Environment and Ecology 42 (4A) : 1720—1725, October—December 2024
Article DOI: https://doi.org/10.60151/envec/YCBV8833
ISSN 0970-0420

Response of Gladiolus Varieties on Floral Quality and Post-Harvest Parameters as Influenced by Gamma Irradiation

Rishika Choudhary, Anuj Kumar

Received 25 July 2024, Accepted 28 September 2024, Published on 15 November 2024

ABSTRACT

An empirical study conducted during the year 2022-23 at KNK College of Horticulture, Mandsaur (MP), India investigated the impact of gamma irradiation on floral quality and post-harvest parameters of four gladiolus varieties (V_1 : Arka Aayush, V_2: Arka Pratham, V_3 : Arka Kesar and V_4 : Arka Tilak) using five gamma doses (G_1: 0.0 kr, G_2 : 1.25 kr, G_3 : 2.25 kr, G_4 : 3.25 kr and G_5 : 4.25 kr) in a Factorial Randomized Block Design (FRBD). Results indicated that Arka Kesar excelled in various parameters, including diameter and length of florets, spike girth, spike length and flowering duration. While, Arka Aayush exhibited superior performance in terms of vase life. Gamma irradiation at 0.00 kr (control) positively influenced several parameters, such as floret diameter, floret length, spike girth, spike length and vase life. The dose of 1.25 kr was beneficial for flowering duration. The interaction between gamma irradiation and varieties significantly affected vase life. Specifically, Arka Pratham irradiated with 0.00 kr exhibited the longest vase life (12.82 days).

Rishika Choudhary[1]*, Anuj Kumar[2]

[1]Research Scholar, [2]Assistant Professor

[1,2]Department of Floriculture and Landscape Architecture KNK College of Horticulture (RVSKVV Gwalior), Mandsaur (MP) 458001, India

Email : rishikatetarwal@gmail.com
*Corresponding author

Keywords Gladiolus, Varieties, Gamma irradiation, Floral quality, Post harvest parameters.

INTRODUCTION

Flowers and humans share a captivating relationship that has endured across time. Even in periods of scarcity where flowers don't offer tangible nutrition, humans have been inexplicably drawn to them. Flowers are cultivated for their aesthetic appeal and symbolic significance, contributing to both the visual and practical aspects of human life (Choudhary *et al.* 2023).

In India, the floral sector has undergone significant transformations, with a substantial portion of the country's agricultural output dedicated to floriculture. This not only enhances the GDP but also reflects the economic importance of the industry. The cut flower sector, particularly the cultivation of bulbous flowers, plays a dominant role in India's floriculture. Gladiolus (*Gladiolus grandiflorus* L.), known as the 'Queen of Bulb Flowers,' belongs to the Iridaceae family. Renowned for its captivating flowers, Gladiolus holds a special place in ornamental bulbous plant cultivation in India and globally. The versatility of Gladioli is evident in their use for cut flowers, beds, herbaceous borders, and potted plants due to their varied colors, shapes, and sizes. They thrive in diverse climates, making them adaptable to a range of regions, including plains and hills (Cantor and Tolety 2011).

In the year 2020-21, Gladiolus was cultivated on approximately 11.77 thousand hectares in India (Anonymous 2022). With around 300 species worldwide, the majority originating in South Africa, Gladiolus derives its name from the Latin word '*gladius,*' meaning "*sword*," a reference to its sword-like leaves. Also known as the 'sword lily,' Gladiolus is a bulbous herbaceous perennial plant valued for landscaping and cut flowers (Alam *et al.* 2013). The allure of Gladiolus spikes lies in their attractiveness and sophistication, displaying delicate florets in various shades that open sequentially. This sequential blooming extends the flower's lifespan, providing a prolonged vase life for cut spikes (Singh 2006). Consequently, both local and international markets have witnessed a surge in demand for Gladiolus flowers. While, Gladioli have traditionally evolved through breeding, the increasing demand necessitates genetic improvement. The plant exhibits economically significant properties such as floral characteristics (novelty, doubleness, petaloid, vase life), as well as resistance to biotic and abiotic stress. These traits make gladiolus suitable for mutation induction methods, allowing for the observation of changes after mutagenic treatments. As a heterozygous plant propagated vegetatively, gladiolus offers the advantage of altering specific characteristics without compromising the overall genetic makeup. This characteristic makes it a practical test material for physical mutagenesis, enhancing diversity for future adaptations (Datta 2012).

