International Journal of Agricultural Sciences
Volume **10** | Issue 1| January, 2014 | 15-22

RESEARCH PAPER

Effect of integrated nutrient management on floral and cormal parameters in gladiolus (*Gladiolus hybridus* L.)

R. VASANTHA KUMARI*, D.P. KUMAR, B. ARUNKUMAR AND M. MAHADEVAMMA
Department of Horticulture, University of Agricultural Sciences, G.K.V.K., BENGALURU (KARNATAKA) INDIA
(Email : vasanthakumarihortindia@gmail.com)

Abstract : Field investigations were carried out to know the response integrated nutrient management on floral and cormal parameters in gladiolus (*Gladiolus hybridus* l.) cv. AMERICAN BEAUTY" was carried out at precision farming development centre, Division of Horticulture, Gandhi Krishi Vignana Kendra, UAS, Bangalore during 2007-2008 and 2008-2009. The application of bio-fertilizer along with two levels of NPK with vermicompost have shown significant result in the treatments both in *Kharif* and *Rabi* seasons. The treatment T_{11} (52.31) and (48.49) took minimum days for spike emergence followed by T_{10}, T_9 and T_8 treatments during *Kharif* and *Rabi* seasons, respectively. Less number of days taken for flower bud opening, more number of florets per spike, more durability of spike (days) increased spike length, spike girth, floret length, floret diameter, number of florets opening at a time and total number of spikes/plant, fresh weight of spike was found best in the treatment T_{11} the combination of VAM + *Azospirillum* + *Trichoderma* with 75% RDF and vermicompost had shown significant result followed by T_{10} the combination was 50% RDF + VAM + *Azospirillum* + *Trichoderma* with vermicompost 3 tons/ha, during *Kharif* and *Rabi* seasons, respectively. cormal parameters such as number of corms/plant, weight of corms, number of cormels, cormel weight, was maximum in T_{11} treatment followed by T_{10} in both *Kharif* and *Rabi* seasons.

Key Words : Integrated nutrient management, Spike, Cormal, Gladiolus

View Point Article : Kumari, R. Vasantha, Kumar, D.P., Arunkumar, B. and Mahadevamma, M. (2014). Effect of integrated nutrient management on floral and cormal parameters in gladiolus (*Gladiolus hybridus* L.). *Internat. J. agric. Sci.*, **10** (1): 15-22.

Article History : Received : 22.04.2013**; Revised :** 04.09.2013**; Accepted :** 04.10.2013

INTRODUCTION

Gladiolus is an important annual bulbous flower crop which is grown widely in India and also in other countries. It's cultivation in Karnataka is restricted to in and around urban areas. To raise the crop to get healthy, quality spikes with higher productivity, the crop needs good management and improved cultivation practices. Various growth and flowering characters are responsible for getting an economically benefitting flower yield in gladiolus crop. Among them most important ones are number of days taken for spike initiation and number of spikes per plant and first floret to open, spike length, rachis length, and spike weight, number of florets per spike, and vase life of the spikes.

In modern flower production technology a great emphasis is being given for adopting integrated nutrient management practice through organic, inorganic and bio-fertilizers, which increases the yield and quality by eco friendly management but also maintain soil health, soil fertility, physical properties of soil and mobilization of nutrients. The results obtained in this study are discussed here under.

To ensure maximization of productivity in any crop, optimum nutrient supply is one of the important factors. Nitrogen, phosphorus and potassium are the three major nutrients that play very vital role in influencing vegetative growth, flower yield and quality attributes. However, considering the recent concept for ecofriendly-technology, increased cost and timely non-availability of inorganic fertilizers, discriminate usage of chemicals has led to poor soil fertility and soil health. In recent years use of cost effective and eco friendly biofertilizers and different organic

*** Author for correspondence**

sources in combination with inorganic fertilizers has resulted in increased production in many crops besides improving soil health and fertility levels. Similarly it is essential to evolve integrated nutrient management practices suitable for gladiolus crop.

Among the biofertilizers, *Azospirillum*, VAM (*Vesicular arbuscular mycorryizae)* and *Trichoderma* are important. *Azospirillum* is asymbiotic bacterium it lives in association with the host and fixes atmospheric nitrogen. The symbiotic association between fungi and root system of higher plants named as '*mycorrhiza*". Biofertilizers have a supplementary nutritive role in productivity and by their usage; chemical fertilizers can be reduced to certain extent besides maintaining the soil fertility for a long time.

There is a need to standardize the different agro techniques and nutritional requirement through integrated nutrient management approach for improvement of productivity and spike quality of gladiolus. Field investigation was carried out to study the effect of integrated nutrient management on growth, yield and quality of gladiolus cv. American Beauty under open field conditions.

