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Synergistic impact of biofertilizer consortia on vegetative growth of gladiolus under different concentrations

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Abstract
Gladiolus, being highly popular and well-known, is extensively utilized in home gardening and landscaping, apart from its widespread use as a cut flower. The cultivation practices for crops in India, including flower crops like Gladiolus, heavily rely on the use of inorganic fertilizers, pesticides, and insecticides. However, the prolonged use of these inorganic inputs has led to various issues, such as land degradation, toxicity, and declining surface and groundwater quality, posing significant threats to land sustainability and soil health. Consequently, the concept of natural farming is gaining widespread popularity, emphasizing the use of organic manures and fertilizers, along with exploring bio-substitutes to replace synthetic fertilizers, growth regulators, pesticides, and insecticides. The results showed that the maximum vegetative growth parameters viz. plant height at 30 days (59.94 cm), 60 days (90.87cm), 90 days (120.56 cm); number of leaves(21.54); fresh weight of plant (161.78) was observed highest under treatment T_7 (PSB + KSB + ZSB + Azotobacter enriched vermicompost) and which was at par with treatment T_5 (Azotobacter enriched Vermicompost). The minimum were observed in the treatment T_1 (Control).

Keywords: Gladiolus (*Gladiolus grandifloras*), PSB-phosphorus solubising bacteria, KSB-Potasium solubising bacteria, ZSB-Zinc solubi

Introduction
Gladiolus (*Gladiolus grandifloras*) comprises perennial bulbous flowering plants belonging to the iris family (Iridaceae). Recognized as one of the most significant ornamental bulbous crops, it is cultivated globally as a popular cut flower. Often called the 'Sword lily,' it is also celebrated as the "Queen of bulbous ornamental crops." In the country, Gladiolus is grown over an area of approximately 11, 660 hectares, yielding around 106 crore cut flowers. Among cut flowers, it ranks third in both area and production (Anonymous, 2023) [1]. Environmentally friendly microorganisms are increasingly gaining popularity as biological control agents for managing plant infections. These microorganisms have proven effective in promoting plant growth, contributing significantly to nutrient cycling (Bhattacharyya and Jha, 2012) [2], and aiding in infection management. Keeping these points in view, a study was carried out to identify best biofertilizer viz., PSB enriched Vermicompost, KSB enriched Vermicompost, ZSB enriched Vermicompost, Azotobacter enriched Vermicompost, ZSB + KSB enriched, (PSB + KSB + ZSB + Azotobacter) enriched Vermicompost extend the longevity and physical attributes of plant.

Materials and Methods
The field experiment has been performed at Horticulture Research cum Instructional Farm, Department of Floriculture and Landscape Architecture, College of Agriculture, IGKV, Raipur (C.G) during 2024-25. The goal of the study was to investigation entitled "Enrichment of vermicompost by using biofertilizer and its effect in Gladiolus". The experiment was carried out with 7 treatments (including control) in Randomized Block Design (RBD) with 3 replications under the open field condition. There were 7 treatments viz., T_1 Control (No biofertlizer only RDF), T_2 (PSB enriched Vermicompost @ 5 t/ha + 142 kg), T_3 (KSB enriched Vermicompost @ 5 t/ha + 8.77kg/ha), T_4 (ZSB enriched

Vermicompost @ 5 t/ha + 5 kg/ha), T_5 (Azotobacter enriched Vermicompost @ 5 t/ha + 152 kg), T_6 (ZSB + KSB enriched vermicompost @ 5 t/ha + 143.77kg/ha)., T_7 ((PSB + KSB + ZSB + Azotobacter) enriched Vermicompost @ 5 t/ha + 450.77 kg/ha). The vermicompost were spread out on a clean polyethene sheet. Jaggery (200 gms) and biofertilizer was dissolved in water which was sprinkled over the vermicompost later on and mixed with both the hands so that vermicompost became sticky. Simultaneously vermicompost covered with a moist cloth and left undisturbed for seven days to maintain proper moisture and enhance microbial activity. After the incubation period, the enriched vermicompost was applied in the field along with the treated corms to support better plant growth and nutrient uptake.. To test the impact of biofertlizer on vegetative parameter of plant Biofertilizers were calculated as per treatment and well mixed in organic manure and then applied in the soil of respective plots at the time of planting.

Results and Discussion

The data on height of plant in gladiolus, at 30, 45 and 60 days after planting was differed significantly with enrichment of vermicompost by using biofertilizers in Gladiolus data are presented in Table 4.1.1. Plant height varied significantly among them. The data observed at 30 DAP, depicted that the plant height (59.94), was observed maximum in treatment T_7 (PSB + KSB + ZSB + Azotobacter) enriched Vermicompost) which was statistically followed by treatment T_5. However, the lowest plant height of gladiolus (55.36) had been found from treatment T_1 (Control).Similarly At 60 DAP And 90 DAP maximum plant height (120.56 cm) was observed maximum in treatment T_7 (PSB + KSB + ZSB + Azotobacter) enriched Vermicompost) which was statistically followed by treatment T_5. However, the lowest plant height of gladiolus (119.02) had been found from treatment T_1 (Control). Enhancement in the height of plant with combined application of PSB + KSB + ZSB + Azotobacter enriched vermicompost could be accredited to the appropriate nitrogen fixation by Azotobacter as non-symbiotic bacteria in the rhizosphere of the plant while, PSB, on the other hand, act as an effective phosphate solubilizer, contributing to increased phosphorus absorption in the roots, which allows the plants to sustain their vegetative growth. The results of present study are in close conformity with findings of Bhalla *et al*. (2006) [3], Pandey *et al*. (2013) [4] in gladiolus.

