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Changes in nutrient content and iron deficiency in growing media of *Cymbidium* hybrid 'Pine Clash Moon Venus'*

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The orchid plant in its natural habitat receives necessary nutrients through air and rainfall. The roots of orchid plant need more air space and thus potting material that drains rapidly and at the same time retains moisture is the best growing substratum. Orchids are similar to the other plants in their requirements and generally take a longer time to show mineral deficiency. It has been reported that *Dendrobium phalaenopsis* is severely affected by the omission of N, P, K, Ca and Mg in nutrient solution and the leaves drop before deficiency symptoms appear (Poole and Sheehan 1982). The slow development of deficiency symptoms in orchids is related to their remarkable ability to remobilise minerals from older leaves and other storage organs such as pseudobulbs, to meet the nutrient demand of new growth. This 'efficient-recycling' phenomenon observed in most tropical orchids may be attributed to its epiphytic origin where the supply of minerals is scanty and unpredictable. The present investigation was under taken to evaluate the nutrient content of growing media and iron deficiency in *Cymbidium* 'Pine Clash Moon Venus'.

The present experiment was undertaken at NRC for Orchids, Pakyong, Sikkim under poly house condition during 2008 and 2009. Six-month-old tissue cultured plants of *Cymbidium* "Pine Clash Moon Venus" were planted in a raised bed size of 60 × 60 × 70 cm^3 (L × B × H) in groups inside the poly house. The raised bed contains growing media comprising of leafmould, cocochips, vermiculite and bricks in the ratio of 4:2:1:1. The first cycle of growing media indicates the first phase of transferring of tissue culture plant to the growing media till it hardens for about six months. After hardening the plants were shifted to polybags containing the growing media for commercial sale. After removal of all the plants from the growing media, it is ready to receive another lot of tissue culture plant for hardening for six months and it signifies the second cycle of hardening in the same media. Similarly the third cycle of hardening in the same media. Sampling of growing media of different cycles was done at the end of each cycle and divided into three phases at six month interval. Growing media were collected from five to six randomly selected locations in each bed. Composite growing media were made for each bed and dried in shade, ground and passed through 80-mesh sieve. Dried samples (1.0 g) were digested with diacid mixture (HNO_3: $HClO_4$ = 9:4; Jackson 1973). After digestion of samples the total N was determined by micro kjeldahl method (Bremner 1965), total P was determined by Vanodomolybdo-phosphoric yellow colour method (Jackson 1973), total K was determined by flame photometer method (Jackson 1973), total Ca and Mg were determined by Versanate method (Hesse 1971), the total S was determined by turbidity method (Cottenie *et al.* 1979), the total Fe, Mn, Cu and Zn were estimated with the help of Atomic Absorption Spectrophotometer (Perkin Elmer; Model – AAnalyst 100).

All the major and micronutrients gradually decreased with the progress of crop growth. The nitrogen content was highest of 1.26% in the first phase of sampling the growing media and gradually decreased with the progress of crop growth (Fig 1). Similarly the phosphorus and potassium content of the media (0.19 and 0.29%) were more in the first phase of sampling and then decreased with the progress of crop growth. Among the macronutrients, N and P content were in the sufficiency range while K content was in deficiency range. Although potassium is low in the media, but the plant does not show deficiency symptom of K. The reason may be attributed to the presence of high K content of tissue culture media like MS (Murashige and Skoog 1962) during the process of *in-vitro* regeneration to *in-vitro* hardening. Orchids have the ability to remobilise minerals from pseudobulbs to

