments consists of T_1-POP recommendations of KAU (foliar feeding with fertilizer mixture of $N:P_2O_5:K_2O$ 3:1:1 during vegetative period and 1:2:2 during flowering period @ 0.2 per cent, spraying at weekly twice as ammonium nitrate, ortho-phosphoric acid and potassium nitrate respectively), T_2-POP + PGPRE (the fungal culture of *Piriformospora indica* was mixed with vermiculite @ 1 g per 100 g of vermiculite and applied near the root zone at the time of planting) + bone meal (15 g per plant applied near root zone at the time of planting), T_3 - POP + OM (bone meal, neem cake and ground nut cake 100 g each, soaked in water for 3-4 days and diluted to 10-15 times with water, filtered and sprayed over plants at 15 days interval) + vermiwash (diluted to 3 per cent and sprayed at 15 days interval) + PGPRE + bone meal, T_4- POP + OM + VW + PGPRE + bone meal + GR (BA 50 mg/l and GA_3 10 mg/l sprayed at monthly intervals), T_5 - 10:20:10 NPK + GR and T_6 - NPK + GR + OM + VW + PGPRE + bone meal. The experiment was laid out in completely randomized design comprising six treatments, four replications and five plants per treatment for recording observations. The observations on flowering and physiological traits were recorded. The experimental data were analyzed by the ANOVA (Analysis of Variance technique (Panse and Sukhatme, 1985).

RESULTS AND DISCUSSION

Days to flowering

Days to flowering did not vary significantly among various nutrients. This result could be explained by the phenomenon that the *Dendrobium* plants normally bloom one year after planting. Since the age of the plant is below one year at the time of initiation of investigation (vegetative phase), the treatment had no influence on blooming. The present findings are in line with reports of Dhinesh (2009) in *Dendrobium*. Among three microclimatic conditions, the system S_2 took least duration on days to flowering (252.95). The reason for this finding could be attributed that temperature is the most important factor coupled with light which controls the performance of the plant both in terms of growth and development in top ventilated polyhouse. These reasons may be attributed to early flowering. In interaction, the combination of POP + OM + VW + PGPRE + Bone meal and top ventilated polyhouse (T_3S_2) recorded minimum time for

days to flowering (128.06 days). The possible reason that could be attributed to this phenomenon is that the days to flowering was purely influenced by the systems of growing.

Days to first flower opening

The influence of plant growth promoters showed that the combination of NPK + GR + OM + VW + PGPRE + Bone meal (T_6) advanced the days to first flower opening (14.52). The reason could be due to positive influence of nutrients along with *P. indica* which may be favourable for best growth and ultimately for earliest time for the plants to come to show first flower opening. These results are in accordance with those of Sugapriya *et al*. (2012) and Nambiar *et al*. (2012) in *Dendrobium*. None of the microclimatic conditions had significant influence on days to first flower opening (Table 1). The combination of NPK + GR + OM + VW + PGPRE + Bone meal and two level shade house (T_6S_1) took minimum duration for first flower opening (12.76).

Days to last flower opening

Days to last flower opening was not significantly influenced by various treatments and microclimatic conditions (Table 1). In interaction, the combination of NPK + GR + OM + VW + PGPRE + Bone meal and top ventilated polyhouse (T_6S_2) took least period for last flower opening in the spike (9.62 days). This might be due to positive influence of nutrients and congenial environmental conditions could be the reason for taking minimum period for last flower opening in plants grown under top ventilated polyhouse.

Vase life

The combination of POP + OM + VW + PGPRE + Bone meal + GR (T_4) recorded significantly maximum vase life (30.00 days). This might be due to the reason that the influence of *P. indica* and growth regulators in the nutrient combination increased the vase life of florets in the spike. Similar finding was reported by Dhinesh (2009) in *Dendrobium*. Among systems of growing, top ventilated polyhouse (S_2) recorded significantly higher vase life (27.71 days). Favourable temperature, lower relative humidity and higher light intensity were observed under S_2. This could be the reason for maximum vase life of the flowers recorded under the growing system. The results presented here are in agreement with Fernandez (2001) in *Dendrobium*. The interaction of POP + OM + VW + PGPRE + Bone meal + GR and top ventilated polyhouse (T_4S_2) recorded significantly higher vase life (33.06 days). The attributes explained for plant growth promoters (treatments) and systems of growing for vase life might be the reason for the obtained result.

Number of stomata

The input POP + OM + VW + PGPRE + Bone meal + GR (T_4) recoded higher number of stomata (41.14) (Table 2). The number of leaves per plant was high due to influence of growth regulators in earlier finding. This may be the result of higher number of stomata due to increasing number of leaves and larger area of the leaves. These results are in consonance with the findings of Yukawa *et al*. (1992) in *Dendrobium*. The fan and pad system (S_3) recorded highest number of stomata (38.34). Under fan and pad system, the uniform environmental conditions were maintained throughout the growth phase of the plants. This may be the adaptations for maintaining the better physiological processes of the plants. The interaction of POP + PGPRE + Bone meal and top ventilated polyhouse (T_2S_2) had more influence on number of stomata (44.92). This may be due to the fact that in top ventilated polyhouse, the favourable environmental conditions would have influenced the number of stomata in the leaves of plants.

