

Original Research Article

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## Impact of Organic and Inorganic Nutrient Management Practices on Flowering, Corm Traits and Profitability of Gladiolus Hybrids

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### ABSTRACT

Integrated use of inorganic and organic manures has become important for higher agricultural produce as no single source of plant nutrients, either it is chemical, organic or bio fertilizers can meet the entire needs of crop. Bio-fertilizers add nutrients through the natural processes and stimulating plant growth through the synthesis of growth promoting substances and thus help in sustainable crop production through maintenance of soil productivity. Two year study was conducted at the research farm of the Division of Floriculture & Landscaping, Indian Agricultural Research Institute, New Delhi during 2016-17 and 2017-18 under integrated nutrient management approaches using two IARI, gladiolus hybrids as Melody Open Seedling and P-16-1 x Eurovision in split plot design with three replications and twelve treatment combinations. The two year mean data revealed that application of organic, inorganic and bio fertilizers had produced significant effect on vegetative and corm production parameters viz., days to first flowering, plant height, spike length, number of florets per spike, number of marketable spikes and number of corms per hectare. The data indicated that between two hybrids, P-16-1 x Eurovision hybrid had showed earliness and taken minimum 85.75 and 88.50 days respectively during both years. Among the hybrids, average maximum plant height (111.50 cm and 108.16 cm) was recorded in Melody Open Seedling which was significantly lengthier than the P-16-1 x Eurovision hybrid during both the year. Significant variation was also observed for spike length and mean of two year showed maximum spike length (100.91 cm and 98.16 cm) respectively in Melody Open Seedling hybrid. The interaction effect of INM treatments on marketable spikes per hectare and that was maximum under treatment T<sub>7</sub> with hybrid Melody Open Seedling and recorded 3.450 lakh spikes per ha during first year and 3.500 lakh per hectare during second year respectively. Maximum number of corms (3.950 lakh/ha) was recorded during first year and during second year, it was again produced (4.00 lakh/ha corms) in hybrid Melody Open Seedling with the application of 125 % RDF + Azospirillum + PSB. Further, the treatment T<sub>4</sub> i.e. application of FYM @ 10 t/ha resulted in the highest number of corms (3.712 lakh/ha) giving maximum gross income of Rs. 7.425 lakh/ha and net realization of Rs.4.225 lakh/ha and gave the highest CBR (1:2.32).

#### Keywords

Gladiolus, Hybrids,  
Net returns,  
Organic, Inorganic,  
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### Introduction

Gladiolus is an important bulbous flower grown throughout the world. It is originated from South Africa and belongs to the family *Iridaceae*. It is also ideal both for garden display and floral arrangements for table and interior decoration as well as making high quality bouquet (Lepcha *et al.*, 2007). The

main emphasis in gladiolus improvement has been on development of varieties having attractive colour and large number of florets mainly for cut flower, long spikes, more number of well-spaced large sized florets, and good corm multiplication ability. Gladiolus is very rich in varietal wealth and every year there is an addition of new varieties (Rajiv Kumar and Yadav, 2005). These varieties

require more nutrients for higher growth, production and quality of flowers.

The Integrated nutrient management (INM) is an approach to ensure the desired flower crop productivity through optimization of various plant nutrients in an integrated manner. INM adopts a holistic view of plant nutrient management by considering the totality of the farm resources that can be used as plant nutrients. The use of organic manures and bio-fertilizers along with the balance use of chemical fertilizers is known to improve physicochemical and biological properties of soil, besides improving the efficiency of applied fertilizers. The objective of INM is to optimize the use of all available resources of plant nutrients for higher crop productivity without impairing the inherent soil fertility. If in the past, the emphasis was on increased use of fertilizer; the current approach should aim on educating farmers to optimize use of organic, inorganic and biological fertilizer in an integrated way. In recent years, integrated use of inorganic and organic manures has become important for higher agricultural produce as no single source of plant nutrients, either it is chemical, organic or bio fertilizers can meet the entire needs of crop. Plant nutrition today requires judicious and integrated management of all sources of nutrients with the objective of sustaining high yields over years without deteriorating/impairing the soil health in any respect. Use of organic manures in INM helps in mitigating multiple nutrient deficiency (Kanaujia *et al.*, 2018).

