

ISSN Print: 2664-844X
ISSN Online: 2664-8458
NAAS Rating (2026): 4.97
IJAFS 2026; 8(11): 189-192
www.agriculturaljournals.com
Received: 01-09-2026
Accepted: 23-10-2026
Published: 05-11-2026

Pratik Kumar Gupta
Department of Floriculture and Landscaping, Mahatma Gandhi Udyanikee Evam Vanikee Vishwavidyalaya, Durg, Chhattisgarh, India

Toran Lal Sahu
Department of Floriculture and Landscaping, Mahatma Gandhi Udyanikee Evam Vanikee Vishwavidyalaya, Durg, Chhattisgarh, India

Abhishek Tiwari
Department of Floriculture and Landscaping, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Navdeep Kumar
Department of Floriculture and Landscaping, Mahatma Gandhi Udyanikee Evam Vanikee Vishwavidyalaya, Durg, Chhattisgarh, India

Yashwant Kumar
Department of Floriculture and Landscaping, Mahatma Gandhi Udyanikee Evam Vanikee Vishwavidyalaya, Durg, Chhattisgarh, India

Vinay Dansena
Department of Floriculture and Landscaping, Mahatma Gandhi Udyanikee Evam Vanikee Vishwavidyalaya, Durg, Chhattisgarh, India

Sakina Begam
Department of Physiology, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Corresponding Author:
Pratik Kumar Gupta
Department of Floriculture and Landscaping, Mahatma Gandhi Udyanikee Evam Vanikee Vishwavidyalaya, Durg, Chhattisgarh, India

Impact of biostimulants on growth, flowering attributes and yield of *Gladiolus*: A review

Pratik Kumar Gupta[1], Toran Lal Sahu[2], Abhishek Tiwari[3], Navdeep Kumar[4], Yashwant Kumar[5], Vinay Dansena[6], Sakina Begam[7]

DOI: https://www.doi.org/10.33545/2664844X.2026.v8.i11c.90230

Abstract
Gladiolus (*Gladiolus* × grandiflorus; commonly reported in literature as *Gladiolus grandiflorus* L.) is an important cut flower and ornamental bulbous crop valued for its attractive florets, long spikes and corm-based propagation. The quality and marketable yield of gladiolus depend on genotype, growing conditions, nutrient supply and crop management. Biostimulants—including humic substances, seaweed extracts, amino-acid formulations, fermented organic preparations and beneficial microorganisms—are increasingly studied as complementary inputs to improve nutrient-use efficiency, root and shoot growth, flowering performance and corm/cormel production. Published gladiolus studies report improvements in plant height, leaf growth, spike length, floret number, flowering duration, vase life and underground propagule traits with selected treatments; however, responses differ with cultivar, formulation, concentration, application route and background fertility. Evidence from humic-acid trials is particularly encouraging, while studies of Panchagavya, Manchurian mushroom tea, seaweed extracts and microbial inoculants indicate potential benefits but also show that not every measured trait responds significantly. This review synthesizes accessible research on biostimulants and related biological inputs in gladiolus, compares reported outcomes in tabular form, discusses likely mechanisms and identifies priorities for locally validated recommendations. Biostimulants should be considered supplements to balanced nutrient and crop management rather than substitutes for sound agronomy.

Keywords: *Gladiolus*, biostimulants, humic acid, seaweed extract, biofertilizers, flowering, spike quality, corm yield

1. Introduction

Gladiolus is a commercially important ornamental crop grown for cut spikes, garden display and production of corms and cormels. Market value is influenced by spike length and strength, rachis length, floret number and size, uniformity, colour, flowering time and post-harvest longevity. For growers, successful production therefore requires both high-quality spikes and adequate multiplication of planting material.

Conventional nutrient management remains essential, but excessive or poorly timed fertilizer use can reduce nutrient-use efficiency and increase production costs. Biostimulants have attracted attention because they may stimulate plant processes and improve responses to nutrient availability or environmental stress. The term covers diverse materials, so products grouped under this label should not be assumed to act identically. Their effects are often context-dependent and must be evaluated for the crop, cultivar, rate and application method.