Genetic changes through mutation have proven successful in creating new types of ornamental plants. Gamma rays, accounting for about 70% of mutant types worldwide, have been instrumental in developing novel ornamental varieties (Sisodia and Singh 2014). Despite numerous studies on the impact of gamma rays on Gladiolus cultivars, only a limited number of varieties have been developed through radiation. As a consequence, the current investigation was conducted with the intention of identifying positive differences caused by various gamma irradiation dosages on floral quality and post-harvest parameters of gladiolus varieties.

MATERIALS AND METHODS

The research was conducted at KNK College of Horticulture, Mandsaur (MP), Mandsaur, located in the Malwa plateau in the western part of Madhya Pradesh, India falls within the North latitude of 23.45° to 24.13° and East longitudes of 74.44° to 75.18°, with an altitude of 435.02 meters above mean sea level, categorizing it under Agro climatic zone number 11 of the state. The meteorological parameters, including temperature and rainfall at the experimental site, are visually presented in Fig. 1, illustrating mean weekly values during the crop period. In terms of soil properties, the field experimentation revealed a clay loam texture (47.0% sand, 24.0% silt, and 29.0% clay). The soil in the experimental trail prior to exhibited low levels of available nitrogen (154 kg/ha), medium levels of phosphorus (18.5 kg/ha), and potassium (293 kg/ha). The soil reaction was slightly alkaline with a pH of 7.24. The experimental design adopted a Factorial Randomized Block Design with three replications. Four gladiolus varieties (Arka Aayush, Arka Pratham, Arka Kesar, Arka Tilak) were chosen for exposure to different gamma doses. Corms of each variety were subjected to varying gamma irradiation doses, with untreated gladiolus corms serving as the control. Treated and untreated corms of each variety were planted in beds for comparative analysis. Measurements included the diameter of first floret, diameter of third floret, length of first floret, length of third floret, duration of flowering, vase life, girth of spike, length of spike and yield of spike per plot. The obtained data underwent statistical analysis through "Analysis of Variance," following the methodology advocated by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Effect of varieties

The results obtained from Table 1 reveal significant variations in the flowering parameters of different gladiolus varieties subjected to gamma irradiation. In terms of floret diameter, Arka Kesar demonstrated the maximum diameter for both the first and third florets, out performing all other varieties, with the exception of Arka Pratham. Conversely, Arka Tilak exhibited the lowest diameter for both the first and third florets. This

Table 1. Effect of gamma irradiation on flowering parameters of gladiolus varieties.

Treatments	Diameter of first floret (cm)	Diameter of third floret (cm)	Length of first floret (cm)	Length of third floret (cm)
Varieties				
V_1 (Arka Aayush)	9.65	9.18	8.28	7.80
V_2 (Arka Pratham)	10.52	9.82	9.48	8.50
V_3 (Arka Kesar)	10.68	9.93	10.14	9.16
V_4 (Arka Tilak)	9.35	8.88	8.07	7.76
SEm ±	**0.19**	**0.14**	**0.15**	**0.14**
CD at 5%	**0.55**	**0.39**	**0.43**	**0.40**
Gamma irradiation				
G_1 (0.00 kr)	10.44	9.83	9.33	8.63
G_2 (1.25 kr)	10.37	9.77	9.20	8.50
G_3 (2.25 kr)	10.11	9.46	8.93	8.23
G_4 (3.25 kr)	9.79	9.25	8.86	8.14
G_5 (4.25 kr)	9.53	8.97	8.64	8.03
SEm ±	**0.22**	**0.15**	**0.17**	**0.16**
CD at 5%	**0.62**	**0.44**	**0.48**	**0.44**

Table 2. Effect of gamma irradiation on flowering and post-harvest parameters of gladiolus varieties.

Treatments	Duration of flowering (days)	Girth of spike (mm)	Length of spike (cm)	Vase life of cut spikes (days)
Varieties				
V_1 (Arka Aayush)	15.90	9.37	78.64	11.67
V_2 (Arka Pratham)	18.33	8.84	80.58	11.30
V_3 (Arka Kesar)	18.90	9.87	93.32	10.03
V_4 (Arka Tilak)	14.07	9.04	73.10	9.15
SEm ±	**0.47**	**0.22**	**1.16**	**0.15**
CD at 5%	**1.35**	**0.63**	**3.31**	**0.44**
Gamma irradiation				
G_1 (0.00 kr)	17.58	9.52	84.87	11.04
G_2 (1.25 kr)	17.91	9.50	82.20	10.95
G_3 (2.25 kr)	16.45	9.41	80.85	10.56
G_4 (3.25 kr)	15.95	9.10	80.27	10.06
G_5 (4.25 kr)	16.12	8.86	78.86	10.08
SEm ±	**0.53**	**0.24**	**1.29**	**0.17**
CD at 5%	**1.51**	**NS**	**3.70**	**0.49**

disparity in floret diameter is attributed to a combination of genetic characteristics specific to each variety and environmental factors. Similar observations have been reported by Chourasia *et al.* (2015), Safeena & Thangam (2019), and Sathyanarayana *et al.* (2019).

