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Effect of plant growth regulators and micronutrients on economic feasibility and profitability of gladiolus (*Gladiolus grandiflorus* L.) for eastern Uttar Pradesh

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Abstract
A field experiment was carried out to study the "effect of plant growth regulators and micronutrients on economic feasibility and profitability of gladiolus (*Gladiolus grandiflorus* L.) for Eastern Uttar Pradesh" at the Main Experiment Station, Department of Floriculture & Landscape, Acharya Narendra Deva University of Agriculture & Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) during winter season in the year 2017-18 and 2018-19. The experiment was conducted in Factorial Randomized Block Design with 12 treatments replicated thrice to assess the effect of plant growth regulators and micronutrients on.

The demand for gladiolus cut flower is gaining momentum with increasing aesthetic sense and higher socio-economic standard of the people. Owing to its ever-increasing demand every year at a galloping speed has now created enough opportunities for economic growth potential in future. Hence, to evaluate economic viability of cultivation as a commercial cut flower crop the present investigation was carried out under open field condition.

Economics study showed that there is a significant difference with respect to plant growth regulators and micronutrients. Among the different treatments studied highest gross returns were obtained from treatment G_3M_4 (10,97,000/ha), followed by G_3M_3 (10,44,000/ha), G_3M_2(9,71,000/ha) and G_3M_1 (9,21,000/ha) with a net return of Rs. 7,52,900/ha, 7,00,525/ha, 6,27,125/ha and 5,77,750/ha, respectively. However, minimum gross was obtained in G_1M_1 (7, 53, 000/ha) with a net return of Rs. 4, 19, 750/ha compared to other treatments grown under open field condition.

The investment in gladiolus crop was found to be economically sound and highly remunerative as these treatments produce highest yield (flower spikes) per hectare resulted in maximum B:C ratio of 2.19, 2.04 and 1.82 respectively, hence the same can be exploited for commercial cultivation to meet the increasing global demand.

Keywords: B:C ratio, Economics, Gladiolus, Nova lux and cast benefit ratio.

Introduction

India has a long tradition of floriculture. Floriculture is gaining importance as a good source of income apart from giving pleasure and happiness. References to flowers and gardens are found in ancient Sanskrit classics like Rigveda, Ramayana and Mahabharata. The social and economic aspects of flower growing were however, recognized much later. With changing life style and increased urban affluence, floriculture has assumed a definite commercial status in recent times and it has emerged as an important agri-business venture.

The modern gladiolus hybrids are botanically known as *Gladiolus grandiflorus*. Gladiolus is one of the important monocotyledonous flowering perennial bulbous plant that belongs to family Irridaceae and widely grown as a cut flower in the world and referred to as the "Queen of Bulbous" flowers. It has basic chromosome number n=15 and majority of South African species are diploid (2n=30). The genus "Gladiolus" consists of 260 species, out of which 250 belong to sub-saharan Africa while 10 species from Eurasia. The word "gladiolus" is derived from the Latin word "gladius" meaning "a sword" shape like leaves of the plants. The flowers open from bottom to upwards.

The gladiolus has a long and noble history. The history of gladiolus cultivation dates back to 2000 years, when some species commonly known as 'corn flag' because Gladiolus illyricus is found wild as weed in the corn fields. Most of these species are native to Mediterranean region and tropical part of South Africa, particularly the region of the 'Cape of Good Hope'.

Flowers showy in one sided spikes, irregular, borne in two spathe valves, perianth segments six, united basically into curved, funnel form tube, the upper three segments larger than lower

three, stamens 3, filaments not united, borne below the throat, style branches three entire, fruit, a three valved capsule and the winged seeds are arranged in two rows in each locales.

