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Effect of Foliar Application of Chemical Nutrient Mixture and Growth Regulators on Different Leaf Parameters of Pot-*Anthuriums*

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ABSTRACT

Background: Leaves are vital plant organs executing major physiological functions of plants. They act as a primary site for carbohydrate synthesis and transpiration. The leaf characteristics also readily affect the flowering. Chlorophyll in the leaves plays major role in photosynthesis. In pot plant industry, the size, shape and colour hold the commercial value. An experiment was carried out on tropical flowering Anthuriums for pot plant production in coastal Bhubaneswar area under AICRP floriculture to study effect of different nutrients and growth regulators/bio-stimulants on pot- *Anthuriums* leaves.

Methods: The treatments include five types of nutrient solution sprayed with varying frequency of weekly once and twice and six types of growth regulators with varying forms and concentrations. Significant variation was observed in different leaf parameters obtained from different treatment combinations.

Result: Among all the nutrient treatments, liquid MS medium resulted better leaf characteristics with once week spray and among different growth regulators, GA_3 @ 200 ppm resulted better leaf characteristics. Among the treatments, spraying of liquid MS medium once in week resulted in highest leaf breadth (1.93 cm), leaf area (8.20 cm^2) and leaf chlorophyll content (0.87 mg/ cm^2). Spraying liquid MS medium once in a week along with GA_3 @ 200ppm sprayed at two months interval resulted in largest leaf area (12.42 cm^2).

Key words: GA_3, Leaf parameters, Liquid MS medium, Pot-*Anthuriums*.

INTRODUCTION

City dwellers prefer pot plants especially with flowers due to their easy adaptation to indoor space. The *Anthuriums* are tropical flowering genus of Aracaece family renowned for its bright colourful spathe and spadix. These plants grow well under semi shade condition with slow growth habit. *Anthuriums* ranks next to the orchids in Asian cut flower market. According to Volza's Global Export data, World exported 178 shipments of *Anthurium* to India from Mar 2023 to Feb 2024 which indicates increasing popularity of the flower in our country. The long-lasting nature of this flower has helped them in gaining popularity in pot plant industry. In Odisha, the floriculture industry is still in fledging stage. There are vast scopes for the emerging entrepreneurs of the state to encourage activities for pot plant production in nurseries in subsequent years. The climate of undivided Koraput district and coastal districts of Odisha is well suited for cultivation *Anthuriums* in Odisha (Beura *et al.*, 2017) and agri-entrepreneurs can draw benefits from this. External application of nutrient solutions help plant in attaining the optimal growth. Primary nutrients such as nitrogen, phosphorus, potassium perform crucial role in plant growth and metabolism. Nitrogen is basic components of plant proteins, enzymes and leaf chlorophyll. Phosphorus actively takes part in fat metabolism and producing energy coin. Potassium has significant control

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in plant water regulation through stomatal opening and closing and also important for enhancing plant biotic and abiotic resistance. Flowering behavior of Anthurium plants has been drastically modified by the foliar spray of nutrients (Anand and Jawaharlal, 2004). In anthurium, yield and quality were affected by nutritional status of the plant (Cuquel and Grossi, 2004). Growth and development exert profound impact on anthurium blooms because after attaining a certain number of good sized leaves, the plant enters in to reproductive phase (Dai and Paull, 1990). Hence balanced nutrition bears prior importance in producing healthy plants. Foliar application develops immediate noticeable impact on plants and is also referred as the most effective way to grow plants in areas of water scarcity. Growth regulators also play vital role in plant lifecycle. They are signal molecules occurring naturally in little concentration inside the plant (Opik Helgi *et al.*, 2005). The practice of extraneous application of growth regulator has unveiled difference in the production, developmental process and flowers qualities (Swapna, 2000; Havale *et al.*, 2008). The entitled study "Effect of foliar application chemical nutrient mixture and growth regulators on different leaf parameters of pot-Anthuriums" was found to be effectual.