In gladiolus, experiments have examined humic acid, seaweed extract, Panchagavya, Manchurian mushroom tea, commercial formulations and microbial inoculants. The available literature includes studies focused on vegetative growth, flowering, corm production and vase life. This review summarizes these findings and highlights the strength and limitations of the current evidence.

2. Scope and approach of the review

This narrative review was prepared from accessible research articles and abstracts concerning biostimulants, biofertilizers and related inputs in gladiolus. Studies were selected for their relevance to growth, flowering, spike quality, post-harvest performance or corm/cormel yield. Where only an abstract or bibliographic record was accessible, the review reports only the information available there. Since studies used different cultivars, treatments and experimental conditions, their numerical results should not be interpreted as a direct ranking across experiments.

26648458, 2026, 8(11), Downloaded from https://www.doi.org/10.33545/2664844X.2026.v8.i11c.90230 by International Journal of Agriculture and Food Science on [05/11/2026]. See the Terms and Conditions (https://www.agriculturaljournals.com) for rules of use; OA articles are governed by the applicable Creative Commons License

3. Major classes of biostimulants and their potential roles

3.1 Humic and fulvic substances

Humic substances are complex organic fractions that may influence root development, nutrient availability, membrane activity and plant metabolism. In gladiolus cv. Arkaamar, a study of pre-soaking and foliar application reported that humic acid at 4 ml L^{-1} performed strongly for several vegetative and flowering traits, including plant height, spike length, floret number and spikes per unit area (Ravikumarbolagam *et al.*, 2019) [1]. A related study reported improved vase life and water uptake following humic-acid treatment, although post-harvest responses should be distinguished from field yield responses (Ravikumarbolagam *et al.*, 2020) [2]. The reported concentration is specific to the tested formulation and should not be treated as a universal recommendation.

Fulvic acid is often discussed alongside humic acid, but the two fractions differ in chemical properties and may not produce the same response. In the cited Arkaamar post-harvest study, fulvic acid treatment was associated with high transpirational water loss, whereas humic acid gave better overall vase-life results. This illustrates why treatment selection should consider the target outcome rather than the product category alone.

3.2 Seaweed extracts and amino-acid formulations

Seaweed extracts contain variable mixtures of minerals and bioactive compounds, and their composition depends on seaweed species, extraction process and formulation. They may affect root growth, chlorophyll status, stress responses and flowering, but results are product- and dose-specific. A study in gladiolus evaluated seaweed extract at 300 ppm alongside amino acids, ascorbic acid, salicylic acid, active yeast and a microbial formulation under different compost levels (Abdou *et al.*, 2021) [3]. The study reported that compost improved several growth and flowering measurements; the available summary does not justify attributing all observed gains to seaweed extract alone.

Amino-acid formulations may contribute readily available organic compounds and can interact with nutrient status and stress physiology. However, evidence from trials combining several stimulants and compost treatments should be interpreted carefully because interactions may make it difficult to isolate the contribution of an individual product.

3.3 Fermented organic preparations

Panchagavya and Manchurian mushroom tea have been evaluated as organic stimulatory preparations in gladiolus. Bhalla *et al.* (2006) [4] reported that selected combinations influenced plant height, flowering duration, floret number and size, vase life, and corm/cormel attributes in cv. Red Beauty. The treatment producing the best response varied by trait: for example, maximum floret number and maximum cormel production were not necessarily associated with the same treatment. Such findings support trait-wise evaluation rather than assuming one preparation will optimize every outcome.

Kumar *et al.* (2011) [5] also investigated the integrated use of chemical fertilizers, biofertilizers and biostimulants in gladiolus cv. Sancerre. Their findings indicate that integrated treatment combinations can improve several growth, flowering and corm traits, but the results cannot be assigned to a biostimulant in isolation where treatments combine multiple inputs.