The data on No. of leaves in gladiolus was differed significantly with enrichment of vermicompost by using biofertilizers in Gladiolus data are presented in Table 4.1.2. Plant no. of leaves varied significantly among them. The data depicted that No. of leaves (21.54), was observed maximum in treatment T_7 (PSB + KSB + ZSB + Azotobacter) enriched Vermicompost) which was statistically followed by treatment T_5. However, the lowest No. of leaves of gladiolus (7.43) had been found from treatment T_1 (Control). The results of present study are in close conformity with findings of Jadhav *et al*. (2014) [5] in marigold and Bihari *et al*. (2009) [6] in rose

The data on Fresh weight of plant in gladiolus was differed significantly. Fresh weight of plant varied significantly among them. The data depicted that Fresh weight of plant (161.78), was observed maximum in treatment T_7 (PSB + KSB + ZSB + Azotobacter) enriched Vermicompost) which was statistically followed by treatment T_5. However, the lowest Fresh weight of plant of gladiolus (116.78) had been found from treatment T_1 (Control). The results might be due to application azotobacter substance to plants, the growing plants are supplied with food, its application also results in productive and fertile soil, which increases the water holding capacity of soil and increase quality of flower. Similar results were also obtained by Sankari *et al*. (2015) in gladiolus The results of present study are in close conformity with findings of Godse *et al*. (2006) [7] and Dongardive *et al*. (2007) [8] in gladiolus; Satyavir (2007) [9] in tuberose;

The data on No. of shoot per corm in gladiolus was differed significantly No. of shoot per corm varied significantly among them. The data depicted that No. of shoot per corm (3), was observed maximum in treatment T_7 (PSB + KSB + ZSB + Azotobacter) enriched Vermicompost) which was statistically followed by treatment T_5. However, the lowest No. of shoot per corm of gladiolus (1.03) had been found from treatment T_1 (Control).The no. of floret per spike increases as attributed to easy uptake of nutrients and simultaneous transport of growth promoting substances like cytokinin to the axillary buds, resulting in breakage of apical dominance. The results of present study are in close conformity with findings of Bhalla *et al*. (2006) [3], Pandey *et al*. (2013) [4] in gladiolus; Jadhav *et al*. (2014) [5] in marigold and Bihari *et al*. (2009) [6] in rose.

Table 1: Effect of enrichment of vermicompost by using biofertilizers in Gladiolus plant height (cm) at 30, 60 and 90 days after planting.

Tr. No.	Treatment	Plant height (cm)		
		30 DAT	60 DAT	90 DAT
T_1	Control (No biofertlizer only RDF)	40.23^{e}	67.89^{b}	85.89^{d}
T_2	PSB enriched Vermicompost	52.51^{bc}	85.67^{ab}	103.45^{bc}
T_3	KSB enriched Vermicompost	43.89^{de}	69.87^{b}	98.78^{cd}
T_4	ZSB enriched Vermicompost	45.67^{cde}	71.67^{b}	101.56^{bcd}
T_5	Azotobacter enriched Vermicompost	57.89^{ab}	90.34^{a}	115.45^{ab}
T_6	ZSB + KSB enriched vermicompost	50.78^{bcd}	72.45^{b}	102.45^{bcd}
T_7	(PSB + KSB + ZSB + Azotobacter) enriched Vermicompost	59.94^{a}	90.87^{a}	120.56^{a}
Mean		50.13	78.39	104.02
SEm±		2.29	5.37	4.92
C.D. at 5%		7.05	16.54	15.16
C.V		7.90	11.86	8.19

Table 2: Effect of enrichment of vermicompost by using biofertilizers on number of leaves, fresh weight and No. of shoots per corm in gladiolus.

Tr. No.	Treatment	No. of leaves	Fresh weight of plant	No. of shoots per corm
T_1	Control (No biofertlizer only RDF)	7.43^{e}	116.78^{b}	1.03^{c}
T_2	PSB enriched Vermicompost	16.63^{b}	131.78^{b}	2.5^{b}
T_3	KSB enriched Vermicompost	11.14^{d}	120.89^{b}	1.1^{c}
T_4	ZSB enriched Vermicompost	13.63^{c}	121.78^{b}	2.17^{b}
T_5	Azotobacter enriched Vermicompost	17.07^{b}	144.78^{ab}	2.64^{ab}
T_6	ZSB + KSB enriched vermicompost	16.58^{b}	129.78^{b}	2.23^{b}
T_7	(PSB + KSB + ZSB + Azotobacter) enriched Vermicompost	21.54^{a}	161.78^{a}	3^{a}
Mean		14.862	132.51	2.096
SEm±		0.81	9.12	0.15
C.D. at 5%		2.48	9.12	0.45
C.V		9.39	11.92	12.12

Conclusion

The conclusion drawn from the experimental analysis highlights that the application of T_7 ((PSB + KSB + ZSB + Azotobacter) enriched Vermicompost @ 5 t/ha + 450.77 kg/ha) was initiate to be highly successful for superior performance of different parameters such as vegetative growth parameters viz. plant height at 30 days (59.94 cm), 60 days (90.87 cm), 90 days (120.56 cm); number of leaves (21.54); fresh weight of plant (161.78) was observed highest under treatment T_7 (PSB + KSB + ZSB + Azotobacter enriched vermicompost) and which was at par with treatment T_5 (Azotobacter enriched Vermicompost).Thus, Biofertilizer enriched could be adopted by the gladiolus producers which needs higher price for beautifully fresh flowers in eco-friendly ways.

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