*Journal of Ornamental Horticulture, 13 (3) :182-188, 2010*

# Response of *Cymbidium* Pine Clash Moon Venus to major nutrient at vegetative growth stage

**S.K. NAIK, D. BARMAN and R.P. MEDHI**
National Research Centre for Orchids, Pakyong-737106 (Sikkim). e-mail:sushantanaik7@gmail.com

**ABSTRACT**

**An experiment was conducted during 2007-08 and 2008-09 to standardize the major nutrient requirement of *Cymbidium* "Pine Clash Moon Venus" at vegetative growth stage under polyhouse condition. The various growth parameters namely leaf length and width, pseudobulb length and girth and number of pseudobulb per clump were recorded highest in the treatment $T_4$ ($N_{30}$: $P_{10}$: $K_{10}$) for young Cymbidium (during first year) while for intermediate growth of Cymbidium (during second year), the fertilizer dose of $T_2$ ($N_{20}$: $P_{20}$: $K_{20}$) was best among the different doses of NPK. The fertilizer dose $N_{30}$: $P_{10}$: $K_{10}$ recorded 10 and 14.6 % increase in leaf length and width, 12 and 6.4 % increase in pseudobulb length and girth, 42.9 % increase in number of pseudobulb per clump, respectively over control during first year. However, the treatment $N_{20}$: $P_{20}$: $K_{20}$ showed 14.5 and 12.92 % increase in leaf length and width, 27.3 and 6.6 % increase in pseudobulb length and girth, 55.6 % increase in number of pseudobulb per clump, respectively over control during second year. The pH of the leachate significantly decreased with increasing doses of NPK throughout the sampling date. The electrical conductivity of the leachate was more during winter season (November to February), compared to other season and significantly increased over control with increasing doses of NPK throughout the crop growth period under study.**

**Key words :** *Cymbidium*, EC, NPK, pH, vegetative stage



## INTRODUCTION

*Cymbidium* is considered to be the king of all the orchids for its size, shape and unparallel beauty. Fresh aeration, high light intensity, porous medium, good drainage system and judicious watering are key factors for its successful cultivation (Fung, 2002; Heathcote, 2001; Powel, 2002). The valuable source of nutrients for orchids is rainfall since it washes dust particles out of the air. Nutrition comes from the breakdown of dead plants and is often supplied in rainwater that drips from leaf to leaf and finally to the orchid. Water flowing over the leaf surfaces would also leach mineral and organic nutrients from the leaf. Orchids in the wild receive constant but low levels of plant nutrients from the tree on which they are growing and also from atmosphere and decaying plant parts and dropping of birds. However under controlled conditions they have to be supplied with all these major and minor nutrients. Fertilization affects growing shoots minimally but promotes the growth of subsequent shoots. The reserve nutrients in back bulbs of orchids are utilized for new shoot development (Suto et al., 1982). Among the three major elements (N, P, K), the effects of nitrogen applications are most pronounced. The content of these elements in plants changes depending on the amount of fertilizer, but variation in nitrogen contents are the least affected (Miwa, 1975). The development of deficiency symptoms in orchids is very slow and is related to their remarkable ability to remobilize minerals in older leaves and /or pseudobulbs (Benzing, 1973). Usage of fertilizers should also depend on stage of growth (Naik and Barman, 2006). When the plants are actively growing, from March through to mid September, they must have an NPK fertilizer high in nitrogen to stimulate growth. Poole and Seeley (1978) noted deficiency symptoms of *Cymbidium* plant when supplied with lower concentration of nitrogen. From mid December, when flower spikes initiate, flowering should be encouraged by the use of a fertilizer high in phosphorous and potash. These assist in the formation of flower spikes, ensuring that the flowers will be bigger and stronger and firm up

the leaves thus avoiding soft growth. Taking into consideration the fertilizer need of Cymbidium orchids, an attempt has been made to standardize the nutrient requirement of Cymbidium hybrid at vegetative growth stage.

## MATERIALS AND METHODS

The experiment was carried out at National Research Centre for Orchids, Pakyong, India during the year 2007-08 and 2008-09. One-year-old tissue cultured plants of Cymbidium "Pine Clash Moon Venus" were planted singly in the plastic pots and kept inside the locally made poly house. The media used for growing cymbidium was the mixture of leaf mould, cocochips and brick pieces at 4:2:1 ratio in treated pot while the media used in control pot was leaf mould. The chemical composition of different components of growing media was presented in table 1.

