Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.6701

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **6 (4):** 643-650 (2018)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Studies on Effect of Integrated Nutrient Management on Vegetative Growth, Floral Attributes, Corm Yield and Economics of Gladiolus cv. Arka Amar in Bharsar, Uttarakhand

Yogendra Singh Adhikari, Mamta Bohra*, Parul Punetha, Sandeep Upadhyay and B. P. Nautiyal

College of Horticulture, VCSG, Uttarakhand University of Horticulture and Forestry, Bharsar, Pauri Garhwal, Uttarakhand 246 123

*Corresponding Author E-mail: mbohragbptu@gmail.com

Received: 6.07.2018 | Revised: 13.08.2018 | Accepted: 21.08.2018

ABSTRACT

The investigation was carried out at Floriculture and Landscaping Block, College of Horticulture, VCSG, Uttarakhand University of Horticulture and Forestry, Bharsar, Pauri Garhwal, Uttarakhand, India during March to September, 2017 to find out the effect of integrated nutrient management (INM) on vegetative growth, floral attributes, corm yield and economics of gladiolus var. Arka Amar along with effect on soil. The experiment consists of 8 (x 3) treatments in Randomized Complete Block Design. The minimum number of days taken to corm sprouts (17.27 ± 0.70 days), maximum number of sprouts corm^{-1} (2.40 ± 0.12) and number of leaves (9.80 ± 0.70) were recorded in treatment T_7 i.e., 50% RDF + 50% FYM + Azotobacter @ 25 g L^{-1} + Trichoderma harzianum @ 20 g m^{-2}. The results also showed that earliness in spike emergence and first floret opening (87.00 ± 0.42 days and 95.30 ± 1.19 days, respectively), maximum days taken to full bloom of spike (24.73 ± 0.13), spike length (101.30 ± 1.19 cm), rachis length (72.34 ± 0.97 cm), spike weight (92.84 ± 1.82 g), number of florets spike^{-1} (18.60 ± 1.06), number of spike plant^{-1} and plot^{-1} (2.77 ± 0.03 and 29.33 ± 0.33, respectively) and vase life (10.00 ± 0.19 days), number of corms plant^{-1} and corms plot^{-1} (3.00 ± 0.31 and 34.33 ± 1.45, respectively) were recorded in T_7. However, maximum number of cormels plant^{-1} (44.08 ± 7.97), corm weight and diameter (1.24 ± 0.10 g and 5.10 ± 0.22 cm, respectively) were recorded in T_6 and found statistically at par with T_7 (40.93 ± 6.28, 1.10 ± 0.11 g and 4.83 ± 0.07 cm, respectively). With respect to soil parameters, treatment T_7 recorded the maximum available organic carbon (1.40 ± 0.04 %,), available nitrogen, phosphorus and potassium (389.77 ± 2.03, 38.42 ± 2.85 and 257.24 ± 7.85 kg ha^{-1}, respectively) content in soil after harvesting of corms and cormels. The most profitable treatment in terms of economics of cultivation was T_7 with a cost: benefit ratio of 1:2.12.

Key words: *Azotobacter, Farmyard manure, Gladiolus, Recommended doses of fertilizers, Trichoderma harzianum*

INTRODUCTION

Gladiolus (*Gladiolus grandiflorus* L.) is popularly known as Queen of bulbous flower crop. It belongs to the family Iridaceae and having chromosome number n =15.

Cite this article: Adhikari, Y.S., Bohra, M., Punetha, P., Upadhyay, S. and Nautiyal, B.P., Studies on Effect of Integrated Nutrient Management on Vegetative Growth, Floral Attributes, Corm Yield and Economics of Gladiolus cv. Arka Amar in Bharsar, Uttarakhand, *Int. J. Pure App. Biosci.* **6(4):** 643-650 (2018). doi: http://dx.doi.org/10.18782/2320-7051.6701

The word gladiolus is derived from a Latin word "Gladius" meaning "a sword" due to the shape of the leaves and also called as Sword lily. It ranks top ten among cut flowers in domestic as well as international market. Its tall majestic spike bears attractive and delicate florets, which open in acropetal sequence over a long duration of time that's why it is the first choice of consumers for interior decoration and making flowers arrangements and bouquets. In landscape gardening, it is used in preparing herbaceous borders and as a bedding plant.

