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Foliar Application of Biostimulant Seamel Positively Adjusted the Off-season Flowers Ri 6 durian Trees

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ABSTRACT: Vietnam has rapidly emerged as a major global durian producer, marked by dramatic expansion and record yields in recent years. In 2024, Vietnam's durian output reached approximately 1.43 million tons, a year-on-year increase of nearly 25%. The industry is projected to continue growing at about 7.2% annually through 202. Durian in Vietnam flowers naturally in December–January and is harvested from May to June in the Mekong Delta, coinciding with the effect of the dry season. Off-season flowering (out-of-phase with the natural cycle) is widely practiced extending the harvest window, capture higher prices, and reduce competitive overlap. The current practices for inducing off-season durian flowering in Vietnam are the water stress, plastic mulching, and growth regulators, managed with precise irrigation and timing, to achieve reliable, high-value, year-round harvests. Biostimulants contribute to enhancing plant physiological responses, improving nutrient uptake, and increasing stress tolerance, which aids in reliable flower induction outside the usual season. Thus, the biostimulant application for off-season durian flowering in Vietnam could play supportive ways for high quality durian production and economic benefits for durian farmers. In this study, we evaluated the effectiveness of the foliar fertilizers (Seamel FLOR and Amix SILK) on the Off-season flowers inducing process of in Ri6 durian trees variety to improve flower quality, reduce fruit drop, and increase fruit setting. The results showed that the treatment with Seamel FLOR (3 ml/L) produced the best outcomes during flowering stage. Our collective results demonstrated the importance of integrating a foliar application program in durian production, particularly for influencing off-season flowering.

Keywords: Biostimulants, Seamel FLOR and Amix SILK, off-season.

INTRODUCTION

Durian (*Durio zibethinus* Murr.) production in Vietnam has expanded rapidly in recent years, particularly in the Central Highlands and the Mekong Delta. To meet market demands and increase profitability, Vietnamese farmers widely adopt off-season flowering techniques, which allow durians to be harvested beyond the natural fruiting season and sold at significantly higher prices. These techniques involve the application of water stress, plastic mulching, and growth regulators—notably paclobutrazol (PBZ)—to induce flower bud differentiation. For example, Hau and Hieu (2017) demonstrated that draining irrigation channels for 30–40 days combined with foliar PBZ application (1,000–1,500 ppm) induced flowering within 20–35 days, depending on cultivar. Similar findings were supported by Kozai *et al.* (2024), who found that PBZ combined with soil mulching effectively induced flowering by modifying plant water status and enhancing soil conditions. However, recent studies indicate that Vietnamese farmers often apply PBZ at higher-than-recommended doses—ranging from 1,240 to 1,816 ppm—raising concerns about soil residue accumulation and environmental risks (Pham *et al.*, 2022). This underscores the need to explore alternative or complementary methods, such as the use of plant biostimulants, to reduce reliance on synthetic growth regulators. Biostimulants, including microbial inoculants, seaweed extracts, and organic formulations, have shown promise in improving root development, nutrient uptake, stress tolerance, and overall plant vigor (Tran *et al.*, 2025). In particular, native *Pseudomonas* strains isolated from durian orchard soils demonstrated plant growth-promoting traits, including nitrogen fixation, phosphorus solubilization, and auxin production, suggesting potential to enhance flower development when used during the pre-flowering stage. Additionally, the combination of organic manure and foliar fertilization has been shown to significantly improve soil fertility, nutrient uptake (especially K and Ca), and fruit quality in durian orchards (Dang *et al.*, 2025). This integrated nutrient management approach not only increased yields but also reduced the incidence of physiological disorders by over 85%. Furthermore, research using the DRIS method highlighted nutrient imbalances across durian-growing regions in the Mekong Delta, indicating a need for localized fertilization strategies (Ngo *et al.*, 2024). Despite these findings, few studies have directly evaluated the interactive effects of biostimulants and growth regulators in inducing off-season flowering under Vietnam's tropical conditions. The lack of integrated protocols combining PBZ, biostimulants, water stress management, and nutrition represents a major gap in both research and extension services. This is particularly pressing in newly cultivated areas, where technical guidance for off-season production remains limited. Thus, the development of scientifically validated, region-specific flowering protocols that incorporate biostimulants is essential. These would improve production efficiency, reduce environmental impact, and enhance economic returns for durian farmers in Vietnam.

MATERIALS AND METHODS

A. Materials

—Durian orchard (Ri6 variety): over 5 years old

—Tools and equipment for experimental data collection.

Location: Lợi Trinh hamlet, My Lợi A commune, Cai Be district, Tien Giang province

Duration: June 3, 2024 – November 29, 2024.

