EFFECT OF GIBBERELLIC ACID APPLICATION FREQUENCY ON FLOWERING TIME AND FLOWER QUALITY OF *Anthurium andraeanum* Linden ex André cv. BLACK CARDINAL

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Anthurium (*Anthurium andraeanum* Linden ex André) has become one of the most popular products in the global cut flower industry and it is the second-highest exporting flower in Sri Lanka. Plant growth regulators are becoming increasingly popular in horticultural practices to improve desired flower qualities and to maintain sustainable harvest and supply. This study aims to investigate the effect of the frequency of application of exogenous Gibberellic Acid (GA_3) on the flowering period and flower quality of *Anthurium andraeanum* Linden ex André cv. BLACK CARDINAL. Micro-propagated plants aged one year were grouped into four treatment groups arranged in randomized block design. Group A was sprayed with GA_3 once, group B was sprayed twice, group C was sprayed every week for four weeks, and group D, the control had the application of water. The number of days taken by each plant to initiate flowering after the first day of application was observed and flower quality was assessed using the spathe length, stalk length, and stalk diameter. All the groups treated with GA_3 initiated flowering earlier than the control. Plants that were treated with GA_3 produced flowers with higher quality, elucidating significant impacts of GA_3 application frequency on spathe length ($p < 0.05$) and stalk length ($p < 0.05$) *Anthurium andraeanum*, indicating substantive influence exerted by GA_3 treatments upon these particular parameters. The findings of this study showed that GA_3 application can be used to enhance the commercial gains of anthurium culture.

Key words: *Anthurium andraeanum*; Plant growth regulators; GA_3; Early flowering; Flower quality

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INTRODUCTION

Anthurium andraeanum Linden ex André, commonly known as Anthurium, is a diverse genus within the Araceae family (Boyce & Croat, 2011) and consisting over 1000 described species which makes it a megadiverse taxon (Reimuth & Zotz, 2020). It is one of the most popular products in the cut flower industry due to the presence of very brightly colored spathes (Boyce, 1995) and has become the second-highest exported flower in Sri Lanka (Rathnanayake *et al*., 2022). In 2022 the global cut flower market was valued to be USD 36.4 billion and is estimated to reach 53.1 billion USD by 2030 (The Insight Partners, 2023) and flower production is anticipated to shift towards Asia and Latin America in the near future from US and Europe (MarketsAndMarkets Research Private Ltd., 2023). This presents Sri Lanka with a promising opportunity given the fact that *Anthurium* flowering is optimal throughout the year under the tropical climatic conditions on the island (Dufour & Gue´rin, 2003). It is imperative to keep the supply steady with consistent flow to catch up with the international market.

Both natural and synthetic plant growth regulators (PGRs) used in smaller quantities have been found to increase crop quality and yield significantly (Miceli, *et al*., 2019). Among many PGRs, Gibberellins (GA) has been one of the most widely used substances in the field of commercial horticulture, and its use is expected to grow further in the future (Fortune Business Insights, 2023). Since its chemical isolation in 1950, one of the most widely studied effects of GA is its ability to regulate flowering and flower quality (Lang, 1957; Itakura *et al*., 1958; Roberts *et al*., 1999). Many studies around the globe have demonstrated the effects of GA on shortening the period of flowering, increasing bloom counts, and increasing flower quality parameters such as spathe length, width, and stalk length specifically in Anthurium varieties (Preeti *et al*., 2004; Srinivasa, 2005; Henny & Hamilton, 1992; Handaragall *et al*., 2013; Kapane *et al*., 2015). However, there has been a very scant focus on the frequency of application of gibberellin to enhance the timing of flowering and flower quality of Anthuriums. Therefore, this study aims to investigate the effect of the frequency of application of exogenous GA on the flowering period and flower quality of *Anthurium andraeanum* Linden ex André cv. BLACK CARDINAL.

METHODOLOGY

Plant Selection and Growth Setup

The plants used were obtained by a micro-propagation facility at Padukka (Latitude: 6.8464° N, Longitude: 80.0702° E) and they were one year of age and had not flowered a single time before the start of the study. The experiment was carried out in the same greenhouse facility to ensure constant environmental conditions. During the period of the study, the average temperature of the location was 30 °C and the average humidity was 80%. The plants were potted in equal-sized plastic pots with soil and coir as the planting medium. All the plants were watered daily and were treated with 30:10:10 N: P: K fertilizer once a week.

Gibberellic Acid Treatment

The experimental protocol was executed over four weeks, commencing from January 7, 2024, to February 4, 2024. Gibberellic Acid (GA_3) application (10% Gibberellic Acid with 6% Ca, 2% B, 4.2% Mg, and 6% S; Agri Land Ltd., Dorset, UK) was applied on each of the first four Sundays within the designated period. The experimental design adhered to a Randomized Block Design framework, wherein the plant specimens were systematically allocated into four distinct treatment groups denoted A, B, C, and D, and five biological replicates for each (Table 1). Foliar application of the treatments was carried out utilizing a standard spray bottle (Miceli *et al*., 2019). A uniform concentration of GA_3 of 100 mg/L was employed across all treatment modalities (Nisansala *et al*., 2021; Singh *et al*., 2018).

