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EFFECT OF DIFFERENT DOSE OF NITROGEN AND PHOSPHOROUS ON *GLADIOLUS* YIELD AT ILAM, NEPAL

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ABSTRACT

An experiment was conducted to assess the effect of different levels of nitrogen and phosphorus on *Gladiolus* yield of cultivar (cv.) Jester in Ilam municipality-2 Fulgachi, Ilam. The research was conducted at the Department farm of Bachelors of Science in Horticulture and Floriculture Management (B.Sc. HFM), Ilam from April to September 2014. The experiment consisted of twelve treatment combinations laid out in factorial randomized complete block design with three replications. Four levels of nitrogen 0 kg, 50 kg, 100 kg and 150 kg/ha were experimented as the first factor and three levels of phosphorous 0 kg, 50 kg and 100 kg/ha formed were taken as the second factor which comprised of twelve treatment combinations. Nitrogen and phosphorous significantly affected plant height, number of leaves per plant, spike length, days to first cutting, days to last cutting and yield (number of corm per plant) of *Gladiolus* plant.

Keywords: Corm, *Gladiolus*, nitrogen, phosphorous, yield.

INTRODUCTION

Floriculture can be a promising enterprise in Nepal especially in hilly and inner plane areas. Flowers are high value crops which give higher income per unit of the growing area than other horticultural crops. Despite a wide range of agro-climatic conditions and several micro-climate pocket areas suitable for several diverse flowers and ornamental plants, a systematic and serious attempt has not been made either by growers or entrepreneurs to develop flori-business to its true potential due to lack of market and specialized production techniques. The flower business was limited to vendor sale till 1991/1992 in Nepal (FAN, 2015).

Gladiolus has been rated as one of the most popular flowers in the world, occupying fourth place after rose, chrysanthemum and carnation in international cut flower trade (Bose and Yadav, 1989; Malla, 1998). There is an increasing demand for the spikes owing to its elegance, beauty and long vase life. The availability of wide range of colours varying from white to dark crimson with long spikes make *Gladiolus* a dominating feature in cut flower industry (Kumar *et al.,* 1999).

Gladiolus is becoming one of the most important cut-flowers and is commercially cultivated for cut-flower trade. Cut-flowers are the most dominating features in modern floriculture. The year round and regular supply and quality are prime considerations of cut-flowers. Nepalese nurseries supply limited number of cut-flowers and cut-foliages on the seasonal basis. The flori-products produced in Nepal can meet only 40% of the domestic demand and 60% demands are being met by the supplies from India (FAN, 2015; Regmi, 2000).

Different *Gladiolus* cultivars have varying response to different nutrients in terms of yield and quality of the product. Application of recommended dose of fertilizer have been proven effective and played important role in promoting cut flower and corm production. Soil

and climate of a particular region are important factors affecting the nutritional requirement of *Gladiolus*. It also depends on cultivar, size and chemical composition of corms or cormels. Cormels and smaller corms require more fertilizer than larger corms mainly due to their stored reserve and partly to greater feeding ability of the extensive root system produced by large corms (Woltz *et al.,* 1978). Application of N, P and K at 60, 50 and 60 kg/ha respectively was found to be optimum for cormel formation in cv. Spic and Span. The best results were obtained with 7.5 kg ammonium sulphate, 10 kg super-phosphate and 10 kg murate of potash per 100m^2 (Mishra, 1999). Increasing rate of nitrogen in cv. Friendship delayed the time of flowering and increased the spike length, weight and size of corms and number of cormels where as higher rates of phosphorous and potash tended to improve flower quality, cormel growth and corm production (Bhattacharjee, 1981). Similarly, higher rate of nitrogen delayed flowering especially from cormels. The number of cormels decreased with increasing nitrogen. The beneficial effect of fertilizer application with 600 kg super phosphate, 300 kg murate of potash and 400 kg ammonium nitrate resulted in greatest plant height, flower number and flower size (Bose and Yadav, 1989).

This research was done to determine the optimum nutrient levels of N and P for *Gladiolus* cv. Jester in order to enhance the floriculture business by increasing and improving the cut flower and corm yield in farmer's condition which ultimately helps to improve the economic condition of the farmers.