**Table 1. Chemical composition of components of growing media**

| Total nutrient content (%) | Bricks | Cocopeat | Leaf mould |
|---|---|---|---|
| Nitrogen | -- | 0.17 | 0.22 |
| Phosphorus | -- | 0.03 | 0.10 |
| Potassium | -- | 0.95 | 0.56 |

The temperature during the winter season (November to March) varied from 10-150C and during wet season (April to October) varied from 15-250C. The different graded doses of N-P-K fertilizers were prepared by mixing the appropriate quantities of ammonium nitrate (sources of nitrogen), ammonium dihydrogen phosphate (sources of nitrogen and phosphorus) and potassium nitrate (sources of potassium and nitrogen). The treatments comprised of $T_0$ (Control); $T_1$ ($N_{20}$: $P_{10}$: $K_{10}$); $T_2$ ($N_{20}$: $P_{20}$: $K_{20}$); T3 ($N_{20}$: $P_{30}$: $K_{30}$); $T_4$ ($N_{30}$: $P_{10}$: $K_{10}$); $T_5$ ($N_{30}$: $P_{20}$: $K_{20}$); $T_6$ ($N_{30}$: $P_{30}$: $K_{30}$); $T_7$ ($N_{40}$: $P_{10}$: $K_{10}$); $T_8$ ($N_{40}$: $P_{20}$: $K_{20}$) ; $T_9$ ($N_{40}$: $P_{30}$: $K_{30}$). The fertilizer solutions were applied at 0.1 % at fortnightly intervals. During winter season (November to February) application of fertilizers were restricted to monthly once. Intercultural operations were carried out as and when required.

Growth parameters like length and width of leaf, length and girth of pseudobulb, number of pseudobulb per clump were recorded for two years. The pH and EC of the leachate was measured at an interval of three months throughout the experiment for two years. The leachate was collected by pour thru technique described by Wright (1986). Three representative pots were labeled for each replication and water was added to saturate the pot without leaching. The pots were placed in clean saucer and 100 ml of fresh water was poured over the surface of the media in each pot and the resulting leachate (approx. 70 ml) was collected. Water was applied slowly and evenly to prevent channeling of water through the mix or down the sides of the container so as to prevent dilution of leachate. The leachate was poured from three saucers into a clean jar and swirled to make evenly mixed. Then it is subjected to routine analysis of pH and EC.

The experiment was set up in a completely randomized design (CRD) with three replications. Results were statistically analyzed for Duncan's Multiple Range Test (DMRT) using the statistical computer programme MSTAT, version 5 (New Delhi, India).

## RESULTS AND DISCUSSION

Application of different graded doses of NPK (Table 2) to Cymbidium hybrid recorded significant increase or decrease in leaf length over control during both the years. However, influence of NPK on leaf width shows non significant among the different treatments during both the years. During first year, the fertilizer dose of $N_{30}$: $P_{10}$: $K_{10}$ recorded highest leaf length of 27.93 cm and width of 1.33 cm and resulted in 10 and 14.6 % increase over control, respectively. With the increasing doses of NPK from N30: P10: K10 resulted in gradual decrease in leaf length. The lowest leaf length of 24.42 cm

was recorded with the application of $N_{40}$: $P_{30}$: $K_{30}$ and showed 3.8 % decrease over control. During second year, application of $N_{20}$: $P_{20}$: $K_{20}$ registered highest leaf length and leaf width of 31.45 and 1.66 cm, respectively and resulted in 14.5 and 12.92 % increase over control. With the increasing doses of NPK from $N_{20}$: $P_{20}$: $K_{20}$ recorded gradual decrease in leaf length and width of Cymbidium hybrid. The growth parameter like leaf length and width of Cymbidium hybrid was more with the application of $N_{30}$: $P_{10}$: $K_{10}$ and $N_{20}$: $P_{20}$: $K_{20}$ during first year and second year, respectively. The result of the present investigation find supports from Devi and Chezhiyan (2001) who observed highest leaf length (12.85 cm) and width (6.04cm) of Dendrobium hybrid Sonia -17 in the treatment of 30: 10: 10 (NPK) ratio at 0.2%. The gradual decrease in leaf length and width following increased application of NPK could be attributed to the higher EC of the nutrient solution resulted in increased root injury and the plants showed stunted growth. These results are in accordance with the findings of Wang (1998). Barman et al. (2008) reported that Cymbidium is a slow growing crop with nutrient reserves in the bulb and requires less quantity of nutrition for growth.