Additionally, the analysis of floret length (Table 1) revealed significant differences among the gladiolus varieties. Arka Kesar displayed the maximum length for both the first and third florets, while Arka Tilak exhibited the minimum length. The variations in floret length were attributed to the inherent genetic characteristics of each variety and the influence of environmental variables, consistent with findings from Mushtaq *et al.* (2018) and Safeena & Thangam (2019).

The investigation into the duration of flowering indicated from Table 2 that Arka Kesar exhibited the maximum flowering duration compared to the other varieties, except for Arka Pratham, while Arka Tilak displayed the minimum duration. This variability in flowering duration is linked to the innate genetic features of the varieties and the impact of environmental factors, in line with observations made by Kaur and Bajpay (2019) and Pandey *et al.* (2012).

Regarding spike characteristics, Arka Kesar demonstrated significantly higher girth and length of the spike (Table 2) compared to other varieties. These variations in spike characteristics are attributed to both genetic features inherent to each variety and environmental variables, consistent with conclusions drawn by Kaur and Bajpay (2019), Safeena and Thangam (2019), Shyla and Kumar (2021), and Rizwi *et al.* (2021).

Within different varieties, Arka Aayush exhibited the highest vase life of cut spikes (Table 2) compared to other varieties. The variation in vase life may be attributed to differences in senescence behavior, ethylene production, carbohydrate accumulation, spike length, and the number of florets per spike. Furthermore, the differences in the number of spikes per plot are associated with genetic factors and other influencing variables. Similar findings have been re-

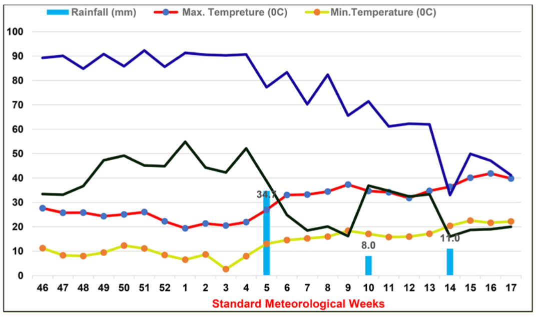

Fig. 1. Mean weekly meteorological parameters during crop period.

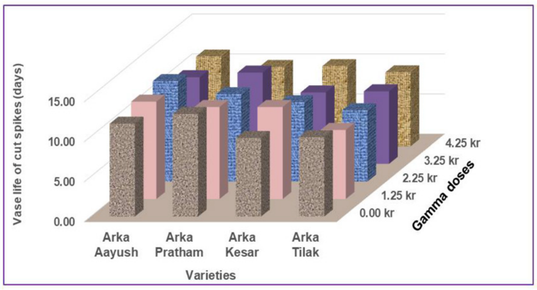

Fig. 2. Interactive effect of gladiolus varieties and gamma doses on vase life of cut spikes.

ported by Momin *et al.* (2015), Naresh *et al.* (2015), Kumawat *et al.* (2018), Kaur and Bajpay (2019), and Sathyanarayana *et al.* (2022).

Effect of gamma irradiation

The examination of the impact of different gamma radiation doses on various flowering parameters (Table 1) in gladiolus varieties revealed noteworthy results. The highest diameter of the first and third florets was observed with G_1 (0.0 kr), followed by G_2 (1.25 kr) and G_3 (2.25 kr), while G_4 (4.25 kr) exhibited the significantly lowest diameter. Gamma radiation appeared to consistently decrease floret size, possibly influenced by alterations to the floret size gene, as noted by Singh *et al.* (2010). Kumari and Kumar (2015) associated the decrease in floret diameter with decreased plant vegetative growth induced by gamma radiation.

In terms of floret length, G_1 (0.0 kr) displayed the longest first floret length, while G_4 (4.25 kr) exhibited the lowest length for both the first and third florets (Table 1). Padhi and Singh (2022) reported similar findings, observing the maximum length of the fifth floret in gladiolus with a gamma radiation dose of 20 Gy. Such changes in floret length may be from physiological anomalies triggered by higher gamma doses, as demonstrated by Banerji and Datta (2002).

