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Screening of physical and chemical mutagens on phenological attributes of cultivars of Gladiolus(*Gladiolus grandiflorus* L.) in M1 generation

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Abstract

An investigation was executed to induce mutations and work out the effective dose of physical and chemical mutagen under varied concentration and isolate desirable mutants in two cultivars viz American beauty and Nova Lux were screened in two consecutive years in two generations M1 and M2. Study was laid out in factorial randomized block design during Rabi season in 2020 and 2021 in the Department of Horticulture, Janta College, Bakewar, Etawah in three replications.The standard sized corms of two cultivars of gladiolus were treated with physical mutagen of dosage of ^{60}Cogamma irradiation source (1kR, 2 kR, 3 kR, 4 kR and 5 kR)and Ethyl methane sulfonate (EMS) (0.4%, 0.6% and 0.8%). Scrutiny of the data on floral characters in each treatment was done to assess the influence of varied mutagenic treatments. The results depicted that Significantly minimum (56.13 and 64.46) days were required for the initiation of spike, more number of 2.20 and 1.86 spikes, length of spike with 71.68 cm and 76.65 cm, higher number of 13.82 and 14.48 florets per spike, maximum diameter of 10.23 cm and 10.74 cm, floret length of 9.41 cm and 10.58 cm, and higher vase life of 9.14 and 10.87 days of cut spike in M_1 generation in American beauty and Nova lux cultivar of gladiolus under the treatment comprising of corms treated with gamma dosage @ 2kR (T_3), respectively. Minimum number of spikes, length of spike, diameter of floret, and vase life of cut spikes were expressed from treatment T6 (gamma irradiation @ 5kR) in vM1 for American beauty cultivar and Nova Lux. Therefore, it can be concluded that floral attributes were better with the application of lower dosage of gamma radiations.

Keywords: Gladiolus, EMS, Gamma irradiation, Florets, spikes.

Introduction

In the realm of commercial flowers in India, gladiolus reigns supreme as one of the most vital species. Its regal spikes showcase an array of enchanting, refined, and delicate florets in various captivating hues. This delicate plant undergoes a sequential blooming process that lasts a significant duration, making it an ideal choice for cut flowers due to its impressive longevity. Spanning an extensive cultivation area of 11.66 thousand hectares, gladiolus yields a production of 10.46 thousand tonnes (loose flower) and 249.18 thousand tonnes (cut value) (NHB,2021). On a global scale, it holds the fourth position in trade, ranks third in India's cut flower output, and secures the sixth spot in loose flower production.Gladiolus L., known as the "Queen of bulbous flower crops", is one of the most commercially cultivated cut flower crops in India. It is cultivated during summer in temperate to sub-temperate regions and winter in tropical to sub-tropical industrial climates. The adaptability of gladiolus to various agro-climatic conditions allows its production round the year especialyt (Nath *et al.*,2020).Gladiolus is a crop is characterized by extensive heterozygocity and intricate genetic composition.Its propagation primarily relies on corms and cormels, employing vegetative propagation techniques. Given its vegetative propagation and heterozygosity, mutation breeding offers promising prospects for introducing desirable variations (Proietti*et al.*,2022). The mutated segment can be perpetuated effortlessly through vegetative means, without altering the surplus in crops propagated vegetatively(Rawat *et al.,* 2021). The significance of induced mutagenesis as a key technology for developing new plant varieties through genetic manipulations is widely recognized. The utilization of physical and chemical mutagens in mutation technique has resulted in successful development of numerous promising new varieties in varied ornamental plants (Belwal*et al.*, 2023). The escalating demand for gladiolus in floriculture market highlights the significance of genetic enhancement that can be swiftly implemented. Morphological and phenological characters have been conventionally utilized to assess the variations in mutant populations as it provides quick and cost effective means of detecting phenotypic changes (Devi *et al.,* 2023). Gama rays, a component of electromagnetic spectrum are classified as ionizing radiations. The biological impact of Gamma ray is attributed to their interaction with atoms and molecules within the cells particularly with water molecules which results in production of free radicles (Kumari *et al.,* 2015)These radicles damages or alters the vital components of the plant cells leading to differential effects on morphology, anatomy, biochemistry and physiology of plants depending on the level of irradiations (Deepa *et al.,* 2022).Gamma ray is well known for their

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ability to influence plant growth and development at physiological and morphogenetic levels. Ethyl methane sulphonate (EMS) is a highly potent mutagen that adds its alkyl group to DNA bases which leads to point mutation. Hence, the purpose of the present study is to examine the effects of EMS and Gamma rays on different phenological characteristics of gladiolus in M1 generation.