The pseudobulb length and girth gradually increased with increasing doses of fertilizer (Table 2). Pseudobulb length shows significant difference among the treatments during both the years, while, pseudobulb girth shows no significant difference among the treatments during first year and significant difference among the different treatments in second year. The highest pseudobulb length and girth of 2.05 and 1.48 cm, respectively was obtained with the application of $N_{30}$: $P_{10}$: $K_{10}$ during first year and resulted in 12 and 6.4 % increase over control, especially for young Cymbidium hybrid. In contrast, the highest pseudobulb length and girth was 2.42 and 1.78 cm, respectively with $N_{20}$: $P_{20}$: $K_{20}$ and showed 27.3 and 6.6 % increase over control in second year. The number of pseudobulb per clump was highest of 3.33 and showed 42.9 % increase over control in the treatment receiving fertilizer dose of $N_{30}$: $P_{10}$: $K_{10}$ during first year while for second year it was 4.67 and resulted in 55.6 % increase over control in the treatment supplied with fertilizer dose of $N_{20}$: $P_{20}$: $K_{20}$. The pseudobulb length and girth of Cymbidium hybrid was highest in the treatment receiving $N_{30}$: $P_{10}$: $K_{10}$ and $N_{20}$: $P_{20}$: $K_{20}$ during first year and second year, respectively. Lunt and Kofranek (1961) observed that high rate of liquid nitrogen fertilizers promoted vegetative growth at the expense of flowering in Cymbidium. Consistent with our results, Barman et al. (2008) found that application of 200 ppm each of N, P and K recorded highest pseudobulb diameter in Cymbidium "Soulhunt-6".

The leachate was collected at an interval of 3 months (90 days) from each replication and then subjected to routine analysis of pH and EC. Application of different graded doses of fertilizer resulted in significantly lower pH compared to control throughout the sampling date (Table 3). However, there was no significant difference among the different treatments in the sampling date of November 2007 and February 2008. The pH of the leachate gradually decreased with the progress of crop growth, irrespective of different treatments and the lowest pH was recorded in the treatment supplied with $N_{40}$: $P_{30}$: $K_{30}$, irrespective of sampling date. However, higher pH was observed in control compared to other treatments throughout the sampling date and gradually decreased with the progress of crop growth. The decrease in pH of the Pour-thru leachate, with the progress of crop growth could be attributed to the leaching of bases due to watering of the media from time to time. While, the decrease in pH of the leachate with the addition of graded doses of fertilizer was due to acidification of the media resulting from the application of fertilizer having acidic nature. The results are in agreement with the findings of Wang and Konow (2002) and Nelson (1985), who observed that lower pH level of the media did not result in any adverse effects on