B. Methods

Experimental design. The experiment was conducted on 16 durian trees, 6-7 years old, at Loi Trinh Hamlet, My Loi A Commune, Cai Be District, Tien Giang Province, from June 2024 to November 2024. The experiment was arranged in a completely randomized block design with 4 treatments and 4 replications, each replication consisting of 1 tree.

Treatment	Application	Dose
1	Seamel FLOR (with PBZ application)	3 ml/L
2	Seamel FLOR và Amix SILK (with PBZ application)	1,5 ml/L + 1,5 ml/L
3	Seamel FLOR và Amix SILK (without PBZ application)	3 ml/L + 3 ml/L
Control	Farmers' cultivation	

Table 1: Application time.

Treatment timing	
1st	20 days before flowering
2nd	20 days after the 1st application
3rd	7 days after the 2nd application
4th	7 days after the 3rd application
5th	15 days after the 4th application
6th	15 days after the 5th application
7th	15 days after the 6th application

Observation:

—Time to first flowering after foliar fertilizer application 1: Start observing and recording from the 15th day after the first foliar fertilizer application.

—Time to first flower thinning after foliar fertilizer application 1: Record the date when flower thinning begins for each treatment after the first foliar fertilizer application.

—Number of flower clusters per branch (count 3 branches per tree, total 12 branches per treatment) at 50, 65, 75, and 85 days after the first foliar fertilizer application.

—Number of flowers per cluster (count 3 clusters per tree, total 12 branches per treatment) at 50, 65, 75, and 85 days after the first foliar fertilizer application.

—Flower drop rate (%) at 65, 75, and 85 days after the first foliar fertilizer application.

— Flower length (mm) in each treatment at 50, 65, and 75 days after the first foliar fertilizer application (abbreviated as DAPFF1).

RESULTS AND DISSCUSION

First flowering and Flower thinning start times. The average time of the first flowering among the four treatments after the first foliar spray ranged from 20.8 ± 1.5 to 44.3 ± 2.2 days. Treatment 1 showed the earliest flowering at 20.8 ± 1.5 days**,** while treatment 2 had the latest flowering time of 44.3 ± 2.2 days. Treatment 2 and the control recorded intermediate values at 26.3 ± 1.0 and 30.8 ± 1.0 days, respectively. This variation suggests that foliar applications in treatment 1 may have accelerated the physiological processes involved in floral induction, possibly due to enhanced nutrient availability or the presence of growth regulators that promote flowering. Early flowering is beneficial in synchronizing fruit development and potentially increasing overall yield (Rademacher, 2015; Taiz *et al.*, 2015). Regarding the time to start flower thinning, treatment 1 also showed the earliest flower thinning at 60.8 ± 1.5 days**,** which was 12.7 days earlier than the control (73.5 ± 1.3 days**).** Treatment 2 followed with thinning starting at 66.3 ± 0.9 days**,** approximately 9 days earlier than the control, while treatment 3 had the latest thinning time at 84.3 ± 2.2 days. Early flower thinning is a critical management practice that can reduce intra-plant competition for nutrients and assimilates, thus enhancing fruit set and improving fruit quality (Link, 2000). The significantly earlier thinning in treatment 1 and 2 likely contributed to better resource allocation withing the durian tree and fruit development, consistent with findings that timely thinning could optimizes carbohydrate partitioning and fruit growth (Wünsche *et al.*, 2005).

Furthermore, the timing of flowering and thinning may also be influenced by microclimatic changes induced by foliar fertilizers, which can modify leaf physiology and photosynthetic efficiency (Fernández *et al*., 2013). Such modifications could accelerate phenological stages by improving assimilate availability during critical growth periods (Taiz *et al.*, 2015). However, excessively early or late flowering/thinning can negatively impact fruit quality and yield stability, highlighting the need for balanced management practices tailored to specific crop varieties and environmental conditions (Byers and Lakso 1992).

Table 2: Time to first flowering and Flower thinning start time.

Treatment	Time to first flowering	Flower thinning start time
1	20.8 ± 1.5c	60.8 ± 1.5c
2	26.3 ± 1.0c	66.3 ± 0.9c
3	44.3 ± 2.2a	84.3 ± 2.2a
Control	30.8 ± 1.0b	73.5 ± 1.3b
Mean	*	*
CV (%)	12.4	8.8

"In the same column, means followed by the same letter are not significantly different according to Duncan's multiple range test. : Significant difference at the 5% level."*

Number of flower clusters per branch. These results suggest that foliar fertilization treatments, especially treatment 1, positively influenced the formation and maintenance of flower clusters on branches over time. The significantly higher number of flower clusters in treatment 1 compared to other treatments may be attributed to enhanced nutrient availability, particularly essential macronutrients and micronutrients that play a critical role in floral initiation and development (Fernández *et al*., 2013). This increased flower cluster density can potentially lead to improved fruit set and yield, as supported by Link (2000), who emphasized that greater flower cluster density generally correlates with higher fruit productivity.

