



***Research Paper***

**STUDIES ON ORGANIC NUTRIENT MANAGEMENT IN CYMBIDIUM ORCHID THROUGH BOTH SPRAY AND MEDIA TREATMENT**

**De, L. C., Rakesh Singh and D.R. Singh**

ICAR-NRC for Orchids,  
Pakyong, Sikkim,  
India.

**Abstract**

Cymbidiums are highly valued for cut flowers, hanging baskets and potted plants. In the present investigation, the experiments were conducted to study the effect of liquid organic manure, tree barks and potting media on growth and development of Cymbidium 'Winter Beach Sea Green' at subtropical belt of Sikkim Himalaya. Spraying of liquid manure with higher dilution (1:30) and (1:20) had improved vegetative and reproductive growth and indicated the presence of higher amount of nitrate (101.707 ppm & 66.43 ppm) and phosphate (174.924 & 122.79 ppm) ions. Tree barks of *Prunus cerasoides* and *Choerospondias axillaris* had given out enhanced number of leaves, pseudobulbs and bulb size. Out of nine potting mixtures, enhanced bulb diameter was observed with cocochips + cocopeat + brick pieces + green moss (4.0cm) in the ratio of 3:1:1:1.

Key words: Cymbidium, orchid, tree barks, potting media, liquid manure.

**INTRODUCTION**

Cymbidium consists of 70 species of semi-terrestrial and epiphytic orchids of tropical and subtropical Asia. The plants are characterized by short and stout pseudobulbs ensheathed by encircling leaf bases. Cymbidiums are famous for its beautiful spikes derived from species and hybrids. The orchids have taken a significant position in cut flower industry due to its attractiveness, long shelf life, high productivity, right season of bloom, easy in packing and transportation. Orchid accounts for a large share of global floriculture trade both as cut flowers and as potted plants and is estimated around 10% of international fresh cut flower trade (De et al, 2014).

Among the orchids, Cymbidium ranks first and in floricultural crops it accounts for 2.7% of the total cut flower production (De and Debnath, 2011). Improper farming practices such as monocropping, imbalanced fertilization, poor soil organic matter management, soil contamination, soil compaction, mining of soil nutrients, water logging, depletion of ground water, decline in soil biodiversity and changing pest and disease complex and application of imbalanced NPK fertilizers ratio of 7.9:3:1 as against normal values of

4:2:1 are the major factors for soil degradation. Looking the adverse effects of fertilizers and chemicals stress is being given to promote organic farming (Bhattacharya, 2004).

## MATERIALS AND METHODS

This study was conducted with cymbidium orchids to study the response of this orchid to organic nutrient management with three separate experiments at midhills of Pakyong, Sikkim, India at an altitude of 1500msl during 2015 and 2016. For all the experiments the orchid plants were grown in protected structure with following growing conditions.

**Light:** A full morning sun or bright dappled afternoon shade during summer and full sun in winter was found ideal. Mature plants were provided 50-55% shade during hot weather. During growing season they required upto 5000-6000 f.c. light whereas in flowering season upto 2000-3000 f.c. light as measured by lux meter (De, 2014). Foliages was observed as yellowish green in colour.

**Temperature:** In general, cymbidiums can tolerate as low as temperature of 7°C. In vegetative stage, plantlets were grown best at temperature of 18°C at night and 24-30°C during the day. A temperature of 10-15°C was required for initiation of flower spikes. During the winter season (Late October to late February) a temperature of 7-12°C at night and 18-24°C during the day was recorded (De, 2014).

**Relative humidity:** An optimum range of relative humidity 80%-90% in summer and 40-55% in winter was recorded by thermo-hygrometer for good growth and flowering. During hot weather, misting down the plants and the surrounding floors and benches maintained humidity.

**Cultivation:** One year old plants were planted in 4 inches plastic pot whereas the full grown bearing plants are planted in 10 to 12 inches plastic pot. Pots were kept on benches made of galvanized iron pipe of 50 meshes with a maximum 75cm in height and maximum 90cm in breadth to hold the weight of sufficient number of pots. About 30 plants of one and half year old were accommodated in a square meter area. However, fully grown plants required more space for aeration and 3 plants were spaced in a square meter area. A healthy growth growing media should contain leaf mould, coconut husk, tree barks or dry leaf ferns and brick pieces (1:1:1:1). The pH of the potting media was kept at 5.5 to 6.5 whereas the electrical conductivity (EC) kept at 1.05 mhos/cm is good for growth.