MATERIAL AND METHODS

The present study was carried out at the Precision Farming Development Centre (PFDC), Division of Horticulture, Gandhi Krishi Vignana Kendra, University of Agricultural Sciences, Bangalore during 2007-08 and 2008-09. The field experiment consisted of eight treatments, were carried out by following Randomized Complete Block Design with three replications. The main objective of the experiment was to study the effect of integrated nutrient management on floral and cormal parameters on gladiolus.

Treatments details:

T_1: Control (RDF + FYM)

T_2: 50% RDF + VC (3 tonnes/ha)

T_3: 75% RDF + VC (3 tonnes/ha)

T_4: 50% RDF+VC (3 tonnes/ha)+VAM (*Glomus mosseae*) 10 kg/ha

T_5: 75% RDF + VC (3 tonnes/ha) + VAM (*Glomus mosseae*) 10 kg/ha

T_6: 50% RDF + VC (3 tonnes/ha) + *Azospirillum brasilense* (10kg.ha)

T_7: 75% RDF + VC (3 tonnes/ha) + *Azospirillum brasilense* (10kg.ha)

T_8: 50% RDF + VC (3 tonnes/ha) + *Trichoderma harzianum* (5 kg/ha)

T_9: 75% RDF + VC (3 tonnes/ha) + *Trichoderma harzianum* (5 kg/ha)

T_{10}: 50% RDF + VC (3 tonnes/ha) + VAM *(Glomus mosseae*) (10 kg/ha) +*Azospirillum brasilense* (10 kg/ha) + *Trichoderma harzianum* (5kg/ha)

T_{11}: 75% RDF + VC (3 tonnes/ha) + VAM (*Glomus mosseae*) (10 kg/ha) + *Azospirillum brasilense* (10 kg/ha) + *Trichoderma harzianum* (5kg/ha)

Note: RDF: Recommended dose of fertilizer: 100:60:60 kg NPK/ha

Basal dose -50:60:60 kg NPK /ha

Top dressing - 50kg N 40 days after planting.

VC: Vermicompost

VAM*: Vescicular Arbuscular mycorrhizae*

FYM: Farm Yard Manure.

The crop was raised in open field condition by adopting the recommended package of practices with integrated nutrient management with varied levels of RDF with common levels of bio-fertilizers and vermicompost. The investigations were carried out during *Kharif* and *Rabi* seasons to know their influence on floral and cormal parameters of cut flowers. The entire plot was thoroughly dug to a depth of 45 cm and brought to a fine tilth after removing the weeds and stubbles prior to planting. Farm yard manure (FYM), basal dose of recommended dose of fertilizer, vermicompost and bio-fertilizers were applied and mixed well with the soil as per the treatment specification.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Floral parameters :

Number of days taken for spike emergence and first flower bud opening in a spike:

The data on number of days taken for spike emergence as influenced by INM treatment during *Kharif* and *Rabi* seasons are presented in Table 1.

During *Kharif* 2008 the number of days taken for spike emergence differed significantly among the treatments. (Control (RDF+FYM)). The minimum (52.31 days) number of days taken for spike emergence was recorded in treatment T_{11} (75% RDF + VC 3 t/ha + VAM *(Glomus mosseae*) (10 kg/ha) + *Azospirillum brasilense* (10 kg/ha) + *Trichoderma harzianum* (5kg/ha) which was at par with treatment T_{10} and T_9, whereas, the maximum number of days taken for spike emergence was recorded in T_2 (56.44 days). Similarly during *Rabi*-2009 there was significant difference among the treatments. The minimum number of days taken for spike emergence was recorded in treatment T_{11} (48.49) (75% RDF + VC 3 t/ha + VAM *(Glomus mosseae*) (10 kg/ha) + *Azospirillum brasilense* (10 kg/ha) + *Trichoderma harzianu* (5kg/ha) *Azospirillum* + *Trichoderma*. Whereas the maximum number of days taken for spike emergence was observed in treatment T_2 (54.20 days) which was at par with T_1 (53.16 days).

