Plant Archives Vol. 26, No. 1, 2026 pp. 380-384 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2026.v26.no.1.052

ASSESSMENT OF PLANT GROWTH REGULATORS ON VASE QUALITY AND POST-HARVEST PHYSIOLOGY OF GLADIOLUS (*GLADIOLUS GRANDIFLORUS* L.) VAR.PUSA SHANTI

Vikas Yadav*,Rupali Sharma, K.M. Roomaand Manisha

Department of Horticulture, COA,C.C.S. Haryana Agricultural University, Hisar-125004, Haryana, India
*Corresponding author E-mail: vikasydv100@gmail.com

(Date of Receiving-16-12-2025; Date of Revision-23-02-2026; Date of Acceptance-05-03-2026)

ABSTRACT

An experimental study was conducted at the Horticulture Farm, Department of Horticulture, CCS Haryana Agricultural University, Hisar, to investigate the Effect of plant growth regulators on corm and cormels production in gladiolus (*Gladiolus grandiflorus* L.) var. Pusa Shanti. The experiment involved the application of different concentrations of various plant growth regulators, namely gibberellic acid (GA_3), naphthalene acetic acid (NAA), indole-3-butyric acid (IBA), and chlormequat chloride (CCC), to assess their effects on post harvest parameters of gladiolus. The results showed that treatment T3 (GA_3@150ppm) gave best results in terms of post-harvest attributes *i.e.* earliest floret opening (1.33days), floret diameter (7.70cm), maximum number of open florets at 1st floret withering (9.00), days to wither 5th floret (12.00), total open florets percent (79.51%), water uptake (100.45ml) and minimum spike weight loss percent *i.e.* 34.17% ensuring better shelf life and marketability which offers better practical insights for growers who are aiming to optimize floriculture productivity and profitability.

Key words: Gladiolus, Post-harvest attributes, GA_3, IBA, NAA and CCC

Introduction

Gladiolus, which is also known as Sword Lily or queen of bulbous flowers, is a flowering genus plant is a perennial plant which belongs to Iridaceae family and is known for its tall spikes and a wide range of colors , attractive shapes, varying sizes and numerous forms suited for different tastes and purposes due to which they have gained popularity in floriculture all over the world. This flower has around 260 species and has basically originated from Sub-Saharan and Mediterranean region. New flower models and genotypes have been developed in this plant through selection and hybridization techniques which leads to the development of new and prominent floral traits (Ranjan *et al.*, 2010). It has basic chromosome number n=15 and majority of South African species are diploid (2n=30). It is usually propagated by corms (which is a short, vertical, underground stem that stores food of a plant) of size 3-4 cm in diameter and is perennial in nature *i.e.* one mother corm produces two to three corms per plant which can be further used to propagate this beautiful plant while other methods of propagation is through seeds and cormels. Its inflorescence is known as spike which bears a large number of florets which open from bottom to top, which makes it excellent cut flower and popular for their fragrance and can be used in flower exhibitions, bouquet formation, Veni and oil extraction etc.

Post-harvest management practices are to be assessed in a best way to fetch maximum market value of the flower. Due to the perishable nature of flower after harvesting they lose their freshness, flower quality and longevity which is a major challenge among cut flower industry.

Different plant growth regulators play different roles in postharvest activity of plants when applied in their different amount of concentrations like GA_3, NAA, IBA and CCC. Gibberellic acid (GA_3) enhances spike elongation, promotes uniform floret opening, and improves water uptake, thereby extending vase life and maintaining ornamental value. Indole-3-butyric acid (IBA) supports better root development when used in planting stages but also contributes indirectly to post-harvest quality by improving nutrient accumulation and overall plant vigor, which reflects in healthier spikes at harvest. Naphthalene acetic acid (NAA) reduces floret drop, delays senescence, and maintains membrane stability, ultimately improving the longevity and freshness of cut flowers. Chlormequat chloride (CCC), being a growth retardant, strengthens stems, increases dry matter accumulation, and improves water balance in spikes, which collectively contribute to delayed senescence and better post-harvest stability. Moreover, GA_3 helps sustain energy flow and turgidity across multiple florets, delaying premature senescence and supporting progressive bloom (Tawar *et al.*, 2002).

