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Plant growth regulator mediated biochemical changes in corms of gladiolus (*Gladiolus grandiflorus* L.) cv. American beauty

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Abstract
Gladiolus is one of the most popular cut flowers for its majestic spikes. An experiment was conducted to study the effect of Gibberellic acid (GA_3), N^6- Benzyl adenine (BA) and Triacontanol each at 25 ppm, 50 ppm and 100 ppm on the biochemical changes in the corms of Gladiolus (*Gladiolus grandiflorus* L.) cv. American Beauty following RBD with 10 treatments replicated thrice grown at Uttar Banga Krishi Viswavidyalaya, India from October, 2013 to April, 2014. Application of GA_3 @ 50 ppm increased non-reducing sugar content of corms (0.665 mg/ g of fresh weight) and corm protein content (6.02 mg/g of fresh weight) whereas, Triacontanol @ 50 ppm improved phenol content of corms (1.07 mg/g of fresh weight) but, Triacontanol @ 100 ppm improved the reducing sugar content (4.089 mg/ g of fresh weight) and enzyme activity of corms (2.73 Δ490nm/min/g fresh weight).

Keywords: Gladiolus, plant growth regulators, triacontanol, GA_3, BA

1. Introduction
Gladiolus is a monocotyledonous, perennial bulbous flowering plant belongs to the plant family *Iridaceae* [1], originated from Mediterranean region and South Africa [2]. Gladiolus is the one of the most popular cut flower in the world for its majestic spikes [3].The spikes are very attractive and elegant which is containing various coloured florets with long vase-life and hence it is called as 'Queen of the Bulbous flowers' [4]. It is called as 'Sword lily' because of its sword like leaves. Gladiolus hold fourth place as a cut flower in international market after Rose, Carnation and Chrysanthemum [5]. Cut flower trade has become a profitable enterprise for many flower growing countries like United States, Holland, Netherland, Thailand, Italy, France, Polland, Bulgaria, Brazil, India, Australia and Israel etc. [6]. In India, the major gladiolus growing states are West Bengal, New Delhi, Jammu and Kashmir, Uttar Pradesh, Maharashtra, Tamil Nadu etc. [7]. In West Bengal, the major producing districts are Darjeeling, Midnapore (East & West), Nadia, Jalpaiguri, Howrah, North 24-Pargana etc. [8]. Besides cut flowers, the corms of *G. edulis* are consumed by roasting them and *G. quartinianus* corms were used as food and cooking beverage in Bassa (Africa). Ancient Greek used the roasted corms of *G. italicus* as food. *G. apicatus* is used as food by Lakoja tribe (Africa) and *G. zambesiacus* by Njelekwas of East Africa [9]. De Meyer (1982) [10] stated that the corms of Psittacinus Hybrid contained high amount of carbohydrates mostly as starch (65.4 to 78.61%) and protein (12.6 to 18.5%). The corms contained pentosan (2.91%), fat (0.58%), saponin and ash (sulphated, 3.48%) and after thorough extraction, glucose, xylose and arabinose were also found in corms. Amino acid analysis revealed the presence of glycine, threonine, glutamic acid, alanine, proline, tyrosine, valine isoluecine and some unidentified compounds in Gladiolus [11].

Plant growth regulators are the organic chemical compounds which influence the plant growth, crop yield and flower quality by altering the plant physiological process when applied in very minute quantity [12] which enhance the source-sink relationship or stimulate the translocation of photo-assimilates thereby influencing the plant growth, flower formation, fruit development, seed development and ultimately enhance the productivity of the crops [13]. Among the different groups of plant growth regulators, three potential compounds namely - Gibberellic acid (GA_3), N^6 Benzyl Adenine (BA) and Triacontanol have been chosen for this experiment to evaluate the effect of those plant bioregulators on the biochemical changes occurred in Gladiolus corms as BA and GA_3 are well reputed for growth promoting and storage reserve enhancing activities and the plant growth regulatory activity of triacontanol, a 30 carbon

containing alcohol having a molecular weight of 438, was first discovered by Ries *et al.* (1977) [14] in alfalfa (*Medicago sativa* L.)

2. Material and Methods

The details of the site of experiment, materials used and methodology adopted during the course of study are discussed herewith.The experiment was conducted following randomized block design with 10 treatments replicated thrice under optimum tilth.The data were analysed according to the Fisher's analysis of variance techniques using mstatC software. Healthy, disease-free corms of Gladiolus cv. American Beauty were selected, treated with Carbendazim 50 WP (Bavistin) @1g/ lit of water for an hour at 7 days prior to planting and the weight and diameter of the corms were measured before planting (Table – 1).

