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Response of organic manure on the growth and flowering behaviour of *Gladiolus* (*Gladiolus grandiflora* L.) cv. summer sunshine under Chhattisgarh plains

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Abstract
The present investigation on Response of organic manure on the growth and flowering behaviour of *Gladiolus* (*Gladiolus grandiflora* L.) cv. Summer sunshine under Chhattisgarh plains was conducted at Horticulture Nursery, Horticultural Research cum instructional farm, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during rabi season 2021-22. The experiment was laid out in Randomized Block Design (RBD) with two replications and 19 treatments. The treatment comprised of FYM 50 t/ha, Vermicompost 30 t/ha, Goat manure 20 t/ha, Mustard cake 500 g/m^2, Neem cake 500 g/m^2, Cow urine 20%, Cow dung wash 20% in different combinations including control (RDF 150:100:120 kg/ha). The result revealed that among all the organic manures and their combinations, treatment T_3 (FYM 50 t/ha + Mustard cake 500 g/m^2 + Cow urine 20%) showed best results in vegetative growth parameters like minimum days to 50% sprouting of corms (6.00 days), maximum plant height (42.79 cm, 77.45 cm at 30 and 60 DAP), maximum number of leaves plant^{-1} (3.60, 8.50 at 30 and 60 DAP). However, flower yield parameters like minimum days to spike emergence (66.50 days), number of spike plant^{-1} (2.30), spike length (71.20 cm), rachis length (45.31 cm), number of floret spike^{-1} (15.80) were also recorded in treatment T_3 (FYM 50 t/ha + Mustard cake 500 g/m^2 + Cow urine 20%) as compare to other treatments.

Keywords: *Gladiolus*, FYM, vermicompost, goat manure, mustard cake, cow urine, growth, flower yield

Introduction
Gladiolus (*Gladiolus grandiflora* L.) belongs to family Iridaceae and said to be "Queen of Bulbous flowers". Origin of *Gladiolus* is South Africa and Asia Minor and also its ranks second among the bulbous cut flowers in the market. *Gladiolus* is well-known for its majestic spikes, which contain attractive, elegant, and delicate florets. It is primarily used for garden display and interior decoration, as well as bouquets. The *Gladiolus* florets open in sequence over a longer period of time, resulting in a good keeping quality of cut spikes. Flowers have for long been imported in India for three main considerations namely aesthetic, economic and social. It is also widely grown as an exhibition specimen. It is mainly cultivated for cut flower which fetches good price in the Indian market besides having export market as well. *Gladiolus* has a nutritive response flower crops, so that proper nutrient management is essential components for its proper growth and development as well as quality flower production.
Chemical fertilisers are commonly used in *Gladiolus* cultivation due to their rapid release of essential elements into the crop, which has some negative effects on flower quality as well as negative effects on soil health, water, and the environment. Organic manures are an excellent and balanced source of nutrients that improve spike quality, soil health, and environmental safety while also increasing nutrient uptake. Farmyard manure application has been found to be good for plant development, blooming, and corm yield metrics, and is recommended for cultivating a successful crop (Gupta *et al*., 2008) [6]. Keeping the above facts in view, the present experiment has been planned to study the response of organic manure on the growth and flowering behaviour of *Gladiolus* cv. summer sunshine under Chhattisgarh plains.

Materials and Methods
The present investigation was conducted at Horticulture Nursery, Horticultural Research cum instructional Farm, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during rabi season, 2021-22. The experiment was conducted in sandy loam soil with pH 7.9. The experiment was laid out in Randomized block design (RBD) with 19 treatments and two replications.