It is a highly nutrient responsive crop. Therefore, for getting higher return farmers are using enormous amount of chemicals in the form of fertilizers, insecticides, fungicides and growth promoters. This has lead into adverse effect on soil fertility as well as available flora and fauna. No single source can fulfill the complete nutritional demand of any crop. Moreover, present day hike in prices of chemicals has left no options but to look for an alternate strategy i.e., integrated nutrient management (INM). INM refers to the judicious and efficient utilization of chemical fertilizers along with organic manures and biofertilizers. It is an economical and sustainable approach. In addition to this one can get higher returns in terms of quality and quantity of flowers without having any detrimental effect on crop, soil and environment. Practice of INM is the better option for the improvement of physical, chemical and biological properties of soil[5]. Wani *et al.*[24] reported that it is important to exploit the potential of organic manures, composts, crop residues, biofertilizers and their synergistic effect with chemical fertilizers for increasing balanced nutrient supply. Keeping above points in view, an investigation was undertaken to study the effect of INM on vegetative, floral attributes, corm yield, economics of gladiolus (*Gladiolus grandiflorus* L.) var. Arka Amar and soil parameters in Bharsar Pauri, Garhwal, Uttarakhand.

MATERIAL AND METHODS

The present investigation was carried out during March-August, 2017 at Floriculture and Landscaping Block, College of Horticulture, V.C.S.G., Uttarakhand University of Horticulture and Forestry, Bharsar, Pauri Gharwal, Uttarakhnd. The soil of experimental site was silty–loam in texture, acidic in reaction (pH 5.6), soil organic carbon content (0.93 %), available nitrogen (N), phosphorus (P_2O_5) and potassium (K_2O) to the tune of 287.68, 14.22 and 129.00kg ha^{-1}. The experiment was conducted using Randomized Complete Block Design with 8 treatments i.e., T_1: Control, T_2: 100% RDF (120:150:150 kg ha^{-1}), T_3: 100% FYM (24 t ha^{-1}), T_4: 50% RDF + 50% FYM, T_5: 75% RDF + 25% FYM, T_6: 25% RDF + 75% FYM + *Azotobacter* @ 25 g L^{-1} + *Trichoderma harzianum* @ 20 g m^{-2}, T_7: 50% RDF + 50% FYM + *Azotobacter* @ 25 g L^{-1} + *Trichoderma harzianum* @ 20 g m^{-2} and T_8: 75% RDF + 25% FYM + *Azotobacter* @ 25 g L^{-1} + *Trichoderma harzianum* @ 20 g m^{-2} replicated thrice. FYM was applied in experimental plots one day before planting of corms as per the treatment basis. Full doses of phosphorus and potassium were applied at the time of planting of corms. Whereas, half dose of N was applied at 3 leaf stage and remaining half dose at 6 leaf stage. *Azotobacter* was applied through slurry method. *Trichoderma harzianum* was applied through soil treatment method. Corms were planted at a spacing of 40 cm x 30 cm accommodating 12 plants per plot. The periodical observations on vegetative, floral, corm yield and soil parameters were recorded. The final data of each characters recorded during the investigation were analyzed statistically using Analysis of Variance. The significance of various treatments was judged by following the methods of Gomez and Gomez[7].

RESULTS AND DISCUSSION

The perusal of data presented in Table 1 indicates that minimum number of days taken for corms sprouts (17.27 ± 0.70 days) was recorded in treatment T_7 and found statistically at par with T_6 (18.00 ± 0.69 days). However, maximum number of days taken to corm sprouts (20.80 ± 0.42 days) was found in control (T_1). Data also reveals that maximum number of sprouts per corm (2.40 ± 0.12) and number of leaves per plant (9.80 ± 0.70) were found in T_7. However, minimum number of sprouts per corm and leaves per plant (1.67 ± 0.24 and 6.60 ± 0.83, respectively) were recorded in T_1. The earliest sprouting of corms and maximum number of sprouts in treatment T_7 might be due to early absorption of N, P and K through the surface of corms or primary roots which might be stimulated early sprouting. The application of chemical fertilizers help in increasing the availability of phosphorus and potassium and inoculation of corms with *Azotobacter* helps in increasing the availability as well as translocation of nitrogen into plant system. FYM supplies all major nutrients (N, P, K, Ca, Mg, S) necessary for growth, as well as micronutrients (Fe, Mn, Cu and Zn). *Trichoderma* application facilitates to reduce the fungal disease in corms. All the factors contribute for the healthy root and root hair development and provided a more balance nutrition for plant to accelerate the physiological process. This reduces the time taken for emergence of corms significantly. Number of corms per sprout also increased. Similar results were also observed by Kashyap *et al.*[12], Hadwani *et al.*[8] and Chaudhary[4] in tuberose. Increase in availability of nutrients specially nitrogen to plants grown in T_7 leads to cell multiplication, cell enlargement and differentiation which could have resulted in better photosynthesis and ultimately exhibited more number of leaves. These finding are in conformity with the findings of Khanna *et al.*[13] in China aster and Kashyap *et al.*[12] in tuberose.