3.4 Beneficial microorganisms and biofertilizers

Biofertilizers such as Azotobacter, *Azospirillum* and phosphorus-solubilizing bacteria (PSB) are not interchangeable with non-microbial biostimulants, although they are often discussed together in crop-management studies. They may support nutrient acquisition through biological nitrogen fixation, nutrient solubilization and root-zone interactions. Baskaran *et al.* (2014) [6] reported trait-specific responses in gladiolus: different biofertilizers or commercial formulations were associated with early corm sprouting, greater leaf number, plant height, spike traits and corm/cormel production. A later study found that soil application of a combination of RDF, Azotobacter and PSB was superior among the tested application methods for several growth, flowering and corm-yield parameters (Sahu *et al.*, 2025) [7]. These findings support integrating biological inputs with a balanced fertilizer programme, while recognizing that performance depends on inoculant quality, soil conditions and application method.

4. Reported effects on growth, flowering and yield

4.1 Vegetative growth

Plant height, leaf number, leaf dimensions and plant biomass establish the source capacity needed to support spike development and corm replenishment. Humic acid produced high plant-height and leaf-growth values in the Arkaamar study (Ravikumarbolagam *et al.*, 2019) [1]. Bhalla *et al.* (2006) [4] reported the highest plant height with a Manchurian mushroom tea–Panchagavya combination. In a more recent study, humic acid combined with Panchagavya improved plant height and leaf number in gladiolus cv. Psittacinus Hybrid (Trivedi *et al.*, 2022 [8]; bibliographic details should be checked against the full article before formal submission). Across studies, no single dose or material can be assumed to be optimal for all cultivars.

4.2 Flowering time and spike quality

Important commercial measurements include days to spike emergence, days to flowering, spike length, rachis length, number of florets per spike, floret diameter and duration of flowering. Ravikumarbolagam *et al.* (2019) [1] reported that humic acid at 4 ml L^{-1} advanced spike emergence and improved several spike and floret traits in cv. Arkaamar. Bhalla *et al.* (2006) [4] found that different combinations maximized different flowering attributes, and Kumar *et al.* (2011) [5] likewise reported trait-dependent responses under integrated nutrient management. These results suggest that treatment recommendations should be based on the intended market: long spikes and more florets for cut-flower markets, or flowering duration and plant appearance for landscape use.

Not all flowering traits respond consistently. Kumar *et al.* (2011) [5] reported that some traits, including days taken to flowering and the number of florets open at one time, were not significantly affected by treatments. Such non-significant responses are important evidence and should be reported alongside positive findings.

4.3 Spike yield, corm and cormel production

For commercial production, spike yield per plant or unit area is a key output; for planting-material production, corm and cormel number, size and weight are equally important. In the Arkaamar study, humic acid at 4 ml L^{-1} was associated with the highest reported spike production per hectare among the tested treatments (Ravikumarbolagam *et al.*, 2019) [1]. Baskaran *et al.* (2014) [6] found that responses in corm and cormel traits differed by inoculant or commercial formulation, while Bhalla *et al.* (2006) [4] reported that a Manchurian mushroom tea–Panchagavya combination was associated with maximum corm weight and cormel production. These differences reinforce that above-ground floral performance and below-ground propagule production should be measured separately.

4.4 Post-harvest quality and vase life

Vase life determines the period during which cut spikes retain acceptable ornamental quality. In cv. Arkaamar, pre-harvest humic-acid treatment at 4 ml L^{-1} improved reported vase life, floret opening and water uptake, and reduced floret spoilage compared with the tested alternatives (Ravikumarbolagam *et al.*, 2020) [2]. This is a useful additional benefit for cut-flower production, but post-harvest results should not be used as a substitute for direct field measurements of spike yield or corm production.