The row to row distance of 30 cm and plant to plant distance of 20 cm in a plot size of 1.2 m x 0.8 m was maintained. The treatments used in the experiment are as follows: T_1: Control (RDF 150:100:120 kg/ha), T_2: FYM 50 t/ha + Mustard cake 500 g/m^2, T_3: FYM 50 t/ha + Mustard cake 500 g/m^2 + Cow urine 20%, T_4: FYM 50 t/ha + Mustard cake 500 g/m^2 + Cow dung wash 20%, T_5: FYM 50 t/ha + Neem cake 500 g/m^2, T_6: FYM 50 t/ha + Neem cake 500 g/m^2 + Cow urine 20%, T_7: FYM 50 t/ha + Neem cake 500 g/m^2 + Cow dung wash 20%, T_8: Vermicompost 30 t/ha + Mustard cake 500 g/m^2, T_9: Vermicompost 30 t/ha + Mustard cake 500 g/m^2 + Cow urine 20%, T_{10}: Vermicompost 30 t/ha + Mustard cake 500 g/m^2 + Cow dung wash 20%, T_{11}: Vermicompost 30 t/ha + Neem cake 500 g/m^2, T_{12}: Vermicompost 30 t/ha + Neem cake 500 g/m^2 + Cow urine 20%, T_{13}: Vermicompost 30 t/ha + Neem cake 500 g/m^2 + Cow dung wash 20%, T_{14}: Goat manure 20 t/ha + Mustard cake 500 g/m^2, T_{15}: Goat manure 20 t/ha + Mustard cake 500 g/m^2 + Cow urine 20%, T_{16}: Goat manure 20 t/ha + Mustard cake 500 g/m^2 + Cow dung wash 20%, T_{17}: Goat manure 20 t/ha + Neem cake 500 g/m^2, $T_{18:}$ Goat manure 20 t/ha + Neem cake 500 g/m^2 + Cow urine 20%, T_{19}: Goat manure 20 t/ha + Neem cake 500 g/m^2 + Cow dung wash 20%. Observations were recorded on following vegetative growth parameters like days to sprouting of corms, plant height (cm), number of leaves plant^{-1}, and flower yield parameters like days to spike emergence, number of spike plant^{-1}, spike length (cm), rachis length (cm), number of floret spike^{-1}. Data for various vegetative and flowering parameters were recorded at appropriate time after planting and analyzed by "analysis of variance" techniques as suggested by Panse and Sukhatme (1967) [16].

Results and Discussion

The results of the present investigation regarding the response of organic manure on the growth and flowering behaviour of *Gladiolus* have been discussed and interpreted in light of previous research work in India and abroad.

The results of the experiment are summarized below and also presented in table 1 and table 2.

Vegetative growth parameters

Days to sprouting of corms

The minimum days for 50% sprouting of corms (6.00 days) was recorded in T_3 (FYM 50 t/ha + Mustard cake 500 g + Cow urine 20%), which was showed significantly earlier than treatment T_{13}, T_{14}, T_{15}, T_{16}, T_{17} respectively. However, it was exhibited at par with rest of the other treatments. The maximum days for 50% sprouting of corms (10.50 days) was observed in T_{18} (Goat manure 20 t/ha + Neem cake 500 g + Cow urine 20%). The early sprouting of *Gladiolus* corm may be because the application of organic manures improved soil texture by loosening the soil, preventing the formation of soil crust and increasing water holding capacity as well as proper aeration that may be resulting in earlier corm sprouting. The results can be conformity with the findings of Kumar *et al*., (2010) [11] in *Gladiolus* and Susheela *et al*., (2016) [20] in tuberose.

Plant height (cm)

The maximum plant height of *Gladiolus* at 30 DAP (42.79 cm) was recorded in Treatment T_3 (FYM 50 t/ha + Mustard cake 500 g + Cow urine 20%), which was found at par with treatment T_4, T_6, T_9, and T_{12} and it was found significant difference with rest of the other treatments. The minimum plant height of *Gladiolus* at 30 DAP (35.22 cm) was recorded by the treatment T_1 (Control). As far as on 60 DAP observed the maximum plant height (77.45 cm) was recorded in treatment T_3 (FYM 50 t/ha + Mustard cake 500 g + Cow urine 20%), which was showed significant difference with treatments T_2, T_{14}, T_{15}, T_{17}, T_{18} and T_{19} respectively. However, it was showed at par with remaining other treatments. The minimum plant height (70.34 cm) was noted in treatment T_1 (Control). The increase in plant height in integrated nutrient management may be due to the readily available form of nutrients. The presence and synthesis of gibberellins in organic manures may be responsible for plant height. Gibberellins cause cell elongation and cell division, which stimulated elongation and increased plant height. These findings were conformity with the results obtained by Gupta *et al.,* (2008) [6], Shankar *et al*., (2010) [17] in *Gladiolus*. Similar results were also observed by Gajbhiye *et al*., (2013) [5].