The number of days taken to spike emergence and opening of first floret was significantly influenced by the different combination of RDF, organic manures and biofertilizers (Table 1). The treatment T_7 took minimum days to spike emergence and first floret opening (87.00 ± 0.42 and 95.30 ± 1.19 days, respectively). Whereas, maximum number of days taken to spike initiation and first floret opening (93.40 ± 0.72 and 100.47 ± 0.59 days, respectively) were recorded in control (T_1). The early spike emergence and first florets opening might be due to easy availability of nutrients by the use of chemical fertilizers, FYM, *Azotobacter* inoculated corms and also due to simultaneous transport of growth promoting substances to the auxiliary buds resulting in breakage of apical dominance. Ultimately, they resulted in better sink for faster mobilization of photosynthates and early transformation of plant parts from vegetative to reproductive phase. Application of *Trichoderma* would have helped in uptake of micronutrients and have provided essential growth promoting substances which leads early flowering. Application of *Trichoderma* also found effective to control diseases like *Fusarium* wilt and corm rot and enhance plant growth which ultimately resulted in early spike emergence and the first floret opening. These results are in close conformity with earlier work by Kukde *et al.*[14] in tuberose and Dubey *et al.*[6] in gladiolus.

Among all the treatments applied, maximum days taken to full bloom of spike (24.73 ± 0.13 days), maximum spike and rachis length (101.30 ± 1.19 cm and 72.34 ± 0.97 cm, respectively) were recorded in T_7. Available NPK status and organic C was also found maximum under T_7 treatment due to application of 50% RDF + 50% FYM + *Azotobacter* @ 25 g L^{-1} + *Trichoderma* @ 20 g m^{-2} (Fig 1). That in turn also resulted increase availability and uptake of all essential macro and micro-nutrients, growth promotive substances *viz.*, vitamins, enzymes and antibiotics to plants. This lead cause significant improvement in spike length, rachis length and enhanced days taken to full bloom of spike. The above results are also corroborated with the findings of Sathyanarayana *et al*.[18] in gladiolus and Kashyap *et al.*[12] in tuberose.

Application of different treatments was found non-significant in respect to spike diameter. The maximum floret diameter and length (11.95 ± 0.17cm and 11.74 ± 0.44 cm, respectively) were recorded under the treatment T_6 and found statistically at par with treatment T_7 (11.92 ± 0.19 cm and 11.07 ± 0.30 cm, respectively) (Table 2). The increase in length and diameter of florets under the treatments containing RDF, *Azotobacter* and *Trichoderma* with farmyard manure might be due to enhance availability and uptake of nutrients by plants that helps in production of auxins like substances which translocated to apical region. Similar trend was also observed by Kumari *et al.*[16] and Chaudhary *et al.*[3] in gladiolus.

The maximum spike weight (92.84 ± 1.82 g) was observed in treatment T_7 and found statistically at par with treatments T_4, T_6 and T_8 (90.85 ± 1.23 g, 92.08 ± 1.33 g and 92.08 ± 1.33 g. However, minimum fresh weight of spike (83.30 ± 3.27 g) was recorded in control. The increase in spike weight might be due to the fact that plants grown under these treatments also had maximum spike length, rachis length, and number of florets per spike, floret length and diameter. All these parameters are closely related to spike weight. Similar results have been reported by Padaganur *et al.*[17] in tuberose, Kumari *et al.*[16], Chaudhary *et al*.[3] and Hassan and Ali[9] in gladiolus.

