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Impact of Fertilizer and Bio Fertilizer on Different Growth Parameters of *Gladiolus* cv. American Beauty

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ABSTRACT

A field study was performed in 2023 and 2024 during the course of the two seasons in the practical filed of Bhai Gurdas Degree College, Sangrur, Punjab, India. The aim of this study was Impact of fertilizer and bio fertilizer on different growth parameters of gladiolus CV. American Beauty. The experiment was set up using a Randomized Block Design with Factorial concept (FRBD) with three replications and twenty-four treatment combos. The treatments included six treatments of biofertilizers (T1 Un-inoculated, T2 Azotobacter, T3 Phosphobacteria, T4 Azospirillum, T5 Azospirillum + Phosphobacteria, and T6 (Azotobacter + Phosphobacteria) and four fertilizer treatments (F0 Control (No fertilizer), F1 RDF, F2 85% RDF, and F3 70% RDF). The longest leaf's length, width, number of leaves per hill, maximum plant height, leaf area, leaf area index, minimum days taken to sprouting, sprouting percentage, number of sprouts per hill, and maximum plant height were all registered as T6 (Azotobacter + phosphobacteria).

Keyword: *Bio- fertilizer, Azotobacter, Phosphobacteria, Azospirillum, growth.*

INTRODUCTION

Gladiolus, often referred to as the "sword lily" due to its sword-shaped leaves, is a genus of ornamental plants in the family Iridaceae. This genus comprises over 260 species, with the majority being native to South Africa, though some species are also found in Europe, the Mediterranean region, and Asia. The name "Gladiolus" is taken from the Latin word "gladius," meaning sword, reflecting the shape of its foliage. Gladiolus is highly valued in the ornamental horticulture business for its tall flower spikes, which come in a wide array of colors including red, pink, yellow, orange, white, and purple. The flowers are arranged on one side of the spike and open sequentially from the bottom to the top, making them particularly popular as cut flowers for floral arrangements and bouquets (Pandey et al., 2020).

Gladiolus is usually grown from corms, which are swollen underground plant stems that store nutrients.

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These corms are planted in well-drained soil and in sunny areas to ensure optimal growth (Ahmad et al., 2008). The plant requires moderate watering and benefits from regular fertilization, especially with phosphorus and potassium, to encourage strong flowering. In addition to its aesthetic appeal, Gladiolus has cultural significance in different regions. It is often linked with strength and moral integrity and is used in celebratory events and ceremonies (Pandey et al., 2020). The plant's versatility and striking look have made it a staple in gardens, landscapes, and floral displays worldwide.

Biofertilizers are natural fertilizers that contain living microorganisms, which, when applied to the seeds, plant surfaces, or soil, promote plant growth by increasing the availability of important nutrients. They include nitrogen-fixing bacteria (e.g., Rhizobium, Azospirillum), phosphate-solubilizing bacteria, and mycorrhizal fungi. These microorganisms play a critical role in nutrient cycling and improve plant growth by fixing atmospheric nitrogen, solubilizing phosphates, and decomposing organic matter, making nutrients more available to plants. Plant height is a vital indicator of general plant health and vigor. Studies have shown that the application of biofertilizers greatly influences the height of Gladiolus cv. American Beauty. The use of nitrogen-fixing bacteria and mycorrhizal fungi can lead to an increase in nitrogen availability, which is important for vegetative growth. Flowering time and flower quality are important factors for ornamental plants. The application of biofertilizers has been found to affect the timing of flowering and the quality of flowers in Gladiolus cv. American Beauty. Biofertilizers, by improving the availability of important nutrients such as nitrogen and phosphorus, can lead to earlier (Anjana et al., 2015).

MATERIALS AND METHODS

The Department of Agriculture at Bhai Gurdas Degree College in Sangrur, Punjab, India, performed the current experiment, "Impact of bio fertilizer on different growth parameters of gladiolus cv. American Beauty," throughout the course of two consecutive Rabi seasons in 2022–2023. The farm with homogenous fertility and consistent textural composition was picked as the experimental field for the field study. From the available data, it is clear that, on average, during the cropping season in 2023–2024 the maximum and lowest temperatures varied from 19.1 to 40.9 and 5.3 to 22.4, respectively.