The yield and quality of flowers and corms can be improved by adopting integrated nutrient management practices which include the judicious and combined use of organic, inorganic and bio-fertilizers (Singh *et al.*, 2006). Multiplication of planting material of gladiolus is most important, because the cut flower trade of gladiolus is lagging behind

over the recent years, owing to the unavailability of sufficient quality planting material at large scale (Barman *et al.*, 2005). Farmers are using chemical fertilizers unscrupulously which are costly and create threat to soil health, ultimately leading to health hazards in human beings. Moreover, this is not sustainable approach; instead it is fiery to get more spikes and corm yield. Wani *et al.*, (1917) also advocated that by reducing the levels of chemical fertilizer and optimizing the dose of different organic fertilizer can improve yield and quality in ornamental crops without adversely affecting the edaphic and environmental features. So, there is a need to develop sustainable production system, where in chemical fertilizers can be minimized by using alternative sources of nutrients such as organic and bio-fertilizers which is supplement nutritional requirement of gladiolus crop. Integrated application of inorganic fertilizers, organic manures and biological sources of nutrients in an efficient way would not only reduce the sole dependence on inorganic fertilizers, but also enhances the productivity as well as minimizing environmental hazards. Integrated Nutrient Management concept is one of the eco-friendly approaches. Although bio-fertilizers are not an alternative to inorganic fertilizers, they may be useful in increasing the yield and quality of flowers when they are combined with organic manures and inorganic fertilizers in balanced proportion. Keeping the above said facts in view, the present investigation has been planned to study the integrated nutrient management by using organic manures, bio-fertilizers and inorganic fertilizers in gladiolus hybrids for flower traits and corm production.

## **Materials and Methods**

The field experiment was carried out over a two year period from 2016-17 to 2017-18 at

the Research Farm of the Division of Floriculture and Landscaping, ICAR-Indian Agricultural Research Institute, New Delhi. The experiment was laid out in split plot design with three replications, at a spacing of 50 cm x 10 cm at 6-8 cm depth in a plot size of 2.00 m x 2.00 m. The experiment was conducted in loam soil with pH 8.3. Well decomposed farmyard manure, Vermicompost, *Azospirillum*, PSB and liquid NPK were applied treatment-wise before planting. Recommended fertilizer doses of 200:100:100 kg/ha NPK were also given treatment-wise as 125%, 100%, 75% and 50%. These fertilizers were applied in the form of Urea, Single super phosphate and Muriate of potash. Uniform size of gladiolus corms (4.0 to 5.0 cm) of hybrids Melody Open Seedling and P-16-1 x Eurovision were planted in the month of October during both the year. The gladiolus hybrids were treated as main plot factor while INM treatments were treated as sub-plot factor. The treatments imposed were : T<sub>1</sub>: Control, T<sub>2</sub>: 75% RDF, T<sub>3</sub>:100% RDF (200:100:100 kg/ha NPK), T<sub>4</sub> : FYM @ 10 t/ha, T<sub>5</sub> : Vermicompost @ 10 t/ha, T<sub>6</sub> : 100% RDF + FYM @ 5 t/ha, T<sub>7</sub> : 100% RDF + Vermicompost @ 5 t/ha, T<sub>8</sub> : 125% RDF + Azospirillum + PSB, T<sub>9</sub> : 75% RDF + FYM @ 10 t/ha + Azospirillum + PSB, T<sub>10</sub> : 75% RDF + Vermicompost @ 10 t/ha + Azospirillum + PSB, T<sub>11</sub> : 75% RDF + FYM @ 5 t/ha + Vermicompost @ 5 t/ha + Azospirillum + PSB, and T<sub>12</sub> : 50% RDF + FYM @ 5 t/ha + Vermicompost @ 5 t/ha + liquid NPK. The entire dose of Single super phosphate and Muriate of potash and half dose of Urea was applied before planting and incorporated in the field uniformly. The remaining half dose of Urea was top dressed after one month of planting. Irrigation was given immediately after planting and thereafter adequate soil moisture was maintained in the soil by giving regular irrigation from time to time. Plots were kept weed free by hand weeding. Disease control

measures were taken up by spraying fungicides such as Bavistin, Captan or M-45 whenever necessary throughout the experiment to grow a healthy crop. Other uniform agronomic practices were followed as and when required. Data for various vegetative and flowering and corm parameters were recorded at appropriate time after planting and analyzed by “analysis of variance” techniques as suggested by Panse and Sukhatme (1967).

