

## Effect of Natural Extracts and Plant Growth Regulators on Dendrobium Orchids

P.I. RANAWAKE<sup>1</sup>, D.A. SHIRANI<sup>2</sup> and S.J.B.A. JAYASEKERA<sup>1</sup>

<sup>1</sup>*Department of Horticulture and Landscape Gardening, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP), 60170, Sri Lanka*

<sup>2</sup>*Agriculture Research Station, Telijjawila, 81060, Sri Lanka*

### ABSTRACT

Dendrobium orchids are one of the best-selling tropical cut flowers and potted plants in the floriculture industry. A large quantity of planting materials is imported annually to fulfill the local demand. To compete with imported plants, sufficient quantities of attractive Dendrobium species with fast growth should be produced locally. A study was conducted at Agriculture Research Station, Telijjawila in 2016 to identify suitable plant growth regulators (PGR) and natural extract to enhance the growth of Dendrobium orchids at two growth stages. First experiment was carried out at community pot stage with Garlic extract, Yeast extract and coconut water (natural extracts) and napGibb (PGR) along with one variety and laid as completely randomized design (CRD). Results revealed that all three natural extracts had no significant effect on weight and height increment. The napGibb increased the plant height significantly while coconut water had significant effect on leaf width. Second experiment was performed additionally using aloe extract (natural), BAP and GA<sub>3</sub> (PGR) with plants at 2" net pot stage with two different varieties as two factor factorial experiment laid as CRD with 10 replicates. The interaction effect was not significant but all the observations had been affected by variety and treatment independently. Aloe extract had significant effect on weight increment (5.95 g) followed by yeast extract (4.55 g). Application of GA<sub>3</sub> and napGibb resulted significantly elongated plants but weaker in terms of fresh weight. However, application of GA<sub>3</sub> favored increment of pseudo bulbs. Two varieties differ in their growth and fast growth was observed in variety 1 (white, intermediate type). Results of both experiments revealed that application of PGR and natural extracts would be more effective at net pot stage than community pot stage.

**KEYWORDS:** Dendrobiums, Growth, Natural extracts, Plant growth regulators

### INTRODUCTION

Production of plants for their flowers or foliage is very popular in Sri Lanka and it deals with growing, marketing and arranging of flowers and ornamental plants. Orchid is an attractive and popular cut flower which belongs to family Orchidaceae. They are monocotyledon and perennials and consist of about 27,800 species and about 750 genera such as Dendrobium, Cattleya, Cymbidium, Oncidium, Phalaenopsis, Arachnis and so on.

Dendrobiums (Spray orchid) is the second largest genera of the Orchidaceae family with more than 1,200 epiphytic species that are native to tropical and sub-tropical Asia, Australia and various Pacific islands (Lopez and Runkle, 2005).

Dendrobiums are popular cut flower and flowering potted plants around the world due to wide range in flower color, size and shape, year round availability and lengthy vase life. A large export market is available if the products are right and marketed properly.

The planting material requirement of the country is fulfilled through importation mainly from Thailand and through local (public and private) laboratories and nurseries. In 2015, nearly 1 mn plants of Dendrobiums have been

imported to Sri Lanka (Anon, 2016) showing the larger demand for the planting materials.

Some growers tend to buy imported plants as they produce flowers within 2-3 months after planting. Some growers believe that the imported plants have vigorous growth compared to local plants. But there are no proper evidences. However, locally produced planting materials must be competitive with imported materials in terms of growth and varieties. Therefore, present experiment was planned to identify suitable plant growth regulators (PGR) and/or natural extracts to enhance the growth of Dendrobium orchids.

### MATERIALS AND METHODS

This investigation was carried out at Agriculture Research Station (ARS), Telijjawila from January to April 2016.

#### Materials

Tissue cultured (vegetatively propagated) plants of two varieties of Dendrobium were used in the study. Planting materials were received from Tissue Culture Laboratory at ARS, Telijjawila.

Coconut water, aloe extract, garlic extract and yeast extract were used as natural extracts while napGibb, GA<sub>3</sub> and BAP were applied as

PGR. The plants were maintained inside an insect proof polytunnel. The temperature varied from 28-34 °C at 9.00 a.m., 31-39 °C at 1.00 p.m. and 26-36 °C at 4.00 p.m. The light intensity varied from 6.9-33.3 klux, 4.5-36.4 klux and 1.42-15.9 klux at 9.00 a.m., 1.00 p.m. and 4.00 p.m. respectively during the growth period. The plants were fertilized with recommended liquid fertilizers twice a week according to the growth stage.