Table 2 showed that maximum number of spikes plant^{-1} and plot^{-1} (2.77 ± 0.03 and 29.33 ± 0.33, respectively) was also recorded in treatment T_7. The increased spike yield could be due to increase in the yield attributing characters such as number of leaves and total chlorophyll content. Similar trend has also been reported by Suseela *et al.*[20] in tuberose and Sisodia and Singh[19] in gladiolus flower.

Maximum floret diameter and length (11.95 ± 0.17cm and 11.74 ± 0.44 cm, respectively) were recorded under T_6 and found statistically at par with treatment T_7 (11.92 ± 0.19 cm and 11.07 ± 0.30 cm, respectively). Whereas, lowest floret diameter and floret length (10.56 ± 0.37 cm and 9.60 ± 0.53 cm, respectively) were recorded from plants grown in control. The increase in length and diameter of florets under the treatments containing RDF, *Azotobacter* and *Trichoderma* with Farmyard manure might be due to enhance availability and uptake of nutrients by plants that helps in production of auxins like substances which translocated to apical region. Similar trend was also observed by Kumari *et al.*[16] and Chaudhary *et al.*[3] in gladiolus.

Spikes harvested from the plot get treatment T_7 (50% RDF + 50% farmyard manure + *Azotobacter* @ 25 g L^{-1} + *Trichoderma* @ 20 g m^{-2}) recorded maximum vase life (10.00 ± 0.19 days). However, minimum vase life was recorded from the spike harvested from control (7.11 ± 0.11 days). The increase in vase life under T_7 might be attributed to the improved food and nutrient supply to spikes. The results were in accordance with the earlier reports of Bhalla *et al*. in carnation, Kumari *et al*. and Chaudhary *et al.*[3] in gladiolus.

Maximum number of corms plant^{-1} and corms plot^{-1} (3.00 ± 0.31 and 34.33 ± 1.45, respectively) were recorded again from plants grown in treatment T_7. A noticeable increase in both numbers of corms plant^{-1}and corms plot^{-1} could be attributed to the balanced nutrition for corm production and development by the effect of RDF + FYM + *Azotobacter* + *Trichoderma* which might have acted synergistically with other soil microorganisms. These results are in accordance with earlier reports of Wange *et al.*[23] in tuberose, Baboo and Singh[1] and Kumari *et al.* [16] in gladiolus.

Maximum number of cormels plant^{-1}, corm diameter and weight (44.08 ± 7.97, 1.24 ± 0.10 g and 3.95 ± 0.06 cm, respectively) were recorded in T_6 which is statistically at par with T_7 (40.93 ± 6.28, 4.83 ± 0.07 cm and 1.10 ± 0.11 g, respectively). The increase might be due to storage of nitrogen compounds in the corms. The soluble nitrogen compounds translocate from leaves to corms and resulting in better vegetative growth of plant. This also leads to better floral parameters and finally boost up the corm yielding attributes. Kumar *et al.*[15] and Baskaran *et al.*[2] found similar results in gladiolus.

The maximum gross return, net return and cost benefit ratio (Rs 1,399,119.52 ha^{-1} and Rs 951,060.04 ha^{-1} and 1:2.12, respectively) was obtained in treatment T_7 as compare to minimum in control. The increase of cost benefit ratio in T_7 might be due the vigorous vegetative growth that would have resulted in production and accumulation of maximum photosynthates, resulting in the production of more number of spikes and corms. The maximum number of spikes per plot and corms per plot were recorded under treatment T_7 which causes increase in C: B ratio. The findings is in line with those reported by Jadhav *et al*.[11] in African marigold. Verma *et al*.[22] reported that combination of *Azospirillum*, Phosphorus solubilising bacteria, vermicompost equivalent to 50% recommended dose of 'N', 50% recommended dose of NPK and 50% FYM recorded maximum net return ha^{-1} with high cost benefit ratio in chrysanthemum.