## Results and Discussion

The two year mean data revealed that application of organic, inorganic and bio fertilizers had produced significant effect on vegetative and corm production parameters viz., days to first flowering, plant height, spike length, number of florets per spike, number of marketable spikes and number of corms per hectare. The data indicated that between two hybrids, P-16-1 x Eurovision had taken minimum 85.75 and 88.50 days respectively during both years while the hybrid Melody Open Seedling had taken maximum 89.58 and 92.50 days during the 2016-17 and 2017-18 respectively. Further, the examination of experimental finding showed that different treatment of organic, inorganic and bio-fertilizers exerted significant effect on days to first flowering during the year 2016-17, 2017-18 and mean. The treatment T<sub>6</sub> (100 % RDF + FYM @ 5 t/ha) in which average mean of both hybrids observed as 84.50 days and treatment T<sub>7</sub> was also at par during first year, but during second year, treatment T<sub>2</sub> i.e. application of 75 % RDF had taken minimum days (86.00). The data presented in table 1 revealed that the interaction effect of hybrids and integrated nutrient management treatments were also found significant with respect to days to first flowering during both the year and data indicated that the hybrid P-16-1 x Eurovision had taken minimum days (84.00) during first

year with the application of FYM @ 10 t/ha, while during second year, it was 79.00 days in the same hybrid with the application of 75 % RDF. The variation in plant height and spike length between the two hybrids was significantly influenced by different treatments of organic, inorganic and bio-fertilizers during the year 2016-17, 2017-18 and mean which presented in table 2 and 3. Among the hybrids, average maximum plant height (111.50 cm and 108.16 cm) was recorded in Melody Open Seedling which was significantly lengthier than the P-16-1 x Eurovision hybrid during both the year. The effect of different treatment of organic, inorganic and bio-fertilizers on plant height differed significantly during the year 2016-17, 2017-18 and mean of two hybrids during the year 2016-17 and data indicated the maximum plant height (124.50 cm) in the treatment T<sub>6</sub> i.e. application of 100 % RDF + FYM @ 5 t/ha while during the year 2017-18, it was recorded maximum (117.50 cm) in the treatment T<sub>12</sub> i.e. 50 % RDF + FYM @ 5 t/ha + Vermicompost @ 5 t/ha + liquid NPK. Significant variation was also observed for spike length and mean of two year showed maximum spike length (100.91 cm and 98.16 cm) respectively in Melody Open Seedling hybrid. The effect of different integrated nutrient management treatment on spike length was significant during both year and it is cleared from the data presented in table 3 revealed that treatment T<sub>6</sub> during the year 2016-17 and treatment T<sub>12</sub> during the year-2017-18 was the best and recorded spike length (113.50 cm and 107.50 cm) respectively. Further, the data presented in table 3 revealed that interaction effect of different INM treatments and hybrids on spike length were found significant during both the year. During the first year, hybrid P-16-1 x Eurovision had recorded the maximum spike length (117.00 cm) at treatment T<sub>6</sub> while during second year, it was 115.00 cm spike length in hybrid Melody Open Seedling

at treatment T<sub>12</sub>. Number of florets per spike was significantly influenced by treatment of organic, inorganic and bio fertilizers during the year 2016-17, 2017-18 and their mean. The maximum mean value of number of florets (16.33) was recorded in hybrid Melody Open Seedling during the first year and it was 17.66 florets per spike during the second year which was significantly higher than the other hybrid i.e. P-16-1 x Eurovision. Further, the treatment T<sub>6</sub> i.e. application of 100 % RDF +@ 5 t/ha and mean of two hybrids was observed maximum 17.50 florets/spike during the year 2016-17 and it was maximum under treatment T<sub>8</sub> and T<sub>12</sub> during the year 2017-18; but it was minimum under control treatment during both the year. The interaction effect of organic, inorganic and bio fertilizers was also found significant on number of florets per spike during both the year and cleared from the data presented in table 4. Kumar *et al.*, 2010 and Chouhan *et al.*, 2014 found the maximum spike length with the application of higher doses of NPK and FYM i.e. 300 kg N, 120 kg P, 120 kg K/ha + 10 t/ha FYM. This might be due to greater uptake of nutrients into the plant system, which assured a rapid growth of stem by mobilization of nutrients toward the developing spikes. Similar beneficial effects of higher doses of primary nutrients on spike were reported by Lakshmi Durga *et al.*, (2018).