Overall, the use of GA_3, IBA, NAA, and CCC enhances vase life, floret opening, freshness, structural strength, and visual appeal of Gladiolus spikes. Their combined or individual application improves post-harvest handling quality, making them highly effective tools in maintaining the commercial value of cut Gladiolus flowers.

Hence the present study was carried out to find the effect of growth regulators on post-harvest attributes (Distilled water) in gladiolus (*Gladiolus grandiflorus* L.) var. Pusa Shanti.

Materials and Methods

The present experiment was conducted at the Horticulture Farm, adjacent to the nursery area, and in the Post-Harvest Laboratory of the Department of Horticulture, College of Agriculture, CCS Haryana Agricultural University (CCS HAU), Hisar, Haryana. Geographically, the experimental site is situated in western Haryana at 29.09°N latitude and 75.43°E longitude, with an elevation of 215 meters above mean sea level. The region experiences a semi-arid subtropical climate, characterized by hot, dry winds during summer and severe cold during the winter season. The study comprised 13 treatment combinations involving pre-sowing dipping of gladiolus corms in different concentrations of plant growth regulators (PGRs) such as gibberellic acid (GA_3), naphthalene acetic acid (NAA), indole-3-butyric acid (IBA), and chlormequat chloride (CCC). Each treatment involved soaking the corms for 24 hours prior to planting. The experiment was laid out in a Randomized Block Design (RBD) with three replications, resulting in a total of 39 experimental units.

Table 1: Treatment Details.

Treatment details		
T1- Control	T5- NAA@ 100 ppm	T9- IBA @150 ppm
T2- GA_3@ 100ppm	T6- NAA @150 ppm	T10- IBA @ 200ppm
T3-GA_3@ 150 ppm	T7- NAA @200 ppm	T11- CCC@ 600 ppm
T4-GA_3 @ 200ppm	T8- IBA @ 100ppm	T12- CCC@ 650ppm
		T13- CCC @ 700ppm

In each plot corms were planted at a spacing of 30 cm × 20 cm. Uniform, healthy, and disease-free corms of gladiolus (*Gladiolus grandiflorus*) variety ‘Pusa Shanti’, with an average diameter of approximately 3.0 cm, were selected for planting. Prior to PGR treatment, the corms were subjected to surface sterilization to eliminate any surface-borne fungal pathogens. For this, a 0.1% solution of carbendazim (Bavistin 50 WP) was prepared by dissolving 30 g of the fungicide in 30 litres of water. The corms were immersed in this solution for 30 minutes and then removed and air-dried under shade to remove excess moisture and allow uniform surface drying then the corms were immersed in their respective PGR solutions for a period of 24 hours, according to the treatment schedule. Immediately after the completion of this pre-sowing treatment, the corms were planted in the well-prepared experimental field on 28th October 2024 at a depth of 5 cm.

Results and Discussions

The data pertaining to the days to first floret opening and floret diameter (cm) were shown in the Fig. 1 and Fig. 2 respectively. Days to first floret opening signifies early aesthetic appeal and consumer acceptance and it was observed among the treatments that the earliest opening of floret (1.33 days) was recorded in T3 (GA_3 @ 150 ppm) which was followed closely by T4 (GA_3@200 ppm) and T2 (GA_3@100 ppm) *i.e.* 1.41 and 1.75 days respectively. On the other hand, maximum days (2.37 days) were taken by T12 (CCC @ 650 ppm) followed by Control (2.25 days). This might be due to the fact that Gibberellic acid (GA_3) stimulates the enzymatic activities of enzymes like nucleic acid synthases which ultimately results in earlier bud opening due to quicker physiological activation in floret tissues while in contrast of it, CCC which is mainly a growth retardant reduces the cell elongation by inhibiting gibberellin biosynthesis, which ultimately delays the floret opening. Thus, earlier floret opening was observed in GA_3 while delayed floret opening was observed under CCC conditions (Hesami & Dolatkhahi, 2016). The results are in close agreement with the findings of Mohibe *et al.* (2020) and Padmalatha *et al.* (2015) where as floret diameter is one of the most crucial aesthetic traits influencing the visual appeal and grading quality of gladiolus spikes and it was found that the maximum floret diameter (7.70cm) was recorded in treatment T3 (GA_3 @ 150 ppm) followed by T4 (GA_3 @ 150 ppm) and T2(GA_3@100 ppm) *i.e.* 7.56 and 7.50cm respectively meanwhile the minimum diameter of floret (4.86cm) was recorded in the control group. Physiologically, GA_3 enhances petal size by promoting cell elongation and increasing turgor pressure within the epidermal tissues of floral organs. It also facilitates higher sugar transport to the petals, increasing osmotic potential and allowing for fuller expansion of petal cells (Kumar & Malik, 2020). Additionally, GA_3 stimulates vacuole development and delays senescence, enabling petals to remain hydrated and structurally intact during development (Hwang *et al.*, 2024). These results are in close confirmation with the findings of Ashwini *et al.* (2019), Zieslin *et al.* (1974) and Padmalatha *et al.* (2015) whereas in context to the number of open florets at first floret withering and Days to wither 5th floret the data pertained was represented in Fig. 3.