GA_3 delays senescence of flowers by reducing the senescence-promoting effect of ethylene. However, the role of GA_3 in plants is complicated. Attempts have been made to explore the role of GA_3 in growth and flowering of gladiolus by various workers and the application of GA_3 was found to shorten number of days to flowering, increase spike length, number of flowers per spike, floret diameter, shoot elongation and vegetative growth significantly. Cycocel (Chlormequat chloride, 2-chloroethyl trimethyl ammonium chloride) is a plant growth regulator for ornamentals, including bedding plants and herbaceous crops. Cycocel enhances the crop's aesthetic appeal and improves durability during post production shipping and handling. Cycocel is a gibberellin inhibitor. Cycocel produces earlier budded plants with multiple buds per shoot. Treated azaleas also have more compact, symmetrical heads Cycocel can be used to reduce stem elongation induction of seed germination, Enzyme production during germination CCC is required for cell division and cell elongation.

Micronutrients such as zinc is an essential element for plants which acts as a cofactor of various enzymes or as a functional structural or regulatory component of various biosynthesis like protein synthesis, photosynthesis, the synthesis of auxin, cell division, the maintenance of membrane structure RNA and ribosome functions and sexual fertilization. The micronutrients are responsible in activating several enzymes (catalase, peroxidase, alcohol dehydrogenase, carbonic dehydrogenase, etc.) and involve them self in chlorophyll synthesis and various physiological activities by which plant growth and development are encouraged (Kumar and Arora, 2000), Zinc also controls the metabolism of plant by stimulating the hydrogenase and carbonic anhydrase activities, stabilization of ribosomal fractions and synthesis of cytochrome.

There was not any in depth study regarding the economics and marketing of floriculture. However, some researchers have conducted economics and marketing studies of floriculture. Since gladiolus cultivation is an upcoming business opportunity especially in India, it is essential to work out the economics, which ultimately reflects on cost of cultivation and finally to recommend the suitable genotypes to produce desired quantity and quality of flowers for domestic as well as export market is of greater importance. Keeping all these point in view the present investigation was carried out to work out the economics of gladiolus genotypes cultivation in open field condition.

Materials and Methods

The present study was under taken at Main Experimental Station, Horticulture, A.N.D.U.A. & T., Kumarganj, Faizabad (U.P.) India during the year 2017-18 and 2018-19. Geographically, it is situated in typical saline alkali belt of Indo-gangetic plains of eastern U.P. at 26.47-0 N latitude, 88.120 E longitudes and at an altitude of 113 meter from mean sea level. The climatic conditions of Kumarganj District Ayodhya locality comes under the semi-arid comprising of three different seasons viz., rainy or wet, winter and summer or hot. The rainy season starts from the last week of the June to last week of September or extends up to second week of October with average rainfall of 1100 mm. The major part of rain is received from mid July to September. The winter season starts from November and continues up the first week of March with mean temperature ranging from 15-25ºC. The period from December to January constitutes the cold weather. January being the coldest month experienced low temperature upto 5ºC. The hot season prevails from April to June, May normally being the hottest month of the year.

The experiment was laid out in Factorial Randomized Block Design (FRBD) with three replications and twelve treatments are G_1M_1 (water dipping + water spray), G_1M_2 (water dipping + $ZnSO_4$ 0.5%), G_1M_3 (water dipping + $FeSO_4$ 0.2%), G_1M_4 (water dipping + $ZnSO_4$ 0.5%+ $FeSO_4$ 0.2%), G_2M_1 (GA_3 200 ppm + water spray), G_2M_2 (GA_3 200 ppm + $ZnSO_4$ 0.5%), G_2M_3 (GA_3 200 ppm + $FeSO_4$ 0.2%), G_2M_4 (GA_3 200 ppm + $ZnSO_4$ 0.5%+ $FeSO_4$ 0.2%), G_3M_1 (CCC 500 ppm + water spray), G_3M_2 (CCC 500 ppm + $ZnSO_4$ 0.5%), G_3M_3 (CCC 500 ppm + $FeSO_4$ 0.2%) and G_3M_4 (CCC 500 ppm + $ZnSO_4$ 0.5%+ $FeSO_4$ 0.2%) were selected to study economic feasibility and profitability.

