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Response of integrated nutrient management on vase life and corm yield of gladiolus (*Gladiolus grandiflorus*) cv. white prosperity

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Abstract
Integrated Nutrient management (INM) is a tool for cultivation of future crops in present era. Thus, it is tried to investigate the response of vase life and corm yield in respect of organic manure, NPK, azotobacter and PSB application in the field of gladiolus. The experiment was laid out in randomized block design with 3 replications with a total of 13 treatments. The experimental findings was revealed that the treatment T_{12} (75% RDF+ VC +Azotobacter +PSB) better response viz. percent increase spike length, per cent opening of floret per spike, number of floret opened at spike time, drooping of florets, spike life equatorial polar diameter of corm, weight of corm, number of corms per plant, number of corms per hectare (Lakh), number of cormels per plant and number of cormels per hectare (Lakh) of gladiolus.

Keywords: Integrated Nutrient management, vase life, corm yield characters, Gladiolus

Introduction
Gladiolus (*Gladiolus grandiflorus* L.) is a queen of bulbous ornamental plants. It is one of the most important bulbous cut flower grown in India and other countries. Gladiolus is one of the popular cut flower in India and cut flowers used for vase decoration and preparation of bouquets. The present popularity is due to its large scale for commercial cultivation in India as well as world. Gladiolus took the first place and accounted 60% of the total turnover of cut flower bulbs followed by Asiatic lily tulip, freesia, iris, narcissus and dahlia (Chaudhary *et al.*, 2002) [2] commercial cultivation of gladiolus is ever increasing due to its vivid colour, shape, size and long durability of spike in holding solution. The climate in our hills during summer and in the plains during winter is ideal for gladiolus cultivation. Area and production of cut flower in India is 3, 09,000 hectare and 5, 93,000 MT (Anonymous 2016-17) [1]. Integrated Nutrients Management (INM) including use of organic manure and bio fertilizers along with appropriate dosage of fertilizer is cost effective method to achieve more yield and better quality crop. Farm yard manure is prepared basically using cow dung, cow urine, waste straw and other dairy wastes. FYM is rich in nutrients, a small portion of N is directly available to the plants while a larger portion is made available as and when the FYM decomposes. When cow dung and urine are mixed, a balanced nutrient is made available to the plants. Vermicomposting is the best alternative to conventional composting as it is a mesophilic process which takes the advantage of earthworms and their associated beneficial microbial partners, to degrade the organic matter. Vermicomposting hastens the composting process and in addition it preserves the diverse beneficial microflora, thus providing even more nutritive and biologically active biofertilizers. Poultry manure is the organic waste material from poultry consisting of animal faces and urine. Poultry litter refers to the manure mixed with some of the bedding material or litter (wood shavings or sawdust) and feathers. These nutrients plus others come largely from the bird faces. Manures decompose (mineralize) in the soil releasing nutrients for crop uptake. Use of bio-fertilizer offers an economically attractive and ecologically sound means for reducing external input and improving the quality and quantity of input resources. Azotobacter is important free living bacteria which are used in fruit crops for sustainable production. Among the free living nitrogen fixing bacteria, azotobacter is most intensively investigated genera. The production of azotobacter is generally low in the rhizosphere of the crop plants. They derived food from organic matter present in the soil and

root exudates and fixes atmospheric nitrogen, Azotobacter is also known to synthesise biologically active growth promoting substances such as Indol Acetic acid (IAA), gibberellic acid, when they are applied to flower crops they fix non symbiotic nitrogen fixation and supplies the required nitrogen to plant for their proper metabolic functioning. Use of phosphorus solubilising bacteria as inoculants increases phosphorus uptake. These bacteria also increase prospects of using phosphatic rocks in crop production. Greater efficiency of phosphorus solubilising bacteria has been shown through co-inoculation with other beneficial bacteria and mycorrhiza.

Materials and Methods

The experiment was conducted during winter season of 2014-15 and 2015-16 at Main Experiment Station, Horticulture, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.). Before planting the corms were dipped in Bavistin (0.2%) solution for one hour to reduce the incidence of corm rotting and dried in shade. The experiment was conducted in Randomized Block Design with 13 treatments and replicated thrice *viz.* RDF (300: 200: 200 kg NPK/ha), organic manure FYM (20t/ha), vermicompost (5t/ha), poultry manure (5t/ha). Two bio-inoculants PSB (5kg/ha) and azotobacter (5kg/ha) were tested alone in their combination along with graded dose 75% (RDF) and 50% (RDF) were applied in the form of urea, single super phosphate and MOP respectively. The planting of corms was done on 16/10/2014 and 20/10/2015 at plot size of 2.0x1.0 m at distance 20 cm × 40 cm and 6 cm deep in soil during both the years of investigation. Similar technique was adopted in next year of investigation. The important vase life and corm yield viz. per cent increase spike length, per cent opening of floret per spike, number of floret opened at specific time, drooping of florets, spike life, equatorial and polar diameter of corm, number of corms per plant, number of corms per hectare, weight of corm, number of cormels per plant and number of cormels per hectare.

