Original Research Article

Integrated Effect of Bio-Fertilizers, Organic and Inorganic Fertilizers on Flowering and Quality Attributes of Gladiolus (*Gladiolus Grandiflorus*L.) cv. Nova Lux

ABSTRACT

The study **"Integrated Effect of Bio-Fertilizers, Organic and Inorganic Fertilizers on Flowering and Quality Attributes of Gladiolus (Gladiolus Grandiflorus L.) cv. Nova Lux",** field experiments conducted during 2020-21. Bulbous gladiolus is a very well-liked plant. **Pliny the Elder (2379 AD)**first used the term "gladiolus" to refer to the blade's sword-like form (Latin word gladiolus means sword). Gladiolus is a delicate perennial herbaceous plant that may be cultivated from seeds or bulbs. The roots of several older leaves that were developed during the previous growing season are covered with 4-6 dry scales or sheaths that cover the bulb. In addition to fixing nitrogen, phosphorus, and other nutrients from organic fertilisers and soil reserves, bio-fertilizers also help plants tolerate drought, boost plant health, and tolerate salt better **(Vessey, 2003; Arora, 2013).**A randomised block design with three replications was used to apply 14 different treatments, including the application of chemical fertilisers (Urea, SSP, and MOP), micronutrients (Zn and Fe), organic sources (FYM and Vermicompost), and bio-fertilizers (Azospirillum, Azotobacter, and PSB). Based upon the results recorded in the investigation it could be concluded that the treatment T10 (75 % RDF + 25% Vermicompost + Azospirillum + PSB + Azotobacter), was found best treatment with reference to vegetative, nutritional, and productive parameters in gladiolus cv. Nova lux as compared to control and other treatments.

Keywords: Biofertilizer, Gladiolus, Manures, Flowering and Quality

1. INTRODUCTION

Gladiolus is a very popular bulbous plant. The name gladiolus was coined by **Pliny the Elder (2379 AD)** to describe the shape of the blade resembling that of the sword (Latin word gladiolus means sword). It has originated from South Africa (tetraploids) and diploid sp. in Europe. Commonly known as the gladiolus, it belongs to the Iridaceae family and the ixioideae subfamily. It has the base chromosome number 15. There are about 260 species of gladiolus. Most members of the genus are heteroploids with very small chromosomes ranging from 2n = 30 to 120 (diploids, triploids, tetraploids, pentaploids, hexaploids, octaploids, and hyperaneuploids).

It is an important commercial flower crop and, as a cut flower, occupies a central position in both national and international markets. Flowers are used in flower arrangements, bouquets and interior decorations. In the Netherlands and other European countries, this flower ranks after the tulip in the trade as a cut flower for bulb plants and fourth in the international trade in ornamental plants for cut flowers. Gladiolus flowers have been worldwide since ancient times, but it was not until the 18th century that their commercialization peaked in other parts of the world. In the 18th century, travellers from South Africa brought large numbers of African gladiolus flowers to Europe via the Indian trade route. This movement led to the hybridization of this plant for gardening purposes.

Gladiolus Blossoms are a well-known symbol of remembrance and falling in love. In the language of flowers, a gladiolus flower also has the symbolic meaning of honour, loyalty, perseverance, calmness, integrity and strength of character. Gladiolus is a flowering perennial that grows from bulbs, which are bulb-like structures. It is an important commercial flower crop and, as a cut flower, occupies a central position in both national and international markets. Flowers are used in flower arrangements, bouquets and interior decorations. In the Netherlands and other European countries, this flower ranks after the tulip in the trade as a cut flower for bulb plants and fourth in the international trade in ornamental plants for cut flowers.

