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Research Article

Identifying a Most Suitable Fertilizer Combination Forsucker Formation of Anthurium Andraeanum 'Lady-Jane-Lalani'

WMDN Warigajeshta[1]*, YMU Anjali[2] and SA Krishnarajah[2]

[1]*Landscape Division, the Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka*

[2]*Floriculture Research and Development Unit, Department of National Botanical Gardens, Peradeniya, Sri Lanka*

***Corresponding Author:** WMDN Warigajeshta, Landscape Division, the Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka.

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Abstract

The effect of fertilizers on shoot initiation of 'Lady Jane' type *Anthuriumandraeanum* cv. 'Lalani' was studied under net house conditions to produce quality plants for ornamental purposes. The experiment was conducted at the Department of National Botanic Gardens, Peradeniya, using tissue cultured *A. andraeanumc* v. 'Lalani' plants grown on a medium of coconut husk pieces only. Four different fertilizer combinations (T1)5g of granule (N: P: K 11:11:18) +Water soluble (N:P:K 6:30:30) + Organic liquid fertilizer, (T2) 5g of granule (N: P: K 11:11:18) + Water soluble (N:P:K 10:20:40)+ trace elements with chelated technology (liquid), (T3) 5g of granule (N:P:K 13:06:27) + Water soluble (N:P:K 10:20:40)+ trace elements with chelated technology (liquid) and (T4) 5g of granule (N:P:K 13:06:27) + Water soluble (N:P:K 20:20:20) +extracts of the sea plant were tested. The fertilizer combination T2showed best performance for parameters number of new shoots, height of plant and number of leaves. Thus 5g of slow release granule (N:P:K11:11:18) combined with Water soluble (N:P:K 10:20:40) + trace elements with chelated technology was considered the most suitable fertilizer combination for the initiation of shoots of *Anthuriumandraeanum* cv. 'Lalani' under local climatic condition in a net house with 70% shade.

Keywords: *Anthuriumandraeanum*; fertilizer; shoots; potted plants

Introduction

Anthuriums are well known as an exotic ornamental crop. They belong to the family Araceaeand are cherished for their colourful long lasting unique flowers and shiny foliage. It is also an excellent plant for interior decor as well as a cut flower, especially for flower arrangements. The "Lady Jane" type potted plant *Anthurium andraeanum* named 'Lalani' is a beautiful new variety produced in 2015 by the Floriculture Research and Development Unit (FRDU), Department of National Botanic Gardens (DNBG) Peradeniya, Sri Lanka.

Quality of plants are directly related to nutritional aspects, that is, the plant needs to be well nourished to exhibit attractive visual characteristics in a controlled development (Ferrante et al. 2015). According to Dufour and Guerin (2005), fertilizer application and chemical composition of nutrients are the main factors affecting *Anthurium* development and yield. Chelated fertilizers have been developed to increase micronutrient utilization efficiency. The word chelate is derived from the Greek word chelé, which refers to a lobster's claw. Hence, chelate refers to the pincer-like manner in which a metal nutrient ion is encircled by the larger organic molecule (the claw), usually called a ligand or chelator. Chelated micronutrients are protected from oxidation, precipitation, and immobilization in certain conditions. The pincer-like manner in which the micronutrient is bonded to the ligand changes the micronutrient's surface property and favors the uptake efficiency of foliar applied micronutrients. This study included the use of fertilizers with chelated micro/ trace elements.

Most *A.andraeanum* varities are used as cut flowers however 'Lady Jane' varieties are widely use as potted plants. The beauty of this variety increases when they have many bushers/suckers with flowers. Yet only avery limited number of experiments have been carried out to assess the most suitable fertilizer combination for increase in sucker formation. This research was initiated with the aim of determining the most suitable fertilizer combination for increase production of new suckers of the new variety, "Lalani' under local climatic conditions.