#### **Preparation of Plant Extracts and PGR**

##### **Garlic Extract (*Allium sativum*): T<sub>2</sub>**

Garlic cloves (250 g) in 250 mL of water were kept in the freezer for 24 h and after freezing container was left to thaw. Freezing and thawing was repeated thrice. Water was added up to one liter to apply to the plants (Hanafy *et al.*, 2012).

##### **Coconut Water (*Cocos nucifera*): T<sub>3</sub>**

Filtered water from immature coconut was directly applied.

##### **Yeast Extract (*Saccharomyces cerevisiae*): T<sub>4</sub>**

Active dry yeast (10 g) in 100 mL of water was kept for 3 h in a dark warm place, after adding table spoon of sugar. Content of the beaker was filtered on a sieve and final solution was volume up to one liter to apply to the plants (Hanafy *et al.*, 2012).

##### **Aloe Extract (*Aloe vera*): T<sub>5</sub>**

*Aloe vera* fresh leaves (250 g) was collected and two side margins were removed and remainder was cut in to pieces and blended. The blend was removed into a gauze mesh. The extract was obtained in a container and 40% concentrated solution was used (Hanafy *et al.*, 2012).

##### **napGibb: T<sub>6</sub>**

napGibb is a commercially available form of GA<sub>3</sub>. Sachet of napGibb (1 g) contains 10% GA<sub>3</sub>, 6% calcium and 2% boron. Gibberellic Acid (100 ppm) solution was prepared and applied.

##### **GA<sub>3</sub> (Gibberellic Acid): T<sub>7</sub>**

Gibberellic Acid (100 ppm) solution (purity>90%, Duchefa, Prod No.G0907.0001) was used.

##### **BAP (Benzyleaminopurine): T<sub>8</sub>**

Benzyleaminopurine (100 ppm) solution (purity>99% Duchefa, Prod. No. B0904.001) was used.

Plants were sprayed with the natural extracts and the PGR once in three weeks and a

total of five sprayings were done during the study period.

#### **Community Pot Stage**

Intermediate type white flowered variety planted in a medium of coir dust and sand (3:1 ratio) was sprayed with garlic extract (T<sub>2</sub>), coconut water (T<sub>3</sub>) yeast extracts (T<sub>4</sub>) and napGibb (T<sub>6</sub>) along with water as control (T<sub>1</sub>). Data were recorded on plant fresh weight, number of pseudo bulbs and height of the plant at the time of planting and 16 weeks after treatments when transferring to net pots. Leaf width was also measured after a 16 week period. The experiment was laid as CRD with four replicates each consisted of six number of plants.

#### **Net Pot Stage (2")**

Two varieties (white intermediate type, and purple phalaenopsis type) were treated with all the natural extracts described above and PGRs. Data were collected on fresh weight, number of pseudo bulbs and height (plant height was measured from the base of the plants to the end of the longest leaves) of the plant at planting and at transferring to 5" pots *i.e.* 16 weeks after planting. Leaf width was also measured after 16 weeks. The experiment was set up as two factor factorial CRD experiment with ten replicates.

Plant growth in terms of fresh weight increment, height increment and pseudo bulb increment during the community pot stage and the 2" net pot stage was calculated and subjected to statistical analysis.

#### **Statistical Analysis**

Data were analyzed using ANOVA method with SAS (9.1.3) computer software. Count data (No. of pseudo bulbs) were square root transformed prior to the analysis.

## **RESULTS AND DISCUSSION**

### **Community Pot Stage**

#### **Weight Increment**

Statistical analysis of this parameter showed that none of the treatments affected the weight increment significantly (Table 1). However, minor differences in mean values were observed among treatments and highest weight increment (3.78 g) was recorded with coconut water application followed by yeast extract (3.67 g). Coconut water enhances the *in-vitro* proliferation of Dendrobiums. Spraying vegetables with mature coconut water resulted in significantly higher yield than control (Omo, 2013). However, in the present study the effect of coconut water on vegetative growth was meager. The plants treated with napGibb

performed poor in terms of weight and recorded the lowest weight increment (2.26 g). Leaf yellowing and leaf senescence were observed in plants treated with napGibb 2-3 days after application and therefore the plants looked weak with low no. of leaves than other treatments. That was the reason for poorest weight increment of those plants.