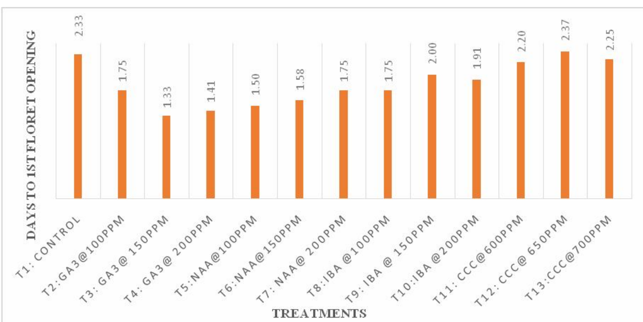

Fig. 1: Effect of plant growth regulators on Days to first floret opening of gladiolus var. Pusa Shanti.

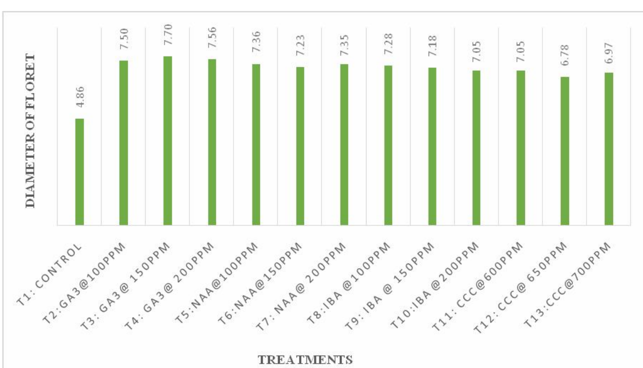

Fig. 2: Effect of plant growth regulators on diameter of floret (cm) of gladiolus var. Pusa Shanti.

Number of open florets at first floret withering serves as a practical measure of floret opening synchrony and overall spike quality and it was found that treatment T3 (GA_3 @ 150 ppm) recorded the highest number of open florets at the first floret's senescence *i.e.* 9.00 and was closely followed by T_4 (GA_3 @ 200 ppm) and T5 (NAA @ 100 ppm) *i.e.* 8.33 and 8.16 whereas the minimum number of open florets at first floret withering (5.16) was recorded in T1 (Control). The opening of florets up the spike is sequentially and synchronously enhanced by GA_3 physiologically that accompanies the homogenous development of the floral buds. This uniformity results from improved sugar translocation, consistent water movement through the xylem, and enhanced hormonal signaling along the rachis. Moreover, GA_3 helps sustain energy flow and turgidity across multiple florets, delaying premature senescence and supporting progressive bloom (Tawar *et al.*, 2002). The similar results were also reported by Umrao *et al.* (2007) and Chopde *et al.* (2012) meanwhile, data pertaining to days to wither 5th floret was represented in the Fig. 4, which represents that it is the number of days taken to reach the senescence of the 5th floret reflecting the sustained freshness and longevity of floral presentation over time and it was found that the treatment T_3 (GA_3 @ 150 ppm) takes maximum number of days for withering of 5th floret *i.e.* 12.00 and was followed by T_4 (GA_3@ @ 200 ppm) and T_5 (NAA @ 100 ppm) *i.e.* 11.16 and 10.66 days whereas the minimum day to wither 5th floret (8.00) was observed in T1 (Control). Physiologically, GA_3 delays floret senescence by inhibiting ethylene production and slowing the expression of senescence-associated genes such as