Table 1: Average weight and diameter of corms before planting

Treatment	Diameter of corm before planting (mm)	Weight of corm before planting (g)
T_0	39.16	22.50
T_1	40.56	26.00
T_2	38.97	21.67
T_3	37.82	20.83
T_4	37.46	20.83
T_5	38.28	21.67
T_6	38.36	21.39
T_7	37.05	20.00
T_8	38.69	22.78
T_9	39.12	22.78
$S.E_m\pm$	1.2401	1.2820
C.D at 5%	NS	NS

The treatment details along with notations are presented herewith.

T_0	Control
T_1	GA_3 @ 25 ppm
T_2	GA_3 @ 50 ppm
T_3	GA_3 @ 100 ppm
T_4	BA @ 25 ppm
T_5	BA @ 50 ppm
T_6	BA @ 100 ppm
T_7	Triacontanol @ 25ppm
T_8	Triacontanol @ 50 ppm.
T_9	Triacontanol @ 100 ppm

Time of application of plant growth regulators: The plant growth regulator solutions were applied twice – one as dipping of corms in solutions before planting (for six hours) and second at 21 days after planting at vegetative growth stage (spraying of solutions).

- The reducing sugar in the corms of Gladiolus cv. American Beauty was estimated following the method of Nelson, N. (1944) and read the absorbance of blue colour at 620 nm. [15]
- The non-reducing sugar from the corms of gladiolus was measured through the processes followed by Nelson, N. (1944) and read the absorbance at 620nm. [15]
- The corm protein concentration was analyzed by Lowry's method (1951) [16]. It was calculated against the BSA standard curve. All the parameters were expressed as mg/g fresh weight of tissue.
- Enzyme (Peroxides) activity was determined as observed in Sadasivam and Manickam (1996) [17] and expressed as Δ490nm/min/g fresh weight of tissue. [16]
- The total phenol content of corm was estimated using Folin-ciocalteau reagent following the method of Malick and Singh (1980) [18] and expressed as mg/g fresh weight of tissue.

3. Results and Discussion

3.1. Reducing sugar content of corms

The effect of plant growth regulators on the reducing sugar content in corms of gladiolus cv. American Beauty was found statistically non-significant. Corms and plants treated with Triacontanol @ 100 ppm showed the highest reducing sugar content (4.089 mg/g of fresh weight) at this stage. The reducing sugar content was found minimum (4.052 mg/g of fresh weight) with GA_3 @ 100 ppm (Table – 2).

3.2. Non-reducing sugar content of corms

The effect of plant growth regulators on the non-reducing sugar estimation in the corms of gladiolus cv. American Beauty was found statistically non-significant. Corms and plants treated with GA_3 @ 50 ppm showed the highest non-reducing sugar content (0.665 mg/g of fresh weight). The non-reducing sugar content was found minimum (0.637 mg/g of fresh weight) with BA @ 25 ppm treatment (Table – 2).

3.3. Corm protein content

The effect of plant growth regulators on protein content of gladiolus corms cv. American Beauty was found statistically significant. Corms and plants treated with GA_3 @ 50 ppm produced highest corm protein content (6.20 mg/g of fresh weight) which was statistically at par with the effect of BA @100 ppm (6.05 mg/g of fresh weight) and Triacontanol @ 25 ppm (5.94 mg/g of fresh weight). Corm protein content was found minimum (1.67 mg/g of fresh weight) with Triacontanol @ 100 ppm treatment (Table – 2).

3.4. Enzyme activity of corm

Statistically significant effect was observed on the enzyme activity of corms of gladiolus when treated with plant growth regulators at varied levels (Table – 2). Corms and plants treated with Triacontanol @ 100 ppm showed the maximum enzyme activity (2.73 Δ490nm/min/g fresh weight) of gladiolus which was statistically at par with the effect of control (2.60 Δ490nm/min/g fresh weights) and GA_3 @ 50 ppm (2.40 Δ490nm/min/g fresh weight). The minimum enzyme activity of corms was obtained from BA and Triacontanol @ 25 ppm (1.93 Δ490nm/min/g fresh weight) treatments.

