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Studies on nitrogen application in combination with phosphorus or potassium on gladiolus cv. Jester Gold

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ABSTRACT

An experiment was carried out to study the effects of nitrogen (20, 40, 60, 80 g/m²) with phosphorus (5, 10, 20 g/m²) and potassium (15, 20, 25 g/m²) and one control without fertilization application on vegetative growth, corm production, nitrogen uptake, phosphorus and potassium content on gladiolus cv. Jester Gold in RBD at IARI, New Delhi for two growing seasons. In all, there were 25 treatments. Application of $N_{80}P_{20}$ g/m² produced significantly maximum leaves/shoots (7.93), leaf area/plant (443.69 cm²), corm size (5.14 cm), weight of corm (45.06 g) and cormel (5.65 g) per mother corm, cormels/plant (42.06), and propagation coefficient (507.12%). Maximum nitrogen uptake at spike emergence (77.03 kg/ha) and at harvest (159.62 kg/ha), phosphorus content at spike emergence (0.38%) and at harvest (0.55%) was noted under $N_{80}P_{20}$ g/m². Higher dose of $N_{80}P_{25}$ g/m² noted maximum potassium content at spike emergence (4.38%) and at harvest (4.53%). However, earliest 50% heading was recorded under $N_{20}P_5$ g/m².

Key words: Gladiolus, nitrogen, phosphorus, potassium, corm.

INTRODUCTION

Gladiolus is an important bulbous crop, which is commercially grown for cut flowers. Nutrition plays an important role in the overall growth performance of the crop. Plant analysis has been found to be a useful diagnostic tool to work out amount of fertilizer to be applied. However, such information in gladiolus is scanty under Delhi conditions. Therefore, the present investigation was carried out to determine the optimum doses of nitrogen, phosphorus and potassium on vegetative growth, N, P, K uptake and corm and cormel production of gladiolus cv. Jester Gold.

MATERIALS AND METHODS

The experiment was conducted on gladiolus cv. Jester Gold in RBD during winter season for two consecutive years at the Division of Floriculture and Landscaping, IARI, New Delhi. The treatments consisted of four doses of nitrogen (20, 40, 60, 80 g/m²), three doses of phosphorus (5, 10, 20 g/m²) and three doses of potassium (15, 20, 25 g/m²) and one control without fertilizer treatment. Nitrogen was applied with phosphorus and potassium separately. In all, there were 25 treatments. The net plot size was 1.5 m x 1.0 m. Each plot was planted with 30 corms at a distance of 40 cm x 20 cm and a depth of 5 cm in the first fortnight of October in each year. Nitrogen was applied as calcium ammonium nitrate (CAN) into two splits, first half as basal dose at the time of planting along with full dose of phosphorus as single super phosphate (SSP) and potassium as muriate of potash (MOP), and the second half of nitrogen at spike emergence to all the treatments. The soil of experimental farm was loam in texture having 8.3 pH with 0.50% organic carbon, 165 kg/ha available phosphorus and 310 kg/ha available potassium. Plant samples were collected from each plot at two stages, i.e. at spike emergence and at harvest and analyzed for nitrogen uptake, phosphorus and potassium content in plant at both the stages. Nitrogen content in plant was estimated by a Technicon Autoanalyser, phosphorus content by vando-molybdate colour reaction method and potassium content by microprocessor based flame photometer (Systronics-Flame Photometer 128, Ahmedabad).

RESULTS AND DISCUSSION

On the perusal of data presented in Table 1 revealed that none of the treatment combination exhibited significant effect on the days to 50% sprouting. Number of leaves per plant was significantly increased with increasing doses of nitrogen either with phosphorus or potassium. A dose of $N_{80}P_{20}$ g/m² produced the maximum number of leaves (7.93), while minimum under control (6.60). Significantly maximum leaf area (443.69 cm²) was recorded in plants receiving $N_{80}P_{20}$ g/m² where it was minimum in control (294.81 cm²). Application of $N_{80}P_{10}$ g/m² produced tallest plant (86.29 cm), while shortest (57.53 cm) under control. Earliest

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Table 1. Vegetative growth of gladiolus cv. Jester Gold as affected by different doses of nitrogen, phosphorus and potassium.