MATERIALS AND METHODS

The experiment was conducted at the Department of Horticulture and Floriculture Management, Fulgaachi, Ilam from April to September, 2014 with the financial support from Research Unit/ Mahendra Ratna Multiple Campus/Tribhuvan University. Two factors experiment was laid out in a completely randomized block design. Four doses of nitrogen (0, 50,100 and 150 kg/ha) and three doses of phosphorous (0, 50 and 150 kg/ha) formed twelve treatment combinations which were replicated thrice. The *Gladiolus* corms were planted at 30×25 cm on each plot having 5 rows with 4 plants per row on the area of 1.5 m^2 accommodating 20 plants/plot. The data were taken from the 6 plants excluding the 14 boarder plants. The *Gladiolus* corms of Jester variety of 5 cm diameter were used as the planting material. The variety Jester was selected as it has shown better performance in Ilam. The corms were collected from the local traders at Ilam municipality. The selected corms were treated by dipping them in 0.2% aqueous solution of bavistin for 30 minutes and were shade dried prior to planting. Dehusking of cormels was done before dipping as it has a pronounced effect on seed germination percentage as husk interferes with cytokinin uptake and prevents the dormancy breaking action of the plant hormone (Salanenka and Taylor, 2006 and Miyoshi and Sato, 1997).

Well decomposed farmyard manure (FYM) per plot was applied at the rate of 25 mt/ha two weeks before planting. Potassium was applied at the rate of 200 kg/ha in all plots. Nitrogen and phosphorous were applied at the treatment rate. Half dose of nitrogen and full dose both of phosphorus and potash were applied as basal dose in each treatment. The remaining doses of nitrogen were further splitted into two parts. The first part was top dressed when plant attained four leaf stage and the second at six leaf stage (Singh *et al.*, 1994). Nitrogen was applied through urea (46 % N), phosphorus through diammonium phosphate (46 % P_2O_5 and 16 % N) and potassium through murate of potash

(60% K_2O) respectively. Remaining part of phosphorous was applied through Single Super Phosphate (16% P) as per the treatments.

The collected data were entered in the spread sheet in Microsoft Excel sheet and was analyzed by using MSTAT-C software package. Data were analyzed statistically by performing analysis of variance (Steel and Torrie, 1980) and means were separated Duncan's Multiple Range Test at 5% level of significance (Gomez and Gomez, 1984).

RESULT AND DISCUSSION

Plant height and number of leaves per plant

The plant height of *Gladiolus* was highest at 150 kg N/ha i.e. 36.00 cm (45 DAT), 46.0 cm (60 DAT) and 59.0 cm (75 DAT) and lowest plant height i.e. 34.33 cm (45 DAT), 43.67 cm (60 DAT) and 57.33 cm (75 DAT) was observed at 0 kg N/ha (table 1). Similarly, highest plant height i.e. 36.25 cm (45 DAT), 46.50 cm (60 DAT) and 58.25 (75 DAT) was observed on the phosphorous level of 100 kg/ha whereas the lowest plant height i.e. 34.0 cm (45 DAT), 43.75 cm (60 DAT) and 57.75 cm (75 DAT) was observed at 0 kg P/ha at 45, 60, and 75 DAT. The increment on plant height with the increment on the nitrogen and phosphorous was also reported by Khan *et al.* (2012) and Hossain *et al.* (2011). Anil *et al.* (2000) reported that growth increased with increasing phosphorous doses. Similarly, Bazwaja *et al.* (2001) and Shah *et al.* (1984) also found the similar result with increase on nitrogen and phosphorous.

The number of leaves per plant was significantly the highest at nitrogen level 150 kg/ha i.e. 3 (45 DAT), 6.667 (60 DAT) and 8.667 (75 DAT) and the lowest leaf number i.e. 1.667 (45 DAT), 3.667 (60 DAT) and 4.667 (75 DAT) were observed at 0 kg N/h. Similarly, the highest i.e. 2.83 (45 DAT), 6.333 (60 DAT) and 7.583 (75 DAT) was observed on the phosphorous level of 100 kg/ha and the lowest height i.e. 1.83 (45 DAT), 4.583 (60 DAT) and 5.583 (75 DAT) cm was observed at 0 kg P/ha (table 1). The increment on number of leaves per plant with the increment on the nitrogen and phosphorous was also reported by Khan *et al.* (2012) and Hossain *et al.* (2011). Increasing nitrogen augmented plant growth and number of leaves per plant on *Gladiolus* plant (Shah *et al.*, 1984).

