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Response of Different Irrigation Scheduling and Nutrients on Growth, Flowering and Corm Traits of Gladiolus (*Gladiolus hybridus* Hort.) under Delhi Condition

Kishan Swaroop [a*], R. Rohit [a], V. K. Sharma [b], Reeta Bhatia [a], Manoj Khanna [c] and Arun Kumar [a]

[a] Division of Floriculture and Landscaping, ICAR-IARI, New Delhi-110012, India.
[b] Division of Soil Science and Agricultural Chemistry, ICAR-IARI, New Delhi-110012, India.
[c] Water Technology Centre, ICAR-IARI, New Delhi-110012, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present experiments were undertaken for standardization of irrigation interval and nutrients on the performance of gladiolus variety under Delhi condition. The field experiments were conducted at the research farm of the Division of Floriculture and Landscaping, ICAR-Indian Agricultural Research Institute, New Delhi, during the winter season of the year 2021 and 2022. The experiment was laid out in factorial completely randomized block design with three replications and consisting of four irrigation regimes and five nutrients' levels including bio-fertilizers. The results of

**Corresponding author: E-mail: kishan.swaroop@rediffmail.com;*

two year experiments showed that maximum plant height (120.56 cm), spike length (97.26 cm), rachis length (63.13 cm) and single corm's weight (50.73 g) and P content % in plant before flower emergence was found maximum with the application of seven irrigations at 15 days intervals along with treatment N_4 i.e. application of Azotobacter + Bio-phosphorous +Bio-potash + Bio-iron +Bio-Zn each 3 litre per hectare foliar spray at 30 and 60 days after planting. Number of florets per spike (21.20), estimated benefit cost ratio (1:2.86), P and K content in plant before flower emergence was found maximum with the application of five irrigations at the interval of 25 days after planting with 50 % RDF + organic manure @ 5 tonnes/ha + Azotobacter + VAM +PSB + KSB @ 2 g per plant.

Keywords: Gladiolus; irrigation schedule; nutrients; bio-fertilizers; growth; flowering; corm traits.

1. INTRODUCTION

Gladiolus (*Gladiolus hybridus* Hort.) is popularly known as "Queen of the bulbous flowers" it is a very prominent bulbous cut flower crop and having a more demand in domestic and international markets due to its use in bouquets, decoration of interior and also in flower arrangements [1, 2]. It is well known ornamental bulbous plant because it has beautiful inflorescence with dazzling colours of florets long keeping quality, varying forms and sizes and it can be kept in vases for about 8 to 10 days depends on varying variety and ambient conditions prevailing in the room. It is an important part in most of flower arrangements including offering in bouquets. The irrigation frequency depends more on the type of soil and availability of climatic conditions, the soil should have sufficient moisture content at the time of planting of gladiolus corms so that up to sprouting no watering is required, during hot or warm weather irrigation requirement is twice a week is needed to root zone to wet it. The quality and yield of gladiolus flowers were best when the plants watered at an interval of 12 to 17 days and a soil moisture minimum of 58% field capacity for successful gladiolus cultivation in sandy clay soil [3]. The gladiolus has sensitivity to drought conditions in different stages of its growth and development. The critical moisture content of soil decreases yields and differed at various developmental stages and condition according to whereas crop grown for its corm or flower, two phases of growth sensitive to water stress condition is the early stage of growth when initiation of flower takes place and another from 4^{th} leaf stage through elongation of flower stem [4]. Gladiolus in water deficient condition reduces the assimilate mobilizing in the inflorescence; increased that of corm and translocation delayed from the leaves due to reduction in CO_2 fixation and slightly assimilate translocation is delayed from the source leaves [5]. Flower crops are more responsive to fertilizers and it is capable of high exhausting of huge nutrients from native soils, so there is requirement of higher amount of organic and inorganic fertilizer in balance proportion for obtaining in maximum production of flower. Fertilizer requirement in gladiolus and other crops has prominent role in quality, growth, corm and cormel production [6]. Nutrition is important aspects in increasing the quality and flower yield of gladiolus spikes, after the green revolution, the excess usage of chemical fertilizers and pesticides in plant production was increased and it is dangerous to environment, so the nutrient application frequently in small doses favours better growth and production of flower spikes, best solution for sustainable agriculture and nutrient efficiency is supply of total nutrients to the crops using organic, inorganic along with bio fertilizer use under integrated nutrient management. Gomez and Gomez [7] reported in their experiment conducted on olive that the increment of irrigation water to 75% of the water requirements during flower initiation along with foliar nutrition at both times had significant influence on the increment of shoot and inflorescence length and perfect flowers with ovary rate 3–4 developed ovules by 56.9%, 39% and 118.9%, respectively. Also, this treatment had the highest increment of water productivity and fruit oil content by 184.2% and 64.8%. Gladiolus requires balanced fertilizer application for its better growth and production of quality flowers, the increasing application of N results in better growth with increase in higher length of flower spike, weight of corm and size with more number of cormels per plant, increase in stalk length and number of florets per stalk [8, 9]. In recent times the bio fertilizers are emerged as most important in improving yield and as well as quality of crops, in gladiolus phosphorus solubilizing bacteria (PSB), azatobacter, vascular arbuscular mycorrhizae (VAM) are capable of mobilization of nutrients from non-available form to available form through biological processes [10, 11] Therefore, the present experiments were designed with varying water regimes and nutrient

