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Effect of Chemicals on Growth and Yield of Gladiolus cv. American Beauty

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ABSTRACT

The study was conducted to find out the effect of GA_3 and chemicals on growth and yield of gladiolus at Nagpur during October, 2016 to April, 2017. The experiment was laid out in Randomized Block Design with three replications. The treatments comprised of three different chemicals viz., Gibberellic acid (GA_3), Potassium nitrate (KNO_3) and Calcium nitrate $Ca(NO_3)_2$ with eleven treatment combinations viz. T_1 (GA_3 100 ppm), T_2 (GA_3 200 ppm), T_3 (KNO_3 1%), T_4 (KNO_3 2%), T_5 $Ca(NO_3)_2$ 1%), T_6 ($Ca(NO_3)_2$ 2%), T_7 (GA_3 100 ppm+KNO_3 1%), T_8 (GA_3 200 ppm+KNO_3 2%), T_9 (GA_3 100 ppm+$Ca(NO_3)_2$ 1%), T_{10} (GA_3 200 ppm+$Ca(NO_3)_2$ 2% and T_{11} (control). The results revealed that, maximum vegetative growth in respect of height of plant (68.05), leaves plant^{-1} (28.97) and leaf area(172.19), earliest flowering in respect of first spike emergence(52.99), opening of first floret(63.29) and 50 per cent flowering(71.17), maximum flowering span(24.84) and longevity of flowers(15.94) in gladiolus were recorded with the treatment GA_3 200 ppm + $Ca(NO_3)_2$ 2%. Similarly, yield parameters like spikes plant^{-1} (2.90), corms plant^{-1}(2.96) and cormels plant^{-1}(45.13), spikes plot^{-1} (95.66), corms plot^{-1}(95.60) and spikes ha^{-1}(2.96),corms ha^{-1}(3.00) in gladiolus were recorded maximum with the treatment GA_3 200 ppm + KNO_3 2%.

Key words: *Gladiolus, Gibberellic acid, Spike, Corm, Potassium nitrate and Calcium nitrate.*

INTRODUCTION

Gladiolus (*Gladiolus grandiflorus* L.) is one of the most beautiful and fascinating bulbous cut flower. It is grown all over the world for its majestic flower spike with brilliant coloured flowers and regarded as "queen of bulbous plants". The gladiolus has a long and noble history. The Latin word "Gladius" means sword and hence it is often called as "sword lily" because of the shape of its leaves. Gladiolus was also called "Xiphium" based on the Greek word "Xiphos" also meaning sword. But in another sense, the gladiolus is a romantic flower as it signifies remembrance and it also expresses infatuation. The roots of the gladiolus plants were thought to be an aphrodisiac.

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Gladiolus magnificent inflorescence in a variety of colours is of widespread use in herbaceous borders, beddings, rockeries, pots and as cut flower crops which has great demand in both domestic and international market.There are over 180 known species of the gladiolus today, but only a few of them are found in most gardens. The orchid like flowers of the butterfly gladiolus and recently a strain of miniatures have also been introduced. The flowers open from the bottom up. The flowers may be frilly, ruffled or plain, solid colored or multicolored and they come in every shade and color combination imaginable. Most of these species are native to Mediterranean region and tropical part of South Africa, particularly the region of the "Cape of Good Hope".Gladiolus is a herbaceous plant which belongs to the family Iridaceae. Usually gladiolus plants are unbranched, leafy, leaves basal and sword shaped, less frequently linear or cylindrical. Flowers are showy in one sided spikes, irregular, born in two spathe values, perianth segment six united basically into curved, funnel form tube, stamens three, filaments not united, borne below the throat, entire; fruit a three valued capsule and the winged seeds are arranged in two rows in each locule. It has its natural habitat in the Mediterranean region and South Africa.In india gladiolus has become an important cut flower crop in the domestic flower markets of Delhi, Kolkata, Bangalore, Mumbai and Hyderabad. Gladiolus is a major crop grown in India with an area of 11.67 thousand hectare with the production of 50.70 thousand tons of loose flowers and 90.89 thousand metric tones of cut flowers. Gladiolus was grown in area of 1000 hectare with approximate production of 8000 metric tons of cut flowers in Maharashtra. Any attempt made to encourage cut flower production in the region not only helps the florists and consumers to get fresh and quality cut flowers regularly, but also helps the small and marginal farmers in the region to improve their economic condition[6]. Gibberellic acid, Potassium nitrate (KNO_3) and Calcium nitrate $Ca(NO_3)_2$ have been found to increase the plant height, leaves and shoots per plant and improve the spike quality[7] stimulate flowering and increase the yield of gladiolus spikes[1]. Therefore, the aim of present study was undertaken to find out the suitable concentration of the chemicals like Gibberellic acid, Potassium nitrate (KNO_3) and Calcium nitrate $Ca(NO_3)_2$ gibberellic acid and for the better growth and yield of gladiolus.