During *Kharif*-2008 the treatments differed significantly with respect to number of days taken for first flower bud opening in a spike. The minimum (58.74 days) was taken for first flower bud opening was recorded in treatment T_{11} (75% RDF + VC 3 t/ha + *VAM* (*Glomus mosseae*) (10 kg/ha) + *Azospirillum brasilense* (10 kg/ha) + *Trichoderma harzianum* (5kg/ha). Whereas the maximum number of days (62.19) taken for first flower bud opening was recorded in T_2 Control (RDF + FYM)) followed by T_{11} (61.25). Similarly during *Rabi* 2009 the number of days taken for first flower bud opening differed significantly. The minimum (54.56 days) number of days taken for first flower bud opening was recorded in treatment T_{11}(75% RDF + VC 3 t/ha + VAM (*Glomus mosseae*) (10 kg/ha) + *Azospirillum brasilense* (10 kg/ha) + *Trichoderma harzianum* (5kg/ha)), which is at par with treatments T_{10}, T_9, T_8, T_7 and T_6, respectively. Whereas the maximum (61.85 days) number of days taken for first flower bud opening in a spike was recorded in treatment T_2 (50% RDF + VC 3 t / ha).

The application of bio-fertilizer along with two levels of NPK with vermicompost have shown significant result in the treatments both in *Kharif* and *Rabi* seasons. The treatment T_{11} (52.31) and (48.49) took minimum days for spike emergence followed by T_{10}, T_9 and T_8 treatments during *Kharif* and *Rabi* seasons, respectively. This could be attributed to vigorous growth of the plants due to increased nutrient levels along with bio-fertilizers. These findings are in confirmation with the results of Vasanthi (1994) in jasmine, Chang (1989) in Zinnia and Wen (1991) in gerbera and Mantur (1988) in China aster and Kathiresan (1999) in gladiolus.

Number of florets per spike, spike length (cm) and spike girth (cm):

The data on number of florets per spike as influenced by INM during *Kharif* and *Rabi* seasons are presented in Table 2.

During *Kharif*-2008, the treatments differed significantly with respect to number of florets per spike. The maximum number of florets per spike (12.00) was recorded in treatment T_{11} (75% RDF + VC + VAM + *Azospirillum* + *Trichoderma)*. Whereas minimum (9.33) number of florets was recorded in T_1 and T_2, respectively. Similarly during *Rabi*-2009 the treatments differed significantly with respect to number florets per spike. The maximum (13.67) number of florets per spike was recorded in treatment T_{11} (75% RDF + VC + *VAM* + *Azospirillum* + *Trichoderma*). Where as minimum (9.67) minimum number of florets per spike was recorded T_1 and T_2, respectively.

During *Kharif*-2008 the treatments differed significantly among the treatments with respect to spike length. The maximum spike length (100.26cm) was recorded in treatment T_{11} (75% RDF + VC + VAM + *Azospirillum* + *Trichoderma*). While minimum (78.46 cm) spike length was recorded in treatment T_2 (50% RDF + VC) followed by T_3 (78.72 cm). Similarly during *Rabi*-2009 the maximum spike length was recorded in treatment T_{11} (129.79 cm) (75% RDF + VC + VAM + *Azospirillum* + *Trichoderma*) followed by T_{10} (119.45cm) (50% RDF + VC + VAM + *Azospirillum* + *Trichoderma)*. The minimum spike length (87.46cm) was recorded in T_2 (50% RDF + VC).

During *Kharif* -2008 the treatments differed significantly among the treatments with respect to spike girth. The maximum spike girth (1.07 cm) was recorded in treatment T_{11} (75% RDF + VC + VAM + *Azpspirillum* +

Table 1 : Effect of integrated nutrient management on days taken for spike emergence and first flower bud opening in a spike in gladiolus cv. AMERICAN BEAUTY

Treatments	Number of days taken					
	Spike emergence			First flower bud opening in a spike		
	Kharif	*Rabi*	Mean	*Kharif*	*Rabi*	Mean
T_1	55.94	53.16	54.55	61.25	59.17	60.21
T_2	56.44	54.20	55.32	62.19	61.85	62.02
T_3	55.73	52.52	54.13	60.14	59.08	59.61
T_4	54.94	51.65	53.30	61.15	58.43	59.79
T_5	53.92	51.40	52.66	60.10	57.74	58.92
T_6	52.68	51.31	52.00	59.85	56.50	58.18
T_7	54.03	51.23	52.63	59.12	55.30	57.21
T_8	52.99	50.73	51.86	59.02	55.55	57.29
T_9	52.70	50.45	51.58	59.70	55.70	57.70
T_{10}	52.64	48.94	50.79	58.43	55.58	57.01
T_{11}	52.31	48.49	50.40	58.74	54.56	56.65
S.E.±	0.61	0.44	-	0.33	0.48	-
C.D. (P=0.05)	1.80	1.30	-	0.97	1.42	-
F test	*	*	-	*	*	-