levels in a sustainable agricultural production system in order to minimize the amount of more chemical fertilizers and to get maximum plant growth, flowering traits and corm production of gladiolus.

2. MATERIALS AND METHODS

The field experiment was conducted at the research farm of the Division of Floriculture and Landscaping, ICAR-Indian Agricultural Research Institute, New Delhi, during the winter season of the year 2021 and 2022 from October to April to see the effect of varying irrigation regimes and nutrients on growth, flowering and corm traits of gladiolus (*Gladiolus hybridus* Hort.) under Delhi condition. New Delhi is situated at the altitude of 28.4° North, longitude 77.1° East and is 250 meter above mean sea level. Geographically, it falls in the semi-arid and sub-tropical region with hot dry summers and cold winter. In general monsoon commences during the first week of July and ends by the second fortnight of September. The experiments were laid out in factorial completely randomized block design with three replications consisting four irrigation regimes and five nutrients' levels including bio-fertilizers. There were four levels of irrigation or water as (i) W_0- 0 control (only supporting irrigation) , (ii) W_1- 3 irrigations (at the interval of 35 DAP), (iii) W_2- 5 irrigations (at the interval of 25 DAP), (iv) W_3- 7 irrigations (at the interval of 15 DAP) and five levels of nutrients (i) N_0- Control (ii) N_1- 100% RDF (200:100:100kg/ha NPK), (iii) N_2- 50% RDF + Organic manure 5t/ha + Azatobacter + VAM + PSB + KSB (Each bio fertilizer 2g/plant) (iv) N_3- 25% RDF + Organic manure 10t/ha + Azatobacter + VAM + PSB + KSB (Each bio fertilizer 2g/plant) (v) N_4- Azatobacter + Bio-Phosphorous + Bio- Potash + Bio-Iron + Bio- Zn (Each bio fertilizer 3 Litre/ha foliar spray at 30 and 60 days after planting). A new gladiolus variety "Pusa Shanti" released by IARI has been taken for this study. This variety was a selection among the progeny obtained from the cross between Yellow Stone x Melody. The soil is alluvial, sandy loam in texture, alkaline in reaction, having pH 7.4 and free from salinity occurring on nearly level to very gently sloping land. The available organic carbon (0.33%), and available N, P, and K content was 203.40, 18.65 and 178.60 kg/ha respectively. The recommended dose of fertilizers (200:100:100 kg/ha N, P, and K applied in the field. Organic manure in the form of vermicompost and all bio-fertilizers were applied treatment wise before and at the time of sowing/planting. All the other cultural operations were carried out as per recommendation to keep the crop healthy. The volume of irrigation water in each plot/treatment was measured by Star Flow. The initial one common irrigation was applied in all plots including control plot after planting for the proper establishment of the plants and thereafter, irrigation was applied as per treatment. The observations/ data were collected as vegetative parameters such as plant height, spike length rachis length, number of florets per spike and corm parameters as number of corms per plant, number of cormels per plant, single corm weight, N, P, and K content in plant before flower emergence and estimated cost benefit ratio were recorded. The data recorded for various parameters under study were subjected to statistically analysed ANOVA given by Khanam et al.[12] to draw an exact conclusion. The variation in the treatment mean was tested by using critical difference (CD) values at a 5% level of significance.