#### Height Increment

Plant height was affected by the treatments significantly (Table 1). Application of napGibb had a significant effect on plant height and recorded the maximum height increase (7.98 cm). However, height increase in other four treatments was not significant. Two of the most characteristic effects of GA<sub>3</sub> on shoot growth are increased inter-node extension and increased leaf-growth as reported by (Brian, 2008). Therefore, in the present study the effect of GA<sub>3</sub> on plant height was clearly seen.

#### Increment of Pseudo Bulbs

Production of pseudo bulbs was not significantly influenced by the application of natural extracts and napGibb (Table 1). However, plants treated with coconut water had slight increase in number of pseudo bulbs (1.00), while the lowest value (0.71) was recorded by napGibb treatment.

#### Leaf Width

Significant increase in leaf width (1.78 cm) was observed in plants treated with coconut water followed by yeast and garlic extracts (Table 1). Coconut water is a rich supplement of plant growth regulators (Auxins and Cytokinines; Omo, 2013) and they promote the vegetative growth of plants. napGibb treatment caused significant decrease in leaf width. Cardoso *et al.* (2012) have also observed same phenomenon when plants were sprayed with low concentration of GA<sub>3</sub>.

#### Net Pot Stage

Statistical analysis of data showed that there was no interaction effect of the two factors considered in this experiment on plant growth. However, all the parameters were significantly influenced at variety level and treatment level separately (Table 2).

Variety 1 (white, intermediate type) had significant weight increment, height increment and pseudo bulb increment than variety 2 (purple, phalaenopsis type). However, variety 2 had significantly broader leaves than variety 1. Morphologically, variety 2 had short and broad leaves, while variety 1 produced thin long leaves. The significant differences in growth of

the plants attributed to the genetic factors of the varieties. With these results it can be understood that growth of the two varieties was not similar. Growth of variety 1 was faster than variety 2.

**Table 1. Growth of Dendrobium plants under different treatment at community pot stage**

| Treatment      | Mean weight increment -ent (g) | Mean height increment -ent (cm) | Mean pseudo bulb increment -ent | Mean leaf width (cm) |
|----------------|--------------------------------|---------------------------------|---------------------------------|----------------------|
| T <sub>1</sub> | 3.18                           | 3.70 <sup>b</sup>               | 0.88                            | 1.26 <sup>bc</sup>   |
| T <sub>2</sub> | 2.63                           | 3.47 <sup>b</sup>               | 0.71                            | 1.43 <sup>ab</sup>   |
| T <sub>3</sub> | 3.78                           | 4.93 <sup>b</sup>               | 1.00                            | 1.78 <sup>a</sup>    |
| T <sub>4</sub> | 3.67                           | 5.08 <sup>b</sup>               | 0.96                            | 1.45 <sup>ab</sup>   |
| T <sub>6</sub> | 2.26                           | 7.98 <sup>a</sup>               | 0.96                            | 0.96 <sup>c</sup>    |
| CV             | 16.36                          | 8.60                            | 12.94                           | 12.24                |

ns ns

T<sub>1</sub>- Control, T<sub>2</sub>- Garlic extract, T<sub>3</sub>- Coconut water, T<sub>4</sub>- Yeast extract, T<sub>6</sub>- napGibb, ns: Not significant at p=0.05, Means followed by the same letter along column are not significantly different at p=0.05

**Table 2. Varietal differences in growth in net pot stage**

| Variety        | Mean weight increme -nt(g) | Mean height increme -nt (cm) | Mean pseudo bulb increme -nt | Mean leaf width (cm) |
|----------------|----------------------------|------------------------------|------------------------------|----------------------|
| V <sub>1</sub> | 3.58 <sup>a</sup>          | 4.17 <sup>a</sup>            | 1.13 <sup>a</sup>            | 1.48 <sup>b</sup>    |
| V <sub>2</sub> | 2.73 <sup>b</sup>          | 3.32 <sup>b</sup>            | 0.82 <sup>b</sup>            | 1.85 <sup>a</sup>    |
| CV             | 16.34                      | 22.56                        | 16.9                         | 8.19                 |