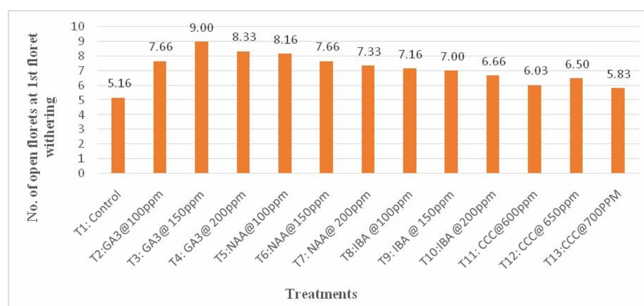

Fig. 3: Effect of plant growth regulators on number of open florets at 1st floret withering of gladiolus var. Pusa Shanti.

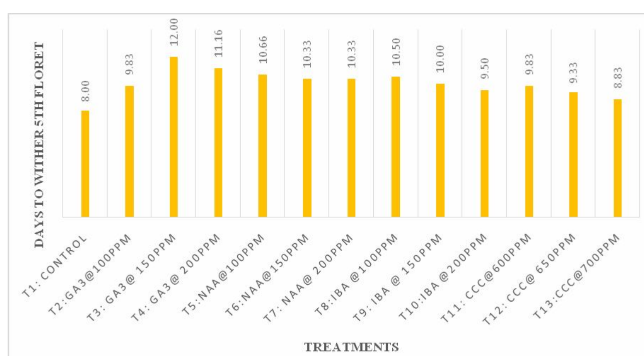

Fig. 4: Effect of plant growth regulators on days to wither 5th floret of gladiolus var. Pusa Shanti.

SAG12. It promotes membrane stability, reduces lipid peroxidation, and supports the maintenance of turgor pressure in floral tissues. This hormonal activity allows the 5th floret and others down the spike to remain fresh for long time after opening. They follow the same trends of findings which were followed in the number of open florets at time of 1st floret withering *i.e.* (Umrao *et al.*, 2007) and (Chopde *et al.*, 2012).

whereas the data pertaining to the total open florets percentage, water uptake (ml) and spike weight loss (%) the results are demonstrated in Fig. 5, 6 and 7 respectively, where the Total open florets percentage is a vital postharvest indicator that reflects the proportion of florets that successfully open out of the total number of florets in that spike during the postharvest life period and was important for aesthetic value and visual appeal of spike and it was found that the highest percentage of total open florets(79.51%) was recorded in treatment T3 (GA_3@ 150 ppm), followed by T6 (NAA @ 150 ppm) and T4 (GA_3 @ 200 ppm) *i.e.* 76.48% and 76.09% whereas the lowest total open floret percentage (58.75%) were found in treatment T1(Control). Physiologically, GA_3 facilitates the development and maturation of floral buds along the entire spike, ensuring that most of the florets proceed to full bloom. It supports efficient transport of sugars and water, and regulates hormonal balance in a way that sustains bud growth and delays abscission. This contributes to a more complete opening of the entire spike over time (Kumar & Malik, 2020) whereas Gupta and Dubey (2018) found that postharvest life of the flower depends on some preharvest factors like stage of harvesting etc. which affects the water uptake of the flower which in turn decides the floret opening percentage of flower, spike weight loss percent and ultimately display life of flower. These results are in contrast with the findings of Saeed *et al*. (2013) where they concluded that application of GA_3 at lower concentrations *i.e.* 25mg/l increases the floret opening percentage as well as water uptake of plant because of the antioxidative activities of superoxide dismutase and free radicals scavenging capacity, meanwhile water uptake is a fundamental physiological trait that directly affects spike turgidity, floret freshness, and overall postharvest life and it was found that maximum water uptake (100.45) was observed in treatment T3 (GA_3 @ 150 ppm), followed by T4 (GA_3 @ 200 ppm) , T2(GA_3 @ 100 ppm) and T5 (NAA@100 ppm) *i.e.* 99.01ml, 98.83ml and 98.35ml respectively whereas in contrast, CCC-treated spikes in treatment T12 and T13 *i.e* CCC@ 650ppm and CCC@ 700ppm respectively shows comparatively lower water uptake and treatment T1(Control) shows the lowest water uptake observation (63.83ml). Physiologically, GA_3 enhances water uptake by maintaining the openness of xylem vessels and promoting the expression of aquaporin proteins that facilitate water transport across cell membranes. It also reduces vascular blockage by lowering microbial growth within cut stems and by sustaining cellular membrane integrity. These physiological mechanisms help ensure uninterrupted upward water movement, which is essential for maintaining floret turgor and delay in senescence These results are in close agreement with the findings of (Gupta & Dubey, 2018), (Saeed *et al.*, 2013), (Ashwini *et al.*, 2019) and (Aier *et al.*, 2015).