Trichoderma, which was at par with T_{10} (1.04cm) (50% RDF+ VC+VAM+*Azospirillum*+*Trichoderma)*, while minimum spike girth (0.90cm) was recorded in treatment T_2. Similarly during *Rabi* 2009 the maximum spike girth (1.10 cm) was recorded in treatment T_{11} (75% RDF + VC + VAM + *Azospirillum* + *Trichoderma*), while minimum spike girth (0.93 cm) was recorded in treatment T_2 (50% RDF + VC 3 t / ha). All these parameters per hectare were significantly influenced by two levels of NPK and bio-fertilizers. These beneficial effects could be attributed to the good vegetative and floral yield parameters attributes which in turn resulted in production of more fresh weight of the spike when compared to the other treatments. These findings are in confirmation with the findings of Kathiresan (1999) in gladiolus Yathindra (2009), Kumar *et al.* (2003) in China aster, Gayathri *et al.* (2004) in statice, Belgaonkar *et al.* (1997) in chrysanthemum, Patil *et al.* (2004) in jasmine, Bhalla *et al*. (2007) and Bhatia and Gupta (2007) in carnation.

Floret length (cm), floret diameter (cm) and number of florets opening at a time:

The data on floret length (cm) as influenced by INM during *Kharif* and *Rabi* seasons are presented in Table 3. During *Kharif* 2008 the treatments differed significantly with respect to floret length among the treatments. The maximum floret length (12.51cm) was recorded in treatment T_{11} (75% RDF + VC + VAM + *Azospirillum* + *Trichoderma)*.

Table 2 : Effect of integrated nutrient management on number of florets, spike length and stem girth in gladiolus cv. AMERICAN BEAUTY

Treatments	Number of florets per spike			Spike length (cm)			Spike girth (cm)		
	Kharif	*Rabi*	Mean	*Kharif*	*Rabi*	Mean	*Kharif*	*Rabi*	Mean
T_1	9.33	9.67	9.50	79.11	88.32	83.72	0.91	0.94	0.93
T_2	9.33	9.67	9.50	78.46	87.46	82.96	0.90	0.93	0.92
T_3	10.00	10.33	10.17	78.72	88.57	83.65	0.93	0.96	0.95
T_4	10.00	10.33	10.17	82.26	89.26	85.76	0.94	0.97	0.96
T_5	10.33	10.33	10.33	86.65	96.65	91.65	0.95	0.98	0.97
T_6	10.00	11.10	10.55	85.23	89.23	87.23	0.95	0.97	0.96
T_7	10.00	11.00	10.50	97.25	103.25	100.25	0.96	0.99	0.98
T_8	10.33	11.60	10.97	92.48	109.73	101.11	0.97	0.99	0.98
T_9	10.33	11.63	10.98	98.23	115.41	106.82	0.97	0.98	0.98
T_{10}	11.67	12.83	12.25	98.59	119.45	109.02	1.04	1.09	1.07
T_{11}	12.00	13.67	12.84	100.26	129.79	115.03	1.07	1.10	1.09
S.E.±	0.45	0.35	-	0.68	0.75	-	0.02	0.03	-
C.D. (P=0.05)	1.32	1.04	-	2.02	2.13	-	0.07	0.09	-
F test	*	*	-	*	*	-	*	*	-

Table 3 : Effect of integrated nutrient management on floret length, floret diameter and number of florets opening in gladiolus cv. AMERICAN BEAUTY

Treatments	Floret length (cm)			Floret diameter (cm)			Number of florets opening at a time		
	Kharif	*Rabi*	Mean	*Kharif*	*Rabi*	Mean	*Kharif*	*Rabi*	Mean
T_1	8.52	8.46	8.49	6.40	6.69	6.55	1.17	1.22	1.20
T_2	8.32	8.32	8.32	6.39	6.58	6.49	1.10	1.12	1.11
T_3	8.36	8.39	8.38	6.67	7.00	6.84	1.13	1.50	1.32
T_4	9.03	9.15	9.09	6.53	7.01	6.77	1.10	1.43	1.27
T_5	9.07	9.15	9.11	6.50	6.71	6.61	1.20	1.32	1.26
T_6	9.09	9.14	9.12	6.46	6.88	6.67	1.30	1.33	1.32
T_7	9.90	9.94	9.92	6.48	7.02	6.75	1.17	1.27	1.22
T_8	10.04	11.14	10.59	6.55	7.38	6.97	1.23	1.33	1.28
T_9	10.90	11.23	11.07	6.69	7.25	6.97	1.23	1.27	1.25
T_{10}	12.40	12.46	12.43	6.65	7.40	7.03	1.33	1.44	1.39
T_{11}	12.51	12.62	12.57	7.00	7.24	7.12	1.38	1.43	1.41
S.E.±	0.04	0.16	-	0.20	0.11	-	-	0.07	-
C.D. (P=0.05)	0.11	0.48	-	0.60	0.34	-	-	0.20	-
F test	*	*	-	*	*	-	NS	*	-

