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# Growth, yield and quality of gladiolus vary by nitrogen and potassium fertility levels

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**Abstract**
A field experiment was conducted to determine the response of different doses of nitrogen and potassium on the growth, flowering and yield of gladiolus was carried out at Farm No. 16, Horticulture Section, College of Agriculture, Nagpur. The experiment was laid out in FRBD with sixteen treatment combinations and was replicated thrice. The treatments comprised of four levels of nitrogen and four levels of potassium. The results of the experiment revealed that, fertilizer treatments had significant response on various growth, flowering and yield parameters.The application of highest dose of nitrogen (450 kg $ha^{-1}$) and potassium (225 kg $ha^{-1}$)resulted in significantly maximum length andwidth of leaf, diameter of floret, number of spikes $plot^{-1}$, corms $plot^{-1}$and cormels $plot^{-1}$. However, lowest dose of nitrogen (0 kg $ha^{-1}$) and potassium (0 kg $ha^{-1}$) took minimum days to first spike emergence and 50% flowering.

**Keywords:** Gladiolus, fertility, nitrogen, potassium, quality

## Introduction

Gladiolus (*Gladiolus grandiflorus* L.) is a flower of breathtaking beauty with wide range of colours, size and form belonging to family Iridaceae. The name gladiolus was originally coined by Pliny the elder deriving from the gladius, meaning a sword, on account of the sword like shape of its foliage. It is one of the important cut flower crops grown in India. It is the only flower crop which is accepted in European countries when grown in open field conditions. Hence as a cut flower, it has great potentiality for export to European countries during winter months to earn valuable foreign exchange for the country. Production of healthy and vigorous corms and cormels depend on many factors, among them nutrient supply is an important one. Gladiolus requires nutrients throughout the period of growth, corm development and flowering. So, application of suitable nutrients in an optimum amount is important. Nitrogen is one of the most important nutrients producing growth and yield response in gladiolus. Due to N deficiency production of corms and cormels was affected and the plants could not utilize the stored food in the old corms properly. Potassium works as a catalyst in many biosynthetic reactions of the photosynthesis and the element K is involved in the synthesis of amino acids and gives resistance to plant against diseases. In the absence of adequate dose of K, higher doses of N are not beneficial to flower quality due to nutritional imbalance. Keeping in view the positive effects of nitrogen and potassium, the present experiment was conductedto assess the effect of different nitrogen and potassium levels on growth, flowering and yield of gladiolus, under soil and climatic conditions of Nagpur.

## Materials and Methods

The experiment was carried out at College of Agriculture, Nagpur (MS) during 2012-13. The best quality and bigger size (3-4 cm diameter) gladiolus corms of the variety American Beauty were used as planting materials. The experimental plot was ploughed and subsequent harrowingwas done. After clod crushing the soil was brought to fine tilth. At the time of land preparation, well-rotted FYM @ 20 t $ha^{-1}$ was mixed uniformly in the soil before last harrowing. The field was laid out with the beds of 45 cm spaced ridges and furrows and the beds were prepared of the dimension of 2.25 m × 1.05 m. The experiment was laid out in Factorial Randomized Block Design with three replications and sixteen treatment combinations. The treatments comprised of four levels of nitrogen *viz*. 0 kg N $ha^{-1}$, 150 kg N $ha^{-1}$, 300 kg N $ha^{-1}$ and 450 kg N $ha^{-1}$ and four levels of potassium *viz*. 0 kg $K_2O$ $ha^{-1}$, 75 kg $K_2O$ $ha^{-1}$, 150 kg $K_2O$ $ha^{-1}$ and 225 kg $K_2O$ $ha^{-1}$. Fertilizer dose of nitrogen, phosphorus and potassium was applied in the form of urea, SSP and MOP, respectively. A recommended dose of phosphorus i.e. 200 kg $ha^{-1}$ was applied for all the treatment plots as a full dose at the time of bed preparation before planting. The dose of potassium was applied as per the treatment as a full dose at the time of bed preparation, however, the dose of nitrogen was splitted in three equal splits and was applied at 2 leaf, 4 leaf and 6 leaf stages as per the treatments, respectively. After collection of data on different parameters was analyzed statistically as per the methods suggested by Panse and Sukhatme (1995) [5].