Experimental Details

During the rabi seasons of 2023–2024 at Bhai Gurdas Degree College in Sangrur, Punjab, India, the experiment was carried out at the same spot and with the same treatments at the farm of agriculture sciences department of agriculture. The experiment layout plan is shown in, and the experiment specifics are given in along with treatment information and their corresponding symbols.

Table.1 Experimental details of field

1.	**Crop**	**:**	Gladiolus
2.	**Cultivar**	**:**	American Beauty
3.	**Experimental design**	**:**	Factorial Randomized Block design (FRBD)
4.	**Replications**	**:**	3
5.	**Main plot treatment bio - fertilizer**	**:**	6
6.	**Treatment Combination**	**:**	24
7.	**Total Number of Plots**	**:**	72
8.	**Gross plot size**	**:**	32 × 22

Table.2 Treatment Details

	Treatment
Fertilizers	
F_0	Control (No fertilizer)
F_1	RDF
F_2	85% RDF
F_3	70% RDF
Bio- fertilizers	
T_1	Control
T_2	Azotobacter
T_3	Phosphobacteria
T_4	Azospirillum
T_5	Azospirillum + Phosphobacteria
T_6	Azotobacter + Phosphobacteria

RESULTS AND DISCUSSION

This chapter summarizes and explains the findings of the current study, "Effect of bio fertilizer on various growth parameters of gladiolus CV. American Beauty," which focused on the effects of different bio-fertilizer treatments on growth, floral characteristics, spike yield, nutrient content, quality of flower, and corm production. After undergoing statistical analysis, the data from the final observations of the different parameters during the growth and flowering phases were presented in tables.

Effect of fertilizer

The data given with fertilizer showed that minimum days taken to sprouting (16.02), Sprouting percentage (95.20), Number of sprouts per hill (2.10), length of longest leaf (59.03), width of the longest leaf (4.92), number of leaves per hill (7.45), maximum plant height (83.13 cm), leaf area (1822.80 cm), leaf area index (3.12) were registered in 100% F1 (RDF) and was significantly. With the inoculation of nitrogen fixers, greater chlorophyll content is formed, which could account for the rise in vegetative growth and other parameters. An further reason for the rise in vegetative growth could be the rhizosphere-dwelling microorganisms producing plant growth regulators that are taken up by the roots. Thus, greater biological nitrogen fixation may be responsible for improved vegetative growth. Plant growth characteristics may have grown as a result of improved root system development, potential manufacture of plant growth hormones such as IAA, GA3, and cytokinins (Pandey et al., 2020). The treatment these results were in line with effect of high fertilizer rates on the growth flowering of three gladiolus cultivars (Abou El-yazeid et al., 2013 & Attalla et al., 2003).

Effect of bio-fertilizer

The data given with bio -fertilizer showed that minimum days taken to sprouting (17.50), Sprouting percentage (94.28), Number of sprouts per hill (2.33), length of longest leaf (56.65), width of longest leaf (4.73), number of leaves per hill (7.30), maximum plant height (83.60 cm), leaf area (1782.71), leaf area index (2.97) were recorded under T6 (Azotobacter + phosphobacteria) treatments, While the maximum days taken to sprouting (21.92), minimum Sprouting percentage (89.38), number of sprouts per hill (1.47), length of longest leaf (46.05), width of longest leaf (3.83), number of leaves per hill (4.30), maximum plant height (64.23 cm), leaf area (1447.51 cm), leaf area index (2.41) were recorded under T1 (Control) treatments. Bio-fertilizer includes growth-promoting substances viz., GA, cytokine, and different micronutrients like Fe, Zn, Mn, and Cu. These nutrients play a very important part on the growth and development of gladiolus plants, because of its stimulatory and catalytic effects on flower yield and metabolic processes. These results corroborate with those of Basoli et al. (2014) in gladiolus and Sunitha et al.