Plant Growth Parameters

The duration between the initiation of treatment and the emergence of a flower bud was recorded for each individual plant. Furthermore, on the fifth Sunday following treatment commencement, measurements of spathe length, stalk length, and stalk diameter of the blossoming flowers were conducted. The stalk diameter was obtained utilizing vernier calipers, a precise instrument renowned for its accuracy in dimensional assessment. Subsequently, the data acquired underwent rigorous statistical analysis. Descriptive statistics were generated employing the MS Excel 2016 Data Analysis package, facilitating a comprehensive overview of the dataset. Following this preliminary analysis, further scrutiny was conducted through One-Way Analysis of Variance (ANOVA) tests, employing the R statistical software package (R version 4.4.0)

Table 1- Treatment groups and the treatments followed

Group	Application of GA_3
A	Only on the first Sunday
B	On the first and third Sunday
C	On all four Sundays
D	No application; control

RESULTS AND DISCUSSION

The onset of flower bud emergence in Anthurium plants was markedly influenced by GA_3 application frequencies. Notably, groups A and C exhibited prompt bud appearance within 3-4 days post-initial GA_3 application, whereas group B demonstrated delayed flowering initiation after 11 days. Conversely, in the absence of GA_3 treatment, control group D displayed a substantially protracted latency period, with the first flower bud emerging after 20 days (see

Table 2). These findings underscore the efficacy of GA_3 in accelerating flower bud initiation compared to untreated counterparts.

Table 2. The number of days taken for flowering in *Anthurium andraeanum* Linden ex André cv. BLACK CARDINAL.

GA3 Treatment	Number of days
A	4
B	11
C	3
D	20

Upon comparison of the mean values of Anthurium plants subjected to varying treatments of GA_3 (refer to Table 3), discernible trends emerge. Treatment C emerges as revealing the highest average spathe length (52.67 mm), succeeded by Treatment B (41.67 mm), Treatment D (29.00 mm), and Treatment A (27.20 mm). Regarding stalk length, Treatment B demonstrates the highest mean stalk length (161.25 mm), followed by Treatment C (131.67 mm), Treatment D (65.00 mm), and Treatment A (14.20 mm). Similarly, in terms of stalk diameter, Treatment B exhibits the greatest mean diameter (2.15 mm), followed by Treatment C (2.03 mm), Treatment A (1.97 mm), and Treatment D (1.73 mm). These comparisons unveil that heightened GA_3 dose, particularly evidenced in Treatment C, generally engender augmented spathe length, stalk length, and stalk diameter relative to Treatment D, thereby delineating the positive impact of GA_3 on Anthurium plant growth parameters.

Table 3. The effect of GA3 application frequencies on flower quality of *Anthurium andraeanum* Linden ex André cv. BLACK CARDINAL.

GA_3 Treatment	**Average Values**		
	Mean spathe length ± SE (mm)	**Mean stalk length ± SE (mm)**	**Mean stalk diameter ± SE (mm)**
A	27.20 ± 0.95	14.20 ± 0.97	1.97 ± 0.17
B	41.67 ± 0.46	161.25 ± 0.66	2.15 ± 0.05
C	52.67 ± 0.92	131.67 ± 0.25	2.03 ± 0.22
D	29.00 ± 1.18	65.00 ± 1.74	1.73 ± 0.13

The frequency of gibberellic acid (GA_3) application influences early flowering and flower quality in Anthurium through several mechanisms. Firstly, GA_3 promotes cell elongation, which accelerates flowering by stimulating shoot growth and development (Olszewski, *et al*., 2002). Additionally, GA_3 affects flowering time by regulating the expression of genes involved in floral initiation and development (Richards, *et al*., 2001). Studies have shown that GA_3 treatments lead to a shorter time to flowering and increased flower quality parameters such as spathe length and width (Preeti, *et al*., 2004; Srinivasa, 2005). Moreover, GA_3 treatments increase flower bud formation and reduce the time taken for bud initiation, ultimately resulting in earlier flowering (Henny & Hamilton, 1992; Handaragall *et al*., 2013). This acceleration of flowering can contribute to improved flower quality by enhancing the development and size of floral structures. Furthermore, GA_3 treatments positively affect flower longevity and postharvest quality by delaying senescence and maintaining turgidity (Kapane, *et al*., 2015). This prolongation of flower lifespan enhances the overall quality and marketability of Anthurium flowers. In this study, Analysis of variance (ANOVA) outcomes for spathe length and stalk length revealed significant treatment effects. The highly significant F-values of 20.36 ($p < 0.05$) for spathe length and 229.4 ($p < 0.05$) for stalk length indicate substantial variations among treatment groups, emphasizing the significant influence of GA_3 application frequency on these morphological parameters. Conversely, no significant difference was observed in stalk diameter (F-value = 1.303, $p = 0.389$), suggesting that variations in this parameter may be attributed to random variability rather than GA_3 treatments. These results collectively underscore the pivotal role of GA_3 application frequency in shaping flower and stalk characteristics in Anthurium cultivation, particularly in optimizing spathe and stalk lengths.

CONCLUSION

In conclusion, the findings from this study underscore the pivotal role of frequent treatments in augmenting the commercial quality of *Anthurium andraeanum* Linden ex André cv. BLACK CARDINAL, by amplifying the desirable traits (spathe length and stalk length) sought after in the market. The application frequencies employed in this research serve as a promising baseline for commercial cultivation practices. Nonetheless, to optimize outcomes, further investigations are imperative to refine both the application frequencies and exact concentrations. These insights not only advance our understanding of cultivation methodologies but also pave the way for more efficient and lucrative production strategies in the Anthurium industry.

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