Kumari *et al.*, (2013) reported that application of 75 per cent RDF + VC (3 tonnes/ha) + VAM (10 kg/ha) + Azospirillum (10 kg/ha) + *Trichoderma harzianum* (5 kg/ha) resulted in maximum plant height (116.28 and 118.60 cm). minimum number of days taken for spike emergence (52.31 and 48.49) and number of days taken for first flower bud opening on a spike (58.74 and 54.56) in Rabi season. The photosynthetic system is activated for enhance biological efficiency, enabling synthesis of maximum metabolites and photosynthesites, thus encouraging quick

growth which might be ultimately leads to increased plant height, length of spike and number of florets (Mageswari *et al.*, 2013). Gaur *et al.*, (2006) carried out an experiment in gladiolus and recorded maximum plant height (108.50 cm) with 75% NPK+ 10 tonnes/ha Vermicompost followed by 50% NPK+ Vermicompost. The increased plant height at doses may be attributed to stimulatory action of sufficient supply of plant nutrients in terms of cell division and cell enlargement and the least determined height could be because of the unavailability of sufficient nutrients at critical crop stages for its luxuriant growth, these findings are supported with differential applications of NPK and FYM on number of florets (Khan and Ahmad, 2004).

The variation between the hybrids for marketable spikes and effect of different INM treatments and their interaction was observed significant during the year 2016-17 and 2017-18. During the first year, hybrid P-16-1 x Eurovision had produced 2.976 lakh spikes and during second year, the same hybrid produced 2.937 lakh spikes per hectare which was higher than the other hybrid i.e. Melody Open Seedling.

Examination of two year experimental finding showed that (Table 5) different treatment of organic, inorganic and bio fertilizers exerted significant effect on marketable spikes of gladiolus hybrids. The maximum mean value of two hybrids during both year was recorded under treatment T<sub>8</sub> i.e. application of 125 % RDF + Azospirillum + PSB followed by treatment T<sub>4</sub>, T<sub>6</sub> and T<sub>7</sub> respectively (Table 5). In regard to interaction effect of INM treatment on marketable spikes/hectare and that was maximum under treatment T<sub>7</sub> with hybrid Melody Open Seedling and recorded 3.450 lakh spikes/ha during first year and 3.500 lakh per hectare during second year respectively.

From the table 6, it was revealed between the hybrids that during first year and second year, mean value of corm per hectare was higher in Melody Open Seedling, but significantly at par with other hybrid P-16-1 x Eurovision. With respect to treatments and mean value of two hybrids, it was maximum under treatment T<sub>8</sub> (3.700 lakh corms per hectare during first year) and treatment T<sub>4</sub> (3.750 lakh corms per hectare during second year) as compared to remaining INM treatments. Further, the data presented in Table 6 revealed that interaction effect of organic, inorganic and bio fertilizers were also found significant on the number of corms per hectare during the year 2016-17 and 2017-18. Maximum number of corms (3.950 lakh/ha) was recorded during first year and during second year, it was again produced (4.00 lakh/ha corms) in hybrid Melody Open Seedling with the application of 125 % RDF + Azospirillum +PSB.

The economics of different organic, inorganic and bio fertilizer treatments are usually a deciding factor for its adoption by the gladiolus growers for commercial spikes/corm production. It is, therefore, of wide interest to estimate and calculate the effects of various treatments on the number of corms production and to work out the most remunerative combination of these factors. The data (Table 7) and mean of two year study revealed that the treatment T<sub>4</sub> i.e. application of FYM @ 10 t/ha resulted in the highest number of corms (3.712 lakh/ha) giving maximum gross income of Rs. 7.425 lakh/ha and net realization of Rs.4.225 lakh/ha and gave the highest CBR (1:2.32). The second best treatment combination in terms of corms production (3.700 lakh/ha and gross income Rs.7.400 lakh/ha), but it was third in net income and gave Rs.3.600 lakh/ha with the application of 125 % RDF + Azospirillum +PSB.

