



# Foliar Spray of GA<sub>3</sub> on Morpho-Physiological Traits and Yield of Gladiolus

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## Authors' contributions

This work was carried out by collaborative efforts of all the authors. All the authors as mentioned read and approved the final manuscript.

## Article Information

DOI: <https://doi.org/10.9734/ijpss/2025/v37i55444>

## Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://pr.sdiarticle5.com/review-history/132763>

Original Research Article

Received: 25/01/2025  
Accepted: 27/03/2025  
Published: 06/05/2025

## ABSTRACT

The present investigation entitled "FOLIAR SPRAY OF GA<sub>3</sub> ON MORPHO-PHYSIOLOGICAL TRAITS AND YIELD OF GLADIOLUS" was conducted during rabi 2023-24 at the Department of Plant Physiology, Agricultural Biochemistry, Medicinal and Aromatic Plants, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh). Five treatments were used in the experiment, which included four concentrations of gibberellic acid (foliar application) along with the control. A Complete Randomized Design (CRD) with three replications. A single application of 160 ppm GA<sub>3</sub> had a significant effect on a number of characteristics, such as the plant height, the number of leaves per plant, the number of corm sprouting plants, the number of flowers per plant, the number of days before the first flower initiation, 50% flowering, and flower diameter, growth and

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phenology parameters such as flowering time and number of florets per inflorescence also increase and yield parameters like corm diameter, weight of corm per plant, yield of spike, yield of corm, and flower yield showed significant increased.

**Keywords:** *Gladiolus*; corms; GA<sub>3</sub>; plant growth regulator; yield.

## 1. INTRODUCTION

The plant *Gladiolus* (*Gladiolus palustris*), which belongs to the Iridaceae family, is native to South Africa and has a basic chromosomal number of  $n = 15$ . The genus now has 255 species (Pragya et al., 2010). For the Indian cut flower trade, it is one of the most important ornamentals created of bulbs. It is also ideal for making high-end bouquets, flower arrangements for interior design and tables and yard displays. Gladioli have corms, which are flat or spherical underground stems clothed in brownish, fibrous tunics. The leaves are tall, slender, green, angular or linear, and have prominent veins, they resemble a sword. *Gladiolus* is the fourth most popular gladiolus in the world, the third most popular cut flower in India, and the sixth most popular loose flower, according to Nath et al. (2020). According to Kumar and Singh (2005), the implementation of growth regulators has resulted in changes to the floriculture industry. *Gladiolus* growth, flowering, and corm production have been discovered to be effectively controlled by synthetic growth-regulating chemicals. The most effective methods for applying growth regulators to gladiolus have been demonstrated to be foliar spraying in the field and chemically treating the corms.

Many plant processes, including seed germination, stem elongation, leaf expansion, and flower formation, depend on gibberellic acid. By decreasing ethylene's ability to hasten senescence, GA<sub>3</sub> postpones flower senescence. Nevertheless, GA<sub>3</sub> plays a complex role in plants. Numerous researchers have tried to look into how GA<sub>3</sub> affects gladiolus growth and bloom. The use of GA<sub>3</sub> has been found to improve spike length, number of flowers per spike, floret diameter, branch elongation, and vegetative growth while also drastically reducing the number of days needed for flowering. The quality, quantity, and development of flowers are all improved by plant growth regulators.

Growth regulators are an efficient way to control gladiolus development and flowering. Growth and development are regulated by one hormone

either alone or in combination with other hormones. According to Nuvale et al. (2010), they are essential for sink setup and organic compound flow regulation. A well-known growth regulator, gibberellic acid enhances bulbous plant corm weight, corm sprouting, plant height, leaf elongation, and flowering induction at different concentrations (Olszewski et al., 2002; Lee and Rhee, 2005; Vijai et al., 2007). At different concentrations, the application of growth regulators, including GA<sub>3</sub>, is known to have positive impacts on the growth and development of gladiolus plants. GA<sub>3</sub> facilitates stem growth, long-day plant bolting, and the stimulation of seed germination.