**Table 2. Effect of different graded doses of NPK on growth attributes of Cymbidium Pine Clash Moon Venus**

| Treatment | Leaf length (cm) | | Leaf width (cm) | | Pseudobulb length (cm) | | Pseudobulb girth (cm) | | Number of Pseudobulbs/ clump | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1st year | 2nd year | 1st year | 2nd year | 1st year | 2nd year | 1st year | 2nd year | 1st year | 2nd year |
| $T_0$ (Control) | 25.39$^{bc\dagger}$ | 27.47$^{bcd}$ | 1.16$^{b}$ | 1.47$^{a}$ | 1.83$^{bc}$ | 1.90$^{c}$ | 1.39$^{ab}$ | 1.67$^{abc}$ | 2.33$^{b}$ | 3.00$^{d}$ |
| $T_1$ ($N_{20}$: $P_{10}$: $K_{10}$) | 25.92$^{b}$ | 31.36$^{a}$ | 1.32$^{a}$ | 1.59$^{a}$ | 1.87$^{bc}$ | 2.35$^{ab}$ | 1.41$^{ab}$ | 1.73$^{ab}$ | 2.67$^{ab}$ | 3.67$^{bcd}$ |
| $T_2$ ($N_{20}$: $P_{20}$: $K_{20}$) | 25.55$^{bc}$ | 31.45$^{a}$ | 1.31$^{a}$ | 1.66$^{a}$ | 1.91$^{abc}$ | 2.42$^{a}$ | 1.40$^{ab}$ | 1.78$^{a}$ | 3.00$^{ab}$ | 4.67$^{a}$ |
| $T_3$ ($N_{20}$: $P_{30}$: $K_{30}$) | 24.56$^{c}$ | 28.08$^{bc}$ | 1.32$^{a}$ | 1.58$^{a}$ | 1.92$^{abc}$ | 2.23$^{abc}$ | 1.40$^{ab}$ | 1.69$^{ab}$ | 2.67$^{ab}$ | 3.67$^{bcd}$ |
| $T_4$ ($N_{30}$: $P_{10}$: $K_{10}$) | 27.93$^{a}$ | 28.47$^{b}$ | 1.33$^{a}$ | 1.56$^{a}$ | 2.05$^{a}$ | 2.33$^{ab}$ | 1.48$^{a}$ | 1.70$^{ab}$ | 3.33$^{a}$ | 4.33$^{ab}$ |
| $T_5$ ($N_{30}$: $P_{20}$: $K_{20}$) | 24.50$^{c}$ | 25.29$^{de}$ | 1.29$^{a}$ | 1.57$^{a}$ | 1.79$^{c}$ | 1.91$^{c}$ | 1.34$^{b}$ | 1.63$^{bcd}$ | 3.00$^{ab}$ | 4.00$^{abc}$ |
| $T_6$ ($N_{30}$: $P_{30}$: $K_{30}$) | 25.28$^{bc}$ | 26.28$^{bcde}$ | 1.25$^{ab}$ | 1.48$^{a}$ | 1.93$^{abc}$ | 2.09$^{abc}$ | 1.43$^{ab}$ | 1.57$^{cd}$ | 3.00$^{ab}$ | 3.67$^{bcd}$ |
| $T_7$ ($N_{40}$: $P_{10}$: $K_{10}$) | 25.61$^{bc}$ | 26.15$^{cde}$ | 1.29$^{ab}$ | 1.57$^{a}$ | 1.92$^{abc}$ | 2.01$^{bc}$ | 1.43$^{ab}$ | 1.53$^{d}$ | 3.00$^{ab}$ | 3.33$^{cd}$ |
| $T_8$ ($N_{40}$: $P_{20}$: $K_{20}$) | 25.35$^{bc}$ | 26.07$^{cde}$ | 1.26$^{ab}$ | 1.50$^{a}$ | 1.95$^{ab}$ | 2.03$^{abc}$ | 1.45$^{a}$ | 1.62$^{bcd}$ | 2.67$^{b}$ | 3.33$^{cd}$ |
| $T_9$ ($N_{40}$: $P_{30}$: $K_{30}$) | 24.42$^{c}$ | 24.97$^{e}$ | 1.23$^{ab}$ | 1.56$^{a}$ | 1.88$^{bc}$ | 2.00$^{bc}$ | 1.43$^{ab}$ | 1.63$^{bcd}$ | 2.67$^{b}$ | 3.00$^{d}$ |

$^{\dagger}$Within a column, means followed by the same letter are not significantly different at the 0.05 level of probability by Duncan's Multiple Range Test (DMRT).

Phalaenopsis and was likely the acidic nature of media. Wang and Gregg (1994) also observed a low pH of 4.4 in the media and had no apparent negative effects on Phalaenopsis. .

The electrical conductivity of the leachate varied significantly among the different treatments throughout the crop growth period under study (Figure 1). The EC of the leachate varied with fertilizer and with time of year. The EC of the leachate gradually increased with the application of graded doses of NPK, irrespective of sampling date. During winter season (November to February), the EC of the leachate was recorded more compared to summer season (March to October), irrespective of treatments. The increased EC of the pour-thru leachate throughout the experiment might be due to the increased concentration soluble salts in the leachate resulting from the application of different graded doses of NPK. This result find supports from Wang (1996), who reported that higher fertilizer concentration caused higher EC of the leachate. The higher medium EC during cooler winter months may have been the result of slower growth due to reduced photosynthetic photon flux and lower air temperatures (Wang and Konow, 2002).