The plot containing 50% RDF + 50% Farmyard manure + *Azotobacter* @ 25 g L^{-1} + *Trichoderma* @ 20 g m^{-2} recorded maximum organic carbon content (1.40 ± 0.04%). This might be due to the fact that the presence of organic sources led to stabilized C: N ratio increasing the organic carbon content of the soil[10]. The available nitrogen content was found highest (389.77 ± 2.03 kg ha^{-1}) in treatment T_7 and found statistically at par with T_2, T_6 and T_8. Verma and Chauhan[21] reported that application of combined use of inorganic and organic nutrients increased the soil nitrogen, phosphorus and potassium. It might be due to slow release of nutrients by the used of farmyard manure. Similar results were also found by Khanam *et al*. and Hazarika *et al.*[10]. The increase of nutrient status under T_2 might be due to the application of chemical fertilizers which released nutrients in the soil but they might be not translocated to the plants therefore, better growth was not observed under this treatment.

Table 1: Effect of INM on vegetative and floral attributes of gladiolus var. Arka Amar

Treatments	Days taken to corm sprouts ± S.E(m)	Number of sprouts $corm^{-1}$ ± S.E(m)	Number of leaves ± S.E(m)	Days taken to spike emergence (Days) ± S.E(m)	Days taken to first floret opening (Days) ± S.E(m)	Days taken to full bloom of spike (Days) ± S.E(m)	Spike length (cm) ± S.E(m)	Rachis length (cm)± S.E(m)
T_1	20.80 ± 0.42	1.67 ± 0.24	6.60 ± 0.83	93.40 ± 0.72	100.47 ± 0.59	18.40 ± 1.33	90.37 ± 0.65	62.32 ± 2.58
T_2	19.87 ± 0.52	1.93 ± 0.24	7.27 ± 0.13	92.67 ± 0.64	98.47 ± 0.87	19.76 ± 1.02	93.58 ± 1.12	66.70 ± 3.250
T_3	19.03* ± 0.56	2.27 ± 0.18	8.07 ± 0.57	89.20* ± 0.61	97.20* ± 1.36	19.33 ± 1.02	97.96* ± 1.45	67.47* ± 2.53
T_4	18.87* ± 0.84	2.00 ± 0.12	7.67 ± 0.48	91.67* ± 0.85	99.57 ± 0.91	22.80* ± 0.50	92.41 ± 0.47	68.97* ± 2.16
T_5	19.27* ± 0.64	2.00 ± 0.31	8.33* ± 0.47	91.13* ± 0.77	99.20 ± 0.64	22.27* ± 0.18	94.86* ± 1.29	70.59* ± 0.31
T_6	18.00* ± 0.69	2.20 ± 0.20	9.33* ± 0.07	87.80* ± 0.50	96.77* ± 0.04	23.88* ± 1.28	99.65* ± 1.31	71.55* ± 0.69
T_7	17.27* ± 0.70	2.40*±0.12	9.80* ± 0.70	87.00* ± 0.42	95.30* ± 1.19	24.73* ± 0.13	101.30* ± 1.19	72.34* ± 0.97
T_8	18.93* ± 0.68	2.20 ± 0.12	8.80* ± 0.40	90.20* ± 0.58	98.83 ± 0.77	21.80* ± 0.46	97.38* ± 1.13	69.49* ±1.67
S.E (d)	0.67	0.29	0.78	0.42	1.28	1.03	1.64	2.15
C.D(0.05)	1.45	0.62	1.68	0.91	2.76	2.24	3.56	4.66