Finding Results and Conclusion

Per cent increase in spike length (10.83 and 11.00), per cent opening of floret (94.87 and 89.58), number of floret opened at specific time (12.33 and 14.33), were recoded significantly maximum with T_{12} (75% RDF+ VC +Azotobacter +PSB) during 2014-15 and 2015-16 respectively. This might be attributed to better over all food and nutrient status of spike under these treatments. Similar observations were also recorded by Hatibarua *et al.* (2002) [2]. in gladiolus. Treatment combination T_{12} (75% RDF +VC +Azotobacter +PSB) showed significantly lowest number of floret drooping (3.67 and 4.33) and vase life 13.33 and 13.00 days during both years of studies. This might be attributed to these treatment combinations with higher amount food material and nutrient status. The present findings are in line with the results of Gayathri Subramanian and Thamburaj (2000) [8] in carnation. Munichaluvaiah *et al.* (2004) [13] in gladiolus

There was significant increase in equatorial and polar diameter of corm with application of T_{12} (75% RDF +VC +Azotobacter +PSB) during both the years of investigation. This might be due to significant increase in plant height and number of leaves that could be attributed to better plant growth leading to increase in photosynthetic area which resulted in increased dry matter production to the developing corms. The present findings are in close agreement with Dhaka and Rajwal (2008) [5] and Deo and Dabey (2005) [4] in gladiolus. The maximum number of corms per ha were produced (2.27 Lakh and 2.34 Lakh ha^{-1}) and average weight of corms was recorded significantly highest (52.73 and 52.87g) in 2014-15 and 2015-16, respectively, with treatment T_{12} (75% RDF +VC +Azotobacter +PSB) during 2014-15 and 2015-16, respectively. The sufficient N and P continuously maintain vegetative growth leading to increase in photosynthetic, which in turn resulted in more accumulation of assumulates and partitioning to developing corms and cormels. Thus increasing the number and weight of corms were noticed. The present findings are in line with the observation of Misra (1998) [12], Dubey (2003) [7], Dongardive *et al.* (2009) [6] and Dhaka and Rajwal (2008) [5], in gladiolus. The highest number of cormels per plant and per hectare was observed with T_{12} (75% RDF +VC +Azotobacter +PSB) in 2014-15 and 2015-16. Production of higher number of daughter cormels might be due to high nitrogen fixation under azotobacter treatment increased absorption of nitrogen under treatment. Greater solubilisation of insoluble P and some other factor such as release of growth promoting substances enhance the cormel production. Kathiresan and Venkatesh (2002) [11], in gladiolus.