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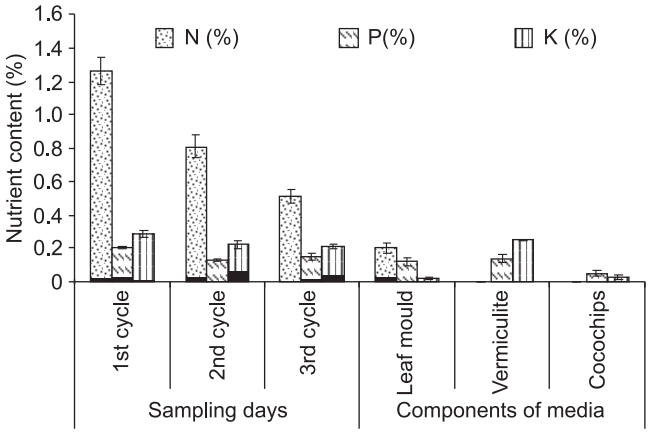

Fig 1 Nitrogen, phosphorus and potassium content of growing media at different days of sampling. Bars are ±s.e of the mean

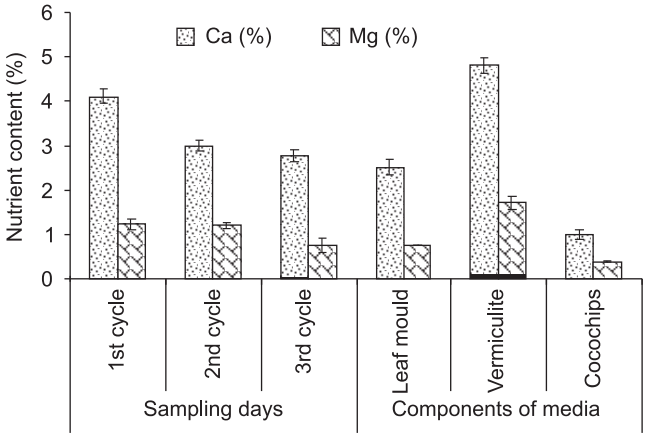

Fig 2 Calcium and magnesium content of growing media at different days of sampling. Bars are ±s.e of the mean.

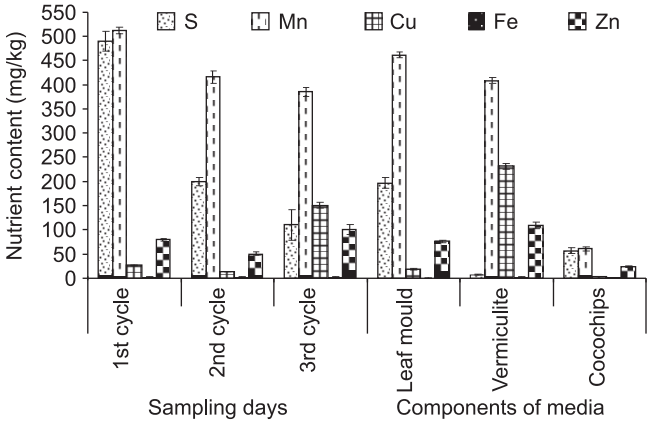

Fig 3 Sulphur, manganese, copper, iron and zinc content of growing media at different days of sampling. Bars are ±s.e of the mean

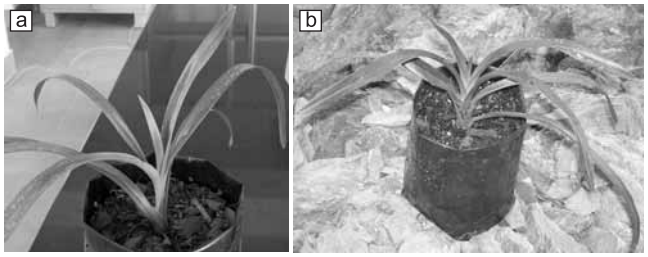

Fig 4a-b (*a*) Iron deficiency in *Cymbidium* 'Pine Clash Moon Venus'. (*b*) application of 50 ppm Fe (0.025% $FeSO_4.7H_2O$) recover from Fe deficiency

meet new growth requirement (Benzing 1990). Among the components of growing media, it was observed that the N content was more in leafmould while traces in other two components. Phosphorus content was more in vermiculite followed by leaf mould and cocochips. Potassium content recorded highest in vermiculite followed by cocochips and leafmould.