MATERIAL AND METHODS

A field experiment was carried out at Floriculture Unit, Horticulture section, College of Agriculture, Nagpur during October, 2016 to April, 2017. In Randomized Block Design with eleven treatment combinations viz. T_1 (GA_3 100 ppm), T_2 (GA_3 200 ppm), T_3 (KNO_3 1%), T_4 (KNO_3 2%), T_5 $Ca(NO_3)_2$ 1%), T_6 ($Ca(NO_3)_2$ 2%), T_7 (GA_3 100 ppm+KNO_3 1%), T_8 (GA_3 200 ppm+KNO_3 2%), T_9 (GA_3 100 ppm+$Ca(NO_3)_2$ 1%), T_{10} (GA_3 200 ppm+$Ca(NO_3)_2$ 2% and T_{11} (control) which were replicated thrice. These treatments were sprayed on gladiolus plants at 30, 45 and 60 days of planting.The experimental plot was ploughed and subsequent harrowing was done. After clod crushing the soil was brought to fine tilth. At the time of land preparation, well-rotten FYM @ 20 t ha^{-1} was mixed uniformly in the soil before last harrowing. The field was laid out into plots with raised beds of 1.80 m X 1.80 m size. The best quality gladiolus corms of medium size of the variety "American Beauty" were obtained from horticulture section, College of Agriculture, Nagpur (M.S.), India. Layout of raised beds was made in Randomized Block Design as per the treatments. Irrigation was given before the planting of gladiolus corms. The rested and cold stored gladiolus corms having corm size of medium (4 to 5 cm diameter) was separated and treated with copper fungicide before planting. After treatment of fungicide for 15 minutes, corms were planted on raised beds at 5 cm depth at spacing viz., 45 x 15 cm. Immediately after planting of gladiolus corms light irrigation was given for better establishment of the corms.

A recommended fertilizer dose of gladiolus i.e. 300:200:200 kg ha^{-1} was applied. Nitrogen was applied through urea, phosphorous through single super phosphate and potash through muriate of potash. 1/3 dose of nitrogen and full dose of phosphorous and potash was applied at the time of planting and the remaining 1/3 dose each of nitrogen was applied at two leaf and four leaf stages, respectively. The manures and fertilizers were applied 5 cm deep in rings and 5 cm away from the main shoot.Foliar spray of GA_3, KNO_3 and $Ca(NO_3)_2$ in the prescribed concentrations and combinations of the treatments was undertaken thrice at 30, 45 and 60 days after planting. The stock solutions of growth regulator and chemicals was prepared for spraying as per the following procedure - One hundered milligram of active substance of GA_3 was dissolved in 10 ml of acetone and final volume made upto 1000 ml by adding distilled water to prepare 100 ppm of GA_3 solution. And in the same manner, 200 ppm concentration of GA_3 solution has prepared.And one gram each of active substances of KNO_3 and $Ca(NO_3)_2$ was dissolved in distilled water and final volume made upto 100 ml by adding distilled water to prepare 1% KNO_3 and 1% $Ca(NO_3)_2$ solution. And in the same manner, 2% concentration of KNO_3 and $Ca(NO_3)_2$ solution has prepared. The growth regulator and chemicals were sprayed with the help of hand sprayer. The whole plant was sprayed completely by taking precaution to avoid the mixing of sprays from one treatment to another. All the cultural operations *viz*., Loosening of soil, weeding, irrigation, Earthing up, pest and disease control etc. were carried out as and when required. Observations on various vegetative characters *viz.*, height of plant, leaves $plant^{-1}$ and leaf area, earliest flowering in respect of first spike emergence, opening of first floret and 50 per cent flowering, maximum flowering span and longevity of flowers and yield parameters *viz.*, spikes $plant^{-1}$ and corms and cormels $plant^{-1}$, spikes and corms $plot^{-1}$ and ha^{-1}were recorded at proper stages and analysed statistically by the method suggested by Panse and Sukhatme[4].