Table 2: Effect of INM on floral attributes of gladiolus var. Arka Amar

Treatments	Spike diameter (cm) ± S.E (m)	Spike weight (g) ± S.E (m)	Number of spike $plant^{-1}$ ± S.E (m)	Number of spike $plot^{-1}$ ± S.E (m)	Number of florets $spike^{-1}$ ±S.E(m)	Floret length (cm) ± S.E(m)	Floret diameter (cm) ± S.E(m)	Vase life (Days) ± S.E (m)
T_1	1.06 ± 0.03	83.30 ± 3.27	1.33 ± 0.07	14.33 ± 1.20	15.07 ± 0.57	9.60 ± 0.53	10.56 ± 0.37	7.11 ± 0.11
T_2	1.10 ± 0.03	84.77 ± 3.64	1.53 ± 0.09	15.67 ± 1.45	16.40 ± 0.61	10.71*±0.30	11.41* ± 0.36	7.44 ± 0.11
T_3	1.04 ± 0.08	86.59* ± 2.90	1.87* ± 0.09	19.67* ± 1.67	16.20 ± 1.04	10.89*±0.17	11.67* ± 0.06	8.00* ± 0.39
T_4	1.11 ± 0.02	90.85* ± 1.23	2.13* ± 0.09	25.67* ± 1.45	17.00* ± 0.61	10.63*±0.07	11.69* ± 0.13	7.67 ± 0.19
T_5	1.10 ± 0.05	87.86* ± 2.03	1.63 ± 0.12	18.33* ± 1.20	16.93* ± 0.70	10.73*±0.14	11.60* ± 0.19	8.78* ± 0.11
T_6	1.13 ± 0.02	92.08* ± 1.33	2.40* ± 0.21	27.67* ± 0.88	17.67* ± 0.47	11.74*±0.44	11.95* ± 0.17	9.78* ± 0.49
T_7	1.11 ± 0.05	92.84* ± 1.82	2.77* ± 0.03	29.33* ± 0.33	18.60* ± 1.06	11.07*±0.30	11.92* ± 0.27	10.00* ± 0.19
T_8	1.09 ± 0.02	89.70* ± 1.55	2.07* ± 0.03	25.33* ± 1.45	16.67 ± 0.47	10.88*±0.07	11.85* ± 0.19	8.33* ± 0.19
S.E (d)	0.06	1.49	0.15	1.83	0.81	0.45	0.33	0.32
C.D(0.05)	0.13	3.23	0.32	3.96	1.76	0.97	0.71	0.70

Table 3: Effect of INM on corm and estimated spike and corms yield of gladiolus var. Arka Amar

Treatments	Number of corms per plant ± S.E(m)	Diameter of corm (cm) ± S.E(m)	Weight of corms (g) ± S.E(m)	Number of corms plot^{-1} ± S.E(m)	Number of cormels plant^{-1} ± S.E(m)	Number of cormels per plot^{-1} ± S.E(m)	Estimated yield (Number ha^{-1})	
							Spikes	Corms
T_1	1.53 ± 0.07	3.95 ± 0.06	0.82 ± 0.02	15.33 ± 1.76	19.27 ± 2.37	182.33 ± 38.37	78,736.19	145,824
T_2	1.80 ± 0.00	4.23 ± 0.05	1.01 ± 0.13	17.33 ± 1.45	19.85 ± 3.03	216.33 ± 60.61	86,098.82	95,219.69
T_3	2.07* ± 0.70	4.23 ± 0.07	0.79 ± 0.03	24.67* ± 0.88	26.27 ± 2.71	224.67 ± 52.17	108076.82	135,549.32
T_4	1.87* ± 0.70	4.51* ± 0.06	0.90 ± 0.10	19.33* ± 1.20	25.27 ± 0.64	218.67 ± 22.45	141,043.82	106,208.69
T_5	2.33* ± 0.13	4.65* ± 0.17	0.96 ± 0.16	26.00* ± 1.73	30.60* ± 4.92	240.67 ± 38.70	100,714.19	142,857
T_6	2.80* ± 0.12	5.10* ± 0.22	1.24* ± 0.10	28.67* ± 1.20	44.08* ± 7.97	271.33 ± 45.24	152,032.82	157,527.32
T_7	3.00* ± 0.31	4.83* ± 0.07	1.10* ± 0.11	34.33* ± 1.45	40.93* ± 6.28	243.33 ± 40.08	161,153.69	188,626.19
T_8	2.20* ± 0.12	4.45* ± 0.11	0.90 ± 0.07	25.33* ± 1.20	26.65 ± 5.53	190.33 ± 82.15	139,175.69	139,175.69
S.E (d)	0.16	0.14	0.10	1.77	3.99	68.87	78,736.19	145,824
C.D(0.05)	0.34	0.30	0.22	3.82	8.65	147.71	86,098.82	95,219.69