In the present investigation, an organic liquid was prepared by mixing of cowdung, leaves of *Artemisia vulgaris* and *Dryopteris sikkimensis* in the ratio of 1:1:1 in water after keeping one month.

## Experiment I: Effect of liquid manure spray on growth, development and flowering in Cymbidium

The experiment was laid out in Cymbidium hybrid 'Winter Beach Sea Green' in CRD with six treatments having 5 replication and five plants were taken for each replication. The treatment details are as T<sub>1</sub>: 1:30 (liquid manure : water), T<sub>2</sub>: 1: 20 (liquid manure : water), T<sub>3</sub>: 1: 10 (liquid manure :water), T<sub>4</sub>: 1:5 (liquid manure: water), T<sub>5</sub>: 0.2 % NPK (19:19:19) and T<sub>6</sub>: water spray. The liquid organic manure were sprayed both in one year young plants and fully grown Cymbidium plants at weekly intervals. Observations were recorded on pseudobulb size (cm), number of leaves/pseudobulb, leaf length (cm), spike length (cm), rachis length (cm), number of spikes/plant, number of flowers/spike, flower width (cm), flower longevity and chlorophyll content (mg/100g) as measured by SPAD chlorophyll meter.

### **Experiment II: Effect of tree barks on growth and development of young plants of Cymbidium**

The experiment was laid out in Cymbidium hybrid 'Winter Beach Sea Green' in CRD with ten treatments having 5 replication and five plants were taken for each replication. The treatment details were as T<sub>1</sub> (Leaf fern + brick pieces + Paiyun barks, *Prunus cerasoides*), T<sub>2</sub> (Leaf fern + brick pieces + Lapsi barks, *Choerospondias axillaris*), T<sub>3</sub> (Leaf fern + brick pieces + Malato barks, *Macaranga pustulata*), T<sub>4</sub> (Leaf fern + brick pieces + Chuletro barks, *Brassaiopsis mitis*), T<sub>5</sub> (Leaf fern + brick pieces + Saur barks, *Betula cylindrostachys*), T<sub>6</sub> (Leaf fern + brick pieces + Tuni barks, *Cedrela febrifuga*), T<sub>7</sub> (Leaf fern + brick pieces + Guyelo barks, *Callicarpa* spp.), T<sub>8</sub> (Leaf fern + brick pieces + Chilauni barks, *Schimma wallichii*), T<sub>9</sub> (Leaf fern + brick pieces + Katus barks, *Castanopsis hystrix*) and T<sub>10</sub> (Leaf fern + brick pieces + Utis barks, *Alnus nepalensis*). All the three potting media were mixed in the ratio of 1:1:1. The liquid organic manure (1:30) was sprayed on one year young plants Cymbidium plants at weekly intervals. Observations were recorded on number of leaves, maximum leaf length, number of bulbs, bulb diameter and chlorophyll content.

### **Experiment III: Effect of potting media on growth and development of full grown plants of Cymbidium**

The experiment was laid out with Cymbidium hybrid 'Winter Beach Sea Green' in CRD with nine treatments having 5 replication and five plants were taken for each replication. The treatments used here were as T<sub>1</sub> (Cocochips + cocopeat + brick pieces + leaf mould), T<sub>2</sub> (Cocochips + cocopeat + brick pieces + vermiculite), T<sub>3</sub> (Cocochips + cocopeat + brick pieces + slow release fertilizers), T<sub>4</sub> (Cocochips + cocopeat + brick pieces + coconut husk), T<sub>5</sub> (Cocochips + cocopeat + brick pieces + cowdung), T<sub>6</sub> (Cocochips + cocopeat + brick pieces + ricehusk), T<sub>7</sub> (Cocochips + cocopeat + brick pieces + green moss), T<sub>8</sub> (Cocochips + cocopeat + brick pieces + tree barks) and T<sub>9</sub> (Cocochips + cocopeat + brick pieces + dry leaf fern). All the potting media were mixed in the ratio of 3:1:1:1. The liquid organic manure (1:10) was sprayed on full grown Cymbidium plants at weekly intervals. Observations were recorded on number of leaves, maximum leaf length, number of bulbs, bulb diameter and chlorophyll content.