**Table.1** Days to first flowering of gladiolus hybrids as influenced by different organic, inorganic and bio fertilizer treatments

S. N.	Treatments	Days to first flowering					
		2016-17			2017-18		
		Melody Open Seedling	P-16-1 x Eurovision	Mean	Melody Open Seedling	P-16-1 x Eurovision	Mean
<b>1</b>	T <sub>1</sub> : Control	91.00	86.00	88.50	93.00	90.00	91.50
<b>2</b>	T <sub>2</sub> : 75% RDF	91.00	86.00	88.50	93.00	79.00	86.00
<b>3</b>	T <sub>3</sub> :100% RDF (200:100:100 kg/ha NPK)	91.00	87.00	89.00	84.00	98.00	91.00
<b>4</b>	T <sub>4</sub> : FYM @ 10 t/ha	91.00	84.00	87.50	90.00	86.00	88.00
<b>5</b>	T <sub>5</sub> : Vermicompost @ 10 t/ha	90.00	85.00	87.50	90.00	86.00	88.00
<b>6</b>	T <sub>6</sub> : 100% RDF + FYM @ 5 t/ha	84.00	85.00	84.50	92.00	92.00	92.00
<b>7</b>	T <sub>7</sub> : 100% RDF + Vermicompost @ 5 t/ha	84.00	85.00	84.50	96.00	90.00	93.00
<b>8</b>	T <sub>8</sub> : 125% RDF + Azospirillum + PSB	91.00	86.00	88.50	93.00	92.00	92.50
<b>9</b>	T <sub>9</sub> : 75% RDF +FYM @ 10 t/ha + Azospirillum + PSB	90.00	87.00	88.50	96.00	80.00	88.00
<b>10</b>	T <sub>10</sub> : 75% RDF + Vermicompost @ 10 t/ha + Azospirillum +PSB	90.00	85.00	87.50	93.00	86.00	89.50
<b>11</b>	T <sub>11</sub> : 75% RDF + FYM @ 5 t/ha + Vermicompost @ 5 t/ha + Azospirillum + PSB	91.00	87.00	89.00	98.00	91.00	94.50
<b>12</b>	T <sub>12</sub> : 50% RDF +FYM @ 5 t/ha + Vermicompost @ 5 t/ha + liquid NPK	91.00	86.00	88.50	92.00	92.00	92.00
	Mean	89.58	85.75		92.50	88.50	
	C D at 5% , For hybrids	2.31			2.59		
	C D at 5% , For treatments	3.01			2.99		
	C D at 5% , For interaction	3.28			5.38		

**Table.2** Plant height of gladiolus hybrids as influenced by different organic, inorganic and bio fertilizer treatments

S. N.	Treatments	Plant height (cm)					
		2016-17			2017-18		
		Melody Open Seedling	P-16-1 x Eurovision	Mean	Melody Open Seedling	P-16-1 x Eurovision	Mean
<b>1</b>	T <sub>1</sub>	99.00	110.00	104.50	95.00	80.00	87.50
<b>2</b>	T <sub>2</sub>	120.00	125.00	122.50	102.00	88.00	95.00
<b>3</b>	T <sub>3</sub>	123.00	108.00	115.50	117.00	100.00	108.50
<b>4</b>	T <sub>4</sub>	121.00	108.00	114.50	109.00	92.00	100.50
<b>5</b>	T <sub>5</sub>	106.00	102.00	104.00	120.00	89.00	104.50
<b>6</b>	T <sub>6</sub>	122.00	127.00	124.50	102.00	90.00	96.00
<b>7</b>	T <sub>7</sub>	110.00	100.00	105.00	107.00	110.00	108.50
<b>8</b>	T <sub>8</sub>	109.00	110.00	109.50	122.00	95.00	108.50
<b>9</b>	T <sub>9</sub>	110.00	100.00	105.00	102.00	100.00	101.00
<b>10</b>	T <sub>10</sub>	95.00	102.00	98.50	102.00	92.00	97.00
<b>11</b>	T <sub>11</sub>	100.00	110.00	105.00	95.00	88.00	91.50
<b>12</b>	T <sub>12</sub>	123.00	100.00	111.50	125.00	110.00	117.50
	Mean	111.50	108.50		108.16	94.50	
	C D at 5% , For varieties		2.44			4.30	
	C D at 5% , For treatments		2.00			5.96	
	C D at 5% , For interaction		2.88			2.65	