V<sub>1</sub>- White intermediate type, V<sub>2</sub>- Purple phalaenopsis type, Means followed by the same letter along the column are not significantly different at p=0.05

#### Weight Increment

Significant differences of weight increment were observed among the treatments (Table 3). Plants sprayed with aloe extract recorded the highest weight increment (5.95 g) and it was twice as the control plants. Yeast extract treated plants had the next highest mean value while garlic extract, BAP and control plants had statistically similar weight increments. The least weight increment (1.35 g) was due to GA<sub>3</sub> application. Atowa, (2012) found a favorable effect of yeast extract on improving vegetative growth of *Freesia refracta* in his experiment. Another study has shown a favorable effect of active dry yeast extract on vegetative growth characters of cucumber plants (El Sagan, 2015). So, our results are on par with these findings.

#### Height Increment

Plants treated with GA<sub>3</sub> and napGibb recorded the highest and statistically similar plant heights, 6.69 cm and 5.44 cm respectively followed by yeast extract treatment (Table 3). For the increase in height however aloe extract

had no favorable effect. Mean height of plants was similar with control (2.35 cm), coconut water (2.68 cm) and BAP (2.72 cm) treated plants. However, as in the community pot stage 1, GA<sub>3</sub> and napGibb treated plants were poor in appearance and had less number of leaves. So in terms of fresh weight the growth was very meager. The increase in plant height was more due to the increase in leaf length. GA<sub>3</sub> when applied in low concentrations, caused significant increase in leaf length as reported by (Cardoso *et al.*, 2012).

**Table 3. Growth of Dendrobium plants under different treatment at net pot stage**

| Treatment      | Mean weight increment (g) | Mean height increment (cm) | Mean pseudo bulb increment | Mean leaf width (cm) |
|----------------|---------------------------|----------------------------|----------------------------|----------------------|
| T <sub>1</sub> | 2.97 <sup>c</sup>         | 2.35 <sup>c</sup>          | 0.78 <sup>c</sup>          | 1.86 <sup>ab</sup>   |
| T <sub>2</sub> | 2.87 <sup>c</sup>         | 3.31 <sup>bc</sup>         | 1.06 <sup>abc</sup>        | 1.63 <sup>c</sup>    |
| T <sub>3</sub> | 2.62 <sup>cd</sup>        | 2.68 <sup>c</sup>          | 0.89 <sup>bc</sup>         | 1.60 <sup>c</sup>    |
| T <sub>4</sub> | 4.55 <sup>b</sup>         | 4.24 <sup>b</sup>          | 0.83 <sup>bc</sup>         | 1.92 <sup>a</sup>    |
| T <sub>5</sub> | 5.95 <sup>a</sup>         | 2.54 <sup>c</sup>          | 0.83 <sup>bc</sup>         | 2.04 <sup>a</sup>    |
| T <sub>6</sub> | 2.12 <sup>d</sup>         | 5.44 <sup>a</sup>          | 1.17 <sup>ab</sup>         | 1.38 <sup>d</sup>    |
| T <sub>7</sub> | 1.35 <sup>e</sup>         | 6.69 <sup>a</sup>          | 1.28 <sup>a</sup>          | 1.23 <sup>e</sup>    |
| T <sub>8</sub> | 2.83 <sup>c</sup>         | 2.72 <sup>c</sup>          | 0.94 <sup>bc</sup>         | 1.69 <sup>bc</sup>   |
| CV             | 16.34                     | 22.56                      | 16.90                      | 8.19                 |

T<sub>1</sub>- Control, T<sub>2</sub>- Garlic extract, T<sub>3</sub>- Coconut water, T<sub>4</sub>- Yeast extract, T<sub>5</sub>- Aloe extract, T<sub>6</sub>- napGibb T<sub>7</sub>- GA<sub>3</sub>, T<sub>8</sub>- BAP, Means followed by the same letter along the column are not significantly different at  $p=0.05$

#### Increment of Pseudo Bulbs

Pseudo bulb increment was significantly affected by treatments (Table 3). The highest increment of pseudo bulbs (1.28) was recorded by GA<sub>3</sub> treated plants. Gibberellic acid is known to increase the vegetative growth of plants. Barman *et al.* (2014) also reported that it increased the number of shoots per plant, when applied at 100 and 200 ppm to Dendrobium hybrid. However, the effect was much higher when it was sprayed in combination with BAP. Coconut water, yeast extract, aloe extract and BAP treated plants produced statistically similar number of pseudo bulbs. Benzyleaminopurine enhances axillary shoot proliferation, however, in this study the effect was not observed and it may be due to the fact that concentration used was low.