The duration of flowering varied significantly among different gamma doses (Table 2), with the longest duration observed at a gamma dose of 1.25 kr compared to the other tested doses, except the control (0.0 kr). Conversely, the shortest duration of flowering was recorded at 3.25 kr. Similar to the changes in floret length, these alterations in flowering duration may be attributed to physiological anomalies associated with higher gamma doses, as indicated by Banerji and Datta (2002).

While gamma doses exhibited a non-significant variation in spike girth, while the length of the spike showed a statistically significant difference (Table 2). The maximum length of the spike was observed with G_1 (0.0 kr), followed by G_2 (1.25 kr) and G_3 (2.25 kr), with the lowest observed with G_5 (4.25 kr). The reduction in spike length with irradiation may result from modifications or destruction of cell components, impacting the biochemistry, physiology, anatomy, and morphology of the plant. Analogous results of anomalous changes in flower shape, size, and color in irradiated gladiolus plants have been observed by Rizwi *et al.* (2021), Devi *et al.* (2022), and Padhi and Singh (2022).

The impact of gamma doses on vase life indicated in Table 2 that the highest vase life of cut spikes was observed with G_1 (0.0 kr). Fluctuations in vase life may be attributed to adverse effects and toxicity associated with greater doses, resulting from altered respiration and photosynthesis, as suggested by Pranom *et al.* (1986). Similar findings were reported by Sisodia and Singh (2014).

Interactive effect of varieties and gamma irradiation

The interactive effect of gladiolus varieties and gamma doses yielded significant results, particularly concerning vase life. The treatment combination V_2G_1 (Arka Pratham with 0.00 kr) exhibited the highest vase life of cut spikes (Fig. 2). The decrease in plant survival to the flowering stage at higher gamma irradiation doses in certain varieties may be attributed to auxin inactivation. The reduction in auxin content with increasing irradiation doses is likely responsible for the diminished plant survival observed at higher doses, as noted by Banerji and Datta (2002).

CONCLUSION

The study on gamma irradiation-induced effects on flowering and post-harvest parameters in different gladiolus varieties demonstrated significant varietal responses to varying doses of gamma radiation. Arka Kesar consistently excelled in most flowering parameters, such as floret diameter, spike girth, spike length, and flowering duration, while Arka Aayush showed superior performance vase life. Gamma irradiation at 0.00 kr positively influenced several parameters, and the dose of 1.25 kr was particularly beneficial for flowering duration. The interaction between gamma irradiation and gladiolus varieties was significant, with Arka Pratham at 0.00 kr exhibiting the longest vase life. These findings suggest that selective gamma irradiation can be an effective tool for enhancing specific flowering and post-harvest traits in gladiolus, thereby improving its commercial and aesthetic value. The study underscores the importance of understanding the interplay between genetic factors and irradiation doses to optimize Gladiolus cultivation and post-harvest performance.

ACKNOWLEDGMENT

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

REFERENCES

Alam A, Iqbal M, Vats S (2013) Cultivation of some over looked bulbous ornamentals- A review on its commercial viability. *Report and Opinion* 5 : 9—34.

Anonymous (2022) Area and production of gladiolus in India (2011–2012 to 2021–2022 2nd Advance Estimates). Available at https://www.indiastatagri. com/table/gladiolus/area-production-gladiolus-india-2011-2012-2021 202/964451. Accessed on 14th September 2022.

Banerji BK, Datta SK (2002) Induction and analysis of gamma ray-induced flower head shape mutation in 'Lalima' chrysanthemum (*Chrysanthemum morifolium*). *Indian Journal of Agricultural Sciences* 72 (1) : 6—10.

Cantor M, Tolety J (2011) Gladiolus. In: Kole C (ed). Wild Crop Relatives: Genomic and Breeding Resources (Plantation and Ornamental Crops). Heidelberg Springer, pp 133—160.

Choudhary R, Kumar A, Kanwar J, Kachouli BK (2023) Interactive effect of gamma irradiation and varieties on growth and corm parameters of gladiolus under Malwa region of Madhya Pradesh, India. *Annals of Agriculture Research* 44(4) : 510—517.

Chourasia A, Viradia RR, Ansar H, Madle SN (2015) Evaluation of different gladiolus cultivars for growth, flowering, spike yield and corm yield under Saurashtra region of Gujarat. *The Bioscan* 10 (1) : 131—134.

Datta SK (2012) Success story of induced mutagenesis for development of new ornamental varieties. *Bioremediation Biodiversity Bioavailability* 6 : 15—26.