3.5. Corm phenol content

The effect of plant growth regulators on the phenol content in corms of gladiolus cv. American Beauty was found statistically non-significant (Table 2). Corms and plants treated with Triacontanol @ 50 ppm showed the highest phenol content (1.07 mg/g of fresh wt) and Triacontanol @ 25 ppm showed the minimum (0.19 mg/g of fresh weight).

Table 2: Effect of plant growth regulators on enzyme activity, reducing sugar, non-reducing sugar, protein and phenol content of corms of Gladiolus cv. American Beauty

Treatment	Reducing Sugar content of Corm (mg/g of fresh weight)	Non Reducing Sugar content of Corms (mg/g of fresh weight)	Corm protein content (mg/g of fresh weight)	Enzyme activity of Corm (Δ490nm/min/g fresh weight)	Corm Phenol content (mg/g of fresh weight)
T_0	4.075	0.647	2.75	2.60	0.20
T_1	4.068	0.651	4.54	2.07	0.55
T_2	4.063	0.665	6.20	2.40	0.62
T_3	4.052	0.639	3.50	2.27	0.28
T_4	4.053	0.637	3.15	1.93	0.27
T_5	4.070	0.649	2.96	2.07	0.49
T_6	4.083	0.643	6.05	1.93	0.38
T_7	4.069	0.639	5.94	1.93	0.19
T_8	4.072	0.647	3.50	1.80	1.07
T_9	4.089	0.659	1.67	2.73	0.72
S. $E_m\pm$	*0.02*	*0.01*	*0.30*	*0.15*	*0.25*
C.D at 5%	NS	NS	0.89	0.43	NS

In the present experiment application of GA_3 @ 50 ppm increased the non-reducing sugar content of corms (0.665 mg/ g of fresh weight) and corm protein content (6.02 mg/g of fresh weight). Improvement of growth and flowering of gladiolus through exogenous application of GA_3 can be attributed to enhance the source-sink relationship or to stimulate the translocation of photo-assimilates was also observed by Khan *et al.*, (2013) [19] in gladiolus. It is a growth promoter in several crop plants like ginger [20]. In the present experiment application of Triacontanol @ 50 ppm improved phenol content of corms (1.07 mg/g of fresh weight). Triacontanol @ 100 ppm improved the reducing sugar content of corm (4.089 mg/ g of fresh weight) and enzyme activity of corm tissues (2.73 Δ490nm/min/g fresh weight). Triacontanol improves the better root development, resulting effective utilization of nutrient as well as improved the photosynthetic activity in crops and thus increases flowering, reduces flower and fruit drop, improves nitrogen fixation, enzyme activities, free amino acids, reducing sugars and soluble protein of plants as observed by Ries (1985) [21] and Ries (1991) [22]. Exogenous application of Tricontanol improved the growth and flowering in plants may be due to their triggering effect on photosynthesis. In other words it enhances the rate of photosynthesis in plant thereby improving growth and flowering. Triacontanol-mediated improvement in growth, yield, photosynthesis, protein synthesis, uptake of water and nutrients, nitrogen-fixation, enzymes activities and contents of free amino acids, reducing sugars, soluble protein, and active constituents of essential oil were observed in various crop plants [22-25]. It enhances the physiological efficiency of the cells and exploits the genetic potential of plant to a large extent. In fact, it increased free amino acids, reducing sugars, and soluble protein of rice (*Oryza sativa* L.) and maize (*Zea mays* L.) [22].

5. Summary and Conclusion

In the present experiment application of GA_3 @ 50 ppm increased the non- reducing sugar and protein content of Gladiolus corms. Application of Triacontanol @ 50 ppm increased the phenol content of corm and Triacontanol @ 100 ppm resulted the maximum content of reducing sugar and improving enzyme activity in corms. These two Plant Growth Regulators increased storage reserve in corms which might be ultimately reflected in growth and production and hence considered as promising for Gladiolus cultivation.