RESULT AND DISCUSSION

Growth attributes

In this parameter the effect of chemicals on gladiolus were significant with respect to growth characters (Table 1). The treatment GA_3 200 ppm + $Ca(NO_3)_2$ 2% was recorded maximum plant height (68.05 cm) which was statistically at par with treatments GA_3 200 ppm + KNO_3 2% (66.07 cm), GA_3 200 ppm (64.77 cm), GA_3 100 ppm + $Ca(NO_3)_2$ 1% (63.83 cm), GA_3 100 ppm + KNO_3 1% (62.92 cm). Similarly, significantly maximum number of leaves (28.97) was recorded with the treatment GA_3 200 ppm + $Ca(NO_3)_2$ 2% which was statistically at par with the treatments GA_3 200 ppm + KNO_3 2% (28.33), GA_3 200 ppm (27.49), GA_3 100 ppm + $Ca(NO_3)_2$ 1% (27.32). Whereas, The treatment GA_3 200 ppm + $Ca(NO_3)_2$ 2% recorded significantly maximum leaf area (172.19 cm^2) at 50 per cent flowering which was found statistically at par with the treatment GA_3 200 ppm + KNO_3 2% (170.56 cm^2). However, significantly minimum plant height, leaves $plant^{-1}$ and leaf area at 50 per cent flowering stage was recorded in control. An increase in vegetative growth might be attributed to cell division, cell elongation and tissue differentiation. Significant effects were observed due to GA_3, while $Ca(NO_3)_2$ had little effect on vegetative growth. These results obtained during this investigation are in close agreement with the findings of Padmalatha *et al*.[3] in gladiolus reported with application of GA_3, and Soltani *et al*.[8] reported with $Ca(NO_3)_2$ in tarragon.

Flowering attributes

In this parameter the effect of chemicals on gladiolus were significant with respect to flowering characters (Table 1).The treatment GA_3 200 ppm + $Ca(NO_3)_2$ 2% which was significantly minimum days for first floret emergence (52.99 days) compared to other treatments and it was found statistically at par with the treatments GA_3 200 ppm + KNO_3 2% (54.77 days), GA_3 200 ppm (55.38 days), $Ca(NO_3)_2$ 2% (57.51 days), GA_3 100 ppm + $Ca(NO_3)_2$ 1% (58.28 days). Similarly, The treatment GA_3 200 ppm + $Ca(NO_3)_2$ 2% which was significantly minimum days for opening

of first floret (63.29 days) compared to other treatments, it was found statistically at par with the treatments GA_3 200 ppm + KNO_3 2% (65.17 days), GA_3 200 ppm (65.32 days), $Ca(NO_3)_2$ 2% (65.65 days), GA_3 100 ppm + $Ca(NO_3)_2$ 1% (66.08 days), GA_3 100 ppm + KNO_3 1% (67.77) and $Ca(NO_3)_2$ 1% (68.18), GA_3 100 ppm (69.19). Similarly, The treatment GA_3 200 ppm + $Ca(NO_3)_2$ 2% which was significantly minimum days for 50% flowering (71.17 days) compared to other treatments, which was found statistically at par with the treatments GA_3 200 ppm + KNO_3 2% (72.49 days), GA_3 200 ppm (73.38 days), $Ca(NO_3)_2$ 2% (74.18 days), GA_3 100 ppm + $Ca(NO_3)_2$ 1% (74.80 days), GA_3 100 ppm + KNO_3 1% (75.27 days), $Ca(NO_3)_2$ 1% (76.93 days). Earliness in flowering might be due to GA_3, it is quite effective in reducing the juvenile period of plants and higher capacity of cell division and elongation and causes flower initiation and besides Calcium has been proposed to be a secondary messenger for flower induction in several plants, Application of calcium nitrate increased floral bud break. These results are in close agreement with the findings of and Padmalatha *et al*.[3]in gladiolus, Ramsy *et al*.[5] in mango reported same results with application of $Ca(NO_3)_2$.

