



## Research Article

# RESPONSE OF GROWTH, FLOWERING AND CORM YIELD OF *GLADIOLUS* CV. PUNJAB MORNING TO PLANT GROWTH REGULATORS IN WINTER SEASON OF UTTARAKHAND TARAI REGION

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**Abstract:** An investigation was carried out to see the response of growth, flowering and yield of *Gladiolus* cv. Punjab Morning to plant growth regulators in winter season in winter season of Uttarakhand tarai region. Four growth regulators each at three levels viz., GA<sub>3</sub> (75, 100 and 125 ppm), BA (75, 100 and 125 ppm), ethrel (250, 500 and 750 ppm) and thiourea (250, 500 and 1000 ppm) along with control were used as treatment in this experiment. The concentration of GA<sub>3</sub> @ 100 ppm produced earlier sprouting (7.77 days), day to flowering (76.00 days), maximum plant height (78.79 cm), spike length (100.45 cm) and number of leaves (5.60). Maximum number of suckers (4.13) and number of corms/plot (68.33) were obtained from BA @ 75ppm. However, maximum value for number of florets (13.67), diameter of 2nd floret (8.33 cm) and weight of largest corm/plot (44.33 g) was recorded from GA<sub>3</sub> @ 125ppm, ethrel @ 250 ppm and thiourea @ 250ppm, respectively.

**Keywords:** BA, Ethrel, Gibberellic Acid, *Gladiolus*, Thiourea

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## Introduction

*Gladiolus* is an important and fascinating commercial cut flower crop of the world. It is known as queen of bulbous flowers. It belongs to the family Iridaceae and is native to Mediterranean region. It has brilliant florets with range of colours and long lasts in vase [18]. The crop is commercially propagated by corms and cormels. Dormancy is the physiological state which blocks the visible growth. But now some information is available on the physiological mechanism regulating bulb dormancy. Recently harvested corm and cormels of *Gladiolus* do not sprout directly even after placing under favourable growing conditions due to a period of dormancy which is regulated by changes in the levels of endogenous promotory or inhibitory substances [10]. Dormancy period of the *Gladiolus* corms ranges from 2 to 4 months under normal storage conditions [2]. Non-treated corms contain high concentrations of inhibitors and it was found that application of different growth regulators increased the concentrations of endogenous promoters in the corm tissue and decreased inhibitors within 24-h of treatments. The growth and development of plant is governed by internal factors, namely, hormonal and nutritional balances which manipulate the growth and flowering and play an important role for breaking dormancy in ornamental plants. Among the chemicals so far used, Benzyl adenine (BA) and Gibberellic acid (GA<sub>3</sub>) were found very effective. BA at 100 ppm was optimum to break the dormancy of *Gladiolus* cv. Friendship. Similarly, GA<sub>3</sub> induces the formation of hydrolytic enzymes which regulates the mobilization of reserves, ultimately resulting early sprouting of *Gladiolus* corm [4]. Also reported GA<sub>3</sub> is effective for seed germination, growth promotion, flowering and senescence inhibition [12].

## Materials and Methods

The experiment was carried out at Model Floriculture Centre, G. B. Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar (Uttarakhand) during winter season 2014. Medium sized (4-6 cm diameter) corms of Punjab Morning were collected from University germplasm. Four growth regulators viz; gibberellic acid (GA<sub>3</sub>), BA, ethrel and thiourea, each at three levels viz., (GA<sub>3</sub> 75, 100 and 125 ppm), (BA 75, 100 and 125 ppm), (Ethrel 250, 500 and 750 ppm) and

(Thiourea 250, 500 and 1000 ppm) including a water control were used as treatment in this experiment. The corms were dipped in the Bavistin @ 0.2 percent for 30 minutes, dried in shade for 24 hours and then soaked in the bio-regulators solutions for 24 hours and again dried in shade for 24 hours then finally, the treated corms from each treatment were planted in the open field, where fertilizers are distributed in the quantity of 200 kg urea, 225 kg TSP and 190 kg MoP and 10 tonne cowdung/ha as suggested by [20]. The experiment was laid out in the Randomized Block Design (RBD) with three replications. Total 585 corms were used in the field for all treatments. Full dose of cowdung, TSP and MoP were applied as basal dose and the urea was applied in two instalments, first at four leaves stage and second at spike initiation stage. Intercultural operations like weeding, watering, etc. were done as and when necessary. After recorded different data, the spikes of *Gladiolus* were harvested when the first floret show colour in the rachis. Data on different growth and yield parameters from some plants of each pot were recorded and analyzed statistically by using STPR computer package program.