The field are prepared by well-decomposed farmyard manure was applied before land preparation at the rate of 25t/ha and mixed well in to soil. Fertilizers were applied at the rate of 300:200:200kg NPK/ha. 50% of nitrogen and full dose of phosphorous and potash were applied as basal dose and remaining 50% of nitrogen was applied at 45 days after planting. Before planting, corms were dipped in prepared GA_3 200 ppm solution for 1 hours and CCC 500 ppm solution for 24 hours after that dried under shade. Planting was taken up at 40 x 20 cm spacing to a depth of 5-6cm in plots of 2.0x1.0 m size. Light irrigation was given immediately after planting and plots were kept weed free by hand weeding. Irrigation was given at regular intervals as to maintain adequate soil moisture in the soil. Pest and disease control measures were taken up whenever necessary. The economics of gladiolus cultivation in open field condition (1ha) was worked out by considering the price of planting material, fertilizers, chemicals and other inputs. The obtained data had statistically analyzed adopting procedure as given by Panse, V. G. and Sukhatme, B. V. (1985).

Results and Discussion

Crop economics

The benefit cost ratio was estimated on the basis of cost of cultivation, gross return and net return obtained by calculation of gladiolus on per hectare basis. The return per hectare was estimated in terms of spike and corm yield per hectare at existing market rate available during the year 2017-18 and 2018-19. Benefit cost ratio was obtained by dividing the net income by cost of cultivation.

$$\text{Cost benefit ratio} = \frac{\text{Net return (Rs.)}}{\text{Total cost of cultivation (Rs.)}}$$

The economics of the crop cultivation under different treatment combination was worked out on the basis of input-output analysis. Thus, the results obtained on various components of crop economics have been presented in Table No. 1.

The statistical analysis of data (Table-1) revealed that length of spike (cm), number of florets, number of spikes per hectare, number of corm/hectare and vase life influenced by different levels of plant growth regulators and micronutrients was found significantly. The maximum length of spike was recorded with combination of CCC 500 ppm with $ZnSO_4$ 0.5% + $FeSO_4$ 0.2% and it followed by G_3M_3, G_3M_2 and

minimum was observed under the control treatment during both the years of investigation. The spike longevity was significantly maximum at cycocel 500 ppm. This might be due to the fact that reserve food material can be utilized for the productive purpose with restriction on vegetative plant growth due to gibberellins action of cycocel. The increase in number of spikes per plant and increase in yield spike per hectare might be due to the development of large number of spikes as the result of reproductive plant growth and maximum tillers of the plant.

Economics of gladiolus treatments for one hectare are presented in Table 2. Different cost components of gladiolus production were evaluated and found that total cost of gladiolus cultivation was Rs. 3,33,249/ha including planting material (2,16,250), Fertilizers (37220), plant protection chemicals (4914), Ploughing, land preparation and planting (6935), Inter-cultivation and weeding (7975), Harvesting and miscellaneous charges were 17250. The economic returns were computed by deducting total cost and the cost incurred for flower production from the gross receipts obtained from the sale of flowers. The economic returns were computed by deducting total cost and the cost incurred for flower production from the gross receipts obtained from the sale.

In Table No. 3. Economics of gladiolus production under different treatment. The economic analysis revealed that, the maximum gross returns were obtained from treatment G_3M_4 (10,97,000/ha), followed by G_3M_3 (10,44,000/ha) with a net return of Rs. 7,52,900/ha and 7,00,525/ha, respectively. However, minimum gross was obtained in G_1M_1 (7,53,000/ha) with a net return of Rs. 4,19,750/ha compared to other treatments grown under open field condition.

The increased yield in these cultivars might be attributed to the greater leaf area and more number of leaves would have resulted in production and accumulation of maximum photosynthates, resulting in the production of more number of flowers which ultimately fetches highest returns per unit area. The results are in accordance with the findings of Rashmi and Chandrashekar (2016) [6], Pragya *et al.* (2010) [5], Chopde *et al.* (2012) [8] and Geeta *et al.* (2014) [1] in gladiolus.