3. RESULTS AND DISCUSSION

3.1 Growth Characters

The observations/ data were collected, compiled and statistically analysed. The results showed that different water intervals and nutrient levels had significant effect on almost all the growth characters and results of two year experiments showed that maximum mean value of plant height (120.56 cm), spike length (97.26 cm), rachis length (63.13 cm) was found maximum with the application of seven irrigations at 15 days intervals along with treatment N4 i.e. application of Azotobacter + Bio-phosphorous +Bio-potash + Bio-iron +Bio-Zn each 3 litre per hectare foliar spray at 30 and 60 days after planting (Table 1 and 2). Similar results were also reported by Ahmmad and Abdullatif and they revealed that when gladiolus variety Cartago treated with 2% poultry manure, bio fertilizer and magnetic water in irrigation resulted in significant increase in plant vegetative growth characters. Kumar et al. et al. [13] stated that when gladiolus varieties i.e. Red Balance, Priscilla and Peter Pears treated with drip irrigation with 4 irrigation levels 25, 50, 75 and 100% and Priscilla was found that it is more sensitive for water stress, so the use of thermal imaging with regard to both selection of variety resistant to drought and water stress is useful method. Kumar et al. [14] investigated that when Sancerre variety of gladiolus plant treated with T_{17} CBD + vermicompost 5t/ha + panchagavya 3% +

manchurian tea 3% resulted in maximum spike length 88.2 cm, plant height 101.2cm and rachis length 62.4cm. Kumar et al. [15] reported that when gladiolus variety Peater Pears treated with T_4 (75% RDF + 2g/plant azospirullum + 25% vermicompost + 2g/plant PSB) significantly increases height of plant and T_{10} (50% RDF + 50% vermicompost + 2g/plant azospirullum+ 2g/plant PSB) treatment minimize days required for opening of first flower on spike and more longevity of spike. Pansuriya et al. [16] revealed that when the gladiolus variety American Beauty was treated with the humic acid 0.2% with the azatobacter is 2.5ml/plant + PSB is 2.5ml/plant + KSB is 2.5ml/plant at 30 days after planting, 2nd spray at 45 DAP and the 3rd spray at 60 DAP of soil application of bio-fertilizers and bio-stimulants during the planting time and the 2 months after the planting results in higher growth of vegetative characters, flowering and the quality parameters in gladiolus. Younis et al. [17] observed that when White Prosperity variety of gladiolus treated with azospirullum resulted in significant increase in vegetative and reproductive attributes. Zhang et al. [18] reported that irrigation significantly promoted the growth of edible sunflower although the effects varied with treatments by plant height, stem diameter, leaf area, stem weight, disc weight, and leaf weight. Further, Wan H et al. [19] reported in maize crop that overall, these findings suggest that WSP combined with PRD could be a promising strategy to improve the growth and nutrient uptake of maize plants. These findings are similar to the present study.

3.2 Floral Characters

Number florets per spike (21.20) was found maximum with the application of five irrigations at the interval of 25 days after planting with 50 % RDF + organic manure @ 5 tonnes/ha + Azotobacter + VAM +PSB + KSB @ 2 g per plant. Bastug et al. [20] had reported similar results that when gladiolus plants treated with drip irrigation for two varieties Eurovision and Peter Pears and its results are found that the levels of irrigation affect the growth and flowering, flowering quality of gladiolus and highest quality of flowers obtained at L_3 i.e. 18.1mm/week and every mm of water is helped in increasing flowering percentage of gladiolus about 0.3%. Hassan and El-Azeim [21] reported that when gladiolus plants were treated with compost (organic nile compost) 15t/fed resulted in significant increase in flowering parameters, number of florets/spike, and increased yield and spike length. Pandey et al. [22] investigated that when Sancerre variety of gladiolus plant treated with T_{17} CBD + vermicompost 5t/ha + panchagavya 3% + manchurian tea 3% resulted in maximum number of florets per spike 14.4. Jha et al. [23] described that an experiment on gladiolus cv. American Beauty with the use of different bio-fertilizers combination and obtained best results with (azospirullum+ phosphobacteria) like more number of florets per spike i.e. 10.86, per plant spikes are 2.90, per ha spikes are 398065.70. The results of present investigation are similar with the above said workers.