MATERIALS AND METHODS

The abovementioned experiment was conducted under AICRP on Floriculture, OUAT in the premises of Biotechnology-cum-Tissue Culture Centre, Bhubaneswar (Fig 1) during 2021-2022. Anthuriums plants were grown from suckers separated from previous plants and treated with streptocyclin solution before planting. The cocopeat was chosen to be the primary material of potting mixture due to its high water holding capacity for which it acts as

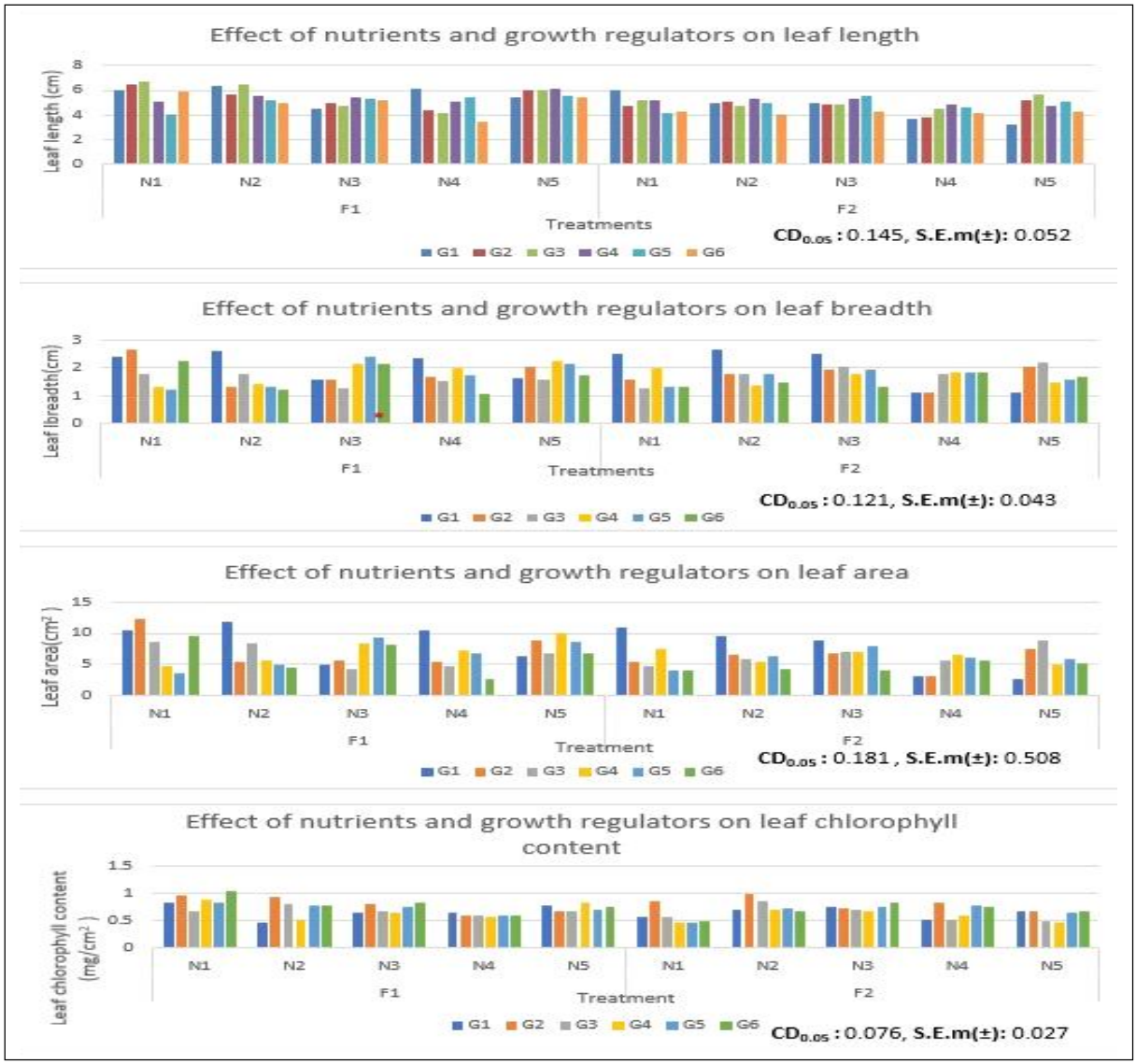


Fig 1: Effect of nutrients and growth regulators on leaf parameters of pot- *Anthuriums* (F×N×G interaction).