Dose (g/m^2)	Days to 50% sprouting	Leaves/ shoot	Leaf area/ plant (cm^2)	Plant height (cm)	Days to 50% heading
Control	10.78	6.60	294.81	57.55	90.87
$N_{20}P_5$	10.93	6.90	308.52	68.79	90.77
$N_{20}P_{10}$	11.11	7.32	315.43	64.03	92.18
$N_{20}P_{20}$	10.88	7.39	329.61	67.74	93.53
$N_{40}P_5$	11.17	7.46	352.36	75.08	94.60
$N_{40}P_{10}$	10.83	7.55	360.79	77.98	95.28
$N_{40}P_{20}$	10.95	7.59	366.53	79.80	96.24
$N_{60}P_5$	10.70	7.58	380.90	83.76	99.18
$N_{60}P_{10}$	10.89	7.69	388.87	85.93	100.01
$N_{60}P_{20}$	10.63	7.56	402.93	90.27	100.97
$N_{80}P_5$	10.83	7.75	421.08	81.85	102.45
$N_{80}P_{10}$	10.94	7.80	431.06	86.29	103.62
$N_{80}P_{20}$	10.75	7.93	443.69	85.25	105.19
$N_{20}K_{15}$	11.23	7.23	315.23	62.35	95.08
$N_{20}K_{20}$	11.00	7.37	323.06	65.41	95.71
$N_{20}K_{25}$	10.93	7.37	334.49	65.33	95.72
$N_{40}K_{15}$	10.77	7.45	342.53	69.06	96.81
$N_{40}K_{20}$	10.71	7.52	355.32	72.42	97.72
$N_{40}K_{25}$	10.72	7.45	365.62	75.04	98.65
$N_{60}K_{15}$	11.02	7.50	374.00	78.14	99.77
$N_{60}K_{20}$	10.46	7.58	378.87	80.33	100.41
$N_{60}K_{25}$	10.90	7.53	385.60	78.12	100.90
$N_{80}K_{15}$	10.86	7.63	392.86	79.73	102.08
$N_{80}K_{20}$	10.82	7.65	407.58	77.45	103.13
$N_{80}K_{25}$	11.05	7.68	422.53	80.86	103.98
CD at 5%	NS	0.20	10.34	2.28	2.64

50% heading (90.77 days) was found under the lower doses of nitrogen and phosphorus, i.e., $N_{20}P_5$ g/m^2, whereas higher doses of nitrogen and phosphorus $N_{80}P_{20}$ g/m^2 delayed it (105.19 days). Improvement in plant height with the application of $N_{60}P_{20}$ g/m^2 could be attributed to the presence of calcium ions in calcium ammonium nitrate, which has been reported to increase nitrate absorption (Horst *et al.*, 4; Jackson, 5) and ammonium absorption in plants (Mills *et al.*, 8; Fenn *et al.,* 2). Phosphorus stimulates the root system through efficient translocation to roots of certain growth stimulating compounds formed in plants, which enhanced the absorption of nutrients thus resulting in a vigorous growth. Plants supplied with high phosphorus along with nitrogen continuously maintain vegetative growth. Better plant height may be the result of increased meristematic activities and increase in the number and size of cells. On the other hand, plants without additional nitrogen and phosphorus were underdeveloped and shorter in stature. Beneficial effects on vegetative characters by higher doses of nitrogen and phosphorus were also reported by Patel *et al.* (10), and Sharma and Singh (11).