Table 1: Effect of integrated nutrient management on vase life of gladiolus

Treatments		Percent increase spike length		Per cent opening of floret per spike		Number of floret opened at specific time		Drooping of florets		Spike life	
		2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
T_1	RDF (300: 200: 200 kg NPK/ha)	8.77	9.00	76.29	82.05	11.00	10.67	5.33	6.33	11.00	10.67
T_2	75% RDF+ FYM+Azotobacter	7.70	7.83	68.88	69.04	10.33	9.67	5.67	5.33	11.33	11.67
T_3	75% RDF+VC + Azotobacter	8.17	8.37	83.09	83.33	11.33	11.67	6.50	6.00	10.67	11.00
T_4	75% RDF+PM + Azotobacter	7.87	8.00	80.95	80.95	11.67	11.33	5.33	5.67	11.67	11.33
T_5	50% RDF+FYM+Azotobacter	7.97	7.93	78.57	76.19	11.00	10.67	6.00	5.67	10.67	11.33
T_6	50% RDF+VC + Azotobacter	7.57	7.73	76.19	73.80	10.67	10.33	4.67	5.00	11.67	12.00
T_7	50% RDF+PM + Azotobacter	8.23	8.33	84.64	82.05	11.00	10.67	5.33	5.00	11.67	12.00
T_8	50% RDF+FYM+Azotobacter+PSB	8.50	8.30	76.19	78.57	10.67	11.00	5.33	5.67	11.00	11.33
T_9	50% RDF+VC +Azotobacter +PSB	8.63	8.67	76.19	78.57	10.67	11.00	5.00	4.67	12.00	12.33
T_{10}	50% RDF+PM +Azotobacter +PSB	7.50	7.67	88.09	82.05	12.33	10.67	6.67	6.00	10.67	11.00
T_{11}	75% RDF+FYM+Azotobacter+PSB	9.00	8.93	92.30	88.09	14.00	12.33	4.67	4.33	12.00	12.33
T_{12}	75% RDF+VC +Azotobacter +PSB	10.83	11.00	94.87	89.58	12.33	14.33	3.67	4.33	13.33	13.00
T_{13}	75% RDF+PM +Azotobacter +PSB	8.87	9.17	83.33	80.00	11.67	12.00	5.67	6.00	11.00	11.33
	SEm±	0.38	0.39	2.96	3.49	0.56	0.51	0.28	0.29	0.40	0.33
	CD at 5%	1.12	1.13	8.64	10.19	1.63	1.48	0.82	0.86	1.16	0.96

Table 2: Effect of integrated nutrient management on corm yield characters of gladiolus

Treatments		Equatorial diameter of corm		Polar diameter of corm		Weight of corm (g)		Number of corms / plant		Number of corms / ha (lakh)		Number of cormels / plant		Number of cormels / ha(lakh)	
		2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
T_1	RDF (300: 200: 200 kg NPK/ha)	5.16	5.01	2.67	2.62	32.60	32.53	1.67	1.73	1.77	1.84	29.47	29.73	31.31	31.59
T_2	75% RDF+ FYM+Azotobacter	4.65	4.76	2.33	2.32	40.87	40.87	1.67	1.73	1.77	1.84	28.20	28.53	29.97	30.35
T_3	75% RDF+VC + Azotobacter	4.65	4.66	2.34	2.35	41.27	41.53	1.60	1.67	1.70	1.77	28.13	28.23	29.89	30.00
T_4	75% RDF+PM + Azotobacter	4.59	4.60	2.49	2.45	39.87	40.27	1.60	1.67	1.70	1.77	28.67	29.07	30.46	30.88
T_5	50% RDF+FYM+Azotobacter	4.45	4.48	2.39	2.35	33.53	40.33	1.73	1.80	1.84	1.91	26.33	27.53	27.98	29.26
T_6	50% RDF+VC + Azotobacter	4.62	4.63	2.50	2.57	39.67	39.73	1.60	1.67	1.70	1.77	28.00	27.80	29.75	29.54
T_7	50% RDF+PM + Azotobacter	4.52	4.55	2.28	2.25	39.60	39.73	1.53	1.60	1.63	1.70	27.47	27.60	29.18	29.32
T_8	50% RDF+FYM+Azotobacter+PSB	4.53	4.47	2.35	2.38	41.07	41.33	1.60	1.73	1.70	1.84	30.27	29.60	31.17	31.45
T_9	50% RDF+VC +Azotobacter +PSB	4.88	4.70	2.49	2.56	43.53	43.40	1.73	1.67	1.84	1.77	30.00	30.33	31.88	32.23
T_{10}	50% RDF+PM +Azotobacter +PSB	4.59	4.61	2.26	2.27	42.00	42.87	1.87	1.80	1.98	1.91	27.13	28.13	28.83	29.89
T_{11}	75% RDF+FYM+Azotobacter+PSB	5.24	5.10	2.55	2.53	46.53	47.07	1.80	1.87	1.91	1.98	31.73	32.07	33.37	34.07
T_{12}	75% RDF+VC +Azotobacter +PSB	5.33	5.43	2.92	2.90	52.73	52.87	2.13	2.20	2.27	2.34	37.00	37.13	39.31	39.45
T_{13}	75% RDF+PM +Azotobacter +PSB	4.81	4.83	2.69	2.83	45.80	46.13	1.93	2.00	2.05	2.12	29.80	30.80	31.66	32.73
	SEm±	0.15	0.13	0.12	0.09	2.69	2.19	0.07	0.09	0.10	0.11	1.68	0.65	0.67	0.69
	CD at 5%	0.43	0.39	0.36	0.25	7.86	6.40	0.22	0.27	0.31	0.33	4.91	1.90	1.96	2.02

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