**Table.3** Spike length of gladiolus hybrids as influenced by different organic, inorganic and bio fertilizer treatments

S. N.	Treatments	Spike length (cm)					
		2016-17			2017-18		
		Melody Open Seedling	P-16-1 x Eurovision	Mean	Melody Open Seedling	P-16-1 x Eurovision	Mean
<b>1</b>	T <sub>1</sub>	88.00	100.00	94.00	85.00	70.00	77.50
<b>2</b>	T <sub>2</sub>	110.00	115.00	112.50	92.00	78.00	85.00
<b>3</b>	T <sub>3</sub>	113.00	98.00	105.50	107.00	90.00	98.50
<b>4</b>	T <sub>4</sub>	110.00	98.00	104.00	99.00	82.00	90.50
<b>5</b>	T <sub>5</sub>	96.00	90.00	93.00	110.00	79.00	94.50
<b>6</b>	T <sub>6</sub>	110.00	117.00	113.50	92.00	80.00	86.00
<b>7</b>	T <sub>7</sub>	100.00	90.00	95.00	97.00	90.00	93.50
<b>8</b>	T <sub>8</sub>	98.00	100.00	99.00	112.00	85.00	98.50
<b>9</b>	T <sub>9</sub>	100.00	90.00	95.00	92.00	90.00	91.00
<b>10</b>	T <sub>10</sub>	84.00	92.00	88.00	92.00	82.00	87.00
<b>11</b>	T <sub>11</sub>	90.00	100.00	95.00	85.00	78.00	81.50
<b>12</b>	T <sub>12</sub>	112.00	90.00	101.00	115.00	100.00	107.50
	Mean	100.91	98.33		98.16	83.66	
	C D at 5% , For varieties		1.98			2.83	
	C D at 5% , For treatments		1.55			3.76	
	C D at 5% , For interaction		2.25			3.98	

**Table.4** Number of florets per spike of gladiolus hybrids as influenced by different organic, inorganic and bio fertilizer treatments

S. N.	Treatments	Number of florets per spike					
		2016-17			2017-18		
		Melody Open Seedling	P-16-1 x Eurovision	Mean	Melody Open Seedling	P-16-1 x Eurovision	Mean
<b>1</b>	T <sub>1</sub>	14.00	14.00	14.00	14.00	12.00	13.00
<b>2</b>	T <sub>2</sub>	17.00	15.00	16.00	18.00	11.00	14.50
<b>3</b>	T <sub>3</sub>	16.00	15.00	15.50	18.00	12.00	15.00
<b>4</b>	T <sub>4</sub>	18.00	14.00	16.00	18.00	10.00	14.00
<b>5</b>	T <sub>5</sub>	14.00	13.00	13.50	19.00	11.00	15.00
<b>6</b>	T <sub>6</sub>	18.00	17.00	17.50	16.00	12.00	14.00
<b>7</b>	T <sub>7</sub>	15.00	13.00	14.00	16.00	14.00	15.00
<b>8</b>	T <sub>8</sub>	16.00	15.00	15.50	20.00	14.00	17.00
<b>9</b>	T <sub>9</sub>	17.00	12.00	14.50	17.00	14.00	15.50
<b>10</b>	T <sub>10</sub>	17.00	12.00	14.50	18.00	12.00	15.00
<b>11</b>	T <sub>11</sub>	16.00	12.00	14.00	18.00	13.00	15.50
<b>12</b>	T <sub>12</sub>	18.00	11.00	14.50	20.00	14.00	17.00
	Mean	16.33	13.58		17.66	12.41	
	C D at 5% , For varieties		1.08			2.44	
	C D at 5% , For treatments		0.99			1.33	
	C D at 5% , For interaction		1.08			1.55	

**Table.5** Number of marketable spike per hectare of gladiolus hybrids as influenced by different organic, inorganic and bio fertilizer treatments

