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Effect of bio-fertilizer on flowering, and corm parameters of *Gladiolus* cv. American beauty

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Abstract
An experiment was undertaken to explore the effect on flowering and corm parameters of the biofertilizer in gladiolus (*Gladiolus grandiflorus* L.) cv. and laid out in Randomized Block Architecture (RBD) experiment with Azotobacter, Phosphobacteria, Azospirllium (Azotobacter + Phosphobacteria), respectively, (Azospirillum + Phosphobacteria). Results showed that minimum days taken to spike initiation (48.67 days), maximum diameter of 2nd floret (9.14 cm), number of florets per spike (10.86), number of spikes per plant (2.90), number of spikes per hectare (398065.70), number of corms per plant (2.59), weight of corms per plant (74.00 g), weight of cormels per plant (11.92 g), size of corm (5.86 cm), nitrogen (1.84 percentages per plant) Bio-fertilizer was identified in this experiment, in order to increase soil fertility and crop production in sustainable agriculture.

Keywords: Bio-fertilizer, plant growth, flower quality, nutrient uptake, *Gladiolus*

Introduction
Gladiolus (*Gladiolus grandiflorus* L.) is one of the most common ornamental plants cultivated for its enchanting flowers in many parts of the world. It is renowned internationally for its spectacular florets of colour, robust spike, scale, elegant appearance and consistency that occupies fifth place in international trade. It is native to South Africa, and ranks second in the Netherlands market among the bulbous cut flowers. This crop's success as a cut flower is increasing worldwide, which is a possible money-spinner for the floriculture industry with annual production of about 120 million spikes. To ensure productivity maximisation in any crop nitrogen, phosphorus and potassium are the three main nutrients that play a very crucial role in influencing vegetative growth, flower yield and quality attributes. However, given the recent definition of eco-friendly production increased prices, and the timely non-availability of inorganic fertilisers, the use of chemicals contributing to low soil fertility and soil quality is selective. The use of cost-effective and eco-friendly bio-fertilizers in recent years has resulted in improved production of many crops, of addition to increasing soil quality and fertility levels along with preserving nutrient physical properties.

Various bio-fertilizers, namely Azotobacter and Trichoderma are significant. Azotobacter is a symbiotic bacterium where it lives in tandem with the host and fixes nitrogen in the environment. The symbiotic combination of higher plant fungi and root systems called "Mycorrhiza." Bio-fertilizers have a supplementary nutritional function in and by their use in productivity.

The various agro-techniques and nutritional requirements need to be streamlined by including nutrient management method for productivity improvement and gladiolus spike consistency. A field investigation was performed to research the impact of biofertilizer on parameters of gladiolus cv in flowering and corm. American conditions for beautyunder open area.

Material and methods
The experiment was carried out at the School of Agriculture, Research Farm, Career Point University, Kota, Rajasthan, India. And laid out in Randomized Block Design replicated thrice with three treatments.

At the time of planting, Bio-fertilizers were applied treatment-wise at 40 days after corms were planted. Before laying out the blocks a basal dose of NPK was applied @200:180:200 kg ha-1. Cv gladiolus corms are uniform in size. Planting American Beauty. Row to row distance of 30 cm and plant to plant distance of 20 cm in a 2.4 x 1.6 m plot size. Was upheld. The treatments imposed were: T1 (Control), T2 Azotobacter, T3 Phospirillum, T4 Azospirillum, T5 (Azotobacter + Phospirillum), T6 (Azospirillum + Phospirillum) Fertilizer. The observations on various flowering, corm yield characters.

Effect of bio-fertilizer on flowering parameters

It is evident from table 1and 2 that the integration of bio-fertilizers showed significant response towards flower and corm yield attributes of gladiolus.

The results showed that minimum days taken to spike initiation (48.67 days), maximum diameter of 2nd floret (9.14 cm), number of florets per spike (10.86), number of spikes per plant (2.90) and number of spikes per hectare (398065.70) were recorded under treatment T6 (Azospirillum + Phospirillum) followed by T5, T4, T3 and T2, whereas minimum values of above-mentioned parameters were recorded in treatments T1 (control).

The significant increase in these parameters could be due to an intense and rapid increase in bacteria, particularly in the rhizosphere, which creates favourable conditions for nitrogen fixation and phosphorus solubilization at a higher rate through the supply of nitrogen through nitrogen fertilisers and other nutrients, bacterial secretion, hormone production and the supply of antibacterial and antifungal compounds, Bio-fertilizer contains substances that promote growth, such as GA, cytokine and various micronutrients such as Fe, Zn, Mn and Cu.

These nutrients, due to their stimulatory and catalytic effects on flower yield and metabolic processes, play a very important role in the growth and production of gladiolus plants. This observation are substantiated by those of Basoli *et al*., (2014) [2] in gladiolus, Ali *et al*., (2013) [1] in gladiolus and Sunitha *et al*., (2007) [15] and Mittal *et al*., (2010) [8] in marigold.