Number of leaves plant^{-1}

The highest number of leaves plant^{-1} at 30 DAP (3.60) was recorded in treatment T_3 (FYM 50 t/ha + Mustard cake 500 g + Cow urine 20%), which was found at par with treatments T_4, T_6, T_7, T_9 and T_{12}. Whereas it was exhibited significantly differ with rest of the other treatments. The lowest number of leaves plant^{-1} (2.40) was observed in treatment T_1 (Control). As far as the highest number of leaves plant^{-1} at 60 DAP (8.50) was noted in treatment T_3 (FYM 50 t/ha + Mustard cake 500 g + Cow urine 20%), and it was found at par with treatments T_4, T_6, T_7, T_9 and T_{12}. However, it was observed significant difference with rest of the other treatments. The lowest number of leaves plant^{-1} (7.10) was noted in treatment T_1 (Control). These results must be interpreted in light of increased nutrient availability, particularly nitrogen, which is a constituent of protein and protoplasm, as well as increased chlorophyll content in leaves. All of the factors promoted cell multiplication, cell elongation and cell differentiation, which resulted in improved photosynthesis and increase in number of leaves of *Gladiolus*. The results can be conformity with the findings of Narendra *et al.,* (2013) [13], Chaudhary *et al.,* (2013) [2], Kumar (2014) [9] in *Gladiolus*.

Flower yield parameters

Days to spike emergence

The minimum number of days to spike emergence (66.50 days) was noted in treatment T_3 (FYM 50 t/ha + Mustard cake 500 g + Cow urine 20%), which was found at par with treatments T_4, T_6, T_9 and T_{12}. However, it was found significant difference with the remaining treatments. The maximum number of days to spike emergence (78.40 days) was noted in treatment T_{18} (Goat manure 20 t/ha + Neem cake 500 g + Cow urine 20%). It may be due to the early loss of apical dominance, followed by easier and better nutrient translocation to the plant, that may improved plant growth due to increased nutrient availability, and accelerated mobility of photosynthates from source to sink as influenced by growth hormones released or synthesized from organic manures that may be enhanced to early spike emergence. These findings are conformity with the results obtained by Sharma *et al*., (2009) [18] in china aster, Panchal *et al*., (2010) [15] in chrysanthemum, and Narendra *et al.,* (2013) [13] in *Gladiolus*.

Number of spike plant^{-1}

The results showed that there was non - significant difference obtained among different treatments. The highest number of spike plant^{-1} (2.30) was reported in treatment T_3 (FYM 50 t/ha + Mustard cake 500 g + Cow urine 20%) whereas the lowest number of spike plant^{-1} (1.00) was found in treatments T_{10}, T_{13} and T_{14} respectively.

Spike length (cm)

The maximum spike length (71.20 cm) was noted in treatment T_3 (FYM 50 t/ha + Mustard cake 500 g + Cow urine 20%), which was obtained at par with treatments T_4, T_6, T_7, T_9 and T_{12}. Whereas it was showed significant difference with remaining treatments. The minimum spike length (60.90 cm) was recorded in treatment T_1 (Control). The result may be due to the availability of sufficient amount of nutrient in various stages of plant growth and development through application of organic manure. However the organic manure has sufficient amount of nitrogen for growth and development of plant. The photosynthetic system is activated to improve biological efficiency by allowing maximum metabolites and photosynthetes to be synthesized, thus encouraging rapid growth, which may eventually lead to increased spike length. These findings are conformity with the results reported by Singh and Jauhari (2005) [19] in rose, Gupta *et al*., (2008) [6], Kumar *et al*., (2010) [11], Jha *et al*., (2012) [7], Mageswari *et al*., (2017) [12] and Chouhan *et al*., (2014) [3] in *Gladiolus*.