#### **Anion analysis of organic liquid media**

Anion analysis of organic liquid media in different dilutions, NPK and tap water was done by using ion chromatography techniques with automatic computer analytical system (Table 5).

## **RESULTS AND DISCUSSION**

### **Effect of liquid manure spray on growth, development and flowering in Cym. Winter Beach Sea Green'**

Spraying of liquid manure in higher dilution (1:30) improved vegetative growth of young plants of Cymbidium orchids. Maximum pseudobulb size (3.0cm), number of leaves (4.5), leaf length (75cm), number of pseudobulb per plant (3.0) and chlorophyll content (72 mg/100g) were recorded with this treatment (Table 1) also. Out of six treatments, both the sprays of liquid manure (1:30) and (1:20) showed beneficial effect on vegetative growth as compared to NPK sprays. Cowdung can be kept as a component of a growing media because of rich in primary major elements (N, P & K) and secondary elements (Ca, Mg & S) for commercial cultivation of epiphytic orchids like Cymbidium, Dendrobium, Vanda, Phalaenopsis, Cattleya, Oncidium and Paphiopedilum and terrestrial orchids such as *Phaius tankervilleae*, *Thunia* spp, *Arundina graminifolia*,

*Calanthe* spp. (Anonymous, 2004-2005). Application of Panchgavya (1:20 or 1:30) in substrate influenced profoundly on growth of *Cymbidium* as compared to foliar spraying (Anonymous, 2010-11). So, the result of our experiment also find similarity with the above said results performed with other liquid manure in different orchids.

Table 1. Effect of liquid manure spray on growth and development of Cym. 'Winter Beach Sea Green' seedlings

Treatment s	Pseudobulb size (cm)	Number of leaves/pseudobulb	Maximum leaf length (cm)	Number of pseudobulb/plant	Chlorophyll content (mg/100g)
T <sub>1</sub> (1:30)	3.0	4.5	75	3.0	72
T <sub>2</sub> (1:20)	2.0	4.0	46	1.5	70
T <sub>3</sub> (1:10)	1.5	4.0	45	1.0	68
T <sub>4</sub> (1:5)	2.0	4.5	45	1.0	70
T <sub>5</sub> (N:P:K) 19:19:19	2.75	4.5	45	1.5	66
T <sub>6</sub> (Control)	2.25	4.5	60	1.25	66
SE m	0.21	NS	3.74	0.30	NS
CD 5%	0.36	NS	6.48	0.52	NS

T<sub>1</sub> = organic liquid manure: water (1:30), T<sub>2</sub> = organic liquid manure: water (1:20), T<sub>3</sub> = organic liquid manure: water (1:10), T<sub>4</sub> = organic liquid manure: water (1:5), T<sub>5</sub> = (N:P:K) 19:19:19 (0.2%), T<sub>6</sub> = Control (Plain water spray)

Table 2. Effect of liquid manure spray on full grown plant of Cym. 'Winter Beach Sea Green'

Treatments	Pseudobulb size (cm)	Number of leaves/pseudobulb	Maximum leaf length (cm)	Spike length (cm)	Rachis length (cm)	No. of spikes /plant	No. of flowers / spike	Flower width (cm)	Flower longevity (days)	Chlorophyll content (mg/100g)
T <sub>1</sub> (1:30)	7.0	7	87	65	25	1	7	10.0	110	93
T <sub>2</sub> (1:20)	7.0	8	85	60	24	1	7	11.0	108	80
T <sub>3</sub> (1:10)	8.0	8	84	50	20	2	6	11.0	103	75
T <sub>4</sub> (1:5)	5.0	6	64	--	--	--	--	--	--	78
T <sub>5</sub> (N:P:K) 19:19:19	5.0	7	70	--	--	--	--	--	--	80
T <sub>6</sub> (Control)	5.0	6	60	--	--	--	--	--	--	68