3.3 Corm Characters

The number of corms per plant (3.46), and single corm's weight (50.73 g) was found maximum with the application of seven irrigations at 15 days intervals along with treatment N_4 i.e. application of Azotobacter + Bio-phosphorous +Bio-potash + Bio-iron +Bio-Zn each 3 litre per hectare foliar spray at 30 and 60 days after planting; while number of corms per plant (3.36) and number of cormels (42.16) was recorded with 5 irrigations at the interval of 25 DAP with 100 % RDF followed by 50 % RDF + organic manure 5 tones/ha + Azotobactor + VAM + PSB + KSB @ 2 g per plant. Khanam et al. [24] concluded that when cv. Candyman of gladiolus plants were treated with T_7 75% RDF + FYM 10t/ha resulted in better characters like corm diameter, total corm weight and T_{10} 75% RDF + vermicompost 3t/ha resulted in high length of spike, more number of florets/ spike and vase life. Kumari et al. [25] reported that when gladiolus plants were treated with 50% of RDF with 2.5t/ha vermicompost results in maximum flower yield (9731kg/ha), number of corms per plant (3.5) and improved flower quality and productivity. Kumar et al. (13) stated that when gladiolus plant treated with the T_7 (panchagavya 4% + manchurian mushroom tea 2%) resulted in significant increase in more number of florets/spike (16.50). T_1 (panchagavya 2%) resulted in increase of spike length (86.19cm), corm size (5.16cm), spike weight (78.83g) and corm weight (43.75g). Kumar et al. (13) investigated that when Sancerre variety of gladiolus plant treated with T_{17} CBD + vermicompost 5t/ha + panchagavya 3% + manchurian tea 3% resulted in maximum average corm weight 36 g and T_{16} CBD + vermicompost 5t/ha + panchagavya 3% resulted in maximum number of corms per plant 2.3 and cormel weight found 24.5 g.

Table 1. Effect of varying irrigation regimes and nutrients on growth characters of gladiolus, variety pusa shanti under Delhi condition

S. N.	Treatment and Notations		Plant height (cm)		Mean	Spike length (cm)		Mean
			First year	Second year		First year	Second year	
1.	(i) Control (0) only supporting irrigation	(W_0)	108.33	111.46	109.89	89.20	88.80	89.00
	(ii) 3irrigations at the interval of 35 DAP (345mm)	(W_1)	113.00	118.33	115.66	90.66	95.40	93.03
	(iii)5 irrigations at the interval of 25 DAP (575 mm)	(W_2)	117.13	120.80	118.96	90.06	97.73	93.89
	(iv) 7 irrigations at the interval of 15 DAP (805 mm)	(W_3)	119.13	122.00	120.56	96.06	98.46	97.26
	C D at 5 %		2.00	4.833		5.13	3.647	
	SE(M)		1.480	1.231		1.269	1.131	
2.	(i) Control	(N_0)	116.00	115.75	115.87	90.58	96.42	93.50
	(ii) 100 % RDF (200:100:100 kg/ha NPK	(N_1)	112.91	118.75	115.83	91.91	94.33	93.12
	(iii) 50 % RDF+Organic manure 5 tone/ha +Azotobactor+VAM+PSB+KSB@ 2g/plant	(N_2)	109.41	121.00	115.20	91.25	97.33	94.29
	(iv) 25 % RDF+Organic manure 10 tone/ha +Azotobactor+VAM+PSB+KSB@ 2g/plant	(N_3)	117.58	115.50	116.54	91.38	93.16	92.27
	(v) Azotobactor+Bio-phosphorus+Bio-potash+Bio iron+Bio Zn each 3 L/ha foliar spray at 30 and 60 DAP	(N_4)	116.08	119.75	117.92	92.41	94.25	93.33
	C D at 5 %		1.33	1.33		0.59	0.591	
	SE(M)		1.230	1.680		0.123	1.419	

Table 2. Effect of varying irrigation regimes and nutrients on rachis length and number of florets per spike of gladiolus, variety pusa shanti under Delhi condition