Rate of photosynthesis

The plant growth promoter POP + OM + VW + PGPRE + Bone meal (T_3) recorded significantly higher rate of photosynthesis (6.36 µmol CO_2 m^{-2} s^{-1}). Positive influence of POP + OM + VW + PGPRE + Bone meal enhanced the dry matter production and crop growth rate in findings of earlier results which indicated that higher the rate of photosynthesis would increase the food reserves which subsequently increased DMP and CGR. Maximum rate of photosynthesis was recorded in plants grown under S_2 (6.86 µmol CO_2 m^{-2} s^{-1}) (Table 2). This may be explained by the fact that the six month old plants were in active growth stage at the time of starting of the study. Under S_2, high temperature and high light intensity resulted in higher rate of photosynthesis. Significantly maximum rate of photosynthesis of 9.73 µmol CO_2 m^{-2} s^{-1} was registered in the nutrient combination POP + OM + VW + PGPRE + Bone meal and top ventilated polyhouse (T_3S_2). The interaction results conformed the earlier results in independent observations for recording highest photosynthetic rate.

Transpiration rate at night time

The treatment POP + PGPRE + Bone meal (T_2) resulted in highest rate of transpiration during night (0.26 µmol m^{-2} s^{-1}) (Table 2). The *P. indica* along with nutrients access to more vegetative growth, maximum water absorption and hence promoted higher rate of transpiration since it is CAM plant. Transpiration rate during night time was maximum (0.32 µmol m^{-2} s^{-1}) in plants grown under S_2. This could be due to higher temperature, lower relative humidity would result in gradient in vapour pressure deficit resulting

in higher rate of transpiration. The above results corroborate with that of Nagoaka *et al*. (1984) and Samasya (2000) in *Dendrobium*. During night time, higher transpiration rate of 0.46 µmol m^{-2} s^{-1} was resulted by POP + OM + VW + PGPRE + Bone meal + GR and top ventilated polyhouse (T_4S_2). This might be due to reason that positive influences of plant growth promoter's favours for better growth of the plants *i.e.* number of leaves per plant, leaf area, number of stomata were higher in the findings of earlier results. Higher temperature and lower relative humidity prevailing in side S_2 favour for higher transpiration rate.

Transpiration rate during day time

During day time, the nutrient POP + OM + VW + PGPRE + Bone meal (T_3) recorded significantly higher rate of transpiration (6.56 µmol m^{-2} s^{-1}). This might be due to positive influence of all applied plant growth promoters favour for luxurious growth of the plants there by resulted in increased rate of transpiration during day time and *i.e.* the indication for healthy growth of the plants. Among multiple sites, plants grown under system S_2 recorded maximum rate of transpiration (6.00 µmol m^{-2} s^{-1}). The reasons for highest transpiration rate under top ventilated polyhouse are higher temperature, high light intensity and low relative humidity. In high light intensity, the water present in mesophyll cells diffuses rapidly resulting in increase in humidity of internal air and this increases the rate of transpiration (Cho and Kwack, 1996). The interation of NPK + GR and top ventilated polyhouse (T_5S_2) recorded significantly highest rate of transpiration during day time (9.19 µmol m^{-2} s^{-1}).

Table- 1. Influence of plant growth promoters (T), growing systems (S) and T x S interaction on flower parameters in *Dendrobium*cv. Earsakul

Treatments	Days to flowering				Days to first flower opening				Days to last flower opening				Vase life (days)			
	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
T_1	406.87	282.92	477.33	389.04	17.45	19.33	23.39	20.06	17.48	15.26	12.50	15.08	22.81	22.14	19.12	21.36
T_2	381.44	138.06	407.70	309.06	15.22	16.50	16.44	16.06	14.85	11.50	13.90	13.42	24.37	24.37	20.56	23.09
T_3	382.75	128.06	433.28	314.69	15.18	15.58	19.17	16.64	12.07	10.35	13.17	11.86	25.88	26.55	23.30	25.24
T_4	318.25	373.44	381.45	357.71	14.87	16.29	15.11	15.42	10.76	12.63	12.44	11.94	30.72	33.06	26.22	30.00
T_5	347.98	344.50	434.50	375.66	16.76	18.39	15.39	16.84	11.02	13.02	12.33	12.12	26.74	28.07	22.33	25.72
T_6	341.76	250.75	427.94	340.15	12.76	13.04	17.75	14.52	11.37	9.62	17.67	12.89	30.41	32.07	24.33	28.94
Mean	363.17	252.95	427.03		15.37	16.52	17.88		12.93	12.06	13.67		26.82	27.71	22.64	
CD (*P*=0.05)	T: NS S: 56.56 T x S: 145.90				T: 4.38 S: NS T x S: 7.58				T: NS S: NS T x S: 6.27				T: 0.55 S: 0.39 T x S: 0.96			