Maximum leaf length (87cm), spike length (65cm), rachis length (25cm), number of flowers per spike (7), flower longevity (110 days) and chlorophyll content (93mg/100g) were observed with spray of liquid manure in the ratio (1:30) on full grown *Cymbidium* plants. Spraying with liquid manure in the ratio of 1:10 had broader pseudobulb (8.0cm), number of spikes/plant (2.0) and flower width (11cm) (Table 2). Spraying of liquid manure with higher dilution (1:30) and (1:20) had improved

vegetative and reproductive growth due to the presence of higher amount of nitrate (101.707 ppm & 66.43 ppm) and phosphate (174.924 & 122.79 ppm) ions (Table 5 and Fig 1-6).

### Effect of tree barks on growth and development of young plants of Cym. 'Winter Beach Sea Green'

Amongst 10 tree barks used as potting media, highest number of leaves were found with Paiyun barks, *Prunus cerasoides* and Lapsi barks, *Choerospondias axillaris* (5). Maximum leaf length was recorded with Malato barks, *Macaranga pustulata* (75cm). Both Paiyun barks, *Prunus cerasoides* and Lapsi barks, *Choerospondias axillaris* had produced more number of bulbs/plant (2.5) and bulb size (3.5 and 4.0 cm, respectively (Table 3). Enhanced leaf and bulb growth might be due to higher nitrogen content in tree barks (1.70%). Highest chlorophyll content was studied in Utis barks, *Alnus nepalensis* (67 mg/100g) followed by Paiyun barks, *Prunus cerasoides* (Table 3). Carbohydrate reserves in orchid pseudobulbs are important in the initiation of new growth. These carbohydrate reserves are subsequently remobilised to support new shoot and inflorescence development (Hew and Ng, 1996). While leaves are the main sources of currently assimilated carbon, pseudobulbs represent an important supplementary source of carbohydrate that is utilized to meet the increased demand for carbon during inflorescence and new shoot development. This observation explains the need for at least two connected back shoots for optimal inflorescence development (Yong and Hew, 1995b, 1995c). Higher amount of chlorophyll content along with enhanced bulb growth of cymbidium orchids are essential for retaining of water in pseudobulbs for spike initiation (Zheng et al, 1992). Experimental evidences had shown that carbohydrate content in backbulbs of Cymbidium ranges from 70 mg/g in 'Pink' to 152 mg/g in 'Fire Storm Blaze' whereas in flowering pseudobulbs it varies from 88 mg/g in 'Pink' to 180 mg/g in 'Fire Storm Blaze'. In variable response to chlorophyll content in leaves, 'Fire Storm Blaze' had maximum (71.20mg/g) followed by 'Hazel Fay Tangerine'(58.80 mg/100g) and 'Sunny Moon'(55.20 mg/100g) and minimum in 'Red'(19.20mg/100g) (De et al,2011).

Table 3. Effect of tree barks on growth and development of young plants of Cym. 'Winter Beach Sea Green'

Treatments	No. of leaves/pseudobulb	Maximum leaf length (cm)	No. of bulbs/plant	Bulb diameter (cm)	Chlorophyll content (mg/100g)
T <sub>1</sub>	5.0	45	2.5	3.5	63
T <sub>2</sub>	5.0	60	2.5	4.0	49
T <sub>3</sub>	4.0	75	2.0	3.0	57
T <sub>4</sub>	4.0	10	2.0	1.0	25
T <sub>5</sub>	3.75	40	2.0	1.5	58
T <sub>6</sub>	4.75	35	1.0	2.0	56
T <sub>7</sub>	3.5	20	1.0	1.0	56
T <sub>8</sub>	4.5	30	1.0	1.5	56
T <sub>9</sub>	4.0	40	1.0	2.0	54
T <sub>10</sub>	3.5	50	2.0	3.0	67
SEm	0.33	3.80	0.36	0.06	3.30
CD5%	0.55	6.27	0.60	0.09	5.44