Table 1. Effect of nitrogen and phosphorous on plant height of *Gladiolus* at different days of planting in *Gladiolus* under different condition.

Treatment	Plant height (cm)			Number of leaves per plant		
	45 DAT	60 DAT	75 DAT	45 DAT	60 DAT	75 DAT
Nitrogen (F_a)						
N_0	34.33^c	43.67^c	57.33^c	1.667^d	3.667^d	4.667^d
N_{50}	34.67^b	44.67^b	58.00^b	2.667^b	5.667^c	5.667^c
N_{100}	34.57^b	44.0^b	58.33^b	2.0^c	6.0^b	6.667^b
N_{150}	36.00^a	46.0^a	59.0^a	3.0^a	6.667^a	8.667^a
LSD	0.022	0.036	0.016	0.012	0.016	0.045
SEM±	0.005	0.001	0.045	0.007	0.005	0.007
Phosphorous (F_b)						
P_0	34.0^c	43.75^c	57.75^b	1.833^c	4.583^c	5.583^c
P_{50}	35.50^b	45.0^b	57.75^b	2.33^b	5.583^b	6.083^b
P_{100}	36.25^a	46.50^a	58.25^a	2.83^a	6.333^a	7.583^a
$LSD_{0.05}$	0.016	0.025	0.032	0.034	0.096	0.056
CV%	3.8	5.4	4.4	9.1	6.5	7.1

Means within the column followed by the same letter do not differ significantly by DMRT (P=0.05).

Flower spike length, days to first and last cutting

The flower spike length of *Gladiolus* was significantly the highest at nitrogen level of 150 kg/ha irrespective of the stage of growth i.e. 29 cm (75 DAT), 56.33 cm (90 DAT) and 88.67 cm (105 DAT) and the lowest spike length i.e. 23.0 cm (75 DAT), 51.67 cm (90 DAT) and 77.67 cm (105 DAT) were observed at 0 kg N/ha. Similarly, the highest spike length irrespective of growth stage, i.e. 26.25 cm (75 DAT), 55.0 cm (90 DAT) and 84.75 cm (105 DAT) was observed

at the phosphorous level of 100 kg/ha whereas, the lowest spike length i.e. 24.50 cm (75 DAT), 52.75 cm (90 DAT) and 82.50 cm (105 DAT) was observed at 0 kg P/ha respectively (table 2). The longest spikes obtained from higher nitrogen level might be due to protoplasm formation, division and elongation of meristem cells, enhancing the biosynthesis of proteins and carbohydrates which lead to enhanced growth (Verma *et al.,* 2000). Similar result was reported by Sehrawat *et al.,* (2003) and Shah *et al.* (1984). Moreover, Sidhu and Arora (1989) reported that spike length was significantly improved by the application of 20 gram nitrogen per square meter which is equivalent to 200 kg N/ha.

Days to first harvesting of *Gladiolus* flowers was found to be the earliest at nitrogen level of 0 kg/ha, i.e., 121.0 days and the most late i.e. 130.0 days at 150 kg nitrogen per hectare. Similarly, days to first harvesting of *Gladiolus* flower was found to be the earliest at phosphorus level of 0 kg/ha, i.e., 123.8 days and the most late i.e. 126.0 days at 100 kg P/ha (table 2). Moreover, days to final harvesting of *Gladiolus* flowers was found to be the earliest at 0 kg N/ha, i.e., 133.7 days and the most late i.e. 142.0 days at 150 kg N/ha. Similarly, days to final harvesting of *Gladiolus* flower was found to be the earliest at 0 kg P/ha, i.e., 130.0 days and the most late i.e. 138.0 days at 100 kg P/ha (table 2). Higher level of nitrogen increased vegetative growth thereby delaying reproductive phase of the plant. These results are in line with the findings of Bhattacharjee (1981) who stated that increasing the level of nitrogen and phosphorous advanced the time of flowering thereby lengthening the time for the first and final harvesting of the spikes. Similar results were found by Borrelli (1984), Deswal *et al.* (1983), Shah *et al.* (1984) and Sindhu and Arora (1989).