Benefit cost ratio is an important factor which decides the optimum levels of input to be used for maximization of production and returns of crop. The maximum B:C ratio of G_3M_4 (2.19) and G_3M_3 (2.04) respectively, less B:C ratio G_1M_1 (1.26) due to their poor performance in terms of yield, flowering behaviour and susceptibility to biotic factors. Hence the same can be exploited for commercial cultivation to meet the increasing global demand. This was in accordance with the reports of Muhammad and Muhammad (2013) [3] and Singh *et al.* (2014) [7].

Table 1: Flower yield and quality parameters plant growth regulators and micronutrients on gladiolus (*gladiolus grandiflorus* l.) for eastern Uttar Pradesh

Treatment	Length of spike		Number of florets per spike		Vase life (days)	
	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19
G_1	55.78	56.25	10.68	11.00	10.56	11.78
G_2	61.60	62.77	11.24	11.42	12.10	13.53
G_3	72.98	73.84	13.48	13.28	15.10	14.71
SEm±	0.854	1.047	0.182	0.184	0.197	0.161
C.D.(P=0.05)	2.506	3.072	0.533	0.539	0.576	0.472
M_1	60.50	61.50	11.29	11.29	11.82	12.16
M_2	62.22	62.87	11.60	11.58	12.47	13.26
M_3	65.01	65.46	11.87	12.01	12.65	13.94
M_4	66.07	67.32	12.43	12.71	13.40	14.00
SEm±	0.987	1.209	0.210	0.212	0.227	0.186
C.D.(P=0.05)	2.894	3.547	0.615	0.623	0.666	0.545
G_1M_1	50.93	51.47	10.60	10.87	9.97	9.85
G_1M_2	52.87	53.43	10.20	10.67	10.74	12.16
G_1M_3	59.30	59.23	10.70	10.93	10.83	12.33
G_1M_4	60.00	60.87	11.20	11.53	10.71	12.77
G_2M_1	60.20	61.80	10.47	10.87	11.25	12.90
G_2M_2	61.80	62.43	11.20	11.00	11.59	13.33
G_2M_3	62.03	62.67	11.23	11.60	11.62	14.19
G_2M_4	62.37	64.17	12.07	12.20	13.95	13.69
G_3M_1	70.37	71.23	12.80	12.13	14.25	13.72
G_3M_2	72.00	72.73	13.40	13.07	15.10	14.29
G_3M_3	73.70	74.47	13.67	13.50	15.51	15.31
G_3M_4	75.83	76.93	14.03	14.40	15.55	15.53
SEm±	1.709	2.095	0.363	0.368	0.393	0.322
C.D.(P=0.05)	5.012	6.144	NS	NS	1.153	0.943

Table 2: Different cost components of gladiolus production

Sl. No.		Common Cost	Quantity/Time/ Amount	unit	Rate (Rs)		Total Cost (Rs/ha)	
					2017-18 Rate (Rs)	2018-19 Rate (Rs)	2017-18	2018-19
1	**Land Preparation**							
	i.	One Ploughing by soil turning ploughing by tractor	4hr	4	375	375	1500	1500
	ii.	Two Ploughing by tractor drawn cultivator	8hr	8	350	350	2800	2800
	iii.	Levelling by tractor	2hr	2	375	400	750	800
	iv.	Tractor Drawn Ridge Maker	12hr/hectare	12	150	160	1800	1920
Total average land preparation cost							**6935**	