Table 3: Number of flower clusters per branch.

Treatment	50 Days	65 Days	75 Days	85 Days
1	63.1 a	55.8 a	53.0 a	48.5 a
2	58.8 b	46.0 c	44.1 b	45.2 b
3	7.5 d	6.1 d	3.3 d	1.8 d
Control	46.6 c	44.5 b	43.5 c	40.8 c
Mean	**	**	**	**
CV (%)	10.4	8.9	10.9	11.8

"In the same column, means followed by the same letter are not significantly different according to Duncan's multiple range test. : Significant difference at the 5% level."

Conversely, the lower cluster numbers observed in treatment 3 indicate either insufficient nutrient supply or possible phytotoxic effects that may have inhibited floral development. This aligns with a studies indicating that suboptimal fertilization or improper nutrient balance can adversely affect flowering (Taiz *et al*., 2015). Moreover, the gradual decrease in flower cluster numbers across all treatments from 50 to 85 days may reflect natural flower drop or thinning processes, which are essential to reduce competition among developing fruits and optimize final fruit quality (Wünsche *et al*., 2005). The consistent higher number of clusters in treatment 1 through the late observation period indicates better retention, possibly due to improved physiological conditions or hormonal regulation enhanced by the treatment. Overall, the findings underscore the importance of appropriate foliar fertilization regimes in optimizing flower cluster formation and retention, which are key determinants of successful fruit production.

Number of flowers per cluster. At 50, 65, 75, and 85 days after first flowering (DAFF), the average number of flowers per cluster showed statistically significant differences among the four treatments. Treatment 1 consistently produced the highest number of flowers per cluster, reaching 109.8, 84.8, 79.8, and 84.8 flowers/cluster, respectively. These values were significantly higher than those of treatment 2 (91.3–71.1 flowers/cluster), the control (81.3–50.2 flowers/cluster), and especially treatment 3, which recorded the lower impact (10.8–1.6 flowers/cluster).

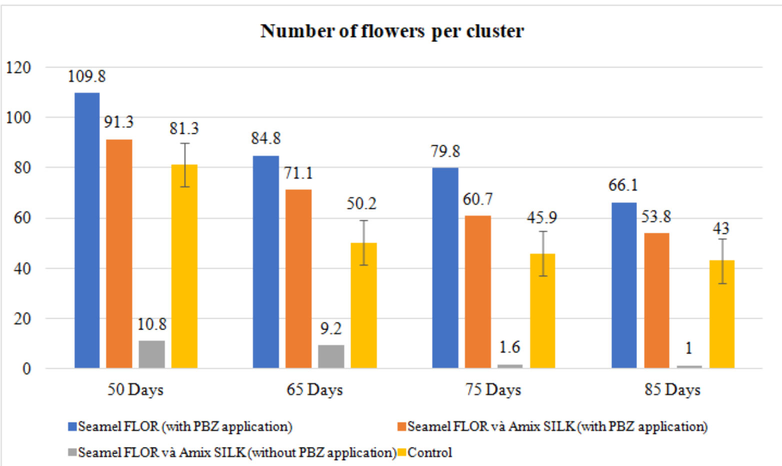

Fig. 1. Number of flowers per cluster.

The consistent superiority of treatment 1 may be attributed to its stimulative effects on floral meristem activity and nutrient efficiency, promoting higher flower density and cluster formation. These findings are in agreement with previous study indicating that optimized hormonal or nutritional treatments can significantly improve floral traits and reproductive performance in crops (Smith *et al*., 2020; Nguyen and Tran 2018; Kumar *et al*., 2017; Li *et al*., 2021; Saichol *et al*., 2021).

Flower length (mm). Similarly, treatment 1 led in flower length across the growth stages, starting from 39.1 mm (50 DAFF), 83.3 mm (65 DAFF), and reaching a maximum of 119.8 mm at 75 DAFF. This increase in flower lengths were statistically higher than those observed in treatment 2 (27.1–86.7 mm), the control (17.4–73.6 mm), and treatment 3 (7.0–38.5 mm).