Materials and Methods

The experiment was conducted in a 70% shade net house of the Floriculture Research and Development Unit (FRDU), Department of National Botanic Gardens (DNBG), Peradeniya with tissue-cultured plants of the hybrid cv. 'Lalani'. Plants with an average mean height of 16.5cm were potted in 12.5cm black plastic pots in a potting media consisting of Coconut husk pieces only. A total of 60 plants were used to test 4 different fertilizer combinations. (T1) N: P: K 11:11:18 (granules) + N:P:K 6:30:30 (liquid) + Organic liquid extract of sea weed containing microelements (Control), (T2) N: P: K 11:11:18 (granules) + 10:20:40 (liquid) + fertilizer with trace elements in chelated form(liquid with Fe 2%, Zn 2%, Mn 1.4%, B 0.75%, Cu 0.25%, Mo 0.04%, Mg 0.94, S 1.4%), (T3) 13:06:27 (granule) + 10:20:40 (liquid) + Fertilizer with trace elements in chelated form(liquid with Fe 2%, Zn 2%, Mn 1.4%, B 0.75%, Cu 0.25%, Mo 0.04%, Mg 0.94, S 1.4%) and (T4) 13:06:27 (granule) + 20:20:20 (liquid) + natural extracts of a sea weed (*Ascopilliumnodosam* and easily absorbed by the plant stomata. The experiment was arranged according to a Complete Randomized Design.

Growth of plants were measured at two-month intervals from June 2021 to March 2022 with following growth parameters, number of new shoots/ suckers, number of new leaves, and height of plant (cm) from the base to the top of the leaf. T1, a fertilizer combination [5g of slow release granule fertilizer (N:P:K 11:11:18) + Water soluble fertilizer (N:P:K at a ratio of 06:30:30)+ Organic liquid] regularly used for Anthuriums at the FRDU of the DNBG was considered as the control treatment.

Statistical analysis was performed using Past 4.03 statistical package. Krukal-Wall is test was also done on data. Data were subjected to analysis of variance (ANOVA). Mean separation was done using Tukey's pair wise procedure.

Results and Discussion

Average number of new shoots is a good indicator for growth of plants, besides increased sucker formation makes Anthuriums more attractive as potted plants. Therefore, number of new shoots per plant is a very important parameter. A significantly ($P<0.05$) high average number of new shoots (7.8) was produced by plants treated with fertilizer combination T2. The second highest number of new shoots (5.6) was produced when treated with the fertilizer combination T1 (Fig 01). Plants treated with the fertilizer combination T4 showed better performance compared to combination T3. Considering the parameter number of new shoots, plants treated with 5g of slow-release granules (N: P: K 11:11:18) and water-soluble fertilizers (N.P.K 10:20:40), along with a liquid fertilizer solution with Trace elements in chelated form developed the highest number of new suckers in this experiment.

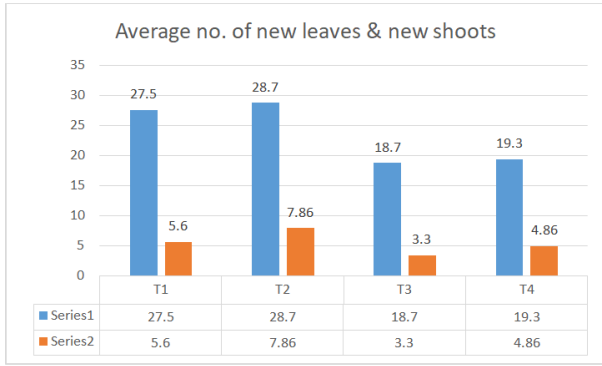
The liquid fertilizer solution with Trace elements used in this study was a product rich in many trace elements; Fe 2%, Zn 2%, Mn 1.4%, B 0.75%, Cu 0.25%, Mo 0.04%, Mg 0.94, S 1.4% with chelated technology. Ease in absorption of chelated chemicals though utilizing of this liquid fertilizer may be one of the reasons to have recorded best shoot development. Besides both Slow release fertilizer pellets and liquid fertilizer with N:P:K used in this treatment contained a higher ratio of Potassium.