S. N.	Treatment and Notations		Rachis length (cm)		Mean	Number of florets per spike		Mean
			First year	Second year		First year	Second year	
1.	(i) Control (0) only supporting irrigation	(W_0)	57.66	54.33	55.99	20.46	19.86	20.16
	(ii) 3irrigations at the interval of 35 DAP (345mm)	(W_1)	61.93	58.40	60.16	20.60	20.86	20.73
	(iii)5 irrigations at the interval of 25 DAP (575 mm)	(W_2)	63.20	57.86	60.53	21.20	21.20	21.20
	(iv) 7 irrigations at the interval of 15 DAP (805 mm)	(W_3)	64.26	62.00	63.13	20.66	20.60	20.63
	C D at 5 %		4.740	3.505		0.140	0.755	
	SE(M)		1.219	1.127		0.263	0.294	
2.	(i) Control	(N_0)	60.25	57.25	58.75	20.50	20.33	20.41
	(ii) 100 % RDF (200:100:100 kg/ha NPK	(N_1)	62.75	57.58	60.16	20.75	20.75	20.75
	(iii) 50 % RDF+Organic manure 5 tone/ha +Azotobactor+VAM+PSB+KSB@ 2g/plant	(N_2)	61.75	59.42	60.58	21.33	20.25	20.79
	(iv) 25 % RDF+Organic manure 10 tone/ha +Azotobactor+VAM+PSB+KSB@ 2g/plant	(N_3)	61.83	58.75	60.29	20.41	20.50	20.45
	(v) Azotobactor+Bio-phosphorus+Bio-potash+Bio iron+Bio Zn each 3 L/ha foliar spray at 30 and 60 DAP	(N_4)	62.25	57.75	60.00	20.66	21.33	20.99
	C D at 5 %		1.750	1.251		0.170	0.150	
	(SE(M)		1.633	1.363		0.126	0.264	

Table 3. Effect of varying irrigation regimes and nutrients on N, P and K content in plant before flower emergence of gladiolus, variety pusa shanti under Delhi condition

S. N.	Treatment and Notations	N content in plant before flower emergence (%)		Mean	P content in plant before flower emergence (%)		Mean	K content in plant before flower emergence (%)		Mean
		First year	Second year		First year	Second year		First year	Second year	
1.	(i) Control (0) only supporting irrigation (W_0)	2.47	2.46	2.465	0.223	0.221	0.222	2.86	2.89	2.875
	(ii) 3 irrigations at the interval of 35 DAP (345mm) (W_1)	2.91	2.92	2.915	0.240	0.242	0.241	3.33	3.39	3.360
	(iii) 5 irrigations at the interval of 25 DAP (575 mm) (W_2)	2.91	2.90	2.905	0.240	0.241	0.241	3.05	3.20	3.121
	(iv) 7 irrigations at the interval of 15 DAP (805 mm) (W_3)	2.67	2.69	2.680	0.245	0.246	0.246	3.20	3.29	3.245
	C D at 5 %	0.013	0.014		0.01	0.02		0.14	0.13	
	SE (M)	0.010	0.011							
2.	(i) Control (N_0)	2.41	2.39	2.400	0.238	0.238	0.238	2.95	2.93	2.940
	(ii) 100 % RDF (200:100:100 kg/ha NPK (N_1)	2.81	2.82	2.815	0.239	0.239	0.239	2.92	2.96	2.940
	(iii) 50 % RDF+Organic manure 5 tone/ha +Azotobactor+VAM+PSB+KSB@ 2g/plant (N_2)	2.74	2.75	2.745	0.248	0.247	0.247	3.42	3.46	3.440
	(iv) 25 % RDF+Organic manure 10 tone/ha+Azotobactor+VAM+PSB +KSB@ 2g/plant (N_3)	2.74	2.74	2.740	0.229	0.225	0.227	3.19	3.24	3.215
	(v)Azotobactor+Bio-phosphorus+Bio-potash+Bio iron+Bio Zn each 3 L/ha foliar spray at 30 and 60DAP (N_4)	3.00	3.01	3.005	0.228	0.229	0.228	3.07	3.12	3.095
	C D at 5 %	0.150	0.160		0.001	0.003		0.080	0.091	
	SE(M)	0.140	0.131		0.002	0.002		0,061	0.076	

Table 4. Effect of varying irrigation regimes and nutrients on corms, cormels and economics of gladiolus, variety pusa shanti under Delhi condition