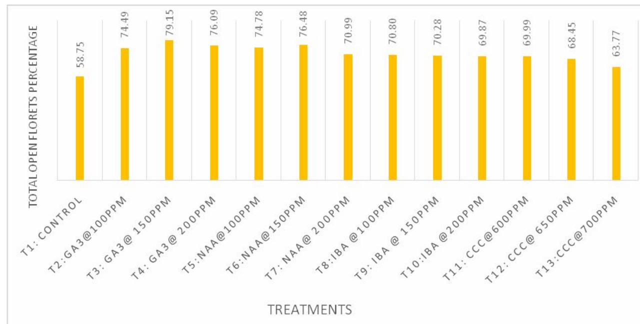

Fig. 5: Effect of plant growth regulators on total open florets (%) of gladiolus var. Pusa Shanti.

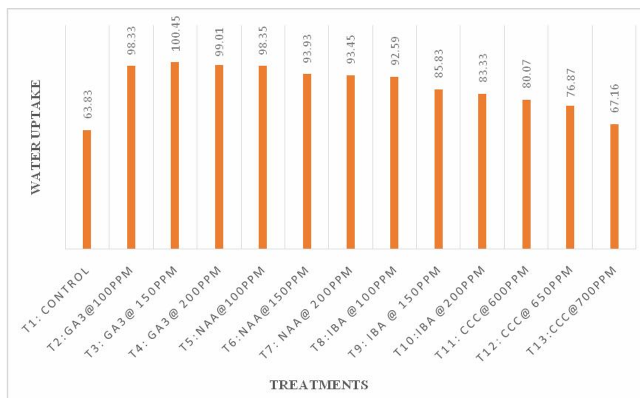

Fig. 6: Effect of plant growth regulators on water uptake (ml) of gladiolus var. Pusa Shanti.

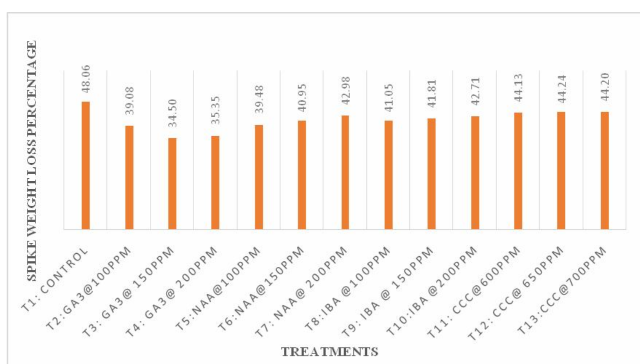

Fig. 7: Effect of plant growth regulators on spike weight loss (%) of gladiolus var. Pusa Shanti.