good replacement of peat and soil medium (Mason, 2003). The plants were planted in 15cm diameter pots having cocopeat, perlite and neem cake (10:1:1) as growing media. Bhubaneswar being situated in coastal region of Odisha experiences tropical climate. The mean average temperature differs from 35°C to 40°C in summer to 13°C to 15°C during winter days and relative humidities ranges from 50% during dry summer to 90% in humid rainy days. The plants were placed under green shade net house with overhead sprinkler. The sprinkler system was managed on accordance with the prevailing weather. Judicious and need based plant protection measures were performed especially for bacterial blight.

The experiment was laid out with Factorial Complete Randomized Design of experiment with total sixty number of treatments comprising three factors such as frequency of nutrient application, type of nutrient solution and type of growth regulator solution. The investigation comprises five number of nutrient solution (N_1- Liquid MS medium, N_2 - Macro and micro nutrient mixture, N_3- NPK (19:19:19), N_4- NPK (10:20:20) and N_5- NPK (12:61:40) along with six numbers of growth regulator solutions. The different growth regulators and bio stimulants applied were Gibberellic acid @ 100 ppm (G_1) and 200 ppm(G_2) at 2 month interval, Benzyl Adenine @ 50 ppm (G_3) and 100 ppm (G_4) at 1 month interval and humic acid @ 0.1% (G_5) and 0.2% (G_6) at 1 month interval (G_5 and G_6). All the nutrients and growth regulators were applied as foliar feeding. Foliar feeding is a technique of feeding plants by applying liquid fertilizer directly to their leaves (Kuepper, 2003).

Different nutrient solutions are sprayed weekly once (F_1) or twice (F_2) according to the treatment. The NPK solutions were sprayed at a concentration of 0.2% and plants treated with those were given an additional spray of micronutrient mixture at fortnight interval. Leaf chlorophyll content was measured by SPAD meter then converting it by using formula (Nur *et* al., 2020).

$$y= 0.0203x+0.3451$$

Where:

y= symbolize the value chlorophyll content in mg/g.

x= SPAD-502 reading.

The treatments were replicated thrice. Three number of plants are selected from every treatment for recording observations of different plant vegetative characteristics. The data recorded from different parameters were averaged to get the mean values. Statistical analysis was made using the mean values.

Statistical analysis

Analysis of variance of different variable data obtained from study was carried out for knowing the degree of freedom among the treatment. The various characteristic data recorded were analyzed by Gomez and Gomez (1984) method of analysis of variance.

RESULTS AND DISCUSSION

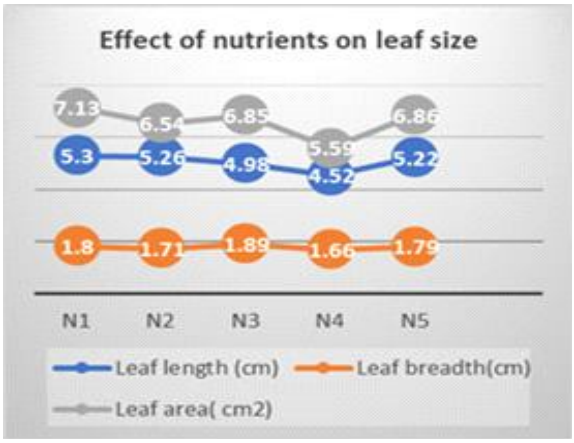
The results revealed that highest leaf length (6.70 cm) occurred in plants getting spray of liquid MS medium once in a week along with BA @ 50 ppm at one month interval (Fig 2). On an average leaf length (5.74 cm) was obtained in the treatment N:P:K (12:61:40) @ 0.2% sprayed once in a week (Table 1) followed by leaf length (5.71 cm) in plants of getting macro and micro nutrient mixture sprayed once in a week and leaf length (5.70 cm) in plants got spray of liquid MS medium once in a week which were found at par with the highest. Among different nutrient solutions, liquid MS medium spray exhibited longest leaf (5.30 cm) (Fig 3a). Among different growth regulators, BA @ 50 ppm spray at monthly interval resulted highest average leaf length (5.29 cm) (Fig 3b). In between nutrient composition and growth regulator interaction N_1G_1 (spraying of liquid MS medium along with GA_3 @ 100 ppm at monthly interval) showed highest leaf length (6.02 cm). The higher leaf length might be result of presence of ample N,P,K and micro nutrients in the liquid MS medium. Similar findings also found by Kaushal, 2018. Nitrogen contributing to vegetative growth, might be attributed better leaf length. Evidences proved maximum plant spread by BA (Mondal and Sarkar, 2018) which can be indication of presence of longer leaves.