## Results and Discussion

### Growth

Growth parameters *viz*. leaf length and leaf width (Table 1) were significantly influenced by nitrogen and potassium levels.

The treatment $N_3$ recorded significantly maximum leaf length and leaf width (66.39 and 1.86 cm, respectively) which was found to be at par with the treatment $N_2$ (63.77 and 1.79 cm, respectively), whereas, treatment $N_0$ noted minimum leaf length and leaf width (56.35 and 1.58cm, respectively). The increase in leaf length and leaf width with increase in levels of nitrogen might be due to important role of adequate dose of nitrogen in photosynthesis as well as cell multiplication and cell elongation. These findings are in close agreement with the findings of Khan *et al*. (2012)[b] [4] in gladiolus.

In case of potassium, significantly maximum leaf length and leaf width were recorded under the treatment $K_3$ (66.53 and 1.86 cm, respectively). Whereas, the control treatment $K_0$ noted minimum leaf length and leaf width (58.17 and 1.63 cm, respectively). Potassium plays a complex role in photosynthesis, the process by which plant synthesize energy from sunlight, carbon dioxide and water. Thus, sufficient supply of potassium helps to enhance healthy plant growth in terms of length and width of leaf. This might have been the reason to increase the leaf length and width of gladiolus with increased dose of potassium. These results are congruent with the findings of Khan *et al*. (2012)[b] [4] in gladiolus.

The interaction effect (Table 1) due to nitrogen and potassium on leaf length and leaf width of gladiolus was found non-significant.

### Flowering

Flowering parameters *viz*. days to first spike emergence and days to 50% flowering (Table 1) were significantly influenced by nitrogen and potassium levels.

The treatment $N_0$ took significantly minimum days (54.67 and 66.25, respectively) for emergence of first spike and 50 % flowering, which was followed by the treatment $N_1$ (56.00 and 67.83 days, respectively), whereas, the treatment $N_3$ took maximum days for emergence of first spike and 50 % flowering (61.00 and 73.92, respectively). The first spike emergence in gladiolus was delayed with the increasing rate of nitrogen and recorded early flower stalk emergence with the treatment of 0 kg N $ha^{-1}$. This may be due to application of nitrogen which enhanced the biological activities like cell division, cell elongation, protein synthesis and food formation thus results in vegetative growth of plants and prolonged the time which the gladiolus takes to enter into reproductive phase from vegetative phase and there by delayed in spike emergence. These findings can be correlated with those of Devi and Singh (2010) [1] in tuberose, Khan *et al*. (2012)[b] [4] in freesia and Sewedan *et al*. (2012) [8] in galdiolus.

In case of potassium, the treatment $K_0$ had recorded significantly minimum days (54.58 and 66.75, respectively) to emergence of first gladiolus spike and 50 % flowering which was found statistically at par with the treatment $K_1$ (56.08 and 67.83, respectively). However, the maximum days to first spike emergence and 50 % flowering were counted under the treatment $K_3$ (60.00 and 73.50, respectively). Potassium increases protein content of plant which in turn improves its vegetative growth which might have been responsible for delay in emergence of first spike with an increase in the dose of potassium. Similar results were also obtained by Zubair *et al.* (2006) [12] and Zubair (2011) [11] in gladiolus.

The interaction effect (Table 1) due to nitrogen and potassium on days to emergence of first spike and 50 % flowering in gladiolus was non-significant.

### Spike quality

The various levels of nitrogen and potassium (Table 2) had significant influence on the diameter of gladiolus florets.

Significantly maximum diameter of floret was recorded in the treatment $N_3$ (6.21 cm) and it was statistically at par with the treatment $N_2$ (5.97 cm). However, minimum diameter of floretwas recorded in the treatment $N_0$ (5.17 cm).The increase in diameter of floret was noted with increase in the level of nitrogen which might be due to the fact that, nitrogen is a constituent of protein, nucleic acid and nucleotides that are essential to the metabolic functions of plants. Also nitrogen aids in food formation. Parallel findings to this result have been cited by Patel *et al*. (2010) [6] in gladiolus.