NS=Non-significant

Which was followed by T_{10} (12.40 cm) (50% RDF + VC + VAM + *Azospirillum* + *Trichoderma)*. The minimum floret length (8.32cm) was recorded in T_2 which was followed by T_3 (8.36 cm) (50% RDF+VC and 75% RDF+VC). Similarly during *Rabi* 2009 the treatments differed significantly with respect to floret length. The maximum floret length (12.62cm) was recorded in treatment T_{11} (75% RDF + VC + VAM + *Azospirillum* + *Trichoderm*), which was at par with T_{10} (12.46 cm), while minimum floret length (8.34 cm) was recorded in treatment T_2 and it was at par with T_3 (8.38 cm).

During *Kharif* 2008 the treatments differed significantly among the treatments with respect to floret diameter. The maximum floret diameter (7.00 cm) recorded in treatment T_{11} (75% RDF + VC + VAM + *Azospirillum* + *Trichoderma)*. Whereas minimum floret diameter (6.32cm) was recorded in T_2. During *Rabi* 2009 the maximum floret diameter (7.40 cm) was recorded in treatment T_{10}, which was at par with T_8. Minimum floret diameter was (6.58 cm) recorded in treatment T_2 (50% RDF + VC 3 t / ha).

During *Kharif* 2008 the treatments did not differed significantly with respect to number of florets opening at a time. The maximum number of florets (1.38) opening at a time was recorded in treatment T_{11} (75% RDF + VC + VAM + *Azpspirillum* + *Trichoderma*. While minimum number florets opening at a time was recorded in treatment T_2 and T_4, respectively. Similarly during *Rabi* 2009 the maximum

Table 4 : Effect of Integrated Nutrient Management on duration of spikes and fresh weight of spike in Gladiolus cv. American Beauty

Treatments	Duration of spikes (Days)			Fresh weight of spike (g)		
	Kharif	*Rabi*	Mean	*Kharif*	*Rabi*	Mean
T_1	7.67	8.20	7.94	85.77	86.08	85.93
T_2	6.67	7.36	7.02	81.91	83.08	82.50
T_3	7.33	8.10	7.72	81.96	81.23	81.60
T_4	7.33	8.20	7.77	88.67	90.02	89.35
T_5	7.67	8.28	7.98	86.22	88.35	87.29
T_6	7.67	7.95	7.81	86.76	88.14	87.45
T_7	7.67	7.52	7.60	87.16	90.17	88.67
T_8	7.67	7.84	7.76	85.49	89.14	87.32
T_9	7.67	7.37	7.52	87.06	96.18	91.62
T_{10}	8.67	8.93	8.80	88.96	88.28	88.62
T_{11}	8.67	9.57	9.12	88.99	88.19	88.59
F test	NS	*	-	*	*	-
S.E.±	-	0.12	-	1.07	0.41	-
C.D. (P=0.05)	-	0.34	-	3.16	1.22	-

NS=Non-significant

Table 5 : Effect of integrated nutrient management on total number of spikes in Gladiolus cv. American Beauty

Treatments	Total number of spikes per								
	Kharif			*Rabi*			Mean		
	Plant	Plot	Ha.	Plant	Plot	Ha.	Plant	Plot	Ha.
T_1	1.47	41.07	198900	2.26	113.00	384200	1.87	77.04	291550
T_2	1.27	41.07	198900	1.20	110.00	374000	1.24	75.54	286450
T_3	1.17	32.67	197200	2.13	106.50	362100	1.65	69.59	279650
T_4	1.47	41.07	195500	1.96	98.00	333200	1.72	69.54	264350
T_5	1.20	33.60	204000	2.30	115.00	391000	1.75	74.30	297500
T_6	1.57	43.87	205700	1.93	96.50	328100	1.75	70.19	266900
T_7	1.50	42.00	205700	2.13	106.50	362100	1.82	74.25	283900
T_8	1.27	35.47	205700	1.86	93.00	316200	1.57	64.24	260950
T_9	1.53	42.93	207400	2.13	106.50	362100	1.83	74.72	284750
T_{10}	1.60	44.80	207400	3.06	153.00	520200	2.33	98.90	363800
T_{11}	1.63	45.73	207400	3.16	158.00	537200	2.40	101.87	372300
S.E.±	-	-	-	0.06	0.24	-	-	-	-
C.D. (P=0.05)	-	-	-	0.20	0.74	-	-	-	-
F test	NS	NS	NS	*		-	-	-	-

NS=Non-significant

number of florets (1.43) opening at a time was recorded in treatment T_{11} (75% RDF + VC + VAM + *Azospirillum* + *Trichoderma*), which was at par with treatment T_{10}, while minimum (1.12) number of florets opening at a time was recorded in treatments T_2 (50% RDF + VC 3 t / ha).