On the perusal of data presented in Table 2 revealed that there was a progressive increase in nitrogen uptake by the whole plant with increasing levels of applied nitrogen at spike emergence and at harvest. However, maximum N-uptake was recorded at harvest (159.62%) with $N_{80}P_{20}$ g/m^2 as compared to spike emergence (77.03%). This could be attributed to calcium-stimulated ammonium and nitrate uptake (Jackson, 5). Nitrate in presence of ammonium enhances plant growth and increase the total acquisition of nitrogen by plants (Mills *et al.*, 8). The results corroborate the findings of Groen and Slangen (3). There was a linear increment in

Table 2. Effect of different doses of nitrogen, phosphorus and potassium on nutrient content (%) of whole plant at spike emergence and at harvest.

Dose (g/m^2)	Nitrogen uptake (kg/ha)		Phosphorus content (%)		Potassium content (%)	
	at spike emergence	at harvest	at spike emergence	at harvest	at spike emergence	at harvest
Control	25.36	49.47	0.15	0.22	3.11	3.02
$N_{20}P_5$	44.35	80.68	0.22	0.27	3.13	3.20
$N_{20}P_{10}$	44.50	81.55	0.22	0.28	3.15	3.19
$N_{20}P_{20}$	44.66	81.69	0.24	0.31	3.15	3.20
$N_{40}P_5$	53.43	108.62	0.26	0.35	3.19	3.21
$N_{40}P_{10}$	53.51	108.21	0.26	0.37	3.20	3.22
$N_{40}P_{20}$	53.76	110.10	0.28	0.38	3.17	3.20
$N_{60}P_5$	64.95	131.99	0.30	0.42	3.17	3.21
$N_{60}P_{10}$	64.94	134.60	0.30	0.44	3.20	3.22
$N_{60}P_{20}$	65.56	134.56	0.31	0.46	3.20	3.19
$N_{80}P_5$	76.23	156.25	0.36	0.50	3.19	3.21
$N_{80}P_{10}$	76.88	158.47	0.36	0.52	3.17	3.21
$N_{80}P_{20}$	77.03	159.62	0.38	0.55	3.16	3.23
$N_{20}K_{15}$	44.45	81.23	0.19	0.21	3.58	3.62
$N_{20}K_{20}$	44.46	80.75	0.19	0.24	3.58	3.63
$N_{20}K_{25}$	44.56	81.49	0.20	0.25	3.62	3.64
$N_{40}K_{15}$	39.23	108.33	0.20	0.24	3.91	3.94
$N_{40}K_{20}$	53.27	108.21	0.21	0.24	3.94	3.97
$N_{40}K_{25}$	53.27	109.58	0.21	0.24	3.96	4.03
$N_{60}K_{15}$	65.04	129.37	0.20	0.22	4.19	4.26
$N_{60}K_{20}$	65.73	132.00	0.19	0.25	4.22	4.30
$N_{60}K_{25}$	65.43	132.93	0.21	0.24	4.28	4.33
$N_{80}K_{15}$	75.90	153.87	0.22	0.25	4.32	4.44
$N_{80}K_{20}$	76.78	155.75	0.21	0.24	4.35	4.47
$N_{80}K_{25}$	76.81	158.01	0.21	0.25	4.38	4.53
CD at 5%	9.07	20.00	0.03	0.04	0.16	0.10

phosphorus and potassium content of the gladiolus plant with increasing levels of nitrogen, phosphorus and potassium. Maximum phosphorus content in plant at spike emergence (0.34%) and at harvest (0.55%) recorded in plants receiving a dose of $N_{80}P_{20}$ g/m^2 and minimum under control. Higher doses of $N_{80}K_{25}$ g/m^2 recorded the maximum potassium content in plants at spike emergence (4.38%) and at harvest (4.53%), while lowest under no fertilizer application, *i.e*. 3.11 and 3.02% at spike emergence and at harvest, respectively. Beneficial effects of higher doses of applied nitrogen, phosphorus and potassium on plant phosphorus and potassium content were reported by Singh (12), Singh *et al.* (13), and Miroiu *et al.* (9).