Materials and Methods

A research was carried out during Rabi season in 2020 and 2021 in the Department of Horticulture,Janta College, Bakewar, Etawah. The corms of two varieties of Gladiolus viz. The American Beauty and Nova Lux were irradiated with gamma 1kR, 2 kR, 3 kR, 4 kR and 5 kR whereas in the case of chemical mutagen corms were dipped in the solution of 0.4% EMS, 0.6% and 0.8% EMS treatment wise. Gamma irradiation of corms was done at Division of floriculture, Botanic Garden and Eco-education, CSIR- National Botanical Research Institute, Lucknow, India. The source of gamma rays was ^{60}Co Low dose irradiator.Chemical mutagen EMS was used in varying concentrations.Corms were pre-soaked in water for six hours. Pre soaked corms were then treated with different mutagenic treatments @ 0.4, 0.6 and 0.8%.After the treatment, corms were washed thoroughly with tap water and then planted in main field. Corms treated with normal water were used an over control. The corms planted in the interimof I year set upto M1 generation. M2 generation corms harvested from these plants were again planted during the first week November. The experiment was spread out in Factorial Randomised block design and replicated thrice. Corms of both varieties ranging from 2cm to 4.5 cm were selected discarding the small and large size corms for all the varied treatment combinations to study the effect of induced mutation on diverse character of gladiolus flower.Treatment combinations during the experimentation were T_1V_1 (Control and American Beauty), T_2V_1 (1 kR Gamma irradiation + American Beauty), T_3V_1 (2 kR Gamma irradiation + American Beauty), T_4V_1 (3 kR Gamma irradiation + American Beauty), T_5V_1 (4 kR Gamma irradiation + American Beauty), T_6V_1 (5 kR Gamma irradiation + American Beauty), T_7V_1 (0.4 % EMS+ American Beauty), T_8V_1 (0.6 % EMS+ American Beauty), T_9V_1 (0.8 % EMS+ American Beauty), T_1V_2 (Control + Nova Lux), T_2V_2 (1 kR Gamma irradiation + Nova Lux), T_3V_2 (2 kR Gamma irradiation + Nova Lux), T_4V_2 (3 kR Gamma irradiation + Nova Lux), T_5V_2 (4 kR Gamma irradiation + Nova Lux), T_6V_2 (5 kR Gamma irradiation + Nova Lux), T_7V_2 (0.4 % EMS + Nova Lux), T_8V_2 (0.6 % EMS + Nova

Lux), T_9V_2 (0.8 % EMS + Nova Lux).The untreated corms of both the varieties were used as control. The corms harvested from each treatment of M_1 generation kept in cold storage room from June to September and planted in the month of October in field for raising M_2 generation. The cultural practices were followed uniformly for growing of Gladiolus for the experimental plots. Uniformly the crop was irrigated depending upon the condition of the weather. The growth and yield of gladiolus flowers were impacted by various parameters at different intervals in M1 Generation. The flowering parametersencompassed the days to spike emergence, number of spikes per plant, length of spike, number of florets per spike, length of floret, Diameter of florets and vase life of cut spike. Days taken to spike emergence was noted from the days after planting of the corms to the emergence of the spike in each of the marked plants. Length of spike was determined from the last leaf which emerged below the spike upto the tip of the spike after the opening of last flower and written in cm. The overall count of the florets generated in each spike of the plants were noted and an average was computed. Number of spikes per plant was counted, the average was computed and data was logged. Vase life refers to the time span upto which the perishable cut flower can be kept at consumable and marketable stage in the vase solution after detaching from the plant. Vase life (days) was noted from the starting of the experiment to the opening of the last floret of spike (Nath *et al.*, 2020). Various meticulous observations were conducted to document any alterations in the hue, form, dimensions and quantity of petals and reproductive organs of the blossoms of gladiolus. Harvesting involved removing the sheaths or bracts clasping at the base of the stem/spike and immersing the cut end in sterile water. The collected data was statistically analyzed for significance and graphically represented with a standard error of 5% as recommended by Panse and Sukhatme (1967). The critical difference at 5% level of significance was worked out for comparing the significance among the treatment means.