T<sub>1</sub> =Leaf fern + brick pieces +Paiyun barks, *Prunus cerasoides*), T<sub>2</sub> =Leaf fern + brick pieces + Lapsi barks,*Choerospondias axillaris*, T<sub>3</sub> =Leaf fern + brick pieces + Malato barks, *Macaranga pustulata*), T<sub>4</sub> =Leaf fern + brick pieces + Chuletro barks, *Brassaiopsis mitis*), T<sub>5</sub> =Leaf fern + brick pieces + Saur barks, *Betula cylindrostachys*, T<sub>6</sub> =Leaf fern + brick pieces + Tuni barks, *Cedrela febrifuga*, T<sub>7</sub> =Leaf fern + brick pieces + Guyelo barks, *Callicarpa* spp.), T<sub>8</sub> =Leaf fern + brick pieces + Chilauni barks, *Schimma wallichii*), T<sub>9</sub> =Leaf fern + brick pieces + Katus barks, *Castanopsis hystrix*) and T<sub>10</sub> =Leaf fern + brick pieces + Utis barks, *Alnus nepalensis*)

### Effect of potting media on growth and development on full grown plants of Cym. 'Winter Beach Sea Green'

Vegetative growth of full grown Cymbidium plants had shown variable response with different combinations of potting media. Out of nine potting media used, highest number of leaves (5.5) were produced with (Cocochips + cocopeat +brick pieces + dry leaf fern) and Cocochips + cocopeat +brick pieces +cowdung). Longest leaf (75cm) was recorded with Cocochips + cocopeat +brick pieces + coconut husk. Cocochips + cocopeat +brick pieces + leaf mould, Cocochips + cocopeat +brick pieces + vermiculite and Cocochips + cocopeat +brick pieces +cowdung had given out maximum number of bulbs/plant (4.5). Enhanced bulb diameter (4.0cm) was observed with Cocochips + cocopeat +brick pieces + green moss. Highest content of chlorophyll (72mg/100g) was recorded with Cocochips + cocopeat +brick pieces +rice husk (Table 4). Production of enhanced number of bulbs /plant with leaf mould might be due to equivalent content of N (0.50%), P (0.50%) and K (0.60%). Higher content of N (1.30%) and K (0.35%) had increased bulb diameter. Enhanced vegetative and reproductive growth with coconut based products as potting media could be due to availability of potassium (0.95%), calcium (2.70%), magnesium (1.32%) and nitrogen (0.17%) (Anonymous, 2004-2005).

Table 4. Effect of potting media on growth and development on full grown plants of Cym. 'Winter Beach Sea Green'

Treatments	No. of leaves/pseudobulb	Maximum leaf length (cm)	No. of bulbs/ plant	Bulb diameter (cm)	Chlorophyll content (mg/100g)
T <sub>1</sub>	5.0	48	4.5	3.5	65
T <sub>2</sub>	5.0	55	4.5	3.25	60
T <sub>3</sub>	4.0	44	4.0	3.00	59
T <sub>4</sub>	4.0	75	2.0	3.25	58
T <sub>5</sub>	5.5	65	4.5	3.75	68
T <sub>6</sub>	5.0	50	3.5	3.25	72
T <sub>7</sub>	4.75	65	4.0	4.0	67
T <sub>8</sub>	4.5	62	3.5	3.75	66
T <sub>9</sub>	5.5	55	1.5	3.75	63
SEm	0.50	3.86	0.43	NS	2.70
CD5%	0.85	6.58	0.73	NS	4.60

T<sub>1</sub> =Cocochips + cocopeat +brick pieces + leaf mould), T<sub>2</sub> =Cocochips + cocopeat +brick pieces + vermiculite), T<sub>3</sub> =Cocochips + cocopeat +brick pieces+ slow release fertilizers), T<sub>4</sub> =Cocochips + cocopeat +brick pieces + coconut husk), T<sub>5</sub> =Cocochips + cocopeat +brick pieces +cowdung), T<sub>6</sub> =Cocochips + cocopeat +brick pieces +ricehusk), T<sub>7</sub>

=Cocochips + cocopeat +brick pieces + green moss), T<sub>8</sub> =Cocochips + cocopeat +brick pieces + tree barks) and T<sub>9</sub> =Cocochips + cocopeat +brick pieces + dry leaf fern).