The correlation and regression studies between pH and EC of the leachate of media for growing Cymbidium hybrid were shown in figure 2. A linear negative correlation was found between pH and EC of the leachate throughout the sampling date under study. The highest significant negative correlation of between and pH and EC of the leachate was -0.993** during August, 2008 and February, 2009. The linear regression analysis indicated that pH of the leachate accounted for 81.8, 78.5, 97.4, 98.6, 96.4 and 98.6 % variation in EC of the leachate during November 2007, February 2008, May 2008, August 2008, November 2008 and February 2009, respectively.

For young plants (1 year old), NPK ratio of 30:10:10 @ 0.1% was found to be best in terms of growth attributes like leaf length, leaf girth,

**Table 3. Changes in pH of the leachate as affected by graded doses of NPK to Cymbidium Pine Clash Moon Venus**

| Treatment | pH of the leachate (sampling date) | | | | | |
|---|---|---|---|---|---|---|
| | Nov, 07 | Feb, 08 | May, 08 | Aug, 08 | Nov, 08 | Feb, 09 |
| $T_0$ (Control) | 6.68$^{a\dagger}$ | 6.45$^{a}$ | 6.25$^{a}$ | 6.14$^{a}$ | 6.10$^{a}$ | 5.91$^{a}$ |
| $T_1$ ($N_{20}$: $P_{10}$: $K_{10}$) | 5.59$^{b}$ | 5.40$^{b}$ | 5.31$^{b}$ | 5.25$^{b}$ | 5.15$^{b}$ | 4.85$^{b}$ |
| $T_2$ ($N_{20}$: $P_{20}$: $K_{20}$) | 5.56$^{b}$ | 5.38$^{b}$ | 5.21$^{bc}$ | 5.14$^{bc}$ | 4.91$^{bc}$ | 4.78$^{bc}$ |
| $T_3$ ($N_{20}$: $P_{30}$: $K_{30}$) | 5.50$^{bc}$ | 5.34$^{b}$ | 5.15$^{bcd}$ | 4.95$^{cd}$ | 4.85$^{cd}$ | 4.65$^{bcd}$ |
| $T_4$ ($N_{30}$: $P_{10}$: $K_{10}$) | 5.43$^{bc}$ | 5.35$^{b}$ | 5.18$^{bcd}$ | 4.96$^{cd}$ | 4.81$^{cde}$ | 4.71$^{bcd}$ |
| $T_5$ ($N_{30}$: $P_{20}$: $K_{20}$) | 5.40$^{bc}$ | 5.30$^{b}$ | 5.12$^{bcd}$ | 4.85$^{de}$ | 4.67$^{cdef}$ | 4.58$^{bcde}$ |
| $T_6$ ($N_{30}$: $P_{30}$: $K_{30}$) | 5.35$^{bc}$ | 5.20$^{b}$ | 4.92$^{cde}$ | 4.74$^{de}$ | 4.52$^{ef}$ | 4.45$^{def}$ |
| $T_7$ ($N_{40}$: $P_{10}$: $K_{10}$) | 5.59$^{b}$ | 5.45$^{b}$ | 4.91$^{de}$ | 4.75$^{de}$ | 4.61$^{def}$ | 4.51c$^{def}$ |
| $T_8$ ($N_{40}$: $P_{20}$: $K_{20}$) | 5.47$^{bc}$ | 5.38$^{b}$ | 4.73$^{ef}$ | 4.64$^{ef}$ | 4.47$^{f}$ | 4.35$^{ef}$ |
| $T_9$ ($N_{40}$: $P_{30}$: $K_{30}$) | 5.25$^{c}$ | 5.30$^{b}$ | 4.61$^{f}$ | 4.45$^{f}$ | 4.38$^{f}$ | 4.26$^{f}$ |

†Within a column, means followed by the same letter are not significantly different at the 0.05 level of probability by Duncan's Multiple Range Test (DMRT).