The higher performance of treatment 1 in Table 4 is likely attributed to its role in promoting meristematic activity, enhancing cell elongation, and improving nutrient uptake. Several studies support these findings: hormonal treatments, particularly with auxin and gibberellins, have been shown to enhance flower density, organ elongation, and reproductive success (Kumar *et al*., 2017; Li *et al*., 2021). Moreover, nutrient optimization and exogenous application of growth regulators have demonstrated significant improvements in flowering characteristics in various crop systems (Smith *et al*., 2020; Nguyen and Tran 2018).

Table 4: Flower length.

Treatment	50 Days	65 Days	75 Days
1	39.1 a	83.3 a	119.8 a
2	27.1 b	52.3 b	86.7 b
3	7.0 d	30.0 d	38.5 d
Control	17.4 c	48.1 c	73.6 c
Mean	**	**	**
CV(%)	31.9	30.2	31.4

“In the same column, means followed by the same letter are not significantly different according to Duncan's multiple range test. : Significant difference at the 5% level."

Flower drop rate (%). Flower abscission was first observed at 65 DAFF. At this stage, treatment 3 showed the lowest flower drop rate (15.0%), followed by treatment 2 (22.1%), treatment 1 (22.8%), and the control (38.2%). However, by 75 DAFF, we have observed a shift in this pattern: treatment 1 showed the lowest drop rate (27.4%), while treatment 3 experienced a dramatic increase to 85.0%, indicating a loss of earlier retention capacity. Treatment 2 and the control showed lower rate in case of flower length compared to treatment 3 (33.5% and 43.5%, respectively). By 85 DAFF, treatment 1 maintained the lowest flower drop rate at 39.8%, followed by treatment 2 (41.1%) and the control (47.0%), while treatment 3 reached the highest rate of 91.2%.

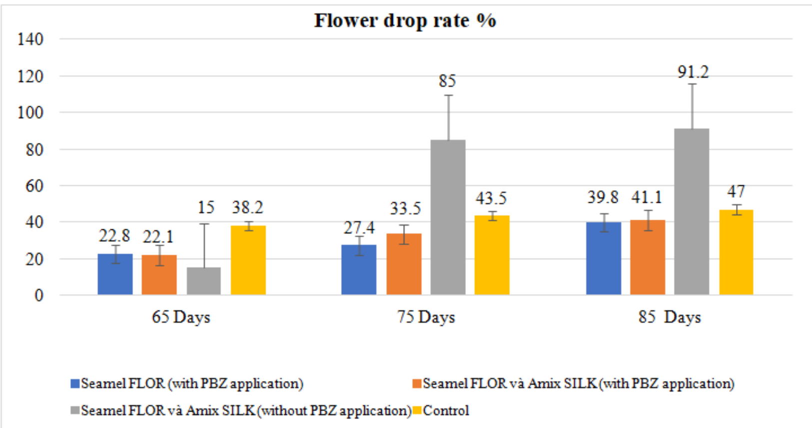

Fig. 2. Flower drop rate (%).

These results suggest that although treatment 3 was initially effective at reducing early-stage abscission, it failed to sustain flower retention during later stages. In contrast, treatment 1 consistently minimized flower shedding from mid to late flowering. This improved floral retention under treatment 1 may be due to a more favourable hormonal regulation (e.g., balanced auxin-ethylene interaction) and enhanced nutrient translocation, which are critical for maintaining floral organs under physiological stress.

Previous studies have also shown that reduced auxin levels and increased ethylene sensitivity are major triggers of flower abscission in many crops (Chen *et al*., 2019; Taylor and Whitelaw 2001). In addition, the biostimulants that improve hormonal balance and nutrient flow - such as those like treatment 1 (Seamel FLOR + PBZ application) have been reported to delay abscission and enhance reproductive success (Bareja, 2012; Patel and Singh 2016; Li *et al*., 2021; Alminda *et al*., 2021).

 **Treatment 1:** Seamel FLOR (with PBZ application)	 **Treatment 2:** Seamel FLOR và Amix SILK (with PBZ application)
 **Treatment 3:** Seamel FLOR và Amix SILK (without PBZ application)	 Control
Photo of Number of flower clusters per branch at 65 DAS	

CONCLUSIONS

Among the treatments tested, treatment 1 (Seamel FLOR + PBZ application) demonstrated the best performance in promoting flowering and improving flower quality in Durian. Treatment 1 accelerated flowering timing by 10 days compared to the control, and produced the highest number of flower clusters per branch (8.5–16.5 clusters). It also increased the number of flowers per cluster and resulted in longer flowers. Additionally, treatment 1 effectively reduced the rate of flower drop during the late stages, indicating better flower retention. These results highlight the significant potential of Seamel FLOR in enhancing floral development and reproductive development.