S. N.	Treatments	Number of marketable spikes (Lakh/ha.)					
		2016-17			2017-18		
		Melody Open Seedling	P-16-1 x Eurovision	Mean	Melody Open Seedling	P-16-1 x Eurovision	Mean
<b>1</b>	T <sub>1</sub>	2.420	2.800	2.610	2.400	2.775	2.587
<b>2</b>	T <sub>2</sub>	1.800	3.000	2.400	1.850	3.075	2.462
<b>3</b>	T <sub>3</sub>	3.100	3.200	2.860	3.150	2.600	2.875
<b>4</b>	T <sub>4</sub>	3.000	3.150	3.100	3.200	3.175	3.187
<b>5</b>	T <sub>5</sub>	2.800	3.250	2.975	2.850	3.100	2.975
<b>6</b>	T <sub>6</sub>	3.100	2.900	3.175	3.000	3.100	3.050
<b>7</b>	T <sub>7</sub>	3.450	3.300	3.175	3.500	2.850	3.175
<b>8</b>	T <sub>8</sub>	3.405	2.900	3.352	3.400	3.250	3.325
<b>9</b>	T <sub>9</sub>	2.800	2.800	2.850	2.750	2.725	2.737
<b>10</b>	T <sub>10</sub>	2.100	2.850	2.450	2.075	2.750	2.412
<b>11</b>	T <sub>11</sub>	3.100	2.950	2.975	3.000	2.800	2.900
<b>12</b>	T <sub>12</sub>	2.850	2.976	2.900	2.750	3.050	2.900
	Mean	2.827			2.827	2.937	
	C D at 5% , For varieties		0.100			0.100	
	C D at 5% , For treatments		0.348			0.405	
	C D at 5% , For interaction		0.700			0.450	

**Table.6** Number of corms per hectare of gladiolus hybrids as influenced by different organic, inorganic and bio fertilizer treatments

S. N.	Treatments	Number of corms (Lakh/ha.)					
		2016-17			2017-18		
		Melody Open Seedling	P-16-1 x Eurovision	Mean	Melody Open Seedling	P-16-1 x Eurovision	Mean
<b>1</b>	T <sub>1</sub>	2.950	2.900	2.925	2.975	2.850	2.912
<b>2</b>	T <sub>2</sub>	2.960	3.150	3.055	3.000	3.100	3.050
<b>3</b>	T <sub>3</sub>	3.200	2.900	3.050	3.375	2.875	3.125
<b>4</b>	T <sub>4</sub>	3.850	3.500	3.675	3.925	3.575	3.750
<b>5</b>	T <sub>5</sub>	3.300	3.750	3.525	3.225	3.625	3.425
<b>6</b>	T <sub>6</sub>	3.300	3.360	3.330	3.375	3.350	3.362
<b>7</b>	T <sub>7</sub>	3.720	2.900	3.310	3.750	2.850	3.300
<b>8</b>	T <sub>8</sub>	3.950	3.450	3.700	4.000	3.400	3.700
<b>9</b>	T <sub>9</sub>	3.000	3.600	3.300	2.925	3.550	3.237
<b>10</b>	T <sub>10</sub>	2.800	3.100	2.950	2.675	3.000	2.837
<b>11</b>	T <sub>11</sub>	3.150	3.350	3.250	3.050	3.400	3.225
<b>12</b>	T <sub>12</sub>	3.200	3.400	3.300	3.075	3.325	3.200
	Mean	3.281	3.280		3.279	3.241	
	C D at 5% , For varieties	NS			0.035		
	C D at 5% , For treatments	0.382			0.488		
	C D at 5% , For interaction	1.180			0.245		

**Table.7** Number of corms, gross and net returns of gladiolus hybrids per hectare as influenced by different organic, inorganic and bio fertilizer treatments