## 2. METHODOLOGY

The experiment was laid out according to Complete Randomized Design (CRD) with three replication and five treatments viz. GA<sub>3</sub> 40 ppm, GA<sub>3</sub> 80 ppm, GA<sub>3</sub> 120 ppm, GA<sub>3</sub> 160 ppm and control (water). Following data on various growth and phenology attributes like number of sprouting of corms, plant height (cm), number of leaves/ plant, number of flower per plant, days to first flower initiation, 50% flowering, flower diameter (cm), number of floret per inflorescence, yield attributes like corm diameter (cm), weight of corm per plant(g), yield of spike per pot, yield of corm per pot, flower yield per pot.

## 3. RESULTS AND DISCUSSION

### 3.1 Plant Height

The data presented in Table 1 indicate that, effect of GA<sub>3</sub> on morpho-physiological attributes of gladiolus parameters significantly increased by the foliar application of GA<sub>3</sub>. Plants treated with gibberellic acid at a concentration of 160 ppm had the highest plant height (76.12 cm), followed by plants treated with a concentration of 120 ppm (74.32 cm). The control treatment had the lowest plant height (54.24 cm). The application of GA<sub>3</sub> may have increased the height of the plant by encouraging cell enlargement, which in turn increased the internodal distance. Ragia M. Mazrou (2019) observed a similar outcome.

### 3.2 Number of Leaves Per Plant

The data presented in Table 1 indicate that, effect of GA<sub>3</sub> on, number of leaves per plant is better in Treatment T<sub>5</sub> GA<sub>3</sub> (160 ppm) foliar spray produced the most leaves (7.25), outperforming all other treatments with the exception of T<sub>4</sub> GA<sub>3</sub> 120 ppm foliar spray (6.61). Treatment T<sub>1</sub> (Control) had the fewest number of leaves per plant (5). Leaf number was unaffected by GA<sub>3</sub> because it causes stem elongation through increased internodal length. M. Sajid et al. (2015) and Havale (2008) have reported similar results.

### 3.3 Number of Sprouting of Corms

The application of GA<sub>3</sub> 160ppm at (3) days was shown to be significantly superior to the other treatments and produced the earliest number of corms sprouting ever seen. The lowest result was observed in control T<sub>1</sub>(4.5). Gibberellic acid promotes effect on gladiolus corm dormancy and increased cell division in the shoot tip and cell elongation may have caused an increase in growth parameters following GA<sub>3</sub> application. A similar outcome was seen by Neha Chopde et.al. (2015).

### 3.4 Number of Flower/ Plant

Treatment T<sub>5</sub> (GA<sub>3</sub> 160 ppm) produced the most flowers per plant (10.83), which was noticeably more than treatments T<sub>4</sub>. At its peak, gibberellic acid would have encouraged the auxiliary buds to expand rapidly and bloom, which is why treatment T<sub>5</sub> (GA<sub>3</sub> 160 ppm foliar spray) outperformed the others. Awad and Hamied (1985) investigated the effects of treating gladiolus corms with different gibberellin concentrations (10–50 ppm). Higher gibberellin concentrations slowed down the growth and differentiation of lobes, floral primordia, and flower extension, whereas lower GA<sub>3</sub> concentrations caused the flower spike to lengthen and individual flower differentiation to occur.

### 3.5 Days to 1<sup>st</sup> Flower Initiation

Three of the treatments have shown early flower initiation T<sub>4</sub> (70.45 days) and T<sub>5</sub> (71.45 days) have comparatively early blossoming. However, the emergence of the first flower has been significantly impacted by plant growth agents. It is noteworthy that T<sub>1</sub> (83.08) showed late blossoming. In terms of parameters impacting floral initiation, exogenous GA<sub>3</sub> supervision would

have been more convenient. By causing vigorous cell division in the apical meristem, GA<sub>3</sub> stimulates vegetative growth and increases photosynthetic and metabolic activity, which leads to higher transport and utilization of photosynthetic products and early gladiolus flowering. As reported by Khiromani Nag et al. (2018).