Bio-fertilizers, or Microbial inoculants, are a promising technology to reduce the use of conventional inorganic fertilizers. Many of them can serve as Bio-fertilizers as they are able to fix nitrogen, help to access nutrients such as phosphorus and nitrogen from organic fertilizers and soil stocks, improve

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drought tolerance, improve plant health or increase salt tolerance **(Vessey, 2003; Arora, 2013).**Numerous reviews on microbial inoculants have been published, but quantitative results are scarce. Bio-fertilizers are not only environmentally friendly and cost-effective, but they also increase phosphorus uptake, promote plant growth and yield by providing nutrients in an available form, provide resistance to pests and diseases and strengthen soil structure **(Sharma, 2002)**. Bio-fertilizers have been shown to be beneficial in 4 flower crops such as gladiolus, tuberose, rose, chrysanthemum and marigold **(Maurya and Beniwal, 2003)**.

2. MATERIALS AND METHODS

The present investigation entitled "Influence of bio-fertilizers on vegetative growth, flower quality and bulb yield of gladiolus (*Gladiolus grandiflorus*L.)" was carried out during *Rabi season* 2020-2021 at Horticulture Research Center of SardarVallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh.

2.1 Experimental Design and Treatments

Nova Lux cultivar of gladiolus was used for the experiment. The healthy corms of Nova Lux were procured from NBRI, Lucknow. Nova Lux has sin developed by the IARI, New Delhi. The experiment was laid out in Randomized Block Design with three replications. Each replication consists of 14 treatment combinations. The field was laid the experimental plan with the help of rope and measuring tape and treatments out as pervert randomized separately in each replication. Single corm was sown at spacing of 30 cm plant to plant and 20 cm from row to row with uniform depth 5-6 cm. Neck of the corms were kept pointing to the soil surface. After planting, corms were covered by the soil. Total number of 14 treatments was comprised during course of investigation including Inorganic fertilizers (Urea, SSP and MOP), micronutrients (Fe and Zn), organic manures (FYM and Vermicompost) and bio-fertilizers (Azotobacter, Azospirillum and PSB). The allotment of treatments details are as follows- T1(Control), T2(200 qt. FYM + 300KgN +200 Kg P2O5+200 Kg K2O/ha)(RDF), T3(RDF + 30% FYM), T4(RDF + 30% Vermicompost), T5(70% RDF+30% FYM), T6(70% RDF + 30% Vermicompost), T7(75% RDF + Azospirillum), T8(75% RDF+ 25% FYM + Azospirillum), T9(75%RDF + 25% FYM + Azospirillum + PSB + Azotobacter), T10(75% RDF + 25% Vermicompost + Azospirillum + PSB + Azotobacter), T11(RDF + ZnSO4 (0.3%) + PSB, T12(RDF + FeSO4(0.4%) + Azotobacter), T13(RDF + ZnSO4 (0.3%) + Azotobacter + PSB + Azospririllum), T14(RDF + FeSO4 (0.4%) + Azotobacter +PSB).The full calculated dose of farmyard manure as per treatment combination was broadcasted as basal dose and mixed in soil to the individual specified plots before two weeks for proper mineralization before sowing of corms. However, vermicompost and bio-fertilizers like PSB, Azatobacter and Azospirillum were mixed with soil at three leaf stages and six leaf stages. Inorganic fertilizers were applied as per the treatment combinations. At the time of planting recommended dose of single super phosphate and muriate of potash was applied as basal dose. The crop was top dressed in Nitrogen dose at three leaves stage and six leaves stage.

2.2 Parameters of Study

2.2.1 Days taken for initiation of first spike

Days required for the first spike emergence were computed from selected five randomly plants from date of planting of corms in each plot and average were worked out in days.

2.2.2 Days taken to opening of first florets

Days taken from the opening of florets on the spike were recorded from the date of visibility of first spike in each plot and average was calculated.

2.2.3 Number of flowers per plant

Number of flowers per plant was measured by counting from five randomly selected plants and recorded plot wise. 27

2.2.4 Flower diameter(cm)

Diameter of flower of five randomly selected plants was recorded from each plot with the help of Vernier callipers and the average was worked out.

2.2.5 Rachis length (cm)

The length of rachis was calculated from the emerging points of spike to the first basal flower from five randomly selected plants in each plot and average length of rachis was computed in centimetre.