Table 5. Anion analysis of organic liquid media in different dilutions

Anion concentration (ppm)	Liquid manure: water(1:30)	Liquid manure: water(1:20)	Liquid manure: water(1: 10)	Liquid manure: water (1:5)	NPK (19:19:19)	Tap water
Flouride	14.530	9.20	4.18	2.220	0.407	0.393
Chloride	91.71	58.44	29.61	17.835	6.836	3.230
Bromide	15.848	10.78	5.43	3.136	1.572	0.285
Nitrate	101.707	66.43	33.48	15.308	231.899	0.312
Phosphate	174.924	122.79	64.74	53.746	1583.046	0.238
Sulfate	939.069	615.21	308.03	138.693	596.113	14.825

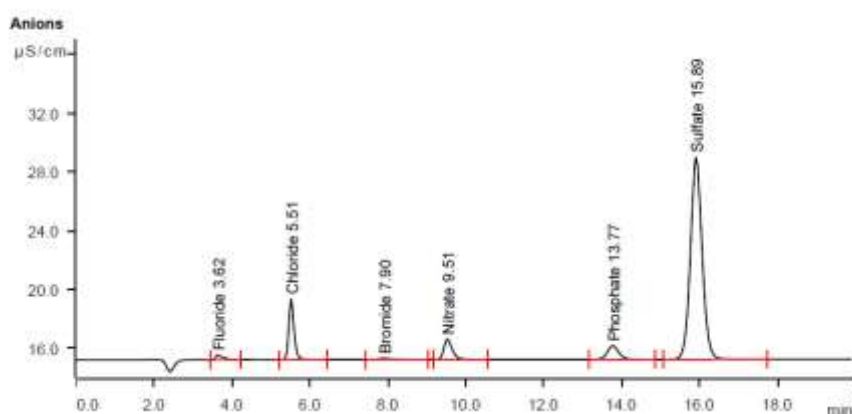


Fig.1. Peaks and retention time of organic liquid manure (1:30)