### 3.6 50% flowering

Treatment T<sub>5</sub> showed noticeably earlier 50% flowering (73.75 days). The first control treatment produced 50% blooming in (87.51) days. It might be occurs because of large size corm reserves more food and supplying more storage nutrients in the corm, that initially helps the plant for growth and development which ultimately affect on the flowering Commercial flower crops are more profitable to produce than any other horticultural commodity because of their high perishability and notable supply and demand swings. By employing appropriate cultural techniques to meet the foliage needs, gladiolus can be made to flower earlier than expected. Similar results were recorded by Padmalatha et al. (2013).

### 3.7 Flower Diameter (cm)

The diameter of the flower was considerably impacted by all GA<sub>3</sub> treatment levels, with the exception of treatment 5 (14.16). Under the control treatment, the smallest flower diameter measured was (8.21 cm). gibberellic acid application in gladiolus can lead to an increase in flower diameter, likely due to its effects on cell elongation and division, promoting overall floral growth and development The findings of Kishan Swaroop and associates (2016) were similar.

### 3.8 No. of Floret/ Inflorescence

Number of florets /inflorescence was affected significantly by the application of GA<sub>3</sub> and corm size. Large size corm produced maximum number of florets /inflorescence (Table 1). It might be due to large size corm reserves more food and supplying more storage nutrients in the corm, that initially helps to vigorous growth and enhance to produce maximum florets inflorescence found in Treatment T<sub>5</sub> (GA<sub>3</sub> 160 ppm foliar spray) had the most florets per spike (11.25), which was much greater than any other treatment except treatment T<sub>4</sub> (GA<sub>3</sub> 160 ppm). The treatment T<sub>1</sub> (control) had the fewest florets per spike (7.58). Pooja Rani et al. (2015) found similar results.

**Table 1. Effect of GA3 on morpho-physiological attributes of gladiolus**

| <b>Treatment</b>         | <b>Plant height (cm)</b> | <b>Number. of leaves/ plant</b> | <b>Number of sprouting of corms</b> | <b>Number of flower/ plant</b> | <b>Days to 1<sup>st</sup> flower initiation</b> | <b>50% flowering</b> | <b>Flower diameter(cm)</b> | <b>No. of floret/ inflorescence</b> |
|--------------------------|--------------------------|---------------------------------|-------------------------------------|--------------------------------|---|----------------------|----------------------------|-------------------------------------|
| T <sub>1</sub> (Control) | 54.24                    | 5                               | 4.5                                 | 6.75                           | 83.08   | 87.51                | 8.21                       | 7.58                                |
| T <sub>2</sub> (40 ppm)  | 64.89                    | 6.5                             | 4.1                                 | 8.25                           | 76.08   | 81.25                | 10.86                      | 8.66                                |
| T <sub>3</sub> (80 ppm)  | 67.33                    | 6.33                            | 4                                   | 9.41                           | 73.88   | 77.25                | 12.54                      | 9.91                                |
| T <sub>4</sub> (120 ppm) | 74.32                    | 6.61                            | 3.5                                 | 10.25                          | 70.45   | 74.33                | 11.85                      | 10.5                                |
| T <sub>5</sub> (160 ppm) | 76.12                    | 7.25                            | 3                                   | 10.83                          | 71.45   | 73.75                | 14.16                      | 11.25                               |
| CD at 5%                 | 10.9                     | 1.28                            | 0.51                                | 1.56                           | 4.54  | 6.30                 | 3.33                       | 1.31                                |

**Table 2. Effect of GA3 on yield attributes of gladiolus**

| Treatment                | Corm diameter (cm) | Weight of corm/plant (g) | Yield of spike per pot | Yield of corms per pot | Flower yield per pot |
|--------------------------|--------------------|--------------------------|------------------------|------------------------|----------------------|
| T <sub>1</sub> (Control) | 4.62               | 20.05                    | 20.20                  | 7.83                   | 18.44                |
| T <sub>2</sub> (40 ppm)  | 5.63               | 24.79                    | 26.14                  | 9.33                   | 22.99                |
| T <sub>3</sub> (80 ppm)  | 6.42               | 28.57                    | 29.77                  | 10.83                  | 24.68                |
| T <sub>4</sub> (120 ppm) | 6.74               | 30.07                    | 30.31                  | 13.5                   | 25.11                |
| T <sub>5</sub> (160 ppm) | 7.62               | 29.60                    | 30.90                  | 15.66                  | 26.72                |
| CD at 5%                 | 1.91               | 5.18                     | 4.93                   | 2.27                   | 4.71                 |