2.2.6 Spike length (cm)

The length of gladiolus spike was recorded from five randomly selected plants in each plot with the help of meter scale and average was worked out.

2**.2.7 Spike diameter (cm)**

Diameter of spike was recorded at full bloom stage from five randomly selected plants in each plot with the help of Vernier callipers. The mean diameters of spike were calculated and expressed in centimetres.

2.2.8 Longevity of spike (days)

Longevity of spike was presented by counting the number of days taken from the date of opening of first floret to the date fading of the last floret in each plot and the average was worked out.

3. RESULTS AND DISCUSSION

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3.1 Flowering Attributes

The combination of bio-fertilizers, organic manures, and inorganic fertilisers significantly improved the gladiolus plant's flower and corm production characteristics.The days taken for opening of first spike was affected by various combinations of chemical fertilizers, organic manure, micronutrients and bio-fertilizers in an improved manner as compared to control during the year. The minimum number of days taken for opening of first spike (40.87 days) was recorded in treatment T10 (75% RDF+ 25% Vermi-compost + Azospirillum + PSB + Azotobacter). Moreover, the delayed opening of spike (51.76 days) was observed in treatment T_1 (control) during the year of Seri mentation. the effect of various treatments, minimum number of days taken to opening floret was recorded with T10 (75% RDF + 25% Vermi-compost + Azospirillum + PSB +Azotobacter) i.e., 49.04 days during the year. However, the control plants had maximum number of days taken to opening of florets (60.02 days). The maximum number of flowers per plant (13.76) was recorded with T10 (75% RDF + 25% Vermicompost + Azospirillum + PSB + Azotobacter) which was significantly superior to T13 (RDF + ZnSO4 + Azotobacter + PSB + Azospirillum) viz. (12.67) during the year 2020-21 of experimentation. In case of control, it has given the minimum number of flowers per plant (8.34). The effect of treatments, diameter of flower ranges from 7.21 cm to 10.52cm during the experimental. The maximum diameter of flower (10.52 cm) was recorded in treatment T9 (75% RDF + 25% FYM + Azospirillum + PSB + Azotobacter) followed by treatment T10 (75%RDF + 25% Vermicompost + Azospirillum + PSB + Azotobacter) viz. (10.26 39 cm). However, in case of control it has given minimum diameter of flower (7.21 cm).

3.2 Quality Attributes

The integration of bio-fertilizers, organic manures with inorganic fertilizers showed significant response towards quality attributes of gladiolus.In terms of rachis length and it has range between 31.28 to 41.87 cm during of investigation. The maximum rachis length (41.87cm) was verified in T10 (75% RDF + 25% Vermi-compost + Azospirillum + PSB + Azotobacter). However, minimum rachis length i.e. (31.28 cm) was noted under treatment T1 (control). The spike lengths range from 98.57 to 119.69 cm. The maximum spike length (119.69 cm) was recorded with treatment T10 (75% RDF+ 25% Vermi-compost + Azospirillum + PSB + Azotobacter) followed by treatment T13 (RDF+ ZnSO4 + Azotobacter + PSB + Azospirillum) viz. (115.17 cm). However, the minimum spike length (98.57 cm) was noticed in treatment T1 (control). The ranges of spike diameter i.e., 0.62 to 1.09 cm were observed. The maximum diameter of spike (1.09 cm) was determined under treatment T10 (75% RDF + 25% Vermi-compost + Azospirillum + PSB + Azotobacter) while the minimum diameter of spike (0.62 cm) was reported in treatment T_1 (control).

Table 1. Influence of Bio-Fertilizers on Flowering Attributes of Gladiolus (*Gladiolus Grandiflorus*L.)