Result and Discussion

Days to emergence of spike

A study of the data diagrammatically presented in figure 1 depicted the days required for spike emergence in gladiolus cultivars for the first generation (M_1) was significantly affected due to varieties and varied mutangens. Significantly minimum (56.13) days were required for the initiation of spike in M_1 generation in American beauty cultivar of gladiolus under the treatment comprising of corms treated with gamma dosage @ 2kR (T_3) which was at par. T_3 was closely followed by treatment T_4 comprising of Gamma dosage @ 3kR which took 56.13 days for spike emergence. Maximum 62.26 days were required for spike emergence by gladiolus cultivar American Beauty when the corms were treated with gamma irradiation @ 5kR (T_6).Flowering time and its duration is influenced by the exposure to radiation or mutagenic treatments which impact various biosynthetic pathways (Patel *et al.,* 2018).

The set of observations pertaining to cultivar Nova lux in M_1 generation expressed that a shorter span of 64.40 days for spike emergence was noted when the corms were treated with chemical mutagen 0.6 % EMS which was closely preceded by treatment T_3 (gamma irradiation at 2kR) and T_2 (gamma irradiation at 1kR) which took 64.46 and 64.93 days, respectively. Longer span of 67.73 days were taken by cultivar Nova Lux for emergence of spike in the plots with treatment combination T_6 (Gamma dosage@5kR).The outcome corresponds with the study conducted by Devi *et al*. (2023) on gladiolus where the application of lower doses of Gamma radiation which resulted in earliest spike emergence.This could be attributed to the activation of growth regulators and inhibition of growth inhibitors by gamma radiation. As a result, root and shoot length enhanced, enables better nutrient absorption and increased rate of photosynthetic activities. Consequently, this led to early emergence of spike (Sathyanarayana, *et al*., 2019). Conversely, higher doses of radiation may cause a delay in spike emergence due to disruptions in biochemical pathways that are altered during the radiation process. These pathways are directly and indirectly associated with physiology of flowering (Sahariya*et al*. 2017). Similar results on delayed flowering due to chemical mutagens were noted by Kapadiya (2014) in chrysanthemum, Yadav *et al.,*(2016), Kumar *et al.,* (2021), Proietti*et al.,*(2022) andBelwal*et al.,(*2023) in gladiolus.