Potassium (K) is the most abundant inorganic cation, and it is important for ensuring optimal plant growth (White and Karley, 2010). K is an activator of dozens of important enzymes, such as protein synthesis, sugar transport, N and C metabolism, as well as photosynthesis. It plays an important role in the formation of yield and quality improvement (Marschner, 2012; Oosterhuis et al., 2014). K is also very important for cell growth, which is an important process for the function and development of plants (Hepler et al., 2001). In terms of the growth-promoting mechanism of K, it is generally agreed that K stimulates and controls ATPase in the plasma membrane to generate acid stimulation, which then triggers cell wall loosening and hydrolase activation (Oosterhuis et al., 2014), thus promoting cell growth. K has strong mobility in plants and plays an important role in regulating cell osmotic pressure as well as bal-

ancing the cations and anions in the cytoplasm (Kaiser, 1982; Hu et al., 2016a). Through these processes, K is involved in the regulation of stomatal opening and closing, cell elongation, and other important physiological processes. The higher level of K may have been another be a reason for the higher number of sucker formation in plants treated with treatment T2.

According to Zeng (2001) application of K improves nut quality in pistachio trees, with increased percentage of split nuts and nut weight and reduced percentages of blank and stained nuts. Moreover, increasing Potassium level had positive effects on plant height, head diameter, number of achenes and seed quality of sunflowers (*Helianthus annuus L.*) (Dar et al., 2021) similar to this experiment. Research conducted in Egypt and Turkey indicated positive response of potassium fertilization on the yield of sugar beet (Basha, 1994; Kasap and killi, 1994; Nigrila et al., 1994). Furthermore, highest increase of 50% over control in paddy yield was recorded in treatment receiving K at 60 kg K2O/ ha (Khan et al., 2007). Alderfasi and Refay (2010) indicated that application of K fertilizer at the rate of 200 kg K2O/ha at different growth stages recorded the highest value of most growth characters. However, increasing potassium rates above this level had no significant effect. In our experiment N:P:K10:20:40 was the most suitable combination for sucker formation, height of plant and number of leaves, however , this experiment did not contain higher amounts of K beyond this ratio. An experiment undertaken in glasshouses at the University of New England to investigated that application of K significantly increased tiller number, plant height, shoot and dry matter production and stem diameter of the rice (Bhiah et al. 2010)

Nutrient management is crucial for optimal productivity in commercial crop production. Nutrients in concentrations of ≤ 100 parts per million (ppm) in plant tissues are described as micronutrients and include iron (Fe), zinc (Zn), manganese (Mn), copper (Cu), boron (B), chlorine (Cl), molybdenum (Mo), and nickel (Ni). Micronutrients such as Fe, Mn, Zn, and Cu are easily oxidized or precipitated in soil, and their utilization is, therefore, not very efficient. Chelated fertilizer application can improve micronutrient use efficiency and make micronutrient fertilization more cost effective.



Series 1: Average no. of new leaves, *Series 2:* Average no. of new shoots.

Figure 1: Average Number of new leaves &shoots in fertilizer combinations.

According to results obtained, fertilizer combination T2 consisting of 5g of slow release granule fertilizer (N:P:K 11:11:18)+ water soluble fertilizer (N: P: K 10:20:40)liquid fertilizer with chelated trace elements was the best combination for leaf production as well, with an average of 28.7 new leaves per plant. T1with 5g of slow release granule fertilizer (N:P:K 11:11:18)+ water soluble fertilizer (N:P:K 6:30:30)+ organic liquid fertilizer which was the control treatment showed the second best performance with an average of 27.5 leaves. T4 [5g of slow release granule fertilizer (N:P:K 13:06:27) + water soluble fertilizer (N:P:K 20:20:20) + sea weed extracts] showed the next best performance for leaf production. However, T3 [5g of slow release granule fertilizer (N:P:K 13:06:27) +water soluble fertilizer (N:P:K 10:20:40) liquid fertilizer with chelated trace elements]showed the lowest performance for leaf production as seen in Fig 2. However, there was no significant difference ($P<0.05$) between T2 and T1.