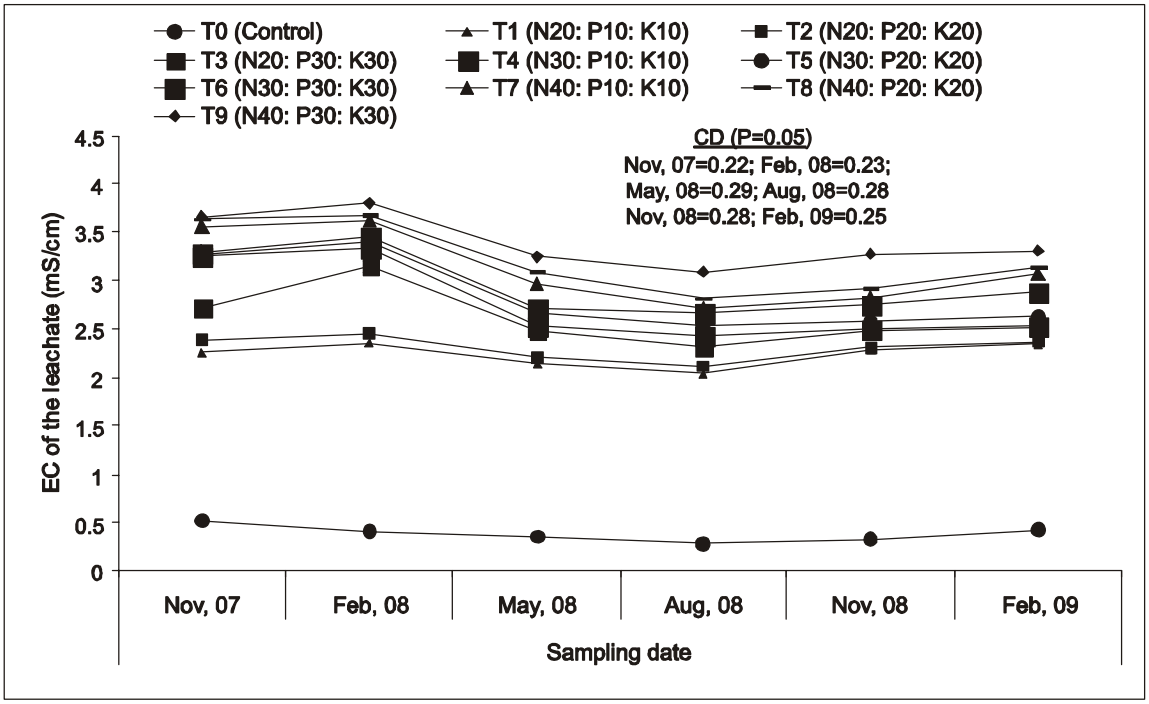


Figure 1. Changes in EC of the leachate as affected by graded doses of NPK to Cymbidium Pine Clash Moon Venus