Table 2. Effect of nitrogen and phosphorous on flower spike length, days to first and last harvesting of *Gladiolus* spike under different condition

Treatment	Flower spike length (cm)			Days to harvesting	
	75 DAT	90 DAT	105 DAT	First	Final
Nitrogen (F_a)					
N_0	23.00^d	51.67^d	77.67^d	121.7^d	133.7^d
N_{50}	24.33^c	52.00^c	82.0^c	122.3^c	134.3^c
N_{100}	26.00^b	55.0^b	86.0^b	125.7^b	137.7^b
N_{150}	29.00^a	56.33^a	88.67^a	130.0^a	142.0^a
LSD	0.018	0.098	0.064	0.018	0.058
SEM±	0.009	0.005	0.009	0.006	0.003
Phosphorous (F_b)					
P_0	24.50^c	52.75^c	82.50^c	123.8^c	130.0^c
P_{50}	26.00^b	53.50^b	83.50^b	125.0^b	132.8^b
P_{100}	26.25^a	55.0^a	84.75^a	126.0^a	138.0^a
$LSD_{0.05}$	0.036	0.063	0.045	0.073	0.018
CV%	10	7.2	6.5	10	4.5

Number and weight of corms per plant and diameter of the corm

The number of corms per *Gladiolus* plant was found to be the highest at 150 kg N/ha i.e. 2.0 and the lowest number i.e. 1.33 at 0 kg N/ha. Similarly, the highest number of corms per plant was found to be highest at 100 kg P/ha i.e. 1.90 and the lowest number i.e. 1.75 at 0 kg P/ha (table 3). In addition, the weight of the corm per plant was found to be the highest at 150 kg N/ha i.e. 28.43 gm and the lowest weight i.e. 22.3 gm at 0 kg N/ha. Similarly, the highest weight of the corms per plant was found to be at 100 kg P/ha i.e. 26.71 gm and the lowest weight i.e. 23.24 gm at 0 kg P/ha. Moreover, the diameter of the corm was found to be highest at 150 kg N/ha i.e. 4.86 cm and the lowest diameter i.e. 3.8 cm at 0 kg N/ha. Similarly, the highest corm diameter was found to be at 100 kg P/ha i.e. 4.5 cm and the lowest diameter i.e. 3.1 at 0 kg P/ha (table 3). Sehrawat et al. (2003) reported that number and weight of corms per plant and diameter of the corm was significantly influenced by the increment of nitrogen and phosphorous level. Similar results were obtained by Hossain *et al.* (2011), Pant (2005), Baral *et al.* (2012), Khan

et al. (2012) Mishra and Singh (1998) and Mukherjee *et al.* (1994).

Table 3. Effect of nitrogen and phosphorous on number and weight of the corm per plant and size of the *Gladiolus* corm under different condition

Treatment	Number of corms per plant	Weight of the corm per plant	Diameter of the corm (cm)
Nitrogen (F_a)			
N_0	1.333^c	22.3^c	3.8^d
N_{50}	1.667^b	23.66^c	4.13^c
N_{100}	1.667^b	25.63^b	4.38^b
N_{150}	2.0^a	28.43^a	4.86^a
LSD	0.023	1.640	0.023
SEM±	0.007	0.559	0.007
Phosphorous (F_b)			
P_0	1.750^b	23.24^c	3.1^c
P_{50}	1.750^b	25.07^b	4.3^b
P_{100}	1.90^a	26.71^a	4.5^a
$LSD_{0.05}$	0.056	1.640	0.245
CV%	7.4	8.4	8.4

Means within the column followed by the same letter do not differ significantly by DMRT (P=0.05).

CONCLUSIONS

The plant height, leaf length, flower spike length, diameter, weight and number of corms per plant was found to be highest at 150 kg N/ ha and 100 kg P/ha. So, it is recommended to use the same rate of fertilizer during commercial cultivation of *Gladiolus* at Nepalese condition.

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