In case of potassium, significantly maximum diameter of floret was recorded in the treatment $K_3$ (6.12 cm). However, minimum diameter of floret was recorded in the treatment $K_0$ (5.32 cm). Higher dose of potassium i.e. 225 kg $K_2O$ $ha^{-1}$ has recorded maximum diameter of floret. This might be due to vital role of potassium in adequate amount to improve the crop quality. Parallel findings to this result have been cited by Patel *et al*. (2010) [6] in gladiolus.

The interaction effect (Table 1) due to nitrogen and potassium on diameter of floret of gladiolus was found to be non-significant.

### Yield

The significant differences in respect of gladiolus spikes $plot^{-1}$, corms $plot^{-1}$ and cormels $plot^{-1}$ (Table 1) amongst the different levels of nitrogen and potassium.

Significantly, maximum number of spikes, corms and cormels $plot^{-1}$ (93.50, 91.75 and 952.00, respectively) were recorded in the treatment $N_3$ which was found statistically at par with the treatment $N_2$ (90.50, 87.00 and 880.92, respectively). However, minimum number of spikes, corms and cormels $plot^{-1}$ were counted with the treatment $N_0$ (72.75, 60.50 and 715.50, respectively). The increase in number of spikes $plot^{-1}$ might be due to the adequate supply of nitrogen to the plants resulted in the proper development of required photosynthetic system which helped to increase the production of spikes. Similar increase in yield of spikes $plot^{-1}$ was also recorded by Yadav (2007) [10] in tuberose. Nitrogen at higher level enhanced the yield of gladiolus corms and cormelsplot$^{-1}$ as higher rate of nitrogen provides better growth and development and helps in translocation of photosynthates from source to sink (corms and cormels) which might have been resulted in an increase in the yield of corms and cormels $plot^{-1}$. Similar results were also reported by Jha *et al*. (2008) [2] in gladiolus, Rathore and Singh (2009) [7] in tuberose and Khan *et al*. (2012)[a] [3] in freesia.

In case of potassium, significantly maximum number of spikes, corms and cormels $plot^{-1}$ (94.50, 89.50 and 957.92, respectively) were recorded with the treatment $K_3$ which was followed by the treatment $K_2$ (87.75, 82.50 and 867.50, respectively). However, minimum number of spikes, corms and cormels $plot^{-1}$ were counted with the control treatment $K_0$ (73.75, 64.25 and 745.00, respectively). An increase in number of spikes, corms and cormels $plot^{-1}$ in gladiolus with the highest level of potassium might be due to increase in number of spikes, corms and cormels $plot^{-1}$. These results are in close conformity with the results of Talukdar *et al.* (2003) [9] in tuberose and Zubair (2011) [11] in gladiolus.

The interaction effect of nitrogen and potassium (Table 2) on spikes and corms $plot^{-1}$ was found to be significant, the treatment combination $N_2K_3$ had produced the maximum number of spikes and corms $plot^{-1}$ (102.00 and 104.00, respectively), which was found statistically at par with the treatment combinations $N_2K_2$ (100.00 and 102.00, respectively), $N_3K_3$ (98.00 and 100.00, respectively) and $N_3K_2$ (97.00 and 98.00, respectively) whereas, minimum number of spikes and corms $plot^{-1}$ were recorded under the treatment combination $N_0K_0$ (66.00 and 56.00, respectively). However, the interaction effect (Table 1) of nitrogen and potassium on cormels $plot^{-1}$ was found to be non-significant.