26648458, 2026, 8(1), Downloaded from https://www.doi.org/10.33545/2664844X.2026.v8.i1c.90230 by International Journal of Agriculture and Food Science on [05/11/2026]. See the Terms and Conditions (https://www.agriculturaljournals.com) for rules of use; OA articles are governed by the applicable Creative Commons License

Table 1. Selected studies on biostimulants and related inputs in gladiolus

Study	Crop/cultivar and input	Main reported findings	Interpretation / limitation
Bhalla *et al.* (2006) [4]	*Gladiolus* cv. Red Beauty; Manchurian mushroom tea and Panchagavya, with a common basal media/nutrient background	Different combinations maximized plant height, flowering duration, floret number/size, vase life and corm/cormel traits.	Responses were trait-specific; the best treatment for one trait was not necessarily best for another.
Kumar *et al.* (2011) [5]	*Gladiolus* cv. Sancerre; integrated chemical fertilizers, biofertilizers and biostimulants	Reported improvements in several vegetative, spike and corm traits under selected integrated combinations.	Multiple inputs were combined, so the independent contribution of each component is difficult to isolate.
Baskaran *et al.* (2014) [6]	*Gladiolus*; biofertilizers and commercial formulations	Azotobacter, *Azospirillum*, PSB and commercial products showed different strengths for sprouting, leaf number, plant height, spike traits and corm/cormel yield.	Trait-specific responses indicate the need to match input choice to production objectives.
Ravikumarbolagam and Natarajan (2019) [1]	Cut gladiolus cv. Arkaamar; humic acid, fulvic acid and other biostimulants	Humic acid at 4 ml L^{-1} gave high values for plant height, spike and floret attributes and spikes per hectare among tested treatments.	Results apply to the tested cultivar, formulation, rates and local experimental conditions.
Ravikumarbolagam and Natarajan (2020) [2]	Cut gladiolus cv. Arkaamar; pre-harvest biostimulant sprays	Humic acid at 4 ml L^{-1} improved reported vase life, water uptake and floret opening and reduced spoilage.	Post-harvest quality outcomes are distinct from field yield outcomes.
Abdou *et al.* (2021) [3]	*Gladiolus*; compost levels with seaweed extract, amino acids and other stimulants	Compost improved several vegetative and flowering attributes; stimulants were evaluated in a factorial context.	Do not attribute the overall compost response to a single stimulant without treatment-level evidence.
Sahu *et al.* (2025) [7]	*Gladiolus*; application methods of Azotobacter and PSB with recommended fertilizer dose	RDF + Azotobacter + PSB applied to soil was reported as superior for several growth, flowering and corm-yield measures among tested treatments.	This is evidence for microbial biofertilizers and application method, not proof that all biostimulants act similarly.

5. Possible mechanisms of action

The physiological basis of biostimulant responses depends on the material. Humic substances may influence root architecture, nutrient availability and membrane processes; seaweed extracts may provide bioactive compounds that alter growth and stress responses; fermented organic preparations may supply a variable mixture of nutrients and metabolites; and beneficial microorganisms may improve nutrient cycling or root-zone function. These mechanisms are plausible explanations, but they should not be inferred as demonstrated in a particular gladiolus trial unless the study measured the relevant physiological or microbial variables.

Growth and flowering responses can also arise indirectly through improved nutrient status, root establishment or plant water relations. The magnitude and direction of the response may change with soil pH, organic matter, baseline fertility, weather, cultivar, product composition and timing of application. Accordingly, reproducible product specifications and clearly described application protocols are essential for comparing studies.

6. Practical implications for gladiolus growers

- Use biostimulants as complementary inputs within a balanced fertilizer, irrigation and crop-protection programme, not as replacements for essential nutrients.
- Follow the label and locally validated recommendations for concentration, application route, crop stage and compatibility; rates reported for one commercial formulation may not transfer to another.
- Choose performance indicators according to the production goal: spike number and quality for cut flowers, and corm/cormel number and weight for planting-material multiplication.
- Evaluate treatments against an untreated or standard-practice control and, where possible, include replicated plots across seasons.
- Record cultivar, corm size, soil properties, weather, fertilizer background, treatment timing and product composition so results can be interpreted and repeated.
- Consider cost-benefit outcomes, including product cost, labour, marketable spike percentage, vase life and corm value, rather than relying on plant height alone.