These increased attributes is due to application of bio-fertilizers in combination with NPK levels. Because of balanced nutrition and better availability of nutrients due to fungal and bacterial activity in the root zone. Bio-fertilizers and inorganic fertilizers with vermicompost combination have improved the length and diameter of florets significantly. Increased length and diameter of floret ultimately results in increased size of the floret, which is also an important quality attribute of gladiolus as cut flower. These results clearly show that *Azospirillum*, VAM and *Trichoderma* with vermicompost had significantly improved the length of florets by enhancing the nutrient uptake, especially helped in production of auxin like substances which was translocated to apical region and increased the floret length during *Kharif* and *Rabi* season, respectively.

Duration of spikes (days) and fresh weight of spike (g):

The data on duration of spikes as influenced by INM during *Kharif* and *Rabi* seasons are presented in Table 4.

During *Kharif* 2008 the treatments did not differ significantly with respect to duration of spike among the treatments. The maximum duration of spike (8.67 days) was recorded in treatment T_{10} and T_{11}. Whereas minimum (6.67

Table 6 : Effect of integrated nutrient management on number of corms in gladiolus cv. AMERICAN BEAUTY

Treatments	Total number of corms					
	Kharif			*Rabi*		
	Per plant	Per plot	Per hectare	Per plant	Per plot	Per hectare
T_1	1.21	60.33	205700	1.27	63.50	215900
T_2	1.10	55.00	187000	1.19	59.16	202300
T_3	1.27	63.33	215900	1.37	68.16	232900
T_4	1.25	62.33	212500	1.30	60.00	223700
T_5	1.36	68.00	231200	1.40	70.00	238000
T_6	1.20	65.00	221000	1.24	67.00	227800
T_7	1.25	67.33	229500	1.41	70.50	239700
T_8	1.20	65.00	221000	1.35	67.16	229500
T_9	1.21	65.50	222700	1.34	67.00	227766
T_{10}	1.89	88.66	304300	1.99	99.83	338200
T_{11}	1.99	99.83	338300	2.11	106.00	360400
S.E.±	0.06	2.01	1.63	0.06	2.22	8.03
C.D. (P=0.05)	0.17	5.92	4.81	0.18	6.54	23.69
F test	*	*	*	*	*	*

Table 7 : Effect of integrated nutrient management on weight of corms, number of cormels and cormel weight in gladiolus cv. AMERICAN BEAUTY

Treatments	Weight of corms per plant (g)			No. of cormels per plant			Cormel weight per plant (g)		
	Kharif	*Rabi*	Mean	*Kharif*	*Rabi*	Mean	*Kharif*	*Rabi*	Mean
T_1	48.44	52.24	50.34	17.33	19.00	18.17	30.93	32.30	31.62
T_2	46.47	49.33	47.90	15.67	18.33	17.00	26.17	29.10	27.68
T_3	47.30	48.70	48.00	16.33	18.33	17.33	26.21	29.21	27.71
T_4	49.65	51.88	50.77	17.33	19.33	18.33	31.89	36.36	34.13
T_5	46.64	53.94	50.29	18.00	20.00	19.00	33.22	35.31	34.27
T_6	49.37	57.12	53.25	17.33	19.67	18.50	32.62	34.69	33.66
T_7	48.46	55.08	51.77	17.67	19.67	18.67	33.57	36.23	34.90
T_8	49.39	52.94	51.17	18.00	20.00	19.00	33.25	37.31	35.28
T_9	50.09	56.00	53.05	17.67	20.03	18.85	35.21	39.21	37.21
T_{10}	51.97	58.00	54.99	18.00	21.33	19.67	36.22	40.55	38.39
T_{11}	54.00	59.35	56.68	21.00	23.00	22.00	36.97	42.27	39.62
S.E.±	0.40	0.16	-	0.36	0.28		0.04	0.11	-
C.D. (P=0.05)	1.20	4.80	-	1.07	0.84		0.11	0.34	-
F test	*	*	-	*	*	-	*	*	-

days) durability of spike was recorded in treatment T_2 (50% RDF + VC 3 t / ha). During *Rabi* – 2009 the treatments differed significantly with respect to duration of spike, 9.57 days was recorded in treatment T_{11} (75% RDF + VC + VAM + *Azospirillum* + *Trichoderma*). Whereas minimum durability of spike (7.36 days) was recorded T_2 (50% RDF + VC 3 t / ha).