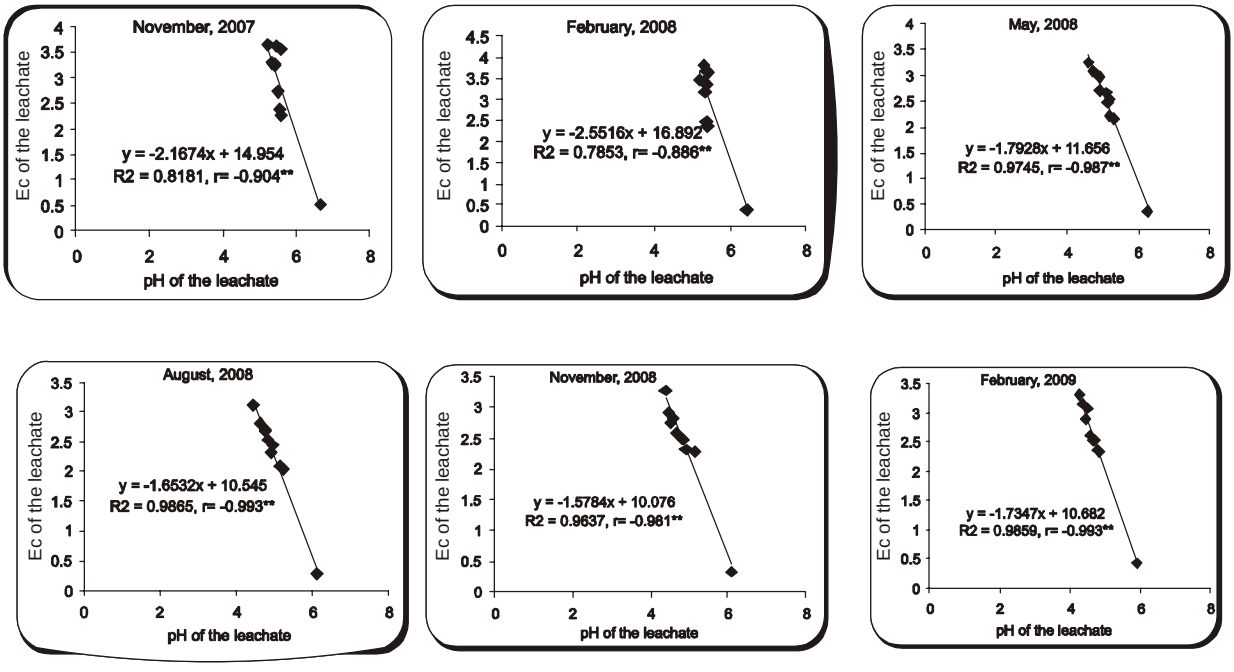


Figure 2. Simple linear regression and correlation studies between pH and EC of the leachate

pseudobulb length, pseudobulb girth and number of pseudobulb per clump of Cymbidium hybrid. For intermediate growth stage (two year old), the NPK ratio of 20:20:20 @ 0.1% was found suitable for growth attributes of Cymbidium hybrid. Further the correlation between pH and EC of the leachate was found negative throughout the sampling date.

## REFERENCES


D. Barman, K. Rajni, S.K. Naik and R.C. Upadhyaya, 2008. Production of Cymbidium 'Soulhunt-6' by manipulating cultural practices under partially modified green house. *Indian Journal of Horticulture*, **65**: 69-72.

Benzing, O.H., 1973. The monocotyledons: their examination and comparative biology I. Mineral nutrition related phenomena. In *Bromeliaceae* and *Orchidaceae*. *The Quarterly Review of Biology,* **48**: 277-290.

Devi, H. and N. Chezhiyan, 2001. Response of nitrogen and growth hormones on leaf parameter of Dendrobium cv. Sonia -17. *Orissa Journal of Horticulture,* **29**: 24-28.

Fung, T.K., 2002. Classic Chinese *Cymbidium:* Harmony in nature. *Orchid Digest*, **66**:145-149.

Heathcote, J., 2001. Orchid cultivation-Basic principles. *Orchid Review*, **109**: 375-377.

Lunt, O.R. and A.M. Kofranek, 1961. Exploratory nutritional studies on Cymbidium using two textures of fir bark. *American Orchid Society Bulletin*, **30**: 297-302.

Miwa, S., 1975. Studies on fertilization of Dendrobium. Effect of N, P and K on plants potted with sphagnum moss and bark. Abstract in *Japanese Society of Horticultural Science, Spring Meet*, pp. 334-335.

Naik, S.K. and D. Barman, 2006. Response of foliar application of nitrogen on flowering in *Cymbidium* hybrid. *Journal of Ornamental Horticulture*, **9**: 270-273.

Nelson, P.V., 1985. Greenhouse operation and management. 3rd edition Reston Publication Company Reston, Va.

Pooley, H..A and J.G.Seeley, 1978. Nitrogen, potassium, and magnesium nutrition of three orchid genera. *American Orchid Society Bulletin*, **104**: 485-488.

Powell, M., 2002. Growing terrestrial orchids. *Orchid Review,* **110**: 225-229.

Suto, K., K. Sinoda and K.Tutui, 1982. Nitrogen fertilization of Dendrobium nobile cultivars. Abstract in *Japanese Society of Horticultural Science, Autumn Meet*, pp. 420-421.

Wang, Y.T., 1996. Effects of six fertilizers on vegetative growth and flowering of phalaenopsis orchids. *Scientia Horticulturae*, **65**: 191-197.

Wang, Y.T., 1998. Impact of salinity and media on growth and flowering of a hybrid Phalaenopsis orchid. *HortScience,* **33**: 247-250.

Wang, Y.T. and E.A. Konow, 2002. Fertilizer source and medium composition affect vegetative growth and mineral nutrition of a hybrid moth orchid. *Journal of American Society of horticultural Science*, **127:** 442-447.

Wang, Y.T. and L. L. Gregg, 1994. Medium and fertilizer affect the performance of phalaenopsis orchids during two flowering cycles. *HortScience,* **29**: 169-271.

Wright, R.D., 1986. The pour-through nutrient extraction procedure*. HortScience*, **21**: 227-229.