Flower yield

In this parameter the effect of chemicals on gladiolus were significant with respect to flower yield (Table 2). Significantly maximum spikes plant^{-1} (2.90) were noticed with the treatment GA_3 200 ppm + KNO_3 2% followed by GA_3 200 ppm + $Ca(NO_3)_2$ 2% (2.62), KNO_3 200 ppm (2.48), GA_3 200 ppm (2.39), GA_3 100 ppm + KNO_3 1% (2.30), $Ca(NO_3)_2$ 2% (2.23). Similarly, Significantly maximum number of spikes plot^{-1} (95.66) were noticed with the treatment GA_3 200 ppm + KNO_3 2% which was found statistically at par with the treatment GA_3 200 ppm + $Ca(NO_3)_2$ 2% (93.90), KNO_3 2% (92.79), GA_3 200 ppm (91.38), GA_3 100 ppm + KNO_3 1% (90.69), $Ca(NO_3)_2$ 2% (90.00), GA_3 100 ppm + $Ca(NO_3)_2$ 1% (89.37), KNO_3 1% (88.06), GA_3 100 ppm (86.70). Similarly, The treatment GA_3 200 ppm + KNO_3 2% showed significantly maximum number of spikes ha^{-1} (2.96 lakh) which was found statistically at par with the treatment GA_3 200 ppm + $Ca(NO_3)_2$ 2% (2.82 lakh), followed by KNO_3 2% (2.69 lakh), GA_3 200 ppm (2.57 lakh), GA_3 100 ppm + KNO_3 1% (2.45 lakh), $Ca(NO_3)_2$ 2% (2.34), GA_3 100 ppm + $Ca(NO_3)_2$ 1% (2.26) However, minimum flower yield was recorded in control. The floral yield of the plant was found more in combine treatment of GA_3 and KNO_3 as compared with the other treatments. These might be due to more production of food material in leaves, due to enhance physiological activities by both GA_3 and KNO_3 treatments, resulted in more spikes yield plant^{-1}, plot^{-1} and ha^{-1}. Similar type of results were also recorded by Karaguzel and Doron[2], Padmalatha *et al*.[3] reported similar results with the application of GA_3 in combination with KNO_3 in gladiolus.

CORM YIELD

In this parameter the effect of chemicals on gladiolus were significant with respect to corm yield (Table 2).Significantly maximum number of cormels plant^{-1} (45.13) were noticed with the treatment GA_3 200 ppm + KNO_3 2% which was found statistically at par with the treatment GA_3 200 ppm + $Ca(NO_3)_2$ 2% (42.57), followed by KNO_3 2% (39.82), GA_3 200 ppm (37.39), $GA_3$100 ppm + KNO_3 1% (34.28). Similarly, Significantly maximum number of corms plot^{-1} (95.60) were noticed with the treatment GA_3 200 ppm + KNO_3 2% which was at par with treatment GA_3 200 ppm + $Ca(NO_3)_2$ 2% (92.07), KNO_3 2% (90.72), GA_3 200 ppm (89.24), GA_3 100 ppm + KNO_3 1% (87.33). Similarly, Significantly maximum number of corms ha^{-1} (3.00 lakh) were noticed with the treatment GA_3 200 ppm + KNO_3 2% which was found statistically at par with the treatment GA_3 200 ppm + $Ca(NO_3)_2$ 2% (2.88 lakh), KNO_3 2% (2.76 lakh). Corm yield of the plant was found more in treatment combination of GA_3 and KNO_3 as compared with the other treatments in the experiment. These might be due to more production of food material in leaves and enhance physiological activities by both GA_3 and KNO_3

treatments, resulted in more corms yield plant^{-1}, plot^{-1} and ha^{-1} Similar type of results were also recorded by Karaguzel and Doron[2] , Padmalatha *et al*.[3] reported similar results with the application of GA_3 in combination with KNO_3 in gladiolus.