The secondary nutrient like calcium, magnesium and sulphur content (Figs 2, 3) of the media was more in the first phase of sampling and was found to be 4.1%, 1.23% and 490 mg/kg, respectively. All the secondary nutrients were in sufficiency range (Dorofaeff 1980). Among the components of growing media, the Ca and Mg content were highest in vermiculite followed by leafmould and cocochips. It has been observed that three cycles of hardening tissue culture *Cymbidium* hybrid can be done in the same growing media without much depletion in major and secondary nutrient. The micronutrient like manganese, copper, iron and zinc gradually decreased with the advance in crop growth and followed the trend as, Mn > Zn > Cu > Fe throughout the sampling period as well as in the components of growing media (Fig 3). In all the phases of sampling Mn content was highest and Fe content was lowest. The highest Mn, Zn, Cu and Fe were 511.6, 79.66, 26.16 and 2.5 mg/kg, respectively in 1st phase of sampling. The nutrient content of the growing media gradually decreased with the progress of crop growth because the plant draws nutrient from the growing media for its growth and development.

By comparing with the nutrient status of *Cymbidium* orchid leaves described by Dorofaeff (1980), it was observed that K and Fe content in the growing media were far below the normal range. It was observed that after six months of growth (1st phase of sampling of growing media) of *Cymbidium* hybrid around 30–40% of the plants suffered from Fe-deficiency. The media used during the process of *in-vitro* regeneration to in-vitro hardening of *Cymbidium* hybrid does not contain iron salt and also the growing media in the poly bag deficient in Fe content resulted in manifestation of Fe-deficiency in the plant. The new leaves develop typical symptoms of Fe deficiency as chlorotic between veins, necrotic spots usually absent, in extreme cases necrosis of margins and tip of leaf, sometimes extending inward, developing large areas (Fig. 4a). However, the plant does not show K deficiency symptom even though the K-content of the growing media was low because *Cymbidium*

hybrid can reutilize the absorbed K stored in the pseudobulb (Benzing 1990). The Fe deficient *Cymbidium* hybrid were sprayed with different concentrations (50, 100 and 200 ppm Fe) of Fe in the form of iron sulphate. Further, the results showed that spraying with 100 and 200 ppm Fe as iron sulphate resulted in scorching symptom on the leaf after one day of spray. The severity of scorching was more in 200 ppm Fe spray compared to 100 ppm. Plants did not show any scorching with spraying at 50 ppm Fe. The leaves of *Cymbidium* "Pine Clash Moon Venus" recovered from iron deficiency after two months of spray (Fig. 4b).

The Fe-deficiency was also seen in two year old *Cymbidium* 'Pine Clash Moon Venus'. About 60% of the plants were affected with Fe deficiency. The Fe deficient *Cymbidium* hybrid was sprayed with 50, 100 and 200 ppm Fe at 15 days interval and the plants did not show scorching symptoms with the spray of 50 and 100 ppm Fe. Leaf burning and foliar damage was observed in 200 ppm Fe. Hence, for adult plants 100 ppm of Fe can be sprayed at 15 days interval to overcome severe Fe deficiency.

SUMMARY

The experiment was undertaken during 2008 and 2009 to study the distribution of major (N, P and K), secondary (Ca, Mg and S) and micronutrient (Fe, Mn, Zn and Cu) on the growing media and to overcome the iron deficiency problem in *Cymbidium* 'Pine Clash Moon Venus'. Among all the nutrients, potassium and iron content were very low in the growing media. Most of the tissue culture *Cymbidium* hybrid shows iron deficiency after six month of growth in plastic poly bag under greenhouse condition. Foliar application of 50 ppm iron in the form of iron sulphate at 15 days interval for two consecutive months controls the iron deficiency in one year old *Cymbidium* 'Pine Clash Moon Venus'. However, foliar application of 100 ppm iron is suitable to overcome Fe deficiency in two year old *Cymbidium* 'Pine Clash Moon Venus'.

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