Furthermore, spike weight loss percentage is a key postharvest parameter that reflects moisture retention and tissue integrity over the postharvest life period. Lower weight loss indicates better hydration and structural stability of the spike and it was found that the minimum spike weight loss (34.17%) was observed in treatment T3 (GA_3 @ 150 ppm), followed by T4 (GA_3 @ 200 ppm) and T5 (NAA @ 100 ppm) *i.e.* 35.94% and 39.81 % respectively, whereas the highest spike weight loss percentage (48.39%) was observed in T1(Control). Physiologically, GA_3 reduces spike weight loss by enhancing water retention in petal and stem tissues and by maintaining stomatal control and strengthens cell wall structures, which helps minimize water evaporation and structural collapse during the postharvest life period. Also, in GA_3-treated spikes, the rate of lipid peroxidation and carbohydrates structural degradation is slowed, keeping more mass through the period. These results are in agreement with the findings of (Gupta & Dubey, 2018) and (Saeed *et al.*, 2013).

References

Aier, S., Langthasa S., Hazarika D.N., Gautam B.P. & Goswami R.K. (2015). Influence of GA_3 and BA on morphological, phonological and yield attributes in gladiolus cv. Red Candyman. *IOSR-Journal of Agriculture and Veterinary Sciences*, **8,** 37–42.

Ashwini, A., Munikrishnappa P.M., Balaji S.K., Kumar R., Taj A. and Kumar M.S. (2019). Effect of plant growth regulators on vegetative and flowering parameters of gladiolus (*Gladiolus hybridus* L.) cv. Adigo yellow. *International Journal of Chemical Studies*, ***7*(2),** 1553–1556.

Chopde, N., Gonge V. S. & Nagre P.K. (2012). Effect of growth regulators on growth and flowering of gladiolus. *Asian Journal of Horticulture*, **6(2),** 398–401.

Gupta, J. and Dubey R.K. (2018). Factors affecting post-harvest life of flower crops. *International Journal of Current Microbiology and Applied Sciences*, ***7*(1),** 548–557. https://doi.org/10.20546/ijcmas.2018.701.065

Hesami, A. and Dolatkhahi A. (2016). Plant growth regulators impact on vegetative and reproductive characteristics of Gladiolus cut flowers (*Gladiolus Hybridus* L.). *Journal of Ornamental Plants*, **6(1),** 33–38.

Hwang, J.E., Park H.B., Jeon D.Y., Park H.J., Kim S., Lee C.W., Kim, Y. and Yoon Y. (2024). Effect of different basal media and organic supplements on in vitro seedling development of the endangered orchid species *Dendrobium moniliforme* (L.) Swartz. *Plants*, **13(19),** 2721. https://doi.org/10.3390/plants13192721

Kumar, V. and Malik R.K. (2020). The influence of IBA and NAA on vegetative and flowering parameters of gladiolus. *Plant Archives*, **20(2),** 1469–1474.

Mohibe, N., Jain S., Mishra A. and Meena N. (2020). Effect of chemicals treatment on keeping quality and vase life of gladiolus flowers. *Alexandria Science Exchange Journal*, **41(3),** 285–293. https://doi.org/10.21608/asejaiqjsae.2020.106474

Padmalatha, T., Reddy G.S. and Chandrasekhar R. (2015). Effect of plant growth regulators on corm production and vase life in gladiolus. *Journal of Horticultural Sciences*, **10(2),** 220–225.

Ranjan, R., Singh A.K. and Lal S.D. (2010). Evaluation of gladiolus genotypes for flowering and corm characters. *Journal of Ornamental Horticulture*, **13(4),** 243–247.

Saeed, T., Hassan I., Abbasi N.A. and Jilani G. (2013). Effect of gibberellic acid on the vase life and oxidative activities in senescing cut gladiolus flowers. *Plant Growth Regulation*, **72(1),** 89–95. https://doi.org/10.1007/s10725-013-9839-y

Tawar, R.V., Sable A.S. and Giri M. D. (2002). Effect of growth regulators on growth and flowering of gladiolus cv. Jester. *Annual Plant Physiology*, **16(2),** 109–111.

Umrao, V.K., Singh R.P. and Singh A.R. (2007). Effect of gibberellic acid and growing media on vegetative and floral attributes of gladiolus. *Indian Journal of Horticulture*, **64(1),** 73–76.

Zieslin, N., Brian I. and Halevy A.H. (1974). The effect of growth regulators on growth and pigmentation of ‘Baccara’ rose flowers. *Plant Cell Physiology*, **15,** 341–349.