Sr.	Notation	Treatment	Days to	Days to	Number	Flower

No.			Initiation of First Spike	Opening of First Floret	of Flowers Per Plant	Diameter (cm)
1.	T1	Control	51.76	60.02	8.34	7.21
2.	T2	200 qt. FYM+300KgN+200KgP2O5+ 200KgK2O/ha (RDF)	50.76	58.36	9.32	8.42
3.	T3	RDF+ 30%FYM	50.01	58.23	10.02	8.13
4.	T4	RDF+ 30%Vermicompost	48.34	56.76	10.68	9.33
5.	T5	70%RDF+30%FYM	48.03	56.76	11.10	9.23
6.	T6	70% RDF+ 30% Vermicompost	46.08	56.03	11.23	8.79
7.	T7	75% RDF+ Azospirillum	47.34	56.03	12.03	9.31
8.	T8	75%RDF+ 25%FYM + Azospirillum	43.65	52.55	10.33	8.56
9.	T9	75%RDF+25%FYM+Azospirillum+PSB+ Azotobacter	43.63	51.36	13.33	10.52
10.	T10	75%RDF+25%Vermicompost +Azospirillum+PSB+ Azotobacter	40.87	49.04	13.76	10.26
11.	T11	RDF+ZnSO4(0.3%) + PSB	42.32	50.23	11.87	9.52
12.	T12	RDF+FeSO4(0.4%) + Azotobacter	44.07	51.76	11.44	8.98
13.	T13	RDF+ZnSO4 (0.3%) + Azotobacter +PSB+ Azospririllum	42.25	50.35	12.67	9.65
14.	T14	RDF+FeSO4 (0.4%) +Azotobacter +PSB	43.56	51.02	12.34	9.18
SE(m)			0.63	1.07	0.19	0.11
C.D. At 5%			1.84	3.13	0.56	0.33
C.V. (%)			2.37	3.42	2.94	2.15

Table 2. Influence of Bio-Fertilizers on Quality Attributes of Gladiolus (*Gladiolus Grandiflorus*L.)

Sr. No.	Notation	Treatment	Rachis Length (cm)	Spike Length (cm)	Spike Diameter (cm)	Longevity of Spike (Days)
1.	**T1**	Control	31.28	98.57	0.62	17.10
2.	**T2**	200 qt. FYM+300KgN+200KgP2O5+ 200KgK2O/ha (RDF)	34.85	103.43	0.73	18.23
3.	**T3**	RDF+ 30%FYM	35.21	108.62	0.81	18.01

4.	**T4**	RDF+ 30%Vermicompost	36.91	109.56	0.85	19.03
5.	**T5**	70%RDF+30%FYM	38.09	111.92	0.94	20.54
6.	**T6**	70% RDF+ 30% Vermicompost	37.56	114.32	0.88	19.34
7.	**T7**	75% RDF+ Azospirillum	37.32	114.23	0.87	20.68
8.	**T8**	75%RDF+ 25%FYM + Azospirillum	38.45	115.26	0.76	21.76
9.	**T9**	75%RDF+25%FYM+Azospirillum+PSB+ Azotobacter	39.07	116.35	1.05	22.76
10.	**T10**	75%RDF+25%Vermicompost +Azospirillum+PSB+ Azotobacter	41.87	119.69	1.09	23.67
11.	**T11**	RDF+ZnSO4(0.3%) + PSB	37.32	112.79	0.86	19.01
12.	**T12**	RDF+FeSO4(0.4%) + Azotobacter	37.71	112.92	0.85	18.34
13.	**T13**	RDF+ZnSO4 (0.3%) + Azotobacter +PSB+ Azospririllum	38.64	115.17	0.98	22.05
14.	**T14**	RDF+FeSO4 (0.4%) +Azotobacter +PSB	38.18	114.15	0.95	21.23
SE(m)			0.73	1.14	0.01	0.19
C.D. At 5%			2.13	3.34	0.02	0.55
C.V. (%)			3.38	1.77	1.44	1.62

Conclusion

Based upon the results recorded in the investigation it could be concluded that the treatment T10 (75 % RDF + 25% Vermicompost + Azospirillum + PSB + Azotobacter), was found best treatment with reference to Flowering and Quality attributes in gladiolus cv. Nova lux as compared to control and other treatments. The availability of nutrient and B:C ratio were also giving the noteworthy results with an application of (T10) (75 % RDF+ 25% Vermicompost + Azospirillum + PSB + Azotobacter), followed by treatment T13 (RDF + ZnSO4(0.3%) + Azotobacter + PSB + Azospirillum) with assessment under control and other treatments. Therefore, it is recommended that an application of chemical fertilizers, organic manure.

