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Effect of GA_3 and biofertilizers on growth and flowering in gladiolus (*Gladiolus floribundus* L.) cv. AMERICAN BEAUTY

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ABSTRACT : The present investigation was undertaken during winter season 2011-12 at the Horticultural Research Farm, Department of Horticulture, Ch. Charan Singh University Campus, Meerut on Gladiolus cv. AMERICAN BEAUTY. The experiment was laid out in Factorial Randomized Block Design in two factors with three replications. There were two factor first factor comprised of foliar application *i.e.* P_1= GA_3 @ 100 ppm, P_2= GA_3 @ 200 ppm and second factor comprised of soil application *i. e*. B_1= PSB @ 0.11 g/m^2, B_2= *Azotobacter* @0.14 ml/m^2. The study shown that all parameters were found higher by using of P_2 B_1 (GA_3 @ 200 ppm at 30 DAP + soil treatment with PSB) in comparasion to all individual treatments.

KEY **W**ORDS : Gladiolus, Variety, GA_3, PSB, *Azotobacter*

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Gladiolus (*Gladiolus grandiflorus* L.) is an important cut flower in India. The cut flowers are used for both outdoor and interior decoration. It gets more popularity among the garden lovers. Generally, ornamental bulbous plants are used for both cut flower and landscape gardening. Bio-fertilizers are cheap, eco-friendly and good source of nutrients. The beneficial soil microbes which are of great significant in biological nitrogen fixation, phosphate solubilizer and mycorrhizal fungi. Bio-fertilizers like *Azotobacter* can play a very significant role in improving soil fertility by fixing atmospheric nitrogen. They also improving crop growth and quality of product by producing phytohormones, enhancing the uptake of plant nutrients by plant roots and thus help in sustainable crop production through maintenance of soil productivity.

Growth regulators play a significant role in the development of plants. The roles of individual regulators are described below, but please remember that the issue is often cloudy. Growth regulators can also be useful tools, and commercial formulations are available to slow stem elongation, promote rooting and to promote flowering (among other things).Gibberellins a growth regulator is important in elongation, bolting and flowering. Probably, the most conspicuous and well known effect of gibberellins is stem elongation. An application of gibberellins to genetically dwarf plants is known to greatly increase their growth to the point where they actually appear normal.

RESEARCH PROCEDURE

The experiments was conducted at Horticulture

Research Farm, Choudhary Charan Singh University, Meerut, during 2011-12 in a Randomized Block Design with three replications. The treatment were P_0=No gibberellic acid, P_1=Gibberellic acid @ 100ppm, P_2=Gibberellic acid @ 200ppm, B_0=No bio- fertilizer (*Azotobacter*/PSB), B_1=PSB@0.11g/m^2, B_2= *Azotobacter* @ 0.14ml./m^2. The application of stock solutations of GA_3 @ 100 ppm and 200 ppm were prepared before use. The gibberellic acid (GA_3) was first dissolved in a little volume of ethyl alcohol and then distilled water was mixed in it to obtain required volume of stock solutions. The gibberellic acid was applied on tested plant in foliar spray form in evening with the help of a fine hand sprayer according to treatments for 30 DAP. The applications of bio-fertilizer were applied in experimental field according to the treatments. The application of bio-fertilizers was applied in soil just before planting the corms.

The investigation was conducted in open field. All recommended agronomic package of practices was followed to grow a successful crop. Observation was recorded on five selected plants from each genotype in each plot. Observation were recorded for number of days for 50 per cent corm sprouting, number of leaves per plant, height of plant (cm.), width of the leaf (cm.), days for appearance of initial spike, days for opening of first floret, number of florets per spike, spike length (cm.), length of rachis (cm.), diameter size of the florets (cm.). Correlation analysis was carried out as per the formulae suggested by Fisher (1954).

RESEARCH ANALYSIS AND REASONING

The findings of present investigation clearly indicate that sprouting of corms (50% sprouting) was non-significantly affected by the applications of GA_3 because the applications of GA_3 were applied after sprouting of corms *i.e.* at 30 DAP.

As regards, the different concentrations of GA_3 applications it was observed that GA_3 applied at the concentration of 100 ppm resulted in more number of leaves per plant (7.12). The minimum number of leaves per plant was obtained under the control. Plant height and width of leaf were increased significantly with GA_3. Maximum plant height (49.17cm) and width of leaf (1.50 cm) were recorded under the treatment P_2, where GA_3 @ 200 ppm at 30 DAP as compared to the control. Increasement in number of leaves per plant, plant height may be due to the abolition of apical dominance, as gibberellins have been categorically shown to be instrumental in lifting. Similar findings were also reported by Dahatonde *et al.* (2008) and Sanap *et al.* (2004), in gladiolus.

Applications of GA_3 significantly influenced the florets per spike, spike length and rachis length better than control. Maximum florets per spike (17.30), spike length (63.06 cm) and rachis length (22.09cm), early appearance of initial spike and opening of first floret were recorded under the treatment P_2 (GA_3 @ 200 ppm at 30 DAP). The enhancement in spike length, rachis length and number of florets/spike with GA_3 may be due to a close parallelism between vegetative growth and flowering and it is possible that promontory effect of GA_3 on vegetative growth associated with efficient mobilization capacity, might have improved flowering indirectly as reported by Sanap *et al.* (2004); Bhattarcharjee (1984) and Kumar *et al.* (2006).