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REFERENCES

Alminda, M. R., Kharelle, S. A. and Saikat, B. (2021). Advances in durian cultivation: Nutrient management and growth regulators. *Horticulture Research*, *8*(1), 67–78.

Bareja, S. (2012). Nutritional and health benefits of durian. *Food Science and Nutrition*, *3*(2), 45–52.

Byers, R. E. and Lakso, A. N. (1992). Influence of thinning on growth and carbohydrate concentration in apple. *Journal of the American Society for Horticultural Science*, *117*(2), 230-234.

Chen, Y., Zhao, X. and Wang, Q. (2019). Environmental and hormonal regulation of flower abscission in horticultural plants. *Plant Growth Regulation*, *88*, 1–14.

Dang, L. V., Quyen, N. K., Ngoc, N. P., Ly, L. M., Thao, P. T. P. and Hung, N. N. (2025). Combining Organic and Foliar Fertilization to Enhance Soil Fertility and Mitigate Physiological Disorders of Durian (*Durio zibethinus* Murr.) *Fruit in the Tropics. Plants*, *14*, 1185.

Fernández, V., Ebert, G. and Eichert, T. (2013). Foliar fertilization – scientific principles and field practices. *International Fertilizer Industry Association* (IFA), 106-107.

Hau, T. V. and Hieu, T. S. (2017). Off-season production of durian in the Mekong delta, Viet Nam. *Acta Horticulturae*, 1186.

Kumar, S., Verma, R. K. and Yadav, R. (2017). Influence of growth regulators on flowering and yield in vegetable crops: A review. *International Journal of Agriculture Sciences*, *9*(10), 4051–4056.

Kozai, N., Higuchi, H., Ogata, T., Kondo, T., Ugawa, S. and Yonemoto, Y. (2024). Effects of paclobutrazol application and soil mulching on flower induction and physiological conditions in durian trees (*Durio zibethinus* Murr.). *Japan Agricultural Research Quarterly*, *58*(2), 121–128.

Li, X., Zhang, W. and Chen, L. (2021). Hormonal regulation of flower development and reproductive success in flowering plants. *Frontiers in Plant Science*, *12*, 642732.

Link, H. (2000). Significance of flower and fruit thinning on fruit quality. *Plant Growth Regulation*, *32*(2), 289–297.

Nguyen, T. M. and Tran, Q. H. (2018). Impact of nutrient management on flowering and fruit set in tropical legumes. *Vietnam Journal of Agricultural Science*, *36*(4), 205–214.

Ngo, P. N., Le, V. D., Ly, L. M., Pham, P. T. T. and Ngo, N. H. (2024). Use of the DRIS system for determining the nutritional balance of durian cultivated in the Vietnamese Mekong Delta. *Horticulture*, *10*(6), 561.

Patel, M. A. and Singh, D. K. (2016). Flower drop in crops: Causes, consequences and management strategies.

Indian Journal of Agricultural Research, *50*(6), 567–573.
Pham, T. T. D., Thai, H. N. D., Bui, T. M., Nguyen, T. L. H. and Nguyen, K. X. (2022). Current status of paclobutrazol application and its residue in durian orchard soil in Tien Giang and Ben Tre provinces. *The Journal of Agriculture and Development*, *21*(2), 1-8.
Rademacher, W. (2015). Plant growth regulators: backgrounds and uses in plant production. *Journal of Plant Growth Regulation*, *34*(4), 845–872.
Smith, R. D., Johnson, A. R. and Lee, Y. S. (2020). Effect of exogenous treatments on FLORal initiation and development in horticultural crops. *Journal of Plant Physiology*, *256*, 153–162.
Saichol, K., Apinya, W., Yossapol, P. and Robert, E. P. (2021). The durian: Botany, cultivation and utilization. *Acta Horticulturae*, *291*, 267–277.
Taiz, L., Zeiger, E., Møller, I. M. and Murphy, A. (2015). Plant Physiology and Development (6th ed.). *Sinauer Associates*, Inc.
Tran, V. T., Vo, T. L., Nguyen, N. L. T., Nguyen, K. N., Dinh, T. Q. and Le, D. D. (2025). Identification and characterization of *Pseudomonas* spp. isolated from durian growing soil in the Central Highlands, Vietnam. *The Journal of Agriculture and Development*, *24*(3), 78-94.
Taylor, J. E. and Whitelaw, C. A. (2001). Signals in abscission. *New Phytologist*, *151*(2), 323–339.
Wünsche, J. N., Lakso, A. N. and Robinson, T. L. (2005). Carbohydrate balance and fruit thinning influence fruit size and quality of apple. *Hort Science*, *40*(7), 2031-2036.

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