REFRENCES

1. **Abdou, M.A.H.; Aly, M.K.; El-Sayed, A. A. and Ahmed, A.S.A. (2019).** Influence of organic manure, biofertilizer and/or some vitamin treatments on: a Vegetative growth and flowering aspects of *Gladiolus grandiflorus*var. Gold field plants. *Scientific Journal Flowers & Ornamental Plants.* **6**(2):113-124.
2. **Abdou, M.A.H. and Ibrahim, T.I.E. (2016).** Effect of mineral and biofertilization treatments on: 1-vegetative growth and flowering of gladiolus plants. *Scientific Journal flowers & ornamental plants*. **3**(1):1-8.
3. **Adhikari, T.S.; Bohra, M.; Punetha, P.; Upadhyay, S. and Nautiyal, B.P. (2018).** Effect ofintegrated nutrient management on vegetative growth, floral attributes, corm yield and economics of gladiolus cv. Arka Amar. *Internatinal Journal Pure AppliedBiosci.* **6** (4): 643-650.
4. **Ahmad, A.; Mehmood, T.; Hussain, R.; Bashir, A.; Sajjad, R. &Ud-Din, N. (2014).** Investigation of biofertilizers influence on vegetative growth, Flower quality, bulb yield and nutrient uptake in

gladiolus (*Gladiolus grandiflorus*L.*). International Journal Plant Animal and Environmental Science* **4**(1): 2231-4490.