Rachis length (cm)

The maximum rachis length (45.31 cm) was observed in treatment T_3 (FYM 50 t/ha + Mustard cake 500 g + Cow urine 20%), which was found to be at par with T_4, T_6, T_7 and T_9 respectively. However, it was found significant difference with the rest of the other treatments. The minimum rachis length (34.67 cm) was noted in treatment T_1 (Control). Rachis length may have increased due to increased nutrient availability from organic manure and translocation of higher amounts of photosynthesis, and maintenance of proper physiological activities of the plant, resulting in more food, which may have been used for better rachis length development. Similar findings were also reported by Padaganur *et al*., (2005) [14], Tripathi *et al*., (2012) [21], Wasim *et al*., (2014) [22] in tuberose, Kumar *et al*., (2014) [9] and Durga *et al*., (2018) [4] in *Gladiolus*.

Number of floret spike^{-1}

The highest number of floret spike^{-1} (15.80) was observed in Treatment T_3 (FYM 50 t/ha + Mustard cake 500 g + Cow urine 20%). The treatment T_4 and T_6 were found to be at par with treatment T_3. However, it was found significant difference with other treatments. The lowest number of floret spike^{-1} (10.90) was counted in treatment T_1 (Control). The number of florets per spike may be influenced by the availability of nutrients over a longer period of time which could be found by application of organic manure. Similar results were also reported by Singh and Jauhari (2005) [19] in rose, Narendra *et al*., (2013) [13], Kumar *et al*., (2011) [10], Bhalla *et al*., (2006) [1] and Keisam *et al*., (2014) [8] in *Gladiolus*.

Table 1: Effect of organic manure and Foliar spray of cow urine and cow dung wash on days to sprouting of corms, plant height (cm), number of leaves plant^{-1}.

Treatment	Days to sprouting of corms	Plant height (cm)		Number of leaves plant^{-1}	
		30 DAP	60 DAP	30 DAP	60 DAP
T_1: RDF (Control) (150:100:120 kg/ha)	7.50	35.22	70.34	2.40	7.10
T_2: FYM 50 t/ha + Mustard Cake 500 g/m^2	7.00	39.55	74.41	3.10	7.60
T_3: FYM 50 t/ha + Mustard Cake 500 g/m^2 + Cow Urine 20%	6.00	42.79	77.45	3.60	8.50
T_4: FYM 50 t/ha + Mustard Cake 500 g/m^2 + Cow Dung wash 20%	6.50	41.23	76.95	3.30	8.40
T_5: FYM 50 t/ha + Neem Cake 500 g/m^2	7.50	38.19	75.20	3.10	7.70
T_6: FYM 50 t/ha + Neem Cake 500 g/m^2 + Cow Urine 20%	7.00	40.84	77.39	3.40	8.20
T_7: FYM 50 t/ha + Neem Cake 500 g/m^2 + Cow Dung Wash 20%	7.00	40.46	75.69	3.30	8.10
T_8: Vermicompost 30 t/ha + Mustard Cake 500 g/m^2	8.00	38.26	74.93	2.90	7.50
T_9: Vermicompost 30 t/ha + Mustard Cake 500 g/m^2 + Cow Urine 20%	6.00	41.75	77.06	3.50	8.10
T_{10}: Vermicompost 30 t/ha + Mustard Cake 500 g/m^2 + Cow Dung Wash 20%	7.50	38.80	76.34	3.20	7.70
T_{11}: Vermicompost 30 t/ha + Neem Cake 500 g/m^2	8.00	38.97	75.61	2.90	7.50
T_{12}: Vermicompost 30 t/ha + Neem Cake 500 g/m^2 + Cow Urine 20%	7.00	40.89	76.65	3.30	8.00
T_{13}: Vermicompost 30 t/ha + Neem Cake 500 g/m^2 + Cow Dung Wash 20%	10.00	37.02	75.50	3.10	7.60
T_{14}: Goat Manure 20 t/ha + Mustard Cake 500 g/m^2	9.00	35.37	72.67	3.20	7.40
T_{15}: Goat Manure 20 t/ha + Mustard Cake 500 g/m^2 + Cow Urine 20%	9.50	37.20	73.13	2.80	7.50
T_{16}: Goat Manure 20 t/ha + Mustard Cake 500 g/m^2 + Cow Dung Wash 20%	8.50	35.24	74.51	2.70	7.40
T_{17}: Goat Manure 20 t/ha + Neem Cake 500 g/m^2	9.50	35.66	73.89	2.50	7.20
T_{18}: Goat Manure 20 t/ha + Neem Cake 500 g/m^2 + Cow Urine 20%	10.50	36.99	72.34	2.60	7.30
T_{19}: Goat Manure 20 t/ha + Neem Cake 500 g/m^2 + Cow Dung Wash 20%	8.00	35.65	71.86	2.50	7.20
S.E m±	0.67	0.66	0.98	0.11	0.17
C.D. at 5 %	2.00	1.99	2.95	0.34	0.52