## Result and Discussion

The results of the study regarding the response of *Gladiolus* plant to different plant growth regulators have been presented and possible interpretations have been made in here.

**Sprouting:** Perusal of data from [Table-1] indicates that during of investigation, the treatment of GA<sub>3</sub> @ 100 ppm had taken minimum number of days (7.77 days) for sprouting followed by 7.82 days in thiourea @500 ppm. And maximum (14.73 days) have recorded in ethrel@ 500 ppm. Comparable result was also reported by [14] which indicate that number of days to sprouting is genetic character as well as optimum dose of GA<sub>3</sub> is given to corms. The results show that pre-planting soaking of corms for 24 h was influencing the sprouting habit of corm over control. This might be due to optimum absorption of GA<sub>3</sub> by corms, which might have been further utilized for physiological processes to influence favourably the sprouting parameters.

Table-1 Response of vegetative growth of *Gladiolus* cv. Punjab Morning to plant growth regulators in winter season of Uttarakhand tarai region

Treatment	Sprouting (days)	No. of Suckers	Plant height at 30 days (cm)	Plant height at 60 days (cm)
GA <sub>3</sub> @ 75ppm	7.89	3.27	44.63	70.59
GA <sub>3</sub> @ 100ppm	7.77	3.07	49.26	78.79
GA <sub>3</sub> @ 125ppm	8.26	3.00	44.35	73.96
BA @ 75ppm	11.02	4.13	27.55	57.29
BA @ 100ppm	10.59	3.93	25.81	53.93
BA @ 125ppm	11.21	3.67	24.67	49.43
Ethrel @ 250ppm	12.91	3.07	31.68	65.24
Ethrel @ 500ppm	14.73	3.07	34.22	64.72
Ethrel @ 750ppm	13.13	3.00	35.73	66.32
Thiourea @ 250ppm	7.95	3.07	47.34	76.06
Thiourea @ 500ppm	7.82	3.00	48.97	76.96
Thiourea @ 1000ppm	9.15	3.27	46.55	76.65
Control	7.88	3.33	43.56	69.95
C.D.(P=0.05)	1.35	0.77	1.89	2.85

Table-2 Response of vegetative and floral growth of *Gladiolus* cv. Punjab Morning to plant growth regulators in winter season of Uttarakhand tarai region

Treatment	No. of leaves at 30 days (no.)	No. of leaves at 60 days (no.)	Day to flowering (days)	Spike length (cm)
GA <sub>3</sub> @ 75ppm	3.33	5.39	77.47	89.48
GA <sub>3</sub> @ 100ppm	3.60	5.63	76.00	100.45
GA <sub>3</sub> @ 125ppm	3.40	5.54	77.20	96.18
BA @ 75ppm	2.07	4.09	87.73	81.29
BA @ 100ppm	2.27	4.29	90.20	76.65
BA @ 125ppm	2.13	4.18	86.00	69.25
Ethrel @ 250ppm	2.40	4.90	83.80	92.27
Ethrel @ 500ppm	2.27	4.30	82.80	88.75
Ethrel @ 750ppm	2.33	4.42	82.73	90.27
Thiourea @ 250ppm	3.00	5.60	80.93	97.18
Thiourea @ 500ppm	3.13	5.19	82.07	97.26
Thiourea @ 1000ppm	3.00	5.16	82.33	99.09
Control	3.33	5.29	81.40	89.35
C.D.(P=0.05)	0.40	0.20	3.47	3.72