Effect of biofertilizer on corm and cormel parameters

In the present study, bio-fertilizers were found to be important in affecting corm characters. T6 (Azospirillum + Phosphobacteria) recorded the slightly higher number of corms per plant (2.59), cormel weight per plant (74.00 g), cormel weight per plant (11.92 g), and corm height (5.86 cm). In addition T4 Azospirilumi.e. And T5 i.e. Azotobacter + Phosphobacteria) for cormella and cormella characters contained at par to T6. The use of bio-fertilizers improves the amount of microbes in the soil resulting in better root multiplication, enhanced absorption of nutrients and water, more photosynthesis of luxuriant leaves and improved food storage, improved combination potential of ions and water from the soil resulting into increase in yield. The results above are consistent with the gladiolus findings of Kumari Vasantha *et al*., (2014) [7] and Godse *et al*., (2006) [3].

An increase in the average diameter and weight of corms and cormels due to the use of bio-fertilizers may be due to the fact that it increases the supply of nutrients to the plants, which increases the photosynthetic behaviour of the plants and thereby accelerates the development of the photosynthetic sink towards the source (corm). In addition, as noted by Srivastava and Govil (2005) [13], Karthiresan, and Venkatesha (2002) [5, 6] in gladiolus and Swaminathan *et al*., (1999) [16] in tuberose, it also raises carbohydrates and auxin concentrations in the roots resulting in thicker and well-branched stems.

Effect of biofertilizer on N, P and K contents in leaves

The data presented in Table 2 clearly indicate that the significantly highest nitrogen (1.84%), phosphorus (1.09%), and potash (2.02%) in leaves of gladiolus. Were recorded with treatment T6 (Azospirillum + Phosphobacteria). Similar results have also been reported by Ali *et al.*, (2013) [1] in gladiolus.

The combined use of organic, inorganic, and bio-fertilizers vastly increased nitrogen content, which may be attributed to the rapid absorption of these elements by the plant surface and their translocation to the soil as reported by Singh *et al*. (2002) [12] in gladiolus.

The position of phosphate solubilizing bacteria increases the availability of phosphorus in the soil through the secretion of phosphate enzyme which leads to the conversion of organic phosphorus to their available forms and therefore increases the absorption and accumulation of phosphorus in plant tissues stated by Swaminathan *et al*. (1999) [16] in tuberose.

Potassium percentage increase may be attributed to the influence of various strain groups and potassium mobilising micro-organisms. In addition, using biofertilizer which contains potash in the available form, and also helps to increase the levels of minerals extracted in the availability of metals.

Conclusion

The following inference can be taken on the basis of conclusions from the present study. The assay consisted respectively of the bio-fertilizers Azotobacter, Phosphobacteria, Azospirllium (Azotobacter + phosphobacteria), (Azospirillum + Phosphobacteria). Results revealed the minimum days taken to spike initiation (48.67 days), maximum diameter of 2nd flower (9.14 cm), number of florets per spike (10.86), number of spikes per plant (2.90), number of spikes per hectare (398065.70), number of corms per plant (2.59), weight of corms per plant (74.00 g), weight of cormels per plant (11.92 g), height of corm (5.86 cm), nitrogen (1.84 percentile per plant) Bio-fertilizer was identified in this experiment, in order to improve soil fertility and crop production in sustainable agriculture.

Table 1: Effect of different Bio-fertilizers on the growth, and quality Characteristics of *Gladiolus grandiflorus* cv. American beauty

	Treatment	Day to spike initation	Diameater of 2nd floret (cm)	No of florets/spike	Number of spike/plant	Number of spikes/ha	No. of corms /plant
T1	Control	55.76	7.60	9.34	2.09	341138.30	1.98
T2	Azotobacter	51.86	8.03	10.82	2.18	364084.60	2.15
T3	Phosphobacteria	51.04	7.46	9.78	2.35	370853.30	2.24
T4	Azospirillum	54.96	7.06	9.63	2.05	339432.90	2.06
T5	Azotobacter+ Phosphobacteria	57.23	7.86	10.12	1.07	327257.40	2.30
T6	Azospirillum + Phosphobacteria	48.67	9.14	10.86	2.90	398065.70	2.59
S.Em±		1.32	0.19	0.25	0.05	8887.44	0.05
CD at 5%		4.22	0.61	0.75	0.16	23366.78	0.17

Table 2: Effect of bio-fertilizer on N, P and K content in leaves

S. No.	Treatment	Weight of corms/ plant(g)	Weight of cormels/ plant(g)	Size of corm (cm)	N, P and K content in Leaf		
					N%	P%	K%
T1	Control	61.86	9.85	4.30	1.20	0.78	1.38
T2	Azotobacter	64.73	11.00	4.90	1.27	0.82	1.69
T3	Phosphobacteria	68.12	11.50	5.40	1.41	0.86	1.92
T4	Azospirillum	62.65	10.95	4.70	1.11	0.69	1.69
T5	Azotobacter + Phosphobacteria	62.12	9.69	4.30	1.19	0.72	1.65
T6	Azospirillum + Phosphobacteria	74.00	11.92	5.86	1.84	1.09	2.02
S.E(m)±		1.62	0.27	0.12	0.03	0.06	0.04
CD at 5%		5.20	0.86	0.39	0.10	0.02	0.13

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