S. N.	Treatments	Number of corms (Lakh/ha.) Mean of two year of both the hybrids	Total gross returns (Rs lakh/ha) Mean of two year of both the hybrids	Total cost of production. (Rs. lakh/ha) Mean of two year of both the hybrids	Net returns (Rs lakh/ha) Mean of two year of both the hybrids	Benefit cost ratio (Rs.)
1	T <sub>1</sub>	2.918	5.837	3.100	2.737	1:1.88
2	T <sub>2</sub>	3.052	6.105	3.050	3.055	1:2.01
3	T <sub>3</sub>	3.087	6.175	3.070	3.105	1:2.01
4	T <sub>4</sub>	3.712	7.425	3.200	4.225	1:2.32
5	T <sub>5</sub>	3.475	6.950	3.300	3.650	1:2.10
6	T <sub>6</sub>	3.346	6.692	3.115	3.577	1:2.14
7	T <sub>7</sub>	3.305	6.610	3.170	3.440	1:2.08
8	T <sub>8</sub>	3.700	7.400	3.800	3.600	1:1.94
9	T <sub>9</sub>	3.268	6.537	3.900	2.637	1:1.67
10	T <sub>10</sub>	2.893	5.787	3.950	1.837	1:1.46
11	T <sub>11</sub>	3.237	6.475	3.980	2.495	1:1.62
12	T <sub>12</sub>	3.250	6.500	3.200	3.300	1:2.03

**Corm rate @ Rs.2/- per corm**

The next best treatment combination which had recorded Rs.3.650 lakh/ha net return with the application of Vermicompost @ 10 t/ha, whereas, it was minimum under treatment T<sub>10</sub> as compared to other remaining treatments. Gangadharan and Gopinath (2000) worked on gladiolus and reported that combination of 10 tonnes ha<sup>-1</sup> Vermicompost+ 80% NPK resulted in the maximum number of corms (6.820 lakh/ha), highest benefit: cost ratio (1.56: 1), gross (Rs 13, 16,400) and net income (Rs 8, 01,779.03). In a field trial conducted by Karthireshan and Venkatesh in 2002 at GKVK, Bangalore, reported that gladiolus cv. White Prosperity produced maximum plant height with the application of Azospirillum and VAM along with recommended dose and 25% (75:45:60 kg/ha) reduced dose of NPK. Further, they reported and found that best combination was 25% reduced dose of NPK i.e.75:45:60 kg NPK/ha+ Azospirillum + VAM. Singhet *al.*, (2008) worked on gladiolus and reported that maximum plant height, spike length. Number of floret per spike, were recorded when Vermicompost @ 10 t ha<sup>-1</sup> and bio-fertilizers namely *Azospirillum* and VAM and PSB were applied. Mageswari *et al.*, 2013 reported further that treatment received 50% of RDF+FYM (2kg/m<sup>2</sup>/year) + Vermicompost (300 g/m<sup>2</sup>) + Azospirillum (2 g /plant) + PSB (2 g/plant) was found to be good with respect to vegetative and floral characters. Kumar *et al.*, (2011) also reported that maximum plant height (101.2 cm), spike length (88.2 cm) and number of florets per spike (14.4) was found maximum with the treatment i.e. (CBD + Vermicompost 5 tonnes/ha). In an investigation conducted by Madinat-ul- Nisa *et al.*,(2016) reported the response of integrative nutrient application in gladiolus cv. Priscilla and found significant differences amongst all the treatments. The results endorsed that the treatment T<sub>6</sub> (Azotobacter 1 litre/10 kg + *Azospirillum* 1 litre/10 kg + 80% N +100% PK) significantly improved

the number of florets per spike (14.20), number of spikes per m<sup>2</sup> (32.00), corms per m<sup>2</sup> (74.70). This may be due to the combined action of bio fertilizers and inorganic fertilizers, which resulted in more assimilation of photosynthates towards sink, and there by increased the yield characters. The results of present investigation are close agreement and conformity with the findings of above mentioned workers.

In conclusions, the results of two year study showed that in and around Delhi condition, the application of organic, inorganic and bio fertilizers had produced significant effect on vegetative and corm production parameters viz., days to first flowering, plant height, spike length, number of florets per spike, number of marketable spikes and number of corms per hectare. Maximum number of corms was produced in hybrid Melody Open Seedling with the application of 125 % RDF + Azospirillum +PSB, and treatment T<sub>4</sub> i.e. application of FYM @ 10 t/ha resulted in the highest number of corms (3.712 lakh/ha) giving maximum gross income of Rs. 7.425 lakh/ha and net realization of Rs.4.225 lakh/ha and gave the highest CBR (1:2.32).

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