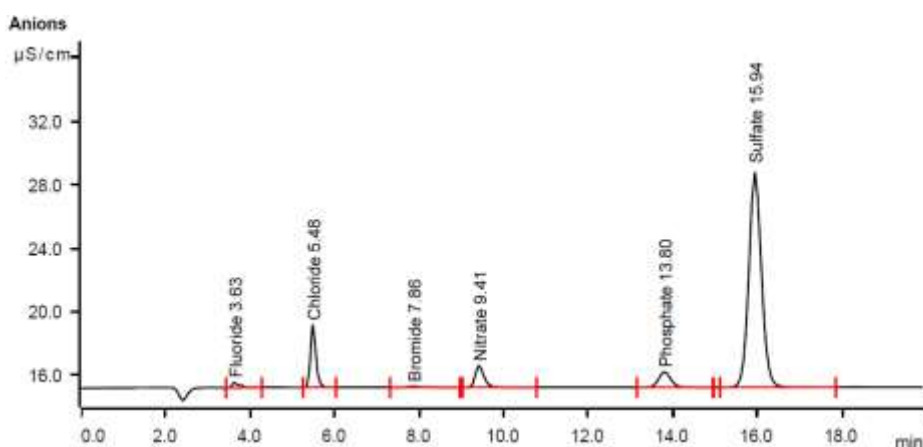
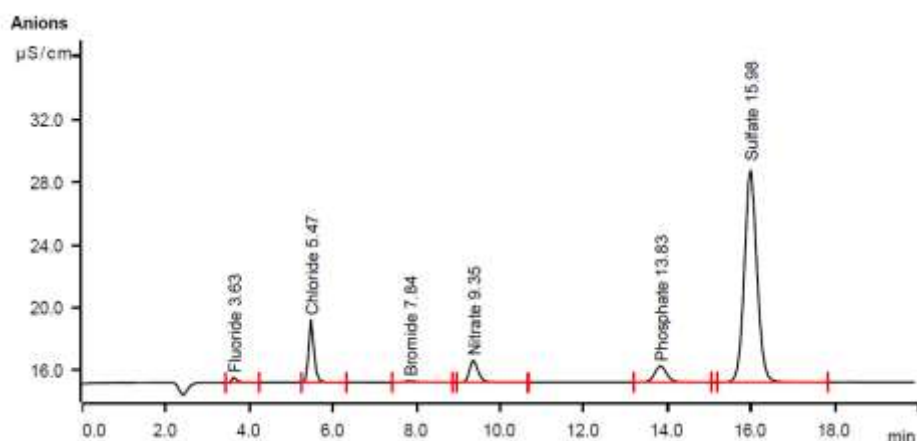
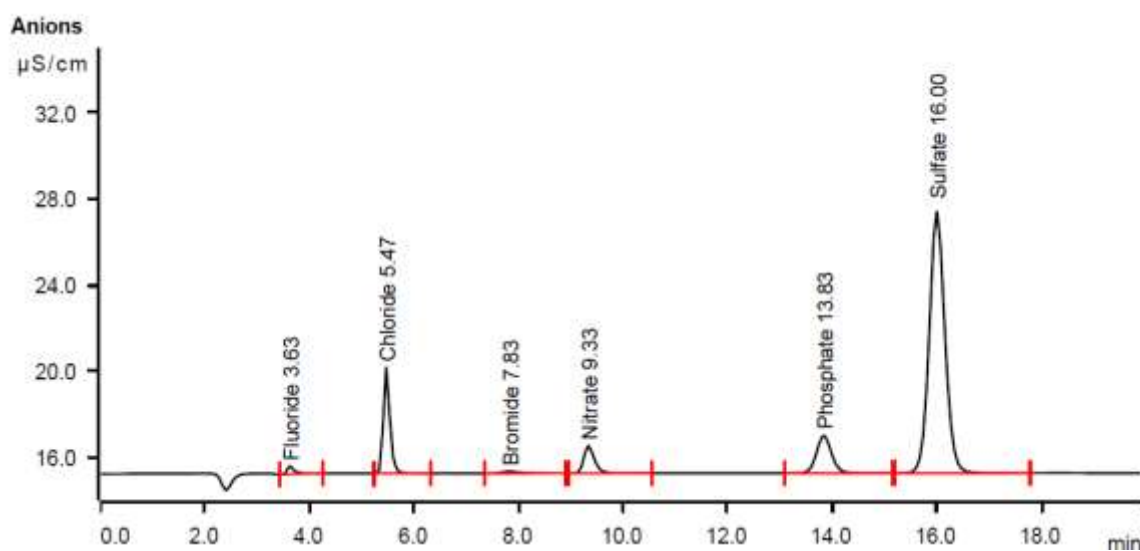


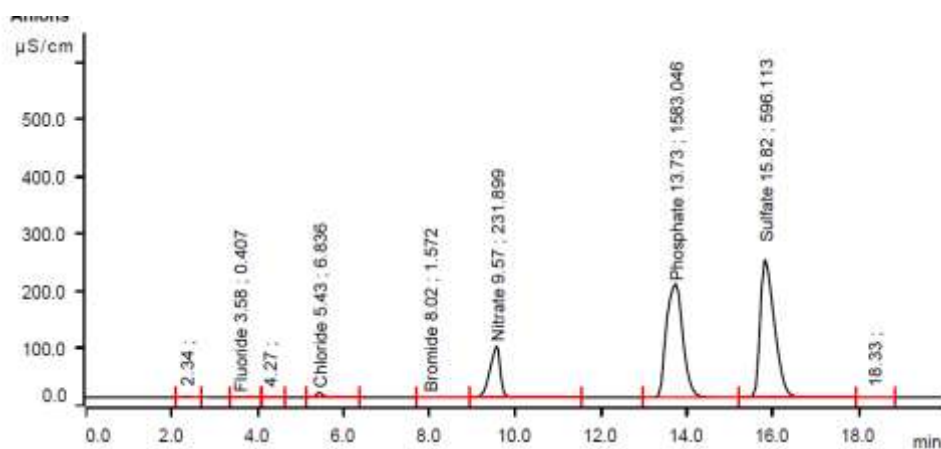
Fig.2 Peaks and retention time of organic liquid manure (1:20)