#### Leaf Width

Aloe extract and yeast extract had profound effect on increasing leaf width. The narrowest (1.23 cm) leaves had been produced in the plants treated with GA<sub>3</sub>. So extracts of aloe and yeast could be used as bio stimulants in improving the growth of agricultural crops specially for ornamental plants. Cardoso *et al.* (2012) found that leaf width of phalaenopsis

orchid decreased with the application of GA<sub>3</sub> which we have also observed in our experiments.

### CONCLUSIONS

Results of the present study showed that effects of natural extracts on plant growth parameters varied with growth stage. At community pot stage garlic extract, yeast extract and coconut water had no favorable effect on fresh weight and height increments. napGibb increased the plant height and coconut water had significant effect on leaf width.

In the second experiment with 2" net pot plants, treatment and the variety independently affected the growth parameters. Aloe extract had a profound effect on weight increment of plants and significant increase in leaf size could be the main reason. GA<sub>3</sub> and napGibb significantly increased the plant height but both treatments gave weaker plants. However, application of GA<sub>3</sub> favored increment of pseudo bulbs. The cytokinin; BAP had not favorably affected any growth parameters measured in the experiment. It was also identified that variety 1 had quicker growth than variety 2. The plants should be observed for flowering characteristics to draw a better conclusion.

### ACKNOWLEDGEMENTS

The authors wish to express sincere gratitude to Ms. J.C. Rajapakse, Research Officer In-Charge, Agriculture Research Station, Telijjawila for facilitating this study. Thanks are also due to staff members of Tissue Culture and Floriculture Division for their support. Gratitude is extended to Dr. Kapila Yakandawala, Head of the Department of Horticulture and Landscape Gardening and Mr. K.H.M.I. Karunaratne, Instructor, Information and Communication Center, Wayamba University of Sri Lanka, for his assistance in analyzing the results.

### REFERENCES

- Anon. (2016). Plant Quarantine Station, Katunayaka, Sri Lanka.
- Atowa, D.I. (2012). Effect of growing media, Organic and Biofertilizers on growth and flowering of *Freesia refracta* cv.Redlion, MSc thesis, Department of Ornamental Horticulture Faculty of Agriculture Cairo University, Egypt.
- Barman, D., Bharathi, T.U., Pokhrel, H., Naik, S.K. and Medhi, R.P. (2014). Influence of concentration and mode of application of different growth regulators on dendrobium hybrid *Thongchai Gold*, *Journal of Crop and Weed*, 10 (2), 223-230.

- Brian, P.W. (2008). Effect of gibberellins on plant growth and development, online publication, available at <http://onlinelibrary.wiley.com/doi/10.1111/j.1469-185.1959.tb01301.x/references>. (Accessed 30 May 2015).
- Cardoso, J.C., Ono, E.O. and Rodrigues, J.D. (2012). Gibberellic acid in vegetative and reproductive development of *Phalaenopsis* orchid hybrid genus. *Horticultura Brasileira*, **30**, 71-74.
- El Sagan, M. A. M. (2015). Effect of Some Natural Extracts on Growth and Productivity of Cucumber under Sandy Soil Conditions. *International Journal of Advanced Research*, **3** (9), 677-686.
- Hanafy, M.S., Saadawy, F.M., Milad, S.M.N. and Ali, R.M. (2012). Effect of Some Natural Extracts on Growth and Chemical Constituents of *Schefflera arboricola* Plants. *Journal of Horticultural Science and Ornamental Plants*, **4** (1), 26-33.
- Lopez, R.G. and Runkle, E.S. (2005). Environmental Physiology of Growth and Flowering of Orchids, *Hortscience*, **40** (7), 1969-1973.
- Omo, G.D. (2013). Growth and Yield of Selected Vegetables, Sprayed with Mature Coconut Water, *International Scientific Research Journal*, **5**, 3.