S_1 – Two level shade house; S_2- Top ventilated polyhouse; S_3 – Fan and pad system

Table -2. Influence of plant growth promoters (T), growing systems (S) and T x S interaction on physiological traits in *Dendrobium* cv. Earsakul

Treatments	Number of stomata				Rate of photosynthesis (µmol CO_2 m^{-2} s^{-1})				Rate of transpiration (Night) (µmol m^{-2} s^{-1})				Rate of transpiration (Day) (µmol m^{-2} s^{-1})			
	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
T_1	34.32	31.80	28.26	31.46	4.24	8.86	3.73	5.61	0.14	0.23	0.11	0.16	1.73	4.40	3.15	3.09
T_2	31.80	44.92	39.38	38.70	4.83	6.10	3.49	4.81	0.16	0.45	0.18	0.26	3.81	5.27	3.11	4.06
T_3	34.82	34.33	39.38	36.17	4.94	9.73	4.41	6.36	0.14	0.23	0.10	0.16	8.83	7.77	3.09	6.56
T_4	40.33	41.38	41.72	41.14	3.62	6.01	3.26	4.29	0.21	0.46	0.07	0.25	3.88	5.39	3.24	4.17
T_5	28.55	37.85	38.35	34.91	2.48	6.90	3.88	4.42	0.10	0.37	0.12	0.19	4.46	9.19	2.47	5.37
T_6	32.29	39.36	43.00	38.21	4.20	3.58	2.58	3.45	0.15	0.14	0.15	0.15	2.41	3.95	2.96	3.10
Mean	33.68	38.27	38.34		4.05	6.86	3.55		0.15	0.32	0.12		4.18	6.00	3.00	
CD (*P*=0.05)	T: 3.41 S: 2.41 T x S: 5.91				T: 1.72 S: 1.21 T x S: 2.98				T: 0.032 S: 0.023 T x S: 0.056				T:1.29 S:0.91 T x S:2.23			

S_1 – Two level shade house; S_2- Top ventilated polyhouse; S_3 – Fan and pad system

REFERENCES

1. Cho, K. H. and Kwack, B. (1996). Effect of environmental factors on leaf temperature and transpiration rate of *Cymbidium goeringii. J. Korean Soc. Hortic. Sci*. *37* (5): 708-712.
2. Dhinesh, D. (2009). Influence of nutrients and Plant Growth Promoting Root Endophyte (PGPRE) on growth and development of *Dendrobium* cv. Earsakul. *MSc (Ag) thesis, Kerala Agricultural University,* Thrissur. 68p.
3. Femina, Valsalakumari, P.K. and Rajeevan, P.K. (2006). Performance of anthuriam (*Anthuriamandreanum* Lind.) cultivars under different systems of growing in humid tropical plains. *J. Ornamental Hortic., 9 (4):* 274-277.
4. Fernandez, S. (2001). Standardization of shade requirement in *Dendrobium*. *MSc (Ag) thesis, Kerala Agricultural University,* Thrissur, Kerala, 75p.
5. Leonhardt, K. W. (2000). Potted, blooming Dendrobium orchids. *Hort. Technol. 10:* 431.
6. Nagoaka, M.; Takahashi, K. and Arai, K. (1984). Effect of environmental factors on photosynthesis and transpiration of tomato and cucumber plants. *Bull. Veg*. *Ornamental Crops Res. Stn*. 12: 97-117.

7. Nambiar, N.; Siang, T. C. and Mahmood, M. (2012). Effect of 6-benzylamonipurine on flowering of a *Dendrobium* orchid. *Australian J. Crop Sci*. 6(2): 225-231.
8. Panse, V.G. and Sukhatme, P.V. (1985). Statistical methods for agricultural workers, ICAR, New Delhi, pp. 97-164.
9. Puchooa, D. (2004). Comparison of different culture media for the in vitro culture of *Dendrobium* (*Orchidaceae*). *Intl. J.Agric. Biol. 6:* 884-888.
10. Rajeevan, P.K. and Sobhana, A. (1993). Performance of certain epiphytic orchid species in Central Kerala. *J.Orchid Soc. India. 7 (1-2):* 31-35.
11. Samasya, K. S. 2000. Physiological aspects of *ex vitro* establishment of tissue cultured orchid (*Dendrobium* var. 'Sonia 17') plantlets. MSc (Ag) thesis, Kerala Agricultural University, Thrissur, Kerala, 89p.
12. Sugapriya, S.; Mathad, J.C., Patil, A.A., Hegde, R.V., Lingaraju, S., and Biradar, M.S. (2012). Evaluation of Dendrobium orchids for growth and yield grown under greenhouse. *Karnataka J. Agric. Sci., 25(1):* 104-107.
13. Yukawa, T.; Ando, T., Karasawa, K., and Hashimoto, K. (1992). Existence of two stomatal shapes in the genus *Dendrobium* and its systematic significance. *Am. J. Bot. 79 (8*): 946-952.

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