### 3.9 Post Harvest Parameters

#### 3.9.1 Corm diameter (cm)

Treatment 5 had the largest corm diameter (7.62 cm), whereas treatment 1 had the smallest (4.62 cm). Additionally, it was evident from the data that the GA<sub>3</sub> 80 ppm produced a much larger corm. Corm of maximum diameter generally produced from large size corm because larger ones having higher amount of food component that helps to vigorous growth of plant and attributed to larger corm size. These findings are similar with the findings of Ragia M. Mazrou (2019).

#### 3.10 Weight of Corm/Plant (g)

Regarding the corm weight, there were notable differences across the gladiolus varieties and treatments. Treatment 4 had the highest corm weight (30.07 g), followed by treatment 5 (29.60 gm). Treatment 1 had the lowest corm weight (20.05 g). Applying GA<sub>3</sub> to gladiolus can increase corm weight and size by promoting early sprouting, enhancing carbohydrate mobilization, and increasing the number of leaves, which in turn boosts photosynthesis and nutrient translocation to the corms. These findings are similar with the findings of Y.A.A. Ghatas (2016)

#### 3.11 Yield of Spike Per Pot

When it came to the gladiolus types and treatments varied considerably. The highest spike yield per pot was seen with GA<sub>3</sub> 160 ppm (30.90), which was followed by GA<sub>3</sub> 120 ppm (30.31). The control group treatment T<sub>1</sub> (20.20) had the lowest spike yield, ornamental plants exhibit a great deal of variation in their growth patterns, colours, flowering structures, and flower sizes and shapes. There-fore, environmental factors, especially combined temperature and light, are known to have a significant impact on a cultivar's performance in terms of growth and

yield. This might be due to availability of more nutrients reserved on larger corm and plants take this opportunity to consume more food during vegetative and reproductive stage of plant. Healthy plants increases the rate of photosynthesis and helps to translocation of assimilates to the storage food component and ultimately plant produces highest yield of spikes. The findings of MK Islam et al. (2017) were similar.

#### 3.12 Yield of Corms Per Pot

GA<sub>3</sub> 160 ppm (15.66) had the highest corm production per pot, followed by GA<sub>3</sub> 120 ppm (13.5). In the control group (no growth regulator) the lowest corm yield per hectare was measured at (7.83). In gladiolus that due to availability of more nutrient reserved on larger corm and plants take this opportunity to consume more food during vegetative and reproductive stage of plant. Healthy plant increases the rate of photosynthesis and helps to translocation of assimilates to the storage food component and ultimately plant produces highest yield of corms. These outcomes are related with those of Sudhakar et al. (2012).

#### 3.13 Flower Yield Per Pot

GA<sub>3</sub> 160 ppm (26.72) had the highest flower output per pot, followed by GA<sub>3</sub> 120 ppm (25.11). Treatment T<sub>1</sub> (18.44) control had the lowest floral output. Applying GA<sub>3</sub> to gladiolus can increase flower yield per pot by promoting vegetative growth, early flowering, and potentially larger spikes, leading to a greater number of flowers per plant. The findings of Kapil V. Patil et al. (2011) were similar.

### 4. CONCLUSION

- A foliar spray of GA<sub>3</sub> at 160 ppm was found to be more successful in enhancing a number of characteristics, such as plant

height (76.12) the number of leaves per plant (7.25), corm sprouting number (3), flower number per plant (10.83), days to first flower initiation (71.45), 50% flowering (73.75), and flower diameter (14.16), number of florets per inflorescence (11.25).

- The yield parameters, including corm diameter (7.62 cm), weight of corm per plant (30.07gm), yield of spike per pot (30.90), yield of corm per pot (15.66), and flower yield per pot (26.72), were significantly improved by the application of GA<sub>3</sub> 160 ppm.

#### DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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