It is revealed that numbers of daughter corms produced per mother corm was non-significant in different doses of nitrogen, phosphorus and potassium. However, there was a marked difference in the size and weight of corms between the two years of investigation. Application of highest dose of $N_{80}P_{20}$ g/m^2 recorded maximum corm size (5.14 cm), corm weight (45.06 g), cormels per plant (42.06), cormels weight per plant (5.65 g) and propagation coefficient (507.12%), while minimum under no fertilization application. The results from these tests demonstrate that corms harvested in the first year were produced from corms, which did not receive nitrogen, phosphorus and potassium in the previous year, as in the usual practice in the field. The corms were more responsive to nitrogen and phosphorus application in the next season resulting

Table 3. Corm and cormel production of gladiolus cv. Jester Gold as affected by different doses of nitrogen, phosphorus and potassium.

Dose (g/m^2)	Corms produced/ mother corm	Corm size (cm)	Corm wt. (g)	Cormels/ plant	Cormels wt. / plant (g)	Propagation coefficient (%)
Control	1.00	3.31	24.08	27.48	2.40	263.55
$N_{20}P_5$	1.02	3.91	30.58	29.23	2.42	330.10
$N_{20}P_{10}$	1.10	4.24	31.18	29.61	2.45	336.50
$N_{20}P_{20}$	1.13	4.26	31.68	30.35	2.71	344.47
$N_{40}P_5$	1.15	4.58	33.36	32.23	3.39	367.62
$N_{40}P_{10}$	1.17	4.56	34.38	32.65	3.46	378.45
$N_{40}P_{20}$	1.21	4.78	35.81	34.41	3.69	398.11
$N_{60}P_5$	1.15	4.56	38.24	36.51	4.33	425.93
$N_{60}P_{10}$	1.17	4.74	38.83	37.51	4.71	437.13
$N_{60}P_{20}$	1.24	4.90	39.79	38.30	4.58	443.76
$N_{80}P_5$	1.26	4.90	41.85	40.43	5.10	469.56
$N_{80}P_{10}$	1.24	4.94	42.73	41.18	5.51	482.37
$N_{80}P_{20}$	1.25	5.14	45.06	42.06	5.65	507.12
$N_{20}K_{15}$	1.00	3.98	30.51	29.29	2.44	328.76
$N_{20}K_{20}$	1.10	4.39	31.52	29.58	2.42	341.85
$N_{20}K_{25}$	1.08	4.43	31.81	30.44	2.47	342.79
$N_{40}K_{15}$	1.07	4.42	32.01	31.51	2.69	346.95
$N_{40}K_{20}$	1.10	4.49	33.48	31.65	2.65	361.39
$N_{40}K_{25}$	1.14	4.44	33.81	32.07	2.73	365.30
$N_{60}K_{15}$	1.20	4.35	34.78	34.57	3.15	379.39
$N_{60}K_{20}$	1.22	4.58	35.90	35.48	3.25	392.02
$N_{60}K_{25}$	1.25	4.30	36.22	37.19	3.39	396.18
$N_{80}K_{15}$	1.25	4.56	37.75	39.31	4.06	418.15
$N_{80}K_{20}$	1.25	4.61	40.43	40.26	4.31	447.43
$N_{80}K_{25}$	1.27	4.68	40.98	42.98	4.37	453.51
CD at 5%	NS	0.07	1.07	0.53	0.06	10.20

in substantially improved size and weight of corms at harvest. The present findings are in accordance with the reports of Woltz (15), and Litterell and Waters (7) who observed that gladiolus is relatively slow to respond to nitrogen and phosphorus fertilization and the effect might not be apparent in one season. Higher yield in terms of corm and cormels due to higher doses of nitrogen and phosphorus may be because of the rapid vegetative growth which resulted into dry matter production and partitioning to the developing corms. Nitrogen and phosphorus application resulted in corms of superior quality may be attributed to enhanced ammonium absorption (Horst *et al.*, 4; Taylor *et al.*, 14; Fenn *et al.*, 2) and nitrate absorption (Jackson, 5) triggered by the calcium present in CAN, resulting in increased photosynthetic activity to produce additional biomass, which was manifested in bigger and heavier corms. Beneficial effects of higher doses of nitrogen, phosphorus on corm characters have also been reported by Baboo and Singh (1), Sharma and Singh (11), and Kumar *et al.* (6).