Table 4: Effect of INM on treatments economics and soil parameters

Treatments	Cost of Cultivation (Rs ha^{-1})	Gross Return (Rs ha^{-1})	Net Return (Rs ha^{-1})	Cost : Benefit ratio	Organic carbon (%) ± S.E(m)	Available N (kg/ha) ± S.E(m)	Available P_2O_5 (kg/ha) ± S.E(m)	Available K_2O (kg/ha) ± S.E(m)
T_1	362,249.58	651,867.52	289,617.94	1:0.80	0.93 ± 0.02	277.68 ± 10.30	12.22 ± 1.94	120.19* ± 5.65
T_2	380,850.72	725,274.04	344,423.32	1:0.90	1.00 ± 0.03	375.32* ± 18.92	36.13* ± 1.77	238.13* ± 6.81
T_3	364,374.78	974,504.56	610,129.78	1:1.67	1.23* ± 0.03	309.01 ± 14.63	24.53* ± 5.26	196.75* ± 12.68
T_4	372,612.76	989,010.04	616,397.28	1:1.65	1.29* ± 0.07	315.83 ± 20.92	28.56* ± 1.77	198.96* ± 9.56
T_5	376,731.74	974,284.76	597,553.02	1:1.59	1.11 ± 0.07	319.30 ± 2.38	29.12* ± 4.69	216.53* ± 13.68
T_6	437,183.92	1,238,240.56	801,056.64	1:1.83	1.21* ± 0.07	355.25* ± 12.54	34.13* ± 1.21	228.35* ± 3.38
T_7	441,302.92	1,399,119.52	957,816.60	1:2.17	1.40* ± 0.04	389.77* ± 2.03	38.42* ± 2.85	257.24* ± 7.85
T_8	445,421.90	1,113,405.52	667,983.62	1:1.50	1.07 ± 0.12	339.20* ± 28.53	31.46* ± 1.03	225.43* ± 23.41
S.E (d)	362,249.58	651,867.52	289,617.94	1:0.80	0.09	23.64	3.00	16.27
C.D(0.05)	380,850.72	725,274.04	344,423.32	1:0.90	0.19	51.20	9.20	35.23

CONCLUSION

The study revealed that the significantly higher yield and monetary benefit was obtained by following INM approach with the application of 50% RDF + 50% FYM + *Azotobacter* @ 25 g L^{-1} + *Trichoderma harzianum* @ 20 g m^{-2}.

REFERENCES

1. Baboo, R., Singh, R. D., Response of Nitrogen phosphorus and corm size and lowering and corm production in gladiolus. *Journal of ornamental Horticulture* **9(1):** 66-68 (2006).
2. Baskaran, V., Misra, R. L., Abirami, K., Effect of plant growth regulators on corm production in gladiolus. *Journal of Horticultural Sciences* **4(1):** 78-80 (2009).
3. Chaudhary, N., Swaroop, K., Janakiram, T., Biswas, D. R., Singh, G., Effect of integrated nutrient management on vegetative growth and flowering characters of gladiolus. *Indian Journal of Horticulture* **70(1):** 156-159 (2013).
4. Chaudhary, S. V. S., Influence of various biofertilizers on growth, flowering and bulb production of tuberose (*Polianthes tuberosa*) cv. Double. *Annals of Horticulture* **2(1):** 92-94 (2009).
5. Das, D., Dwivedi, B. S., Meena, M. C., Integrated nutrient management for improving soil health and crop productivity. *Indian Journal of Fertilizers* **11(4):** 64-83 (2015).
6. Dubey, R. K., Kumar, P., Singh, N., Kumar, R., Effect of *Trichoderma viride* and *Pseudomonas fluorescens* on growth and flowering of gladiolus. *Indian Journal of Ecology* **35(1):** 554-556 (2008).
7. Gomez, L. A. and Gomez, A. A., *Statistical Procedure for Agriculture Research*, John Wiley and Sons. 680 p (1984).