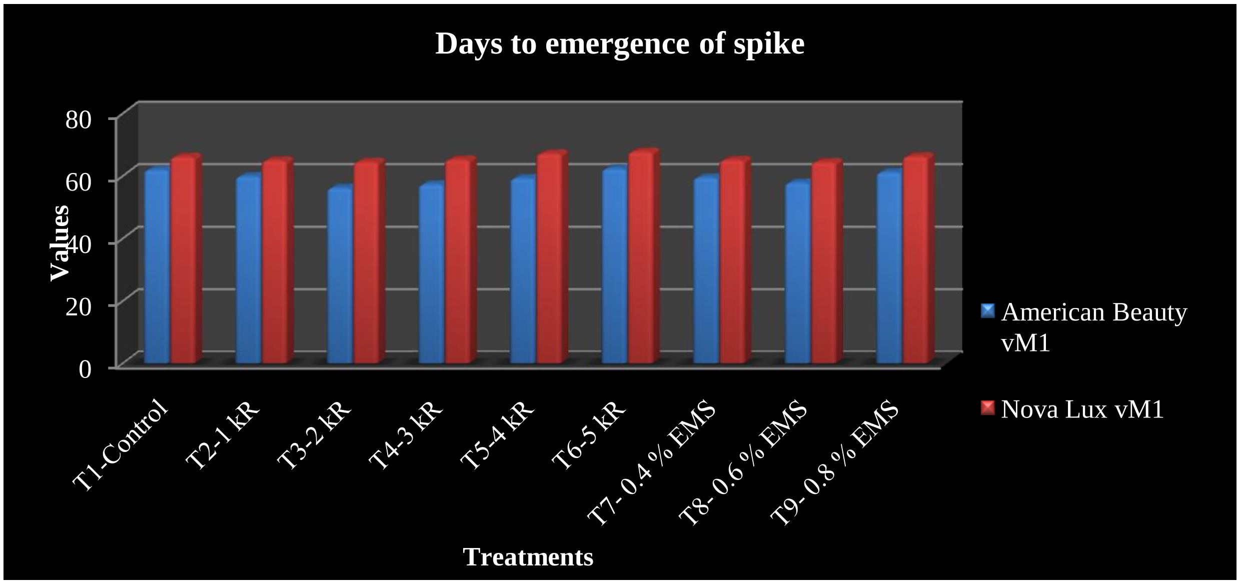


Fig 1 Effect of varied doses of Gamma irradiations and EMS treatments on Days to emergence of spike of vM1 Generation of cultivar Nova Lux

Number of spikes per plant

The findings embossed in Table 1 explicated that physical and chemical mutagens and its compositions significantly influenced the number of spikes per plants in cultivar American beauty and Nova Lux. It is ascertained from the data that maximum number of 2.20 spikes per plants of American beauty cultivarwere produced in the plots when corms were treated with physical mutagen of Gamma irradiation @2kR (T_3) which showed significant superiority over the other treatments. T_3 was closely preceded by T_1 (control) with 1.97 spikes per plant. Minimum number of 1.26 spikes per plant were produced in the plots when corms were treated with physical mutagen of Gamma irradiation @ 5kR (T_6) in M_1 generation of American beauty. Irradiation boosts photosynthetic and enzymatic functions which stimulates activation of gibberellins and auxins resulting in a greater number of spikes per plant. However, heightened levels of irradiations, alters plant metabolism, causing detrimental effect on plant hormones which subsequently reduces flower production (Devi *et al*., 2023).

The series of observation (Table 2) appertaining to Nova lux variety in first generation expressed that maximum number of 1.86 spikes per plantswere obtained from the plots when corms were treated with physical mutagen of Gamma irradiation @2kR (T_3) which showed significant superiority over the other treatments. T_3 was closely preceded by T_1 (control) with 1.76 spikes per plant. Minimum number of 1.33 spikes per plant were produced in the plots when corms were treated with physical mutagen of Gamma irradiation @ 5kR (T_6) of Nova Lux. The research carries out by Sahariya*et al.*, (2017) revealed a reduction in the number of florets per spike under a higher concentration of mutants and an increase in florets per spike with the application of lower doses of gamma rays. These findings contradict with those of Singh *et al.* (2017) who opined a higher number of florets per spike in untreated tuberose plants. As in this experiment also T_1 closely preceded T_3. A decline in the floret quantity per spike was noted at elevated doses of mutants might be due to degradation of auxin, irregular synthesis of auxin, insufficient assimilation, inhibition of mitotic activity and chromosomal changes, or damage associated with secondary physiological impairments (Devi *et al.* 2023). Higher doses of physical mutagens such as 4 and 5kR gave detrimental effect on corms since they produced fewer spikes. The observations coincide with the findings ofProietti*etal.,(*2022) who reported spike number increase in lower doses and decrease with higher doses.

Length of spike

The data presented in the table 1 and 2, revealed that maximum (71.68 cm)length of spike was noted from the plots when corms were treated with physical mutagen of Gamma irradiation @2kR (T_3)which was followed by treatment T_4 (Gamma dosage @ 3kR) with length of spike (71.12 cm) and showed numerical difference with the former in American Beauty cultivar in M1 generation. Minimum value of 59.81 cm length of spike was recordedfrom the plots with physical mutagen gamma irradiation @ 5kR (T_6) in American beauty cultivar.