Application of *Azotobacter* resulted in better vegetative growth and development of plant. *Azotobacter* under the investigation significantly influenced the number of days to 50 per cent sprouting of corms, plant height, width of leaf, number of floret per spike, spike length. Moreover, inoculation of corms with *Azotobacter* under the treatment B_2 (soil treatment with *Azotobacter*) gave significantly induced earliness in corms sprouting (8.73 days) as compared to control and maximum number of leaves per plant (8.13), plant height (52.12 cm) and earlier number of days to 50 per cent sprouting of corms was recorded under the treatment B_1, (soil treatment with PSB) (Table 1a). These findings are corroborated with the findings of Barman *et al.* (2003); Dongradive *et al.* (2007) and Yadav *et al.* (2005).

Application of *Azotobacter* gave significant effect on all flowering parameters. The improvement in various flowering parameters related to number of days for appearance of initial spike, *Azotobacter* treatment as reflected in minimum days for appearance of initial spike (60.81 days), florets per spike (19.32), maximum length of spike (71.10cm) and diameter of floret (14.02cm) under the treatment B_2 (soil treatment with *Azotobacter*) as compared to control and all others best parameters were recorded under the treatment B_1. The possible reason only for fixed atmospheric nitrogen but also produced some growth promoting hormones. Similar results were obtained by Barman *et al.* (2003) and Barman *et al.* (2006) in gladiolus and Srivastava *et al.* (2006) in tuberose.

Table 1(a): Effect of GA_3 and bio-fertilizers on corm sprouting and number of leaves per plant

Sr. No.	Treatments	No. of days for 50% corms sprouting	No. of leaves per plant	Plant height (cm)	Width of leaf (cm.)	Days for appearance of spikes	Days for opening of first floret	No. of florets per spike	Spike length (cm.)	Length of rachis (cm.)	Diameter of florets (cm.)
Plant growth regulator GA_3 (P)											
1.	P_1 (GA_3 @ 100 ppm at 30DAP)	10.13	7.12	47.40	1.34	63.82	82.32	17.30	63.10	22.13	13.37
2.	P_2 (GA_3 @ 200 ppm at 30 DAP)	10.17	7.09	49.17	1.50	63.13	78.32	17.30	63.06	22.09	13.80
	C.D. (P=0.05)	NS	0.412								
Biofertilizers (*Azotobacter* and PSB) B											
3.	B_1 (Soil treatment with PSB)	8.16	8.13	52.12	1.40	62.60	78.90	18.70	67.34	27.05	14.01
4.	B_2 (Soil treatment with *Azotobacter*)	8.73	7.57	49.40	1.41	60.81	79.87	19.32	71.10	25.69	14.02
5.	Control	10.68	7.02	46.11	1.23	65.90	85.45	16.10	62.44	20.12	12.32
	S.E.±	0.162	0.137	0.723	0.018	0.275	0.499	0.575	0.587	0.4993	0.039
	C.D. (P=0.05)	0.486	N.S.	2.169	0.054	0.824	1.497	0.192	1.760	0.864	0.117

Table 1(b): Interaction effect of GA_3 and bio-fertilizers on corms sprouting and number of leaves per plant

Sr. No.	Treatments	No. of days for 50% corms sprouting	No. of leaves per plant	Plant height (cm.)	Width of leaf (cm.)	Days for appearance of spikes	Days for opening of first floret	No. of florets per spike	Spike length (cm.)	Length of rachis (cm.)	Diameter of florets (cm.)
1.	P_1B_1 (GA_3 @ 100 ppm at 30 DAP + Soil treatment with PSB)	8.10	7.54	54.10	1.50	63.70	79.47	17.70	62.75	23.15	14.01
2.	P_1B_2 (GA_3 @ 100 ppm at 30 DAP + Soil treatment with *Azotobacter*)	8.70	7.25	51.83	1.50	61.50	79.86	19.01	67.50	22.40	13.96
3.	P_2B_1 (GA_3 @ 200 ppm at 30 DAP + Soil treatment with PSB)	8.22	8.20	57.11	1.54	59.74	77.32	20.01	72.32	28.97	14.90
4.	P_2B_2 (GA_3 @ 200 ppm at 30 DAP + Soil treatment with *Azotobacter*)	8.71	7.71	52.45	1.47	62.40	78.53	18.31	65.06	25.76	14.02
5.	Control	10.68	7.02	46.11	1.23	65.90	85.45	16.10	62.04	20.12	12.32
	S.E.±	0.280	0.238	1.253	0.094	0.476	0.865	0.332	1.016	0.4993	0.067
	C.D. (P=0.05)	N.S.	0.715	3.75	0.0313	1.428	2.594	0.997	3.049	1.497	0.067

The interaction effect of GA_3 and biofertilizers (*Azotobacter* and PSB) were found significant with respect to number of leaves per plant, plant height, width of leaf, days for appearance of initial spike, number of florets, length of spike, rachis length and diameter of the florets, and days for opening of first florets which were recorded highest under the treatment combination P_2B_1, (GA_3 @ 200 ppm at 30 DAP + soil treatment with PSB) as compared to control (Table 1b). Increase in number of leaves per plant and plant height might be due to increased cell division and cell enlargement by GA_3 and increased phosphorus availability by PSB. Similar results were also recorded by Patil *et al.* (2008) in Ross and Bhalla *et al.* (2008).

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