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**Table 1.** Growth, yield and quality of gladiolus as influenced by nitrogen and potassium.

| Treatments | leaf length (cm) | leaf width ($cm^2$) | Days to first spike emergence | Days to 50% flowering | Diameter of floret (cm) | Spike $plot^{-1}$ | Corms $plot^{-1}$ | Cormels $plot^{-1}$ |
|---|---|---|---|---|---|---|---|---|
| **Nitrogen (N)** | | | | | | | | |
| $N_0$-0 kg N $ha^{-1}$ | 56.35 | 1.58 | 54.67 | 66.25 | 5.17 | 72.75 | 66.50 | 715.50 |
| $N_1$-150 kg N $ha^{-1}$ | 61.15 | 1.71 | 56.00 | 67.83 | 5.40 | 78.00 | 69.00 | 807.50 |
| $N_2$-300 kg N $ha^{-1}$ | 63.77 | 1.79 | 57.00 | 70.83 | 5.97 | 90.50 | 87.00 | 880.92 |
| $N_3$-450 kg N $ha^{-1}$ | 66.39 | 1.86 | 61.00 | 73.92 | 6.21 | 93.50 | 91.75 | 952.00 |
| F test | Sig | Sig | Sig | Sig | Sig | Sig | Sig | Sig |
| SE (m) ± | 01.05 | 0.03 | 01.00 | 01.22 | 0.11 | 01.82 | 02.22 | 029.22 |
| CD at 5% | 03.01 | 0.08 | 02.90 | 03.52 | 0.31 | 05.24 | 06.41 | 084.31 |
| Potassium ($K_2O$) | | | | | | | | |
| $K_0$-0 kg $K_2O$ $ha^{-1}$ | 58.17 | 1.63 | 54.58 | 66.75 | 5.32 | 73.75 | 64.25 | 745.00 |
| $K_1$-75 kg $K_2O$ $ha^{-1}$ | 59.45 | 1.66 | 56.08 | 67.83 | 5.59 | 78.75 | 72.00 | 785.50 |
| $K_2$-150 kg $K_2O$ $ha^{-1}$ | 63.48 | 1.77 | 58.00 | 70.25 | 5.70 | 87.75 | 82.50 | 867.50 |
| $K_3$-225 kg $K_2O$ $ha^{-1}$ | 66.53 | 1.86 | 60.00 | 73.50 | 6.12 | 94.50 | 89.50 | 957.92 |
| F test | Sig | Sig | Sig | Sig | Sig | Sig | Sig | Sig |
| SE (m) ± | 01.05 | 0.03 | 01.00 | 01.22 | 0.11 | 01.82 | 02.22 | 029.22 |
| CD at 5% | 03.01 | 0.08 | 02.90 | 03.52 | 0.31 | 05.24 | 06.41 | 084.31 |
| Interaction effect (N x K) | | | | | | | | |
| F test | NS | NS | NS | NS | NS | Sig | Sig | NS |
| SE (m) ± | 02.09 | 0.05 | 02.01 | 02.44 | 0.22 | 03.63 | 04.44 | 058.45 |
| CD at 5% | - | - | - | - | - | 10.48 | 12.81 | - |

**Table 2:** Interaction effect of nitrogen and potassium on spikes and corms yield.

| Treatment combinations | Spikes $plot^{-1}$ | Corms $plot^{-1}$ |
|---|---|---|
| $N_0K_0$ | 66.00 | 56.00 |
| $N_0K_1$ | 67.00 | 56.00 |
| $N_0K_2$ | 70.00 | 58.00 |
| $N_0K_3$ | 88.00 | 72.00 |
| $N_1K_0$ | 68.00 | 58.00 |
| $N_1K_1$ | 70.00 | 64.00 |
| $N_1K_2$ | 84.00 | 72.00 |
| $N_1K_3$ | 90.00 | 82.00 |
| $N_2K_0$ | 72.00 | 64.00 |
| $N_2K_1$ | 88.00 | 78.00 |
| $N_2K_2$ | 100.0 | 102.00 |
| $N_2K_3$ | 102.00 | 104.00 |
| $N_3K_0$ | 89.00 | 73.00 |
| $N_3K_1$ | 90.00 | 90.00 |
| $N_3K_2$ | 97.00 | 98.00 |
| $N_3K_3$ | 98.00 | 100.00 |
| F test | Sig | Sig |
| SE (m) ± | 03.63 | 04.44 |
| CD at 5% | 10.48 | 12.81 |

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