Number of leaves in plants affects the rate of photosynthesis, which is a main metabolic activity that affects growth and development (Suarez, 2010). Vegetative growth such as number of leaves, length of stalk and flowering of gerbera was increased through application of liquid fertilizer in the form of foliar application (Khosa et al., 2011). Plants treated with the fertilizer combination T2 may have produced highest number of leaves due to optimum amount of nutrients received by these plants through foliar and slow release applications of fertilizers.

Optimum amount of nutrients is important for maximum leaf growth. According to Fageria et al. (2009) multi nutrient fertilization could be a practical method to provide balanced plant nutrition in horticulture. The liquid fertilizer with chelated trace elements used in the study coupled with slow release and liquid fertilizers with major element N:P:K is also a multi nutrient fertilizer combination. A combination of Fe 2%, Zn 2%, Mn 1.4%, B 0.75%, Cu 0.25%, Mo 0.04%, Mg 0.94, S 1.4% with water soluble fertilizer (N:P:K10:20:40) and slow release (N:P:K 11:11:18) at the optimum amount would have increased leaf number in plants. However, there was no significant difference between T2 and T1. This may be due to a combination of the organic liquid fertilizer which is also a multi nutrient foliage fertilizer along with water soluble fertilizer (N:P:K6:30:30). Javaid et al. (2005) revealed, highest number of leaves can be obtained by application of macro and micronutrient solutions.

Nitrogen (N) is one of the most compulsory mineral elements for growth of plants and K plays a great role in N metabolism, both elements being widely applied as fertilizers in agricultural production. Plants require P during early growth, the importance of adequate tissue P concentrations during early-season growth has been reported in many different crop species (Grant et al. 2001). Experiments in Ontario have shown that corn grain yield was strongly affected by P supply and tissue P concentration in the early stage, rather than by P concentration later in growth (Barry and Miller 1989; Lauzon and Miller 1997). Gavito and Miller (1998a) reported that enhanced early-season P nutrition in corn increased dry matter partitioning to the grain at later development stages. In this experiment too, better performance was observed when fertilizer combination with a comparatively high P ratios were used, as slow release NPK 11:11:18 and liquid fertilizer 10:20:40 and 6:30:30. They showed the best performance for shoot initiation as well as number of new leaves. While the combination T3 had a lower P ratio and produced the lowest number of leaves.

Many reports have also been published on the effect of K on plant growth. Jin et al. (2007) found that the highest yield and fruit quality were obtained in Red Fuji apple under treatment with 600 kg/ha K; Wang et al. (2017) determined that 6 mM K treatment promoted pear growth and improved photosynthetic efficiency; and Lu et al. (2001) also reported increased production with better fruit quality parameters in navel orange supplied under 500 kg/ha K. In this experiment too, it was observed that the best performance of both new shoots and new leaves formation was recorded when the fertilizer combination contained high K (Liquid form KPK 10:20:40). An increased amount of potassium as discussed earlier for production of higher number of shoots may have also resulted in the production of a higher number of leaves.

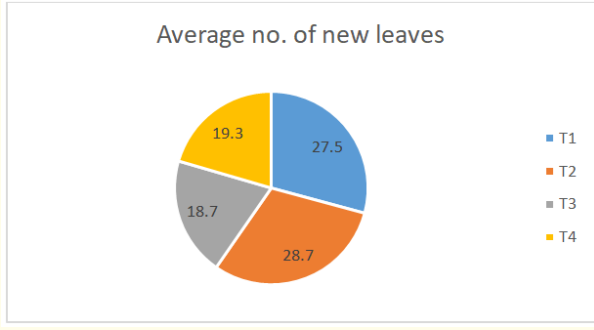


Figure 2: Average Number of Leaves in different fertilizer combinations.