7. Research gaps and future prospects

The available studies are promising but heterogeneous. Future work should compare well-characterized formulations under common protocols and across cultivars and seasons. Trials should separate single-input effects from combinations, establish dose-response curves, and report both statistical significance and practical effect size. Research should also examine root traits, chlorophyll and nutrient status, photosynthetic performance, stress tolerance, soil biological activity and post-harvest physiology where relevant.

For Indian growing conditions, multi-location validation is needed before recommending a universal treatment package. Economic analysis should accompany biological measurements, and studies should report product identity and composition in sufficient detail for replication. Standardized reporting of spike yield per unit area, marketable spike grade, corm and cormel yield, and vase life would make comparisons between studies more meaningful.

8. Conclusion

Research in gladiolus indicates that selected biostimulants and related biological inputs can improve vegetative growth, flowering attributes, spike production, vase life and corm/cormel development. Humic acid has shown encouraging responses in studies of cv. Arkaamar, while Panchagavya, Manchurian mushroom tea, seaweed-based treatments and microbial inoculants have also produced benefits for particular traits under particular experimental conditions. Nevertheless, responses are not uniform across traits or studies, and several experiments combine multiple inputs. The most defensible recommendation is therefore to use biostimulants selectively, validate them locally and evaluate them against clear commercial objectives within an integrated nutrient-management programme.

2664844X, 2026, 8(1), Downloaded from https://www.doi.org/10.33545/2664844X.2026.v8.i1.c.90230 by International Journal of Agriculture and Food Science on [05/11/2026]. See the Terms and Conditions (https://www.agriculturaljournals.com) for rules of use; OA articles are governed by the applicable Creative Commons License

References

1. Ravikumarbolagam, Natarajan S. Effect of biostimulants sprays on growth and flowering of cut gladiolus (*Gladiolus grandiflorus* L.) cv. Arkaamar. International Journal of Current Microbiology and Applied Sciences. 2019;8(9):1742–1751.
2. Ravikumarbolagam, Natarajan S. Effect of pre-harvest sprays of biostimulants on post-harvest vase life of cut gladiolus cv. Arka Amar. The Bioscan. 2020;15(1):15–18.
3. Abdou M, Aly M, El-Sayed A, Khalil A, Helmy T. Effect of compost and some stimulatory substances on gladiolus plant A. Vegetative growth and flowering characters. Scientific Journal of Flowers and Ornamental Plants. 2021;8(1):65–74.
4. Bhalla R, Kanwar P, Dhiman SR, Jain R. Effect of biofertilizers and biostimulants on growth and flowering in gladiolus. Journal of Ornamental Horticulture. 2006;9(4):248–252.
5. Kumar R, Kumar R, Kumar P. Effect of integrated use of chemical fertilizers, biofertilizers and biostimulants in gladiolus (*Gladiolus grandiflorus* L.) cv. Sancerre. Progressive Horticulture. 2011;43(1):149–152.
6. Baskaran V, Misra RL, Singh SK, Abirami K. Response of biofertilizers and commercial formulations on growth, yield and corm production of gladiolus. Indian Journal of Horticulture. 2014;71(2):237–241.
7. Sahu JK, Abhangrao AK, Mashkey VK, Tripathi V. Effect in growth, flowering and corm yield of gladiolus by different application methods of biofertilizers. Agricultural Science Digest. 2025;45(1):30–35.
8. Trivedi S, Patel BB, Jadav J. Effect of biostimulants on growth and yield in gladiolus. 2022.

How to cite this article: Gupta PK, Sahu TL, Tiwari A, Kumar N, Kumar Y, Dansena V, et al. Impact of biostimulants on growth, flowering attributes and yield of *Gladiolus*: A review. *International Journal of Agriculture and Food Science*. 2026;8(11):189-192. doi: https://www.doi.org/10.33545/2664844X.2026.v8.i11c.90230

2664844X, 2026, 8(11), Downloaded from https://www.doi.org/10.33545/2664844X.2026.v8.i11c.90230 by International Journal of Agriculture and Food Science on [05/11/2026]. See the Terms and Conditions (https://www.agriculturaljournals.com) for rules of use; OA articles are governed by the applicable Creative Commons License