Table 2: Effect of organic manure and foliar spray of cow urine and cow dung wash on days to spike emergence, number of spike plant^{-1}, spike length (cm), rachis length (cm), number of floret spike^{-1}.

Treatment	Days to spike emergence	Number of spike plant^{-1}	Spike length (cm)	Rachis length (cm)	Number of floret spike^{-1}
T_1: RDF (Control) (150:100:120 kg/ha)	75.00	1.40	60.90	34.67	10.90
T_2: FYM 50 t/ha + Mustard Cake 500 g/m^2	71.80	1.50	67.00	41.77	13.80
T_3: FYM 50 t/ha + Mustard Cake 500 g/m^2 + Cow Urine 20%	66.50	2.30	71.20	45.31	15.80
T_4: FYM 50 t/ha + Mustard Cake 500 g/m^2 + Cow Dung wash 20%	68.00	2.00	70.28	44.83	15.40
T_5: FYM 50 t/ha + Neem Cake 500 g/m^2	71.80	1.50	67.33	42.12	13.30
T_6: FYM 50 t/ha + Neem Cake 500 g/m^2 + Cow Urine 20%	68.20	1.30	70.15	43.58	14.80
T_7: FYM 50 t/ha + Neem Cake 500 g/m^2 + Cow Dung Wash 20%	69.50	1.80	68.76	43.08	14.50
T_8: Vermicompost 30 t/ha + Mustard Cake 500 g/m^2	73.20	1.50	67.06	41.31	12.80
T_9: Vermicompost 30 t/ha + Mustard Cake 500 g/m^2 + Cow Urine 20%	68.10	1.50	69.39	43.05	14.40
T_{10}: Vermicompost 30 t/ha + Mustard Cake 500 g/m^2 + Cow Dung Wash 20%	71.80	1.00	66.11	40.66	11.60
T_{11}: Vermicompost 30 t/ha + Neem Cake 500 g/m^2	74.20	1.10	64.69	38.71	12.10
T_{12}: Vermicompost 30 t/ha + Neem Cake 500 g/m^2 + Cow Urine 20%	67.40	1.50	68.61	41.86	14.30
T_{13}: Vermicompost 30 t/ha + Neem Cake 500 g/m^2 + Cow Dung Wash 20%	75.40	1.00	64.37	39.27	11.70
T_{14}: Goat Manure 20 t/ha + Mustard Cake 500 g/m	73.70	1.00	63.33	36.22	11.20
T_{15}: Goat Manure 20 t/ha + Mustard Cake 500 g/m^2 + Cow Urine 20%	76.90	1.30	63.28	37.04	12.90
T_{16}: Goat Manure 20 t/ha + Mustard Cake 500 g/m^2 + Cow Dung Wash 20%	73.50	1.30	62.20	36.56	11.00
T_{17}: Goat Manure 20 t/ha + Neem Cake 500 g/m^2	74.10	1.20	63.27	35.81	11.30
T_{18}: Goat Manure 20 t/ha + Neem Cake 500 g/m^2 + Cow Urine 20%	78.40	1.40	63.47	37.51	11.50
T_{19}: Goat Manure 20 t/ha + Neem Cake 500 g/m^2 + Cow Dung Wash 20%	76.90	1.70	62.17	36.66	11.50
S.E m±	0.91	0.24	0.87	0.99	0.35
C.D. at 5 %	2.74	NS	2.61	2.97	1.05

Conclusion

It was observed from the results that application of FYM 50 t/ha + Mustard cake 500 g + Cow urine 20% (T_3) was found to be best treatment in terms of plant growth behaviour and flower quality as well as yield of *Gladiolus* as compared with control and other treatments.

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