During *Kharif* – 2008 the treatments differed significantly with respect to fresh weight of spike. The maximum fresh weight of a spike was recorded in treatment T_{11} (88.99 g), which was at par with T_{10} (88.96 g). Where as minimum fresh weight of spike was (81.91g) was recorded in treatment T_2 (50% RDF + VC), which was at par with T_3 (81.96 g). Similarly during *Rabi* – 2009, the maximum fresh weight of spike was (96.18 g) recorded in treatment T_9. Whereas minimum fresh weight of spike (83.08) was recorded in treatment T_2 50% RDF + VC 3 t / ha.

Number of corms/plant, weight of corms, number of cormels, cormel weight, was maximum in T_{11} treatment followed by T_{10} in both *Kharif* and *Rabi* seasons. This could be attributed to the friable nature of soil with balanced nutrition for corm and cormel development by the effect of *Azospirillum* +VAM + *Trichoderma* with vermicompost which might have acted synergistically with other soil microorganisms. These results are in accordance with the observations made by Wange *et al.* (1995) in tuberose and in gladiolus Amritage (1973), Bhattacharjee (1994), Shah *et al.* (1984), Misra and Negi (1977), Kathiresan (1999), Baboo and Singh (2006) in gladiolus.

Total number of spikes per plant, plot and heactre:

The data on number of spikes per plant as influenced by INM during *Kharif* and *Rabi* seasons are presented in Table 5. During *Kharif* 2008 the number of spikes per plant did not differed significantly among the treatments. The maximum number of spikes per plant (1.63) was recorded in treatment T_{11} (75% RDF + VC + VAM + *Azospirillum* + *Trichoderma*) Which was at par with T_{10} (1.60). Where as minimum number of spikes (1.17) per plant was recorded in treatment T_3.

Similarly during *Rabi* – 2009 the maximum number of spikes per plant (3.16) was recorded in treatment T_{11} (75% RDF + VC 3 t/ha + VAM (*Glomus mosseae*) (10 kg/ha) + *Azospirillum brasilense* (10 kg/ha) + *Trichoderma harzianum* (5kg/ha). Whereas minimum number of spikes (1.86) per plant was recorded in T_2.

Number of corms / plant:

The data on number of corms per plant as influenced by INM during *Kharif* and *Rabi* seasons are presented in Table 6.

During *Kharif* – 2008 treatments differed significantly with respect to number of corms per plant. The maximum number of corms per plant was recorded in treatment T_{11} (75% RDF + VC 3 t/ha + VAM (*Glomus mosseae*) (10 kg/ha) + *Azospirillum brasilense* (10 kg/ha) + *Trichoderma harzianum* (5kg/ha), which was at par with T_{10} (1.89). Similarly during *Rabi* – 2009 treatments differed significantly with respect to number of corms per plant. The maximum number of corms (2.11) per plant was recorded in treatment T_{11} (75% RDF + VC 3 t/ha + VAM (*Glomus mosseae*) (10 kg/ha) + *Azospirillum brasilense* (10 kg/ha) + *Trichoderma harzianum* (5kg/ha), while minimum (1.19) recorded in treatment T_2 (50% RDF + VC 3 t / ha).

Weight of corms/ plant, number of cormels / plant and cormel weight per plant (g):

The data on weight of corms differed significantly for both *Kharif* and *Rabi* and presented in Table 7. During *Kharif* 2008 maximum weight of cormels (54.00g) was recorded in T_{11} (75% RDF+VC+VAM+*Azospirillum*+*Trichoderma)*, while minimum (46.47g) was recorded in treatment T_2 50% RDF + VC 3 t / ha.

During *Kharif* 2008 maximum number of cormels (21.00) was recorded in T_{11} (75% RDF+VC+VAM+ *Azospirillum* + *Trichoderma).* Whereas minimum number of cormels (15.67) was recorded tereatment T_2 (50% RDF + VC). Similarly during *Rabi*- 2009 maximum number of cormels per plant (23.00) was recorded in T_{11} (75% RDF+ VC+VAM+*Azospirillum*+*Trichoderma)*. Whereas minimum number of cormels (18.33) was recorded in T_2 (50% RDF + VC) which was at par with T_3.