From the results obtained, it revealed that higher doses of nitrogen and phosphorus, *i.e.*, $N_{80}P_{20}$ g/m^2 produces plants having better vegetative growth, corm and cormel production, however, higher doses of the three nutrients increased the nitrogen, phosphorus and potassium content at spike emergence and at harvest.

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REFERENCES

1. Baboo, R. and Singh, R.D. 2006. Response of nitrogen, phosphorus and corm size on flowering and corm production in gladiolus. *J. Orn. Hort.* **9**: 66-68.

2. Fenn, L.B., Taylor, R.M. and Burks, C.M. 1994. Calcium accumulation of ammonium absorption and growth by beet. *Agron. J.* **86**: 916-20.

3. Groen, N.A.P. and Slangen, J.N.G. 1990. Nitrogen-fertilizer recommendations for gladiolus based on N-mineral soil analysis. *Acta Hort.* **266**: 375-80.

4. Horst, G.L., Fenn, L.B. and Dunning, N.B. 1985. Bermuda grass turf responses to nitrogen sources. *J. American Soc. Hort. Sci.* **110**: 759-61.

5. Jackson, W.A. 1978. Nitrate acquisition and assimilation by higher plants: Process in root system. **In**: *Nitrogen in the Environment*, D.R. Nielsen and MacDonald (Eds.). Academic Press, New York, pp. 45-88.

6. Kumar, R., Yadav, D.S. and Roy, A.R. 2006. Effect of nitrogen, phosphorus and potassium on growth, flowering and corm production of gladiolus cv. Pusa Shabnum under Meghalaya conditions. *Env. Ecol.* **24S**: 939-42.

7. Litterell, R.H. and Waters, W.E. 1967-68. Influence of nitrogen and lime fertilization on gladiolus corm and flower production and internal microflora of corms. *Proc. Florida Sta. Hort. Soc.* **80**: 405-8.

8. Mills, H.A., Barker, A.V. and Maynard, D.N. 1976. Nitrate accumulation in radish in as affected by nitrapyrin. *Agron. J.* **57**: 393-96.

9. Miroiu, D., Velicica, D. and Madjar, R. 2008. Preliminary results regarding the fertilization field culture of *Gladiolus gandavensis*. Lucrari Stiintifice - Universitatea de Stiinte Agronomice si Medicina Veterinara Bucuresti. *Seria B, Horticultura* **51**: 243-48.

10. Patel, N.M., Desai, J.R., Saravaiya, S.N., Patel, N.B., Patel, K.A. and Patel, R.B. 2010. Influence of chemical fertilizers on growth, quality, corm and cormel production of gladiolus (*Gladiolus grandiflorus* L.) cv. Sancerree under South Gujarat conditions. *Asian J. Hort.* **5**: 123-26.

11. Sharma, G. and Singh, P. 2007. Response of N, P, and K on vegetative growth, flowering and corm production in gladiolus under mango orchards. *J. Orn. Hort.* **10**: 52-54.

12. Singh, K.P. 2000. Response of single and split doses of nitrogen application on growth, flowering and corm production in gladiolus. *Adv. Pl. Sci.* **13**: 79-84.

13. Singh, W., Sehrawat, S.K., Dahiya, D.S. and Singh, K. 2002. Leaf nutrient status of gladiolus (*Gladiolus grandiflorus* L.) cv. Sylvia as affected by NPK application. *Haryana J. Hort. Sci.* **31**: 49-51.

14. Taylor, R.M., Fenn, L.B. and Pety, C. 1985. The influence of calcium on growth of selected vegetable species in the presence of ammonium-nitrogen. *J. Plant Nutr.* **8**: 1013-23.

15. Woltz, S.S. 1954. Studies on the nutritional requirement of gladiolus. *Proc. Florida Sta. Hort. Soc*. **67**: 330-34.

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