**Fig.3 Peaks and retention time of organic liquid manure (1:10)**



**Fig. 4 Peaks and retention time of organic liquid manure (1:5)**



**Fig. 5. Peaks and retention time of NPK (19:19:19)**

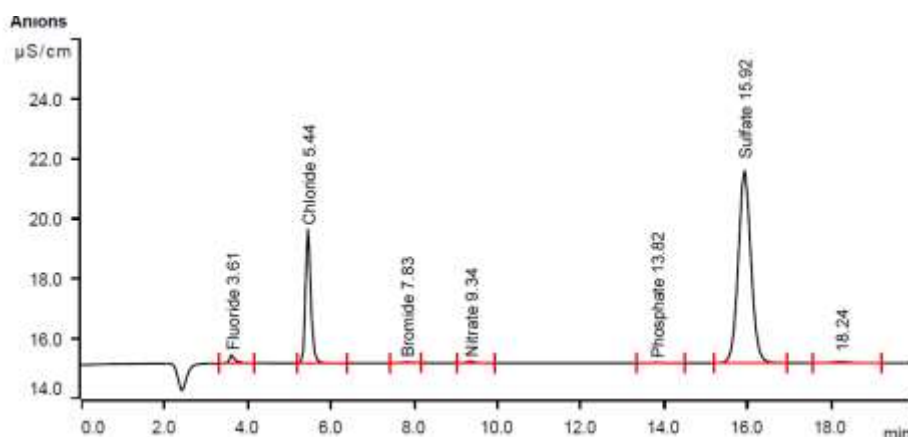


Fig. 6. Peaks and retention time of tap water (control)

## CONCLUSION

Spraying of organic diluted liquid manure in the ratios of 1:30 and 1:20 could be beneficial for improved vegetative and reproductive growth of *Cymbidium* due to the presence of higher amount of nitrate and phosphate ions. Incorporation of Paiyun barks, *Prunus cerasoides* and Lapsi barks, *Choerospondias axillaris* as a component of potting media can be useful for leaf and pseudobulb growth. A potting mixture comprising of cocochips + cocopeat + brick pieces + green moss can be recommended for development of young bulbs in *Cymbidium* orchids.

## REFERENCES

- Anonymous 2004-2005. Annual Report, ICAR-NRC for Orchids, pak Yong-737106, Sikkim.
- Anonymous 2010-2011. Annual Report, ICAR-NRC for Orchids, pak Yong-737106, Sikkim.
- Bhattacharya, P. 2004. Organic food Production in India. Agrobios India, Behind Nasrani Cinema, Chopasani Road, Jodhpur.
- De, L.C. 2014. 'Production Technology of Commercial Flowers': In 2 volumes Pp. 599. Published by Pointer Publisher, Jaipur, Rajasthan (ISBN: 978-81-7132-771-3).
- De, L.C and N.G. Debnath 2011. Vision 2030. NRC for Orchids, Pak Yong, Sikkim, India.
- De, L.C., Arpita Mandal Khan, Rajkumar and R.P. Medhi. 2014. Orchid Farming- A Remunerative Approach for Farmer's Livelihood. *International Journal of Scientific Research*, 3(9): 77-80.
- De, L.C, Ramgopal Devadas, P. Deb and R.P. Medhi. 2011. Variability in growth, flowering and physiological parameters in *Cymbidium* Orchids. *Journal of Ornamental Horticulture*, 14 (3 & 4): 1-4.
- Hew, C.S. and C.K.Y. Ng. 1996. Changes in mineral and carbohydrate content in pseudobulbs of the  $C_3$  epiphytic orchid hybrid *Oncidium* Goldiana at different growth stages. *Lindleyana* 11: 125-134.
- Yong, J.W.H and C.S. Hew. 1995b. The importance of photoassimilate contribution from the current shoot and connected back shoots to inflorescence size in the thin-leaved sympodial orchid *Oncidium* 'Goldiana'. *Int. J. Plant Sci.*, **156**: 450-459.
- Yong, J.W.H and C.S. Hew. 1995c. The patterns of photoassimilate partitioning within connected shoots for the thin-leaved sympodial orchid *Oncidium* 'Goldiana' during different growth stages. *Lindleyana*, **10**: 92-108.

Zheng, X.N., Z.Q. Wen, and C.S. Hew. 1992. Responses of *Cymbidium sinense* to drought stress. *J. Horticultural Sci.* **67**: 295–299.