During *Kharif*-2008 maximum weight of cormels (36.97g) was recorded in T_{11} (75% RDF + VC + VAM + *Azospirillum* + *Trichoderma).* Whereas minimum (26.17g) was recorded in T_2, which was at par with T_3 (26.21). Similarly during *Rabi* – 2009 maximum cormels weight per plant (42.27g) was recorded in T_{11} (75% RDF + VC + VAM + *Azospirillum* + *Trichoderma).* Minimum was recorded in T_2 (29.10), which was at par with T_3.

REFERENCES

Amritage, M.S. (1973). Fertility of gladiolus in Swaziland a preliminary report. *Misc. Rept. Malkernores stanswuaziland,* **19** : 21.

Baboo, Ramesh and Sing, Raman Deep (2006). Response of nitrogen, phosphorus and corm size and lowering and corm production in gladiolus. *J. Orna. Hort.*, **9** (1): 66-68.

Belgaonkar, D.V., Bist, M.A. and Wakde, M.B. (1997). Influence of nitrogen, phosphorus and different spacing on flower quality of chrysanthemum. *J. Soils & Crops,* **7** (1): 90-92.

Bhalla, Rajesh, Shiva Kumar, M.H. and Jain, Ritu (2007). Effect of organic manures and biofertilizers on growth and flowering in standard carnation (*Dianthus carypohyllus* Linn.). *J. Orn. Hort.* **10** (4): 229-234.

Bhatia, Suman and Gupta, Y.C. (2007). Studies on use of bio-fertilizer in carnation (*Dianthus caryophyllus* Linn.) flower production. *J. Orna. Hort.*, **10** (2): 131-132.

Bhattacharjee, S.K., Mukharjee, T. and Yadav, L.P. (1994). Standardizatio of agro-techniques in tuberose (*Polianthus tuberosa* L.). *Indian Perfumer,* **38** (4): 144-152.

Chang, S.F. (1989). Single spore culture of VAM fungi and their effect on three flower crops. M.Sc. Thesis, Deptment of Horticulture National Taiwan, Univ. 101 pp.

Gayithri, H.N., Jayaprasad, K.V. and Narayanaswamy, P. (2004). Response of bio-fertilizers and their combined application with different levels of inorganic fertilizers in Statice *(Limonium caspia)*. *J. Orna. Hort.,* **7** (1): 70-74.

Kathiresan, C. (1999). Effect of bio-fertilizers with different levels of nitrogen and phosphorus on growth, yield and quality of gladiolus (*Gladiolus grandiflorus* Ness). M.Sc. (Hort.) Thesis, University of Agricultural Sciences, Bangalore, KARNATAKA (INDIA).

Kumar, Prabhat, Raghava, S.P.S. and Misra, R.L. (2003). Effect of biofertilizers on growth and yield of China aster. *J. Orna. Hort.*, **6** (2): 85-88.

Mantur, S.M. (1988). Studies on nitrogen, growth regulators and soil salinity on flower and seed production in china aster (*Callistephus chinensis*) cv. Ostrich Plume mixed. Ph.D. Thesis, University of Agricultural Sciences, Dharwad, KARNATAKA (INDIA).

Misra, A.K. and Negi, S.S. (1977). Effect of nitrogen and pinching on main shoot and tuberisation in gladioli. *South Indian J. Hort.*, **25** (2): 88-89.

Patil, S.R., Reddy, B.S. and Prasanth, J.M. (2004). Effect of organic, inorganic and in *stiu* vermiculture on chlorophyll content and flower yield of *Jasminum sambac* Ait. *J. Orn. Hort.,* **7** (3-4) : 164-167.

Shah, A., Lal, S.D. and Seth, J.N. (1984). Effect of different levels of nitrogen and phosphorous on growth, flowering and corm yield of gladiolus cv. 'vinks glory'. *Prof. Work.*, **16**(3-4):305-307.

Wange, S.S., Patil, P.L. and Patil, J.J. (1995). Effect of bio-fertilizers alone and with nitrogen levels on tuberose cv. Single petal. *J. Soils & Crops*, **5** (2) : 97-99.

Wen, C.C. (1991). Effect of temperature and *Glomus* spp. On growth and cut flower quality of micropropagated *Gerbera jamesonii.* M.Sc. Thesis, Department of Horticulture, National Taiwan University.

Yathidra, H.A. (2009). Effect of plastic mulching and fertigation on growth, yield and flower quality of China aster [*Callistephus chinensis* (L.) Nees]. M.Sc. Thesis, University of Agricultural Sciences, Bangalore, KARNATAKA (INDIA).