Devi NS, Jamja T, Tabing R, Tagi N (2022) Influence of gamma radiation on growth, flowers and morphological changes in gladiolus. *Environment Conservation Journal*, ISSN 0972-3099 (print) 2278—5124 (online) 1—10. http://www.environcj.in

Kaur H, Bajpay A (2019) Performance of various gladiolus cultivars under Punjab conditions. *Journal of Pharmacognosy and Phytochemistry* 8 (4) : 875—878.

Kumari K, Kumar S (2015) Effect of gamma irradiation on vegetative and propagule characters in gladiolus and induction of homeotic mutants. *International Journal of Agriculture, Environment and Biotechnology* 8 (2) : 413—422.

Kumawat P, Sisodia A, Singh AK (2018) Evaluation of gladiolus cultivars for plant growth and corm production. *Journal of Pharmacognosy and Phytochemistry* 7 (3) : 3083—3085.

Momin BC, Sunil K, Momin KC, Niki D (2015) Evaluation of gladiolus (*Gladiolus grandiflorus* L.) genotypes under West Garo Hills district, Meghalaya. *Hort Flora Research Spectrum* 4 (3) : 224—229.

Mushtaq S, Hafiz IA, Arif M, Anwar A (2018) Performance evaluation of elite gladiolus cultivars under agro-climatic conditions of Rawalpindi. *Asian Journal of Advances in Agricultural Research* 5 (3) : 1—6.

Naresh S, Rao AVDD, Bhaskar VV, Krishna KU, Rao MP (2015) Evaluation of gladiolus (*Gladiolus hybrida* L.) hybrids under coastal Andhra Pradesh conditions. *Plant Archives*15 (1) : 451—454.

Padhi M, Singh AK (2022) Effect of gamma rays on flowering, post-harvest life and morphological changes in gladiolus varieties. *International Journal of Agriculture*, *Environment and Biotechnology* 15 (02) : 229—237.

Pandey RK, Bhat DJ, Sheetal D, Arvinder S, Nomita L, Shivani J (2012) Evaluation of gladiolus cultivars under subtropical conditions of Jammu. *International Journal of Agricultural Sciences* 8(2): 518—522.

Panse VG, Sukhatme PV (1985) Statistical Methods for Agricultural Workers, Indian Council of Agricultural Research, New Delhi.

Pranom P, Sangtham K, Orwan M (1986) Production of gladiolus: Effect of gamma irradiation on certain characteristics of gladiolas var. Spic and Span, Norwich Canary. Research and

Development Institute. Research Reports. Kasetsart University (Thailand), pp 85.

Rizwi AA, Soni SS, Mishra SK, Singh RK, Singh MK (2021) Effect of gamma radiation on vegetative and floral characters of commercial varieties of gladiolus (*Gladiolus hybrida* L.). *Journal of Pharmacognosy and Phytochemistry* 10(1): 2015—2018.

Safeena SA, Thangam M (2019) Field performance of gladiolus cultivars for growth, yield and quality cut flower production under humid agro climatic conditions of goa. *International Journal of Agriculture Sciences* 11 (3) : 7797—7800.

Sathyanarayana E, Sharma G, Tirkey T, Das BK, Divya K, Kumar J (2019). Studies of gamma irradiation on vegetative and floral characters of gladiolus (*Gladiolus grandiflorus* L.). *Journal of Pharmacognosy and Phytochemistry* 8(5): 227—230.

Sathyanarayana E, Singh J, Das BK (2022) Identification and evaluation of gamma ray induced mutants in gladiolus (*Gladiolus grandifloras* L.). *International Journal of Environment and Climate Change* 12(8): 43—56.

Shyla MR, Kumar R (2021) Evaluation in different gladiolus (*Gladiolus grandifloras* L.) varieties for spike and corm yield enhancement in coastal Tamil Nadu. *Plant Archives* 21: 527—531.

Singh AK (2006) Flower Crops Cultivation and Management. New India Publishing Agency, New Delhi, India, pp 97—104.

Singh VN, Banerji BK, Dwivedi AK, Verma AK (2010) Effect of gamma irradiation on African marigold (*Tagetes erecta* L.) cv Pusa Narangi Gainda. *Journal of Horticultural Sciences* 4(1): 36—40.

Sisodia A, Singh AK (2014) Influence of gamma irradiation on morphological changes, post-harvest life and mutagenesis in gladiolus. *International Journal of Agriculture, Environment and Biotechnology* 7 (3) : 535—545.