The data appertaining to Nova lux variety in first generation expressed that maximum (76.65cm)length of spike per plantwere obtained from the plots when corms were treated with physical mutagen of Gamma irradiation @2kR (T_3) which showed significant superiority over the other treatments. T_3 was closely preceded by T_1 (control) with spike length of 76.36 exhibiting numerical difference. Minimum length of 66.74 cm of spike was noted with physical mutagen of Gamma irradiation @ 5kR (T_6) of Nova Lux. Modification in the length of florets and shapes could be due to chromosomal alterations and exposure to gamma radiations affecting the flower organ tissue development by selectively destroying cells layers in the apical floral meristem. Nonetheless, certain responses to irradiation may be linked to point mutation or chromosomal aberrations with plant abnormalities usually returning to normal growth following recovery period, indicating non genetic physiological disturbances as the underlying cause. A decrease in the length of the spike in the plants is subjected to gamma irradiations and Ems treatment can be attributed to impaired growth of flower heads which resulted in physiological, morphological and cytological disruptions caused by mutagenic treatments (Palekar*et al.,* 2022). Additionally it was discovered that spike length decreased as the gamma ray doses increased. A reduction in the spike length could be due to a reduction in internal auxin production, resulting in stunted plant growth (Patel *et al.,* 2018).

Number of florets per spike

The array of data illustrated in Table 1 abounding with number of florets per spikeshowed a significant effect under the influence of physical and chemical mutagens in cultivar American beauty and Nova Lux. Higher value (13.82) number of florets per spike was obtained in American beauty cultivar from the plots when corms were treated with physical mutagen of Gamma irradiation @2kR (T_3) which surpassed other treatments. T_3 was closely preceded by T_7 (EMS @ 0.4%) with 13.78 florets per spikes. Minimum value of 10.86 florets per spikes were noted from plots with untreated corms T_1 (control) in M_1 generation of American beauty.

The data appertaining to Nova Lux variety in first generation depicted in table 2 expressed that higher magnitude of 14.48 florets per spikewere noted under plots when corms were treated with physical mutagen of Gamma irradiation @2kR (T_3) was at par with others. T_3 was closely preceded by T_2 (Gamma dosage@2kR) with 14.03 florets per spikes exhibiting numerical difference. Minimum number of 12.02 florets per spikes were found in the plots when corms were treated with physical mutagen of Gamma irradiation @ 5kR (T_6) of Nova Lux. The result was supported by Patil et al. (2019) on carnations and Vinod and Kannan (2020) on crossandra, Nath *et al.,(*2020) in gladiolus and Proietti*et al.,(*2022)as their results were parallel to above result where the number of florets reduced by increased dosage of gamma rays. A decrease in the number of florets can be attributed to the impact of gamma rays, potentially as a consequence of somatic competition. Flower induction at a lower dose of radiation occurred due to a mutation in the biochemical pathway that aids in the synthesis of substances responsible for triggering flower formation (Patel *et al.,* 2018). Belwal*et al.,* (2023)noted a delay in flowering and floret formation with high dosage of gamma radiation like 4kR and 5kRowing to high chromosomal aberrations or synthesis of toxic substances due to mutagens which have adverse effects on cell division. Furthermore, Patil *et al.*,(2017) pointed out that elevated levels of gamma rays exposure led to a decrease in simultaneous blooming of flowers. This decline was attributed to the increased duration of phenological phases in gladiolus, which was directly proportional to intensity of radiation applied. A considerable amount of variation observed could be linked to chemical mutagens that inducesingle base substitutions, leading to diverse mutation spectra. This leads to significant variation in yield parameters when compared to control (Tiwari *et al.,* 2018).

Length of florets

Statistically significant differences were observed in length of florets subjected to physical and chemical mutagens. The data presented in the table 1, revealed that morelength of florets (9.41cm) was registered from the plots when corms were treated with physical mutagen of Gamma irradiation @2kR (T_3)which was followed by treatment T_7 (EMS @ 0.4%) with length of floret (9.26 cm) and showed numerical difference with the former in American Beauty cultivar in M1 generation. Minimum value of 8.45 cm for length of florets was recordedfrom the plots with chemical mutagen EMS@0.8% (T_9) in American beauty cultivar.