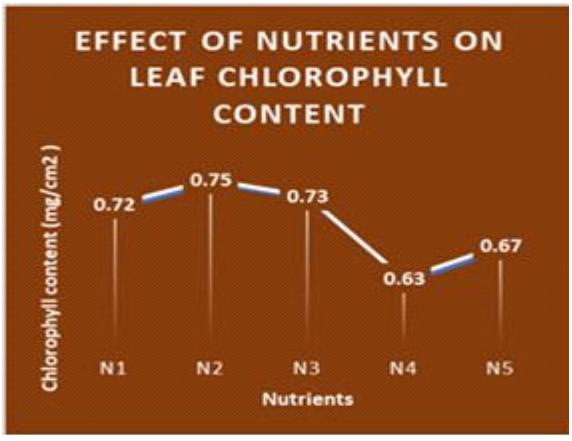
The recorded data showed that spraying of liquid MS medium once in a week along with GA_3@ 200 ppm at bimonthly interval exhibited widest leaf breadth of 2.67 cm, similar results were also seen in $F_2N_2G_1$ (spraying of macro and micro nutrient mixture twice a week along with application GA_3 @ 100 ppm at 2 month interval) (Fig 2). On an average highest leaf breadth (1.93 cm) was obtained in the treatment in F_1N_1 (spraying of liquid MS medium once in a week) and F_2N_3 [spraying of N:P:K (19:19:19) @ 0.2% twice in a week] with spraying of micro nutrient mixture at fortnightly interval] between various interaction of nutrient solutions with their frequency of spraying (Table 1). Among different growth regulators, GA_3 @ 100 ppm at monthly interval resulted highest average leaf breadth (2.05 cm) (Fig 3b) which is found similar to result observed by Bordoloi and Talukdar (2019). In between nutrient composition and growth regulator interaction, N_2G_1 (spraying of macro and micro nutrient mixture along with GA_3 @ 200 ppm at monthly interval) showed widest leaf (2.63 cm). The restorative activities of Gibberellic acid in mounting up cell division and hence impacting cell expansion can be a more possible cause for higher leaf breadth observed in anthuriums plants treated with different concentration of GA_3. The presence of micronutrients may attribute to highest leaf breadth as observed by Kaushal (2018).

It was observed that maximum leaf area (12.42 cm^2) occurred in $F_1N_1G_2$ treatment combination (spraying of liquid MS medium once in a week along with GA_3 @ 200 ppm at bimonthly interval) (Fig 2). On an average highest leaf area (8.20 cm^2) was obtained in the treatment in F_1N_1 (spraying of liquid MS medium once in a week) among various interaction between nutrient solutions with their frequency of spraying. Among different nutrient solution, nutrient solution N_1 (spraying of liquid MS medium) exhibited largest leaf (7.13 cm^2) (Fig 3a). Among different growth regulators, GA_3 @ 100 ppm at monthly interval resulted highest average