Highest average plant height (30.7 cm) was recorded in plants treated with fertilizer combination T2 [5g of slow release granule fertilizer (N:P:K11:11:18) + Water soluble fertilizer (N:P:K10:20:40) + liquid fertilizer with chelated trace elements]. Plants treated with fertilizer combination T3 showed the second best performance of 30.1 cm average height, while fertilizer combination T1 (control) was better than T4 (Fig 03). However there was no significant difference between the fertilizer combinations T2 and T3.

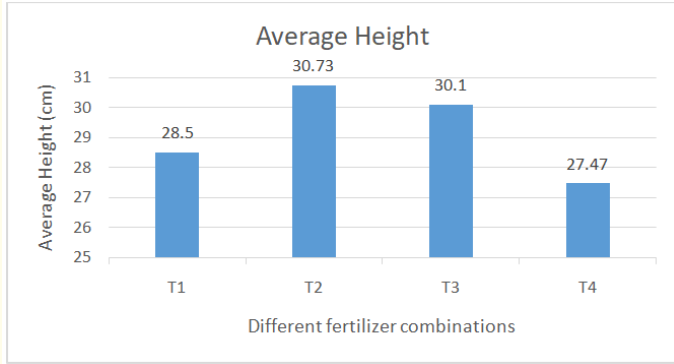


Figure 3: Average plant height (cm) in different fertilizer combinations.

Results show that plant height and number of new shoots were significantly higher in fertilizer combination T2. The highest number of leaves produced was also shown in plants treated with fertilizer combination T2.

According to Frahdian et al. (2018) plant height is influenced by the availability of nutrients and nutrient uptake by roots. Average plant height was significantly higher in fertilizer combination T2 and T3 since both treatments had a combination of liquid and granular fertilizers with both macro and micro nutirents. Application of fertilizers is widely used to improve plant growth and productivity (Shen et al., 2010). Liquid fertilizers have the potential to increase plant growth and development (Liu et al., 2014). Accoding to Zhang et al. (2017) plant height is an imoprtant agronomic feature. Considering the above reports plants treated with fertilizer combinations T2 and T3 may have obtained optimum nutient supply to produce tallest plants due to availbility of macro and micronutirenst in both liquid and soilid form. Besides nutrients were available immediately as well as in the long term with the combination of water soluble as well as slow release fertilizers.

According to Marilyn et al (1999), slow-release fertilizer or time-release fertilizer are excellent for orchids growing in tree-fern bark or other stable soil less material since they need to be fertilized frequently at lower concentrations. Similar finding was observed in this study as well. A combination of N: P: K 11:11:18 (granules) with water soluble fertilizer and liquid fertilizer solution with chelated trace elements was best suited for anthuriums grown in a soil less medium of coconut husk only. Balanced complete fertilizer application gave better plant growth than the other treatments (Nogueira et al. 1981). Anthuriums being epiphytes also prefer a slow but steady absorbtion of nutrients. Continued applications in small quantities. Thus, plants treated with fertilizer combinations consisting of both controled release nutients available in the long term and immediately with liquid fertilizers recorded an appreciable performance for all plant growth prameters.

Plants grown in a substrate of coconut husk pieces only fertilized with slow release granule fertilizer (N:P:K11:11:18) + water soluble fertilizer 10:20:40 + liquid fertilizer solution with chelated trace elements was the significantly best fertilizer combination for growth of anthurium plants in parameters studied (i.e. initiation of new suckers, plant height as well as leaf production).

Conclusion

A combination of slow release granular fertilizer, soluble inorganic fertilizers and liquid fertilizer containing macro and micro elements [Slow release granules N:P:K 11:11:18 + water soluble N: P: K 20:20:40 + liquid fertilizer mixture with trace elements] was observed to be the best treatment for initiation of new shoots, plant height as well as number of new leaves.

Thus it may be concluded that the growing media Coconut husk pieces only supplemented with a combination of5g of slow release granule fertilizer (N:P:K 11:11:18) + water soluble fertilizer (N:P:K 10:20:40) + liquid fertilizer mixture with trace elements was the most suitable fertilizer combination for the growing of 12-14month old *Anthuriumandraeanum* cv. Lalani under 70% shade.

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