8. Hadwani, M. K., Varu, D. K., Panjiar, N., Babariya, V. J., Effect of integrated nutrient management on growth, yield and quality of ratoon tuberose (*Polianthes tuberosa* L.) cv. Double. *The Asian Journal of Horticulture* **8(2):** 448-451 (2012).
9. Hassan, F. A. S., Ali, E., Physiological response of gladiolus flowers to anti-ethylene treatments and their relation to senescence. *International Journal of Advanced Research* **2(10):** 188-199 (2014).
10. Hazarika, T. K., Bhattacharya, R. K., Nautiyal, B. P., Growth parameters, leaf characteristics and nutrient status of banana as influenced by organics, biofertilizers and bio-agents. *Journal of Plant Nutrition* **38:** 1275-1288 (2015).
11. Jadhav, P. B., Singh, A., Mangave, B. D., Patil, N. B., Patel, D. J., Dekhane, S. S., Kireeti, A., Effect of organic and inorganic fertilizers on growth and yield of African marigold (*Tagetes erecta)* cv. Pusa Narangi Gainda. *Annals of Biological Research* **5(9):** 10-14 (2014).
12. Kashyap, R., Chaudhary, S. V. S., Dilta, B. S., Sharma, B. P., Gupta, Y. C., Integrated nutrient management in tuberose (*Polianthes tuberosa* L.) *International Journal of Farm Sciences* **4(1):** 55-59 (2014).
13. Khanna, R., Bohra, M., Punetha, P., Nutiyal, B. P., Studies on the effect of organic manures and PSB on vegetative and floral parameters of China aster (*Callistephus chinensis* L. [Nees])cv. Kamini under mid hills region of Himalaya. *The Bioscan* **11(4):** 2707-2710 (2016).
14. Kukde, S., Pillewan, S., Meshram, N., Khobragade, Y. R., Effect of organic manure and biofertilizers on growth, flowering and yield of tuberose cv. Single. *Journal Soils and Crops* **16(2):** 414-416 (2006).
15. Kumar, R., Yadav, D. S., Ray, A. R., Effect of organic amendments and nitrogen, phosphorus and potassium on growth, flowering and corm production of gladiolus cv. Pusa Shabnum under Meghalaya conditions. *Environment and Ecology* **24:** 939-942 (2006).
16. Kumari, V. R., Kumar, D. P., Kumar, A. B., Mahadevamma, M., Effect of integrated nutrient management on floral and cormel parameters in gladiolus (*Gladiolus hybridus* L.). *International Journal of Agricultural Sciences* **10(1):** 15-22 (2014).
17. Padaganur, V. G., Mokashi, A. N., Pati, V. S., Flower quality and yield of tuberose (*Polianthes tuberosa* L.) as influenced by vermicompost, farmyard manure and fertilizers. *Karnatka Journal of Agriculture Science* **18(3):** 729-734 (2005).
18. Sathyanarayana, E., Sudha, P., Chalwa, S. L., Impact of integrated nutrient management on growth and flowering of gladiolus (*Gladiolus grandiflorus* L.) cv. American Beauty. *International Journal of Chemical Studies* **5(5):** 317-319 (2017).
19. Sisodia, A., Singh, A. K., Effect of farmyard manures, vermicompost and *Trichoderma o*n flowering and corm attributes in gladiolus. *Bangladesh Journal of Botany* **44(2):** 309-314 (2015).
20. Suseela, T., Chandrasekha, R., Vijaya, B. V., Salomi, S. D. R., Umarkrishna K Effect of organic manures, inorganic fertilizers and micronutrients on vegetative and floral characters of tuberose (*Polianthes tuberosa* L.) cv. Suvasini. *International Journal of Scientific and Research Publications* **6(2):** 170-173 (2016).
21. Verma, M. L., Chauhan, J. K., Effect of integrated nutrients application on apple productivity and soil fertility in temperate zone of Himanchal Pradesh. *International Journal of Farm Sciences* **3(2):** 19-27 (2013).
22. Verma, S. K., Angadi, S. G., Patil, V. S., Mokashi, A. N., Mathad, J. C. and Mummigatti, U. V., Growth yield and quality of chrysanthemum (*Chrysanthemum morifolium* Ramat.). cv.

Raja as influenced by integrated nutrient management. *Karnatka Journal of Agricultural Science* **24(5):** 681-683 (2011).

23. Wange, S. S., Patil, P. L., Patil, J. J., Effect of biofertilizers alone and with nitrogen levels on tuberose cv. Single petaled. *Journal of Soils and Crops* **5(2):** 97-99 (1995).
24. Wani, S. A., Ali, T., Chand, S., Sofi, K. A., Improving soil health and productivity in brown sarson var. KS-101 (*Brassica rapa* L.) in alfisols of temperate Kashmir through organic and inorganic nutrient sources. *Ecology Environment Conservation* **22:** 21-22 (2016).