leaf area (7.91 cm^2) (Fig 3b). In between nutrient composition and growth regulator interaction N_1G_1 (spraying of liquid MS medium along with GA_3 @ 100 ppm at monthly interval) showed largest leaf area (10.69 cm^2). This might be attributed by nitrogen presence in MS medium along with interaction of micronutrient present in MS medium as according Kaushal (2018), MS micro medium along with N,P,K solution resulted highest leaf breadth which eventually indicates the leaf area of plant. On an average highest leaf area was observed in GA_3 @ 100 ppm and similar results was noticed by Bordoloi and Talukdar (2019). Rathod *et al.* (2021) also observed maximum leaf area in strawberries with application of 100 ppm of GA_3.

The outcomes of investigation sported that maximum leaf chlorophyll content (1.05 mg/g) occurred in $F_1N_1G_6$ treatment combination (spraying of liquid MS medium once in a week along with humic acid @ 0.2% at monthly interval) (Fig 2). On an average highest leaf chlorophyll content (0.87 mg/g) was obtained in the treatment in F_1N_1 (spraying of liquid MS medium once in a week) among various interaction between nutrient solutions with their frequency of spraying (Table 1). Exogeneous fertilizer



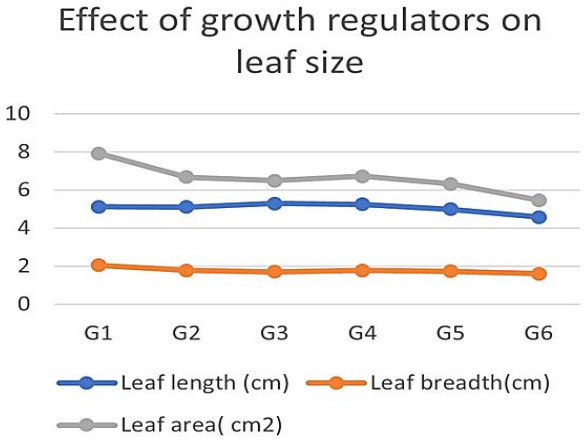


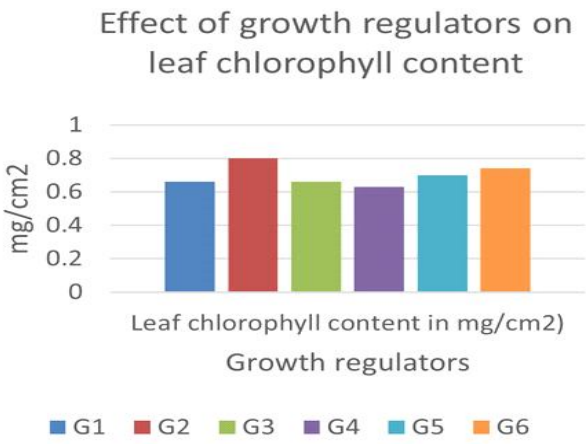
Leaf length- $CD_{0.05}$: 0.042, **S.E.m(±):** 0.015 **Leaf chlorophyll-$CD_{0.05}$:** 0.022, **S.E.m(±):** 0.008