Table 1: Growth and Flowering of Gladiolus as influenced by different chemical treatments

Treatments	Plant height	Leaves plant^{-1}	Leaf area (cm^2)	Days for first spike emergence	Days for first floret opening	Days for 50% flowering
T_1-GA_3 100 ppm	57.13	24.56	118.25	61.09	69.19	79.19
T_2- GA_3 200 ppm	64.77	27.49	156.35	55.38	65.32	73.38
T_3- KNO_3 1%	55.16	22.89	101.90	63.17	71.91	81.46
T_4- KNO_3 2%	58.24	25.16	135.26	60.90	71.02	80.22
T_5- $Ca(NO_3)_2$ 1%	56.29	23.78	111.26	59.90	68.18	76.93
T_6- $Ca(NO_3)_2$ 2%	60.75	26.08	141.16	57.51	65.65	74.18
T_7- GA_3 100 ppm + KNO_3 1%	62.92	26.69	144.98	59.03	67.77	75.27
T_8- GA_3 200 ppm + KNO_3 2%	66.07	28.33	170.56	54.77	65.17	72.49
T_9- GA_3 100 ppm + $Ca(NO_3)_2$ 1%	63.83	27.32	148.98	58.28	66.08	74.80
T_{10}- GA_3 200 ppm + $Ca(NO_3)_2$ 2% **T_{11}- control**	68.05	28.97	172.19	52.99	63.29	71.17
SE(m)±	53.25	22.20	95.16	65.13	75.56	82.31
CD at 5%	Sig.	Sig.	Sig.	Sig	Sig.	Sig.
	1.81	0.76	3.95	1.81	2.00	2.34
	5.34	2.25	11.65	5.34	5.91	6.91

GA_3- Gibberellic acid
KNO_3- Potassium nitrate
$Ca(NO_3)_2$- Calcium nitrate

Table 2: Yield of Gladiolus as influenced by different chemical treatments

Treatments	Spike plant^{-1}	Spike plot^{-1}	Spike ha^{-1}	Corms plant^{-1}	Corms plot^{-1}	Corms ha^{-1}
T_1-GA_3 100 ppm	1.89	86.70	2.09	2.09	77.33	1.98
T_2- GA_3 200 ppm	2.39	91.38	2.57	2.52	89.24	2.65
T_3- KNO_3 1%	2.01	88.06	2.18	2.15	80.82	2.23
T_4- KNO_3 2%	2.48	92.79	2.69	2.63	90.72	2.76
T_5- $Ca(NO_3)_2$ 1%	1.76	83.23	1.95	1.98	74.30	1.85
T_6- $Ca(NO_3)_2$ 2%	2.23	90.00	2.34	2.36	85.69	2.40
T_7- GA_3 100 ppm + KNO_3 1%	2.30	90.69	2.45	2.41	87.33	2.53
T_8- GA_3 200 ppm + KNO_3 2%	2.90	95.66	2.96	2.96	95.60	3.00
T_9- GA_3 100 ppm + $Ca(NO_3)_2$ 1%	2.12	89.37	2.26	2.26	83.93	2.36
T_{10}- GA_3 200 ppm + $Ca(NO_3)_2$ 2% **T_{11}- control**	2.62	93.90	2.82	2.82	92.07	2.88
SE(m)±	1.66	77.04	1.71	1.58	68.51	1.66
CD at 5%	Sig.	Sig.	Sig.	Sig	Sig.	Sig.
	0.07	2.72	0.08	0.11	3.16	0.11
	0.21	8.02	0.23	0.32	9.31	0.33

GA_3- Gibberellic acid
KNO_3- Potassium nitrate
$Ca(NO_3)_2$- Calcium nitrate

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