Table-3 Response of floral and yield parameters of *Gladiolus* cv. Punjab Morning to plant growth regulators in winter season of Uttarakhand tarai region

Treatment	Diameter of 2 <sup>nd</sup> floret (cm)	No. of florets (no.)	Number of corms/plot (in no.)	Weight of largest corm/plot (g)
GA <sub>3</sub> @ 75ppm	7.88	12.93	49.33	34.00
GA <sub>3</sub> @ 100ppm	7.68	12.13	44.00	29.33
GA <sub>3</sub> @ 125ppm	7.78	13.67	48.67	25.00
BA @ 75ppm	7.34	10.53	68.33	23.00
BA @ 100ppm	8.01	9.47	66.33	27.67
BA @ 125ppm	8.04	8.07	65.67	34.33
Ethrel @ 250ppm	8.33	11.53	47.33	34.67
Ethrel @ 500ppm	7.84	11.00	45.33	23.00
Ethrel @ 750ppm	7.59	11.60	40.00	26.33
Thiourea @ 250ppm	7.55	13.33	41.00	44.33
Thiourea @ 500ppm	8.13	13.47	45.00	36.67
Thiourea @ 1000ppm	8.19	13.47	50.00	32.33
Control	8.14	12.60	47.67	35.00
C.D.(P=0.05)	0.81	2.77	9.14	12.63

**Number of suckers:** Number of suckers is playing a vital role in *Gladiolus* cultivation which mean a greater number of suckers have ability to produce more number of spikes which is beneficial for the commercial grower's to get maximum price from the a piece of land. In this investigation [Table-2] maximum numbers of suckers (4.13) was recorded in BA @ 75 ppm followed by 3.93 in BA @100 ppm and minimum (3.00) were recorded under the treatment thiourea @ 500 ppm. This result is in full agreement with [5] who stated that the number of suckers increased with decreasing level of BA.

**Plant height:** Plant height of the *Gladiolus* was influenced to plant growth regulators as shown in [Table-1]. Highest value was observed under GA<sub>3</sub> (100 ppm) treatment at 30 and 60DAP (49.26 and 78.79 cm) respectively, followed by thiourea @ 500 ppm (48.97 and 76.96 cm) respectively, whereas the lowest plant height was recorded in the BA @ 125 ppm (24.67 and 49.43 cm) respectively. These findings are in consonance with the report of [19] in *Gladiolus*. It might be due to optimum concentration of GA<sub>3</sub> promote vegetative growth by inducing active cell division in the apical meristem and promoting DNA synthesis in cells. The increase in vegetative growth characters as a result of GA<sub>3</sub> application is in close agreement with the findings of [3, 13].

**Number of leaves:** The number of leaves per plant was affected significantly to plant growth regulators as exposed in [Table-2]. Result revealed that number of leaves per plant was recorded more in case of GA<sub>3</sub> @ 100 ppm at 30 and 60 DAP (3.60 and 5.63) respectively, as compared to followed by GA<sub>3</sub> @ 125 ppm at 30 and 60 DAP (3.40 and 5.54) respectively. A significantly different data was recorded in both stages 30 and 60 DAP (2.07 and 4.09) from the BA @ 75 ppm treatment in [Table-2]. The numbers of leaves per plant was increased with increasing level of plant height and given GA<sub>3</sub> treatment in optimum quantity (100 ppm) which promotes vegetative growth of the plant. A similar finding was also reported by the [19] in *Gladiolus*.

**Days to flowering:** The data existing in [Table-2] that application of GA<sub>3</sub> have significantly hastened flowering as compared to control, BA, ethrel and thiourea have delayed flowering. Use of diverse plant growth regulators with different concentrations on *Gladiolus* cv. Punjab Morning where as the most effectual treatment found for earlier flowering in *Gladiolus* is GA<sub>3</sub> @ 100 ppm which took minimum days to flowering 76.00 days at par with GA<sub>3</sub> @ 125 ppm (77.20 days). The flowering was very late in BA @ 100 ppm (90.20 days). Earlier flowering has been found under GA<sub>3</sub> @ 100 ppm treatment that may be due to early sprouting

which also found in the same treatment. A similar finding was found in the *Gladiolus* which is reported by [19] in *Gladiolus*.