6. References

1. Manning J, Peter G. The Iris Family: (1st.Ed.) Natural History and Classification. Portland, Oregon: USA. Timber Press. 2008, 138-142.
2. Lewis GJ, Obermeyer AA, Barnard TT. Gladiolus-A revision of the South African species. Journal of South African botany. Supplementary of 10. 1972, 1-316.
3. Sinha P, Roy SK. Plant regeneration through *In vitro* cormel formation from callus culture of gladiolus primulinus Baker. Plant tissue culture. 2002; 12(2):139-145.
4. Bushman JCM. Gladiolus as a cut flower in subtropical and tropical regions. In: Shaukat, S. A.; Shah, S. Z. A.; Shaukat, S. K. and Shoukat, S. W. (2013). Performance of Gladiolus (*Gladiolus grandiflora* L.) cultivars under the climatic conditions of baghazad Jammu and Kashmir Pakistan. Journal of Central European Agriculture. 1990; 14(2): 158-167.
5. Farhat T. Plant characteristic and vase life of gladiolus flowers as influenced by the preharvest and NPK application and postharvest chemical treatment. M.Sc. (Hons). Thesis, PirMehr Ali Shah- Arid Agriculture University, 2004, 2.
6. Memon N. Introduction of Establishing protocols for the propagation of gladiolus. Institute of Horticultural Sciences, University of Agriculture, Faisalabad, Pakistan. 2009, 1-191.
7. Mukhopadhyay A. Gladiolus. M/s Vinayak Press, B-177/1, Okhla Industrial Area, Phase-1. New Delhi. 2002, 2.
8. Anonymous. Area, production & productivity of flowers in west Bengal. Directorate of Horticulture, Government of West Bengal, 2014.
9. Uphof JCT. Dictionary of economic plants, 2nd edn. (1 st edn. 1959). Cramer, Lehre, 1968, 591.
10. De Meyer Jr. Family Food Garden, August-September issue. 1982, 46-49.
11. Khan G, Kapoor VP, Farooqi MIH. Indian Journal of Horticulture. 1980; 37:182-184.
12. Nuvale MU, Aklade SA, Desai JR, Nannavare PV. Influence of PGR's on growth, flowering and yield of chrysanthemum (*Dendranthem grandiflora* Tzvelev) cv. 'IIHR-6'. International Journal of Pharma and Bioscience. 2010; 1(2):1-4.
13. Amanullah MM, Sekar S, Vincent S. Plant growth substance in crop production: A review. Asian Journal of plant Sciences. 2010; 9(4):215

14. Ries SK, Wert VF, Sweelev CC, Leavitt RA. Triacontanol: a new natural occurring plant growth regulator. Science. 1977; 195:1339-1341.
15. Nelson N. A photometric adaptation of the Somogyi method for the determination of glucose. Journal of Biological Chemistry. 1944; 153:375-380.
16. Lowry OH, Rosebrough NJ, Farr AL, Randall RJ. Protein Measurement with the Folin Phenol Reagent. Journal of Biology and Chemistry. 1951; 193:265-275.
17. Sadasivam S, Manickam A. Biochemical methods. 2nd Edn, New Age International Publishers, 1996, 107-109.
18. Malik EP, Singh MB. Plant Enzymology and Hittoenzymology (1st Edn.). Research Journal of Pharmaceutical, Biological and Chemical Science, 1980, 286.
19. Khan FN, Rahman MM, Hossain MM. Effect of Benzyladenine and Gibberellic Acid on Dormancy Breaking, Growth and Yield of Gladiolus Corms over Different Storage Periods. Journal ornamental and horticultural plants. 2013; 3(1):59-71.
20. Singh M, Khan MMA, Moinuddin, Naeem M. Augmentation of nutraceuticals, productivity and quality of ginger (*Zingiber officinale* Rosc.) through triacontanol application. Plant Biosystems. 2012; 146(1):106-113.
21. Ries SK. Regulation of plant growth with triacontanol. Critical Reviews in Plant Sciences. 1985; 2:239-285.
22. Ries S. Triacontanol and its second messenger 9-b-L (+)-adenosine as plant growth substances. Plant Physiology. 1991; 95:986-989.
23. Aftab T, Khan MMA, Idrees M, Naeem M, Singh M, Ram M. Stimulation of crop productivity, photosynthesis and artemisinin production in *Artemisia annua* L. by triacontanol and gibberellic acid application. Journal of Plant Interact. 2010; 5:273-281.
24. Idrees M, Khan MMA, Aftab T, Naeem M. Synergistic effects of gibberellic acid and triacontanol on growth, physiology, enzyme activities and essential oil content of *Coriandrum sativum* L. The Asian Australasian Journal of Plant Science Biotechnology. 2010; 4:24-29.
25. Naeem M, Khan MMA, Moinuddin Idrees M, Aftab T. Triacontanol-mediated regulation of growth and other physiological attributes active constituents and yield of *Mentha arvensis* L. Plant Growth Regulation. 2011; 65:195-206.