S. N.	Treatment and Notations	Number of corms per plant		Mean	Number of cormels per plant		Mean	Single corm weight (g)		Mean	Cost benefit ratio (Estimated)
		First year	Second year		First year	Second year		First year	Second year		
1.	(i) Control (0) only supporting irrigation (W_0)	3.33	2.80	3.06	34.13	33.60	33.86	43.46	44.53	43.99	1:1.47
	(ii) 3 irrigations at the interval of 35 DAP (345 mm) (W_1)	3.33	3.46	3.40	33.73	38.33	36.03	47.33	46.33	46.83	1:2.36
	(iii) 5 irrigations at the interval of 25 DAP (575 mm) (W_2)	3.60	3.33	3.46	36.40	34.20	35.30	47.13	48.80	47.96	1:2.68
	(iv) 7 irrigations at the interval of 15 DAP (805 mm) (W_3)	3.46	3.20	3.33	35.33	36.53	35.93	50.61	50.86	50.73	1:2.47
	C D at 5 %	0.180	0.330		1.021	0.643		4.875	0.760		-
	(SE(M)	0.117	0.110		0.139	0.125		0.265	0.231		
2.	(i) Control (N_0)	3.25	2.58	2.91	34.00	31.58	32.79	43.66	45.33	44.49	1:1.71
	(ii) 100 % RDF (200:100:100 kg/ha NPK (N_1)	3.33	3.16	3.24	42.66	41.66	42.16	53.58	45.16	49.37	1:2.63
	(iii) 50 % RDF+Organic manure 5 tone/ha +Azotobactor+VAM+PSB+KSB@ 2g/plant (N_2)	3.50	3.50	3.50	33.25	38.25	35.75	46.25	48.41	47.33	1:2.86
	(iv) 25 % RDF+Organic manure 10 tone/ha +Azotobactor+VAM+PSB+KSB@ 2g/plant (N_3)	3.58	3.33	3.45	30.75	29.00	29.87	45.58	46.83	46.20	1:2.18
	(v) Azotobactor+Bio-phosphorus+Bio-potash+Bio iron+Bio Zn each 3 L/ha foliar spray at 30 and 60 DAP (N_4)	3.50	3.41	3.45	33.83	37.83	35.83	46.91	52.41	49.66	1:2.54
	C D at 5 %	0.120	0.378		1.333	0.719		5.450	0.853		-
	SE(M)	0.112	0.101		0.156	0.133		0.297	0.101		

Sharma et al. [26] investigated that when Plumtart cultivar of gladiolus was treated with T_{11} (75%RDF + 25% vermicompost) resulted in significant increase in shoots/ corm per plant (2.47), spikes/ha (1,40,848), number of corms per plant (3.20) and corms/ha (2,41,482). Pandey et al. [22] conducted an experiment on gladiolus cv. American Beauty with use of different bio-fertilizers combination and obtained best results with (azospirullum+ phosphobacteria) and reported that per plant corms were 2.59, weight of corms 74 g/plant, weight of cormel 11.92 g/plant.

3.4 Nitrogen, Phosphorus and Potash (N, P and K) Content in Plant before Flower Emergence

Further, the mean value of N, P and K content % in plant before flower emergence (3.005, 0.247 and 3.440 respectively) was recorded with 3 and 7 irrigations along with 50 % RDF + organic manure @ 5 tonnes/ha + Azotobacter + VAM +PSB + KSB @ 2 g per plant followed by application of Azotobactor+Bio-phosphorus+Bio-potash+Bio- iron+Bio Zn each 3 L/ha foliar spray at 30 and 60 DAP. Pandey et al. [22] investigated that when Sancerre variety of gladiolus plant treated with T_{17} CBD + vermicompost 5t/ha + panchagavya 3% + manchurian tea 3% resulted in maximum NPK of leaf. Kumar et al. (17) observed that when White Prosperity variety of gladiolus treated with azospirullum resulted in significant increase in vegetative and reproductive attributes and azospirullum application is followed by azatobacter resulted in increase of total chlorophyll content, protein, soluble sugars and nutrients N, P and K was high in plants.

3.5 Economics

Estimated benefit cost ratio (1:2.68 and 1:2.86) was found maximum with treatment W_2N_2 i.e. application of 5 irrigations at the interval of 25 days after planting with 50 % RDF + organic manure @ 5 tonnes/ha + Azotobacter + VAM+PSB+KSB @ 2 g per plant followed by treatment W_3N_1. Younis et al. [27] reported almost similar results when African marigold was treated with PSB + azospirullum + 5% cow urine +5% RD of N + vermicompost + 50% dose of NPK results showed maximum benefit: cost ratio.

4. CONCLUSION

From the present investigations, a new variety of gladiolus like Pusa Shanti needs to be irrigated 7 times at the interval of 15 DAP (805 mm water) along with 50 % RDF+Organic manure 5 tones/ha + Azotobactor + VAM + PSB+KSB@ 2g/plant followed by 5 irrigations at the interval of 25 DAP (575 mm water) with application of Azotobactor+Bio-phosphorus+Bio-potash+Bio-iron+Bio- Zn, each 3 L/ha foliar spray at 30 and 60 DAP to produce economically optimum corms/cormels yield and number of florets under the Delhi condition.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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