**Spike length (cm):** Spike length play a major role in *Gladiolus* which should be optimum at harvesting stage to get best price from the clients it's publicized in [Table-2]. Among the various treatments GA<sub>3</sub> @ 100 ppm obtained maximum spike length followed by 99.09 cm in thiourea @ 1000 ppm and shortest spikes (76.65 cm) were recorded with BA @ 100 ppm. The present findings are closer to the results of [19] where they found maximum length of spike in the GA<sub>3</sub> (100 ppm) treatment over the other treatments. Gibberellic acid might have increased auxin content in tissue as it is involved in auxin synthesis and it enhanced vegetative growth in early phase due to increased photo synthesis and CO<sub>2</sub> fixation. Further exogenous application of GA<sub>3</sub> would have favoured the convenience of factors influencing floral initiation i.e., carbohydrate pathway and photo periodic pathway with GA<sub>3</sub> pathway.

**Diameter of 2<sup>nd</sup> floret (cm):** Result showed that diameter of 2<sup>nd</sup> floret was higher in ethrel @ 250 ppm then thiourea @ 1000 ppm and the lowest value recorded in BA @ 75 ppm as compare to other treatment these revealed in [Table-3]. These investigated findings are similar to the declaration of [9] in *Gladiolus*.

**Number of florets/spike:** The highest value in number of florets/spike was noticed from the application of GA<sub>3</sub>@ 125 ppm (13.67) than thiourea @ 1000 ppm (13.47) and lowest in BA @ 125 ppm (8.07). The maximum number of florets/spike was recorded in the higher application (125 ppm) of GA<sub>3</sub> in given treatments [Table-3]. These results are in agreement with the findings of [16] where they stated that; number of florets/spike was highest in the higher concentration of given GA<sub>3</sub> treatment. According to [19] gibberellic acid enhances rapid development in cell elongation and cell division and also vegetative growth and floral initiation.

**Number of corms/plot:** Number of corms/plot was not influenced significantly from the different doses of plant growth regulators. But somewhat BA @ 75 ppm produced the maximum (68.33) corms/plot as compared to ethrel @ 750 ppm which produced minimum corms/plot (40.00). This might be due to enhancement of cell division by the application of BA. These findings are somewhat closer to the findings of [7] they recorded maximum number of corms/plot in BA treatments.

**Weight of largest corm/plot (g):** The weight of largest corm/plot also influenced by the treatment of various plant growth regulators which publicized in [Table-3]. Lower concentration of thiourea (250 ppm) produced the heaviest daughter corm (44.33 g) followed by 36.67 g observed in thiourea @ 500 ppm and minimum weight (23.00 g) found in the treatment of BA @ 75 ppm and ethrel @ 500 ppm. These findings are closer to the statement of [6] which reported that the heaviest weight of daughter corm/plot was observed in thiourea.

## Conclusion

Among the growth regulators, GA<sub>3</sub> @ 100 ppm broke the dormancy of corms early days and showed better performance in terms of growth and flowering parameters. The lower concentration of BA showed maximum suckers and corms yield and diameter of 2<sup>nd</sup> florets and weight of largest corm/plot was recorded from ethrel @ 250 ppm and thiourea @ 250 ppm, respectively.

**Application of research:** GA<sub>3</sub> @ 100 ppm has been found most effective in case of plant height, number of leaves, early flowering and spike length. On the bases of present investigation GA<sub>3</sub> @ 100 ppm may be recommended.

**Research Category:** Plant Growth Regulators

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**Study area / Sample Collection:** Model Floriculture Centre, G. B. Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar

**Cultivar / Variety name:** *Gladiolus* cv. Punjab

**Conflict of Interest:** None declared

**Ethical approval:** This article does not contain any studies with human participants or animals performed by any of the authors.

Ethical Committee Approval Number: Nil

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