2	**Planting**							
	i.	Cost of planting material (Corms)	100000	100000	2	2	200000	200000
	ii.	Planting of 100000 @1000 Corn/unit	100	100	150	175	15000	17500
Total average planting cost							**216250**	
3	**Manures and Fertilizers**							
	i	FYM	20t	20	650	700	13000	14000
	ii	Nitrogen through Urea (as per treatment)	435 kg	435	10	10	4350	4350
	iii	Phosphorous through DAP	435 kg	435	25	25	10875	10875
	iv	Potash through MOP	333 kg	333	15	15	4995	4995
	v	Mixing of FYM and chemical fertilizers	20 unit	20	175	175	3500	3500
Total average manures and fertilizers cost							**37220**	
4	**Cultural Practices**							
	i.	Irrigation by tube well	5 irrigation	5	300	300	1500	1500
	ii.	Labour for irrigation	10 labour	10	175	175	1750	1750
	iii.	Weeding for 3 times	15 labour	15	175	175	2625	2625
	iv.	Labour for earthing up	6 labour	6	175	175	1050	1050
	v.	Labour for staking up	6 labour	6	175	175	1050	1050
Total average cultural practices cost							**7975**	
5	**Plant Protection**							
	i.	Cost of Dimethoate (0.04%) 2 spray	2 litre	2	500	500	1000	1000
	ii.	Cost of Clorophyliphos (0.02%)	1 liter	2	632	632	1264	1264
	iii.	Cost of carbendazim for 2 spray	1 kg	1	550	550	550	550
	iv.	Spray unit	6 labour	12	175	175	2100	2100
Total average plant protection cost							**4914**	
6	**Harvesting**							
	i.	Harvesting of spike	40 unit	40	175	175	7000	7000
	ii.	Transport charge for carrying flower to the market						
	iii.	Lifting of corms	30 unit	30	175	175	5250	5250
	iv.	Rental value of land (12 month)	1 years	1	10000	10000	10000	10000
	v.	Miscellaneous charges 1% of the total cost cultivation					2000	2000
Total average harvesting cost							**17250**	
	vi.	Total cost of cultivation					295709	299379
	vii.	Interest on cultivation cost @12%	12 months	12	12%	12%	35485.08	35925.48
	viii	Grand total cost of cultivation					331194.08	335304.48
	ix.	Total average cost 2017-18 and 2018-19					**333249.28**	

Table 3: Economics of gladiolus production under different treatment

Treatment Combinations		Cost of Cultivation	Spike Yield (lakh ha^{-1})	Corm Yield (lakh ha^{-1})	Gross return (lakh ha^{-1})		Net return (lakh ha^{-1})		B:C Ratio
T_1	G_1M_1	333249	3.75	3.78	7.53	753000	4.19	419750	1.26
T_2	G_1M_2	333874	4.05	3.83	7.88	788000	4.54	454125	1.36
T_3	G_1M_3	333474	4.26	3.84	8.10	810000	4.76	476525	1.43
T_4	G_1M_4	334099	4.44	3.98	8.42	842000	5.07	507900	1.52
T_5	G_2M_1	334449	4.05	4.14	8.19	819000	4.84	484550	1.45
T_6	G_2M_2	335074	4.35	4.29	8.64	864000	5.28	528925	1.58
T_7	G_2M_3	334674	4.56	4.70	9.26	926000	5.91	591325	1.77
T_8	G_2M_4	335299	4.74	4.79	9.53	953000	6.17	617700	1.84
T_9	G_3M_1	343249	4.35	4.86	9.21	921000	5.77	577750	1.68
T_{10}	G_3M_2	343874	4.65	5.06	9.71	971000	6.27	627125	1.82
T_{11}	G_3M_3	343474	4.86	5.58	10.44	1044000	7.00	700525	2.04
T_{12}	G_3M_4	344099	5.04	5.93	10.97	1097000	7.52	752900	2.19

Conclusion

The study results were highly encouraging with respect to higher economic return of floriculture. The average net income of obtained from gladiolus ranged from Rs. 419750 to 752900 per hectare. Moreover, the return per rupee spent ranged from Rs. 1.26 to 2.19.

Therefore, presoaking of corms in CCC 500 ppm with foliar application of $ZnSO_4$ 0.5% + $FeSO_4$ 0.2% at 30 day & 60 days after planting of corm will be highly economical hence, it can be recommended to obtained higher production and maximum return for gladiolus growers of Eastern Uttar Pradesh.

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