(2007) Dalve et al. (2009) and Mittal et al. (2010) in marigold. Biofertilizers, which include living microorganisms such as nitrogen-fixing bacteria, phosphate-solubilizing bacteria, and mycorrhizal fungi, are widely recognized as sustainable alternatives to chemical fertilizers in enhancing plant growth and soil health. The experiment was performed in controlled conditions, where Gladiolus corms were treated with various biofertilizers, including Azospirillum, phosphate-solubilizing bacteria, and mycorrhizal fungi, both individually and in combination. Key growth factors such as plant height, leaf number, spike length, root development, flowering time, and corm size were measured throughout the growth cycle. Results showed that the application of biofertilizers significantly improved the growth and yield of Gladiolus plants compared to untreated controls. Plants treated with biofertilizers showed increased plant height, better leaf production, longer spikes, and enhanced root systems. Additionally, biofertilizer-treated plants showed earlier flowering and produced larger, higher-quality flowers with more vibrant colors. The combination of biofertilizers was particularly effective, showing a synergistic effect that further enhanced growth parameters and flower quality. The study finds that biofertilizers are a viable and environmentally friendly alternative to chemical fertilizers for the cultivation of Gladiolus. By improving nutrient availability, enhancing root development, and promoting general plant health, biofertilizers not only boost flower production but also contribute to long-term soil fertility and sustainability. The adoption of biofertilizers in Gladiolus cultivation could lead to more sustainable horticultural practices while keeping high-quality flower yields.

Table.3 Effect of fertilizers and bio fertilizer on various growth parameters of gladiolus CV. American Beauty

	Treatment	Days taken to sprouting	Sprouting percent	Number of sprouts per hill	Length of longest leaf(cm)	Width of longest leaf(cm)	Number of leaves per hill	Plant height(cm)	Leaf area(cm)	Leaf area Index
Fertilizer										
F_0	Control(No fertilizer)	22.00	88.37	1.83	43.25	3.60	4.22	61.07	1358.83	2.26
F_1	RDF	16.02	95.20	2.10	59.04	4.92	7.45	86.13	1822.80	3.12
F_2	85% RDF	19.60	93.98	1.95	53.75	4.48	6.68	78.92	1690.51	2.81
F_3	70%RDF	21.02	93.80	1.90	51.40	4.28	6.00	75.27	1617.36	2.69
SE(m)±		0.333	1.48	0.04	0.84	0.05	0.10	0.52	17.04	0.03
CD at 5%		1.01	4.15	0.6	2.32	0.14	0.28	1.68	52.21	0.09
Bio-Fertilizer										
T_1	Control	21.92	89.38	1.47	46.05	3.83	4.30	64.23	1447.51	2.41
T_2	Azotobacter	21.10	92.03	1.88	50.70	4.20	6.03	74.23	1593.31	2.65
T_3	Phosphobacteria	20.83	93.58	1.99	51.60	4.30	6.60	76.60	1623.38	2.70
T_4	Azospirilum	18.90	93.20	1.79	48.68	4.13	5.38	71.60	1564.75	2.60
T_5	Azospirilum + Phosphobacteria	18.60	93.68	2.11	55.03	4.58	7.00	80.43	1728.59	2.88
T_6	Azotobacter + Phosphobacteria	17.50	94.28	2.33	56.65	4.73	7.30	83.60	1782.71	2.97
SE(m)±		0.41	1.76	0.3	1.05	0.08	0.10	0.73	21.12	0.03
CD at 5 %		1.23	4.12	0.6	2.98	0.18	0.31	2.12	64.75	0.10

CONCLUSION

The results may be stated as application of bio fertilizer singly and different combinations has significant effect on all growth. Among different bio fertilizer and their combinations, (Azotobacter + phosphobacteria) treatment show least value for these parameters during both the seasons of experiment.

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Author Contribution
All authors have participated in critically revising of the entire manuscript and approval of the final manuscript.

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