5. **Ali, A.; Mehmood, T.; Hussain, R.; Bashir, A.; Raza, S.; Din, N.U. and Ahmad, A. (2013).** Investigation of bio-fertilizers influence on vegetative growth, flower quality, bulb yield and nutrient uptake in gladiolus (*Gladiolus grandiflorus*L.). *Internatinal Journal Plant, Animal & Environmental Science* **4**(1): 2231-4490.
6. **Baruati, D.; Talukdar, M.C. and Kumar, V. (2018).** Effect of organic manures and biofertilizers on growth and yield of gladiolus (*Gladiolus grandiflorus*L.). *International Journal of Chemical Studies*. **6**(5): 2529-2532.
7. **Bhalla, R.; Priyanka, K.; Dhiman, S.R. and Jain, R. (2006).** Effect of bio-fertilizers and bio-stimulants on growth and flowering in gladiolus*. J. of Ornamental Hort.* **9**(4): 248-52.
8. **Bose, T.K.; L.P. Yadav; P. Pal; V.A. Parthasarathy and P. Das. (2003).**
9. Commercial Flowers, Vol. II. *Kolkata, India: NayaUdyog.* Buch PO (1972) The species. In: Koening N, Crowedly W (Eds) The World of Gladiolus North America Gladiolus Council, Edgerton Press, MD, pp 2-7.
10. **Chaudhary, N.; Swaroop, K.J.; Biswas, T. and Singh, G. (2013).** Effect of integrated nutrient management on vegetative growth and flowering characters of gladiolus.*Indian Journal Horticulture.* **70**(1): 156-159.
11. **Chauhan, A. and Kumar, V. (2007).** Effect of graded levels of nitrogen and VAM on growth and flowering in calendula (*Calendula officinalis*). *J. of Ornamental Hort.* **10**(1): 61-63.
12. **Eman, A.A.; A.E. Monem; M.M.S. Saleh and E.A.M. Mostafa, (2008).** Minimizing the quantity of mineral nitrogenfertilization grapevine by using humic acid organic mand biofertilizers. *Research Journal Agriculture Science* **4**: 46-50.
13. **Dalve, P. D.; Deshmukh, M.; Dange, N. R. and Kawarkhe, V. J. (2009).** Effect of biofertilizers with reduced doses of nitrogen on growth and flowering of gladiolus. *International Journal Agricultural Science* **5**(1): 258 – 260.
14. **Deshmukh, P.G.; Khiratkar, S.D.; Badge, S.A. and Bhongle, S.A. (2008).** Effect of bioinoculants with graded doses of NPK on growth and yield of gaillardia. *Journal of Soils and Crops.* **18**(1): 212-21.
15. **Dikr, W. and Belete, K. (2017).** Effect of organic fertilizers, biofertilizers and inorganic fertilizers (NPK) on growth and flower yield of marigold (*Targets' erecta*L.). *Academic Research Journal Agricultural Science Research Vol* **5**(3): 192-204.
16. **Gangadharan, G. D. and Gopinath, G. (2000).** Effect of organic and inorganic fertilizers on growth, flowering and quality of gladiolus cv. White Prosperity. *Karnataka J. Agril. Sci.* **11**(3)**:** 401-405.
17. **Godse, S. B.; Golliwar, V. J.; NehaChopde; Bramhankar, K. S. and Kore, M. S. (2006).** Effect of organic manures and biofertilizers with reduced doses of inorganic fertilizers on growth, yield and quality of gladiolus. *J. Soils and Crops* **16**(2)**:** 445-449.
18. **Gupta, Y.C.; Suman, B.; Sharma, Y.D.; Thakur, R. and Ritu, J. (2004).** Effect of growing media and fertilization on growth and flowering of carnation (*Dianthus caryophyllus*L.) under protected conditions. *Ornamental Horticulture.* pp. 77.
19. **Hassan M.R.A.; El-Naggar, A.H.M.; Nasr, M.N. and El-Deeb, M.B. (2016).** Effect Of Mineral, Bio-Fertilization and Growing Media on Growth, Flowering and Corms Production of Gladiolus Cv."White Prosperity" Plant. *Scientific Journal Flowers & Ornamental Plants*. **3**(1):45-70.
20. **Kumar. J.; Kumar, P., and Pal, K. (2011).** Effect of biofertilizer and micronuttrent on growth and flowering of tuberose (*Polianthestuberosa*L.) Cv. Pearl double. *Agricultural Science Digest.* **32**(2): 164-167.
21. **Kumar, M.; Kasera, S.; Mishra, S.; Singh N. V. and Singh D. (2018).** Effect of Organic Manure and Inorganic Fertilizer on Growth and Yield Traits of Gladiolus (*Gladiolus grandiflora* L.) Cv. Plumtart. *Internatinal Journal Current Microbiology Applied Science* **7**: 1430-1435.
22. **Kumar, S.; Kumar, J.; Kaushik H. and Rajbeer. (2016).** Standardization of bio-fertilizer and pgr on growth and flowering in gladiolus (*Gladiolus floribundu*s L.) Cv. American beauty. *Internatinal Journal of Agricultural Invention.* **1**(1):92 – 96.
23. **Kumari, R. V.; Kumar, D.P.; M. Mahadevamma, M. and B. Arunkumar B. (2013).** Effect of integrated nutrient management on growth and floral parameters in gladiolus (*Gladiolus hybridus*L) cv. American Beauty. *Internatinal Journal of Agricultural and Science* (1): 2074-2079.

24. **Meena, M.K.; Byadwal, R.K.; Meena, M.K.; Sharma, A.K. and Rathore J.P. (2018).** Impact of integrated nutrient management on vegetative growth and flowering quality of gladiolus (Gladiolus hybridus Hort.) cv. American Beauty. *Archives of Agriculture and Environmental Science*. **3**(3): 310-316.
25. **Raja, R.; Mukherjee, D. and Manja, S.; (2002)** Plant growth regulators affect the development of both corms and cormels in gladiolus. *Hort. Science.* **37**(2):343-344.
26. Sharma, U., Chaudhary, S.V.S. and Thakur, R. (2008). Response of gladiolus of two integrated nutrient management. *Haryana Journal Horticulture Science*, 37(3&4): 285-286.