Leaf breadth- $CD_{0.05}$: 0.035, **S.E.m(±):** 0.012

Leaf area- $CD_{0.05}$: 0.147, **S.E.m(±):** 0.052

a. Effect of nutrients on leaf parameters of pot- *Anthuriums*





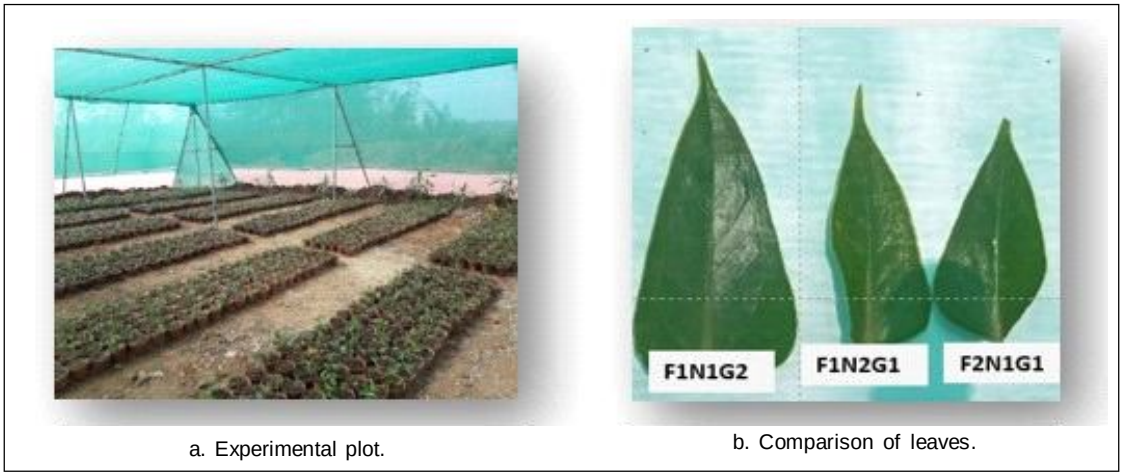
Leaf length- $CD_{0.05}$: 0.059, **S.E.m(±):** 0.021 **Leaf chlorophyll- $CD_{0.05}$:** 0.031, **S.E.m(±):** 0.011

Leaf breadth- $CD_{0.05}$: 0.049, **S.E.m(±):** 0.018

Leaf area - $CD_{0.05}$: 0.207, **S.E.m(±):** 0.074

b. Effect of growth regulators on leaf parameters of pot- *Anthuriums*

Fig 2: Individual effect of nutrients and growth regulators on leaf parameter of pot-*Anthuriums*.



a. Experimental plot. b. Comparison of leaves.

Fig 3: Photos from research field.

Table 1: Effect of interaction of frequency of application with nutrient type on different leaf parameter of pot-*Anthuriums.*

Treatments	Leaf length (cm)	Leaf breadth (cm)	Leaf area in (cm)	Leaf chlorophyll content (mg/cm^2)
F_1N_1	5.67	2.11	8.82	0.87
F_1N_2	5.51	1.87	7.55	0.72
F_1N_3	5.61	1.59	6.51	0.72
F_1N_4	5.43	1.83	7.20	0.60
F_1N_5	5.11	1.76	6.60	0.73
F_2N_1	4.99	1.69	6.33	0.57
F_2N_2	4.57	1.99	7.00	0.77
F_2N_3	4.69	1.69	5.81	0.74
F_2N_4	4.97	1.81	6.48	0.66
F_2N_5	5.07	1.71	6.24	0.60
$CD_{0.05}$	0.046	0.038	0.161	0.024
S.E.m(±)	0.016	0.014	0.057	0.009

applications were found to increase in total chlorophyll content (Duc and Hoang, 2023). The presence of nitrogen in different form along with magnesium sulphate in M liquid medium might supplemented to leaf chlorophyll content as they are the integral part of both chlorophyll a and b. Both increased level of nitrogen and magnesium positively impacts leaf chlorophyll content (Hermans and Verbruggen, 2005; Wang *et al.,* 2021; Adebayo, 2021). Among different growth regulators, GA_3 @ 200 ppm at monthly interval resulted highest leaf chlorophyll content (Fig 3b). Similar findings were obtained by Shanan *et al.* (2014) in Celosia. Aparna (2012) found that with application of higher dose of GA_3, higher chlorophyll content was found.

CONCLUSION

Considering the aforementioned outcomes, application of liquid MS medium once in a week can be recommended for attractive foliage production in pot-Anthuriums and addition of foliar spray of GA_3 @ 200 ppm at two months interval can be suggested for further enhancement of leaf vigor.

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Disclaimers

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Informed consent

All animal procedures for experiments were approved by the Committee of Experimental Animal care and handling techniques were approved by the University of Animal Care Committee.

Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this article. No funding or sponsorship influenced the design of the study, data collection, analysis, decision to publish, or preparation of the manuscript.

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