A reference to the data tabulated in table 2 for Nova Lux variety in first generation showed that maximum (10.58cm) length of floretwere obtained from the plots when corms were treated with physical mutagen of Gamma irradiation @2kR (T_3) which showed significant superiority over the other treatments. T_3 was closely followed by T_4(gamma irradiation @ 3kR) with floret length of 10.23 cm exhibiting numerical difference. Minimum length of 8.54 cm of floret was noted with physical mutagen of Gamma irradiation @ 5kR (T_6) of Nova Lux. Observations revealed that the cultivars displayed an augmentation in the number of floral parts and the length of the spike when exposed to lower doses. Furthermore, higher doses led to severe disruptions in the aestivation of petals and florets, accompanied by the conspicuous occurrence of floral fasciation in American beauty and Nova Lux. The occurrence of these changes may be attributed to the physiological as highlighted byTiwari *et al.,(*2018) and Belwal*et al.,* (2023), physiological disturbances leads to reshuffling of histogen layers. Certain responses to irradiation may result from point mutation or chromosomal aberrations. Nevertheless, in most cases, the abnormality in plants reverts back to normal growth during a recovery period, suggesting that the underlying cause is non-genetic physiological disturbances. Patil *et al.*,(2017) indicated that higher concentration of gamma rays culminate in a decrease in length of florets as the duration of phenological phases of gladiolus increased in a direct correlation with radiation doses applied. The treatment with a higher length of the floret was observed with lower doses of radiation compared to control. The significant variation observed may be attributed to the chemical mutagens causing single base substitutions with diverse mutation spectra, leading to a wide range of variations in length of florets compared to control. Additionally, alkylating agents are known to be highly unstable and can result in abrupt changes (Patel *et al*., 2018).

Diameter of florets

Statistically significant differences were observed in diameter of florets subjected to physical and chemical mutagens. The data presented in the table 1, revealed that morediameter of florets (10.23cm) was registered from the plots when corms were treated with physical mutagen of Gamma irradiation @2kR (T_3)which was followed by treatment T_4 (Gamma irradiation @3kR) with floret diameter (10.04 cm) and showed numerical difference with the former in American Beauty cultivar in M1 generation. Minimum value of 8.83 cm for floret diameter was notedfrom the plots with physical mutagen Gamma irradiation @5kR in American beauty cultivar. Observations depicted that higher doses led to lower diameter of the florets in this cultivar. Belwal*et al*., (2023)also observed a decrease in the floret diameter in gladiolus with an increase in the gamma rays. A decline in the flower head production with a higher dose may primarily result from a reduction in growth of plant as was documented by Shukla *et al.,* (2018) andSathyanarayana*et al.,* (2019). Lower levels of gamma rays exposure were found to accelerate flowering, enhance floret size and increase diameter of florets. Conversely, higher levels of irradiation led to a reduction in both floret diameter and quantity. Mutagenic treatments can impact flowering by altering biosynthetic pathways that disrupts flowering physiology. The decline in floret diameter may be attributed to a decrease in the photosynthetic activity which subsequently affects the production of dry matter. Consequently, decrease in dry matter production leads to a decrease in both diameter and weight (Devi *et al.,* 2019).

A reference to the data tabulated in table 2 for Nova lux variety in first generation showed that maximum (10.74cm) diameter of floretwere obtained from the plots when corms were treated with physical mutagen of Gamma irradiation @2kR (T_3) which showed significant superiority over the other treatments. T_3 was closely followed by T_4 (gamma irradiation @ 3kR) with floret diameter of 10.47 cm exhibiting numerical difference. Minimum diameter of 9.15 cm of floret was noted with physical mutagen of Gamma irradiation @ 5kR (T_6) of Nova Lux.Similar findings were opined on reduced floret diameter due to chemical mutagens by Kapadiya (2014) in chrysanthemum, Yadav *et al.*,(2016), Kumar *et al.,* (2021), Proietti*et al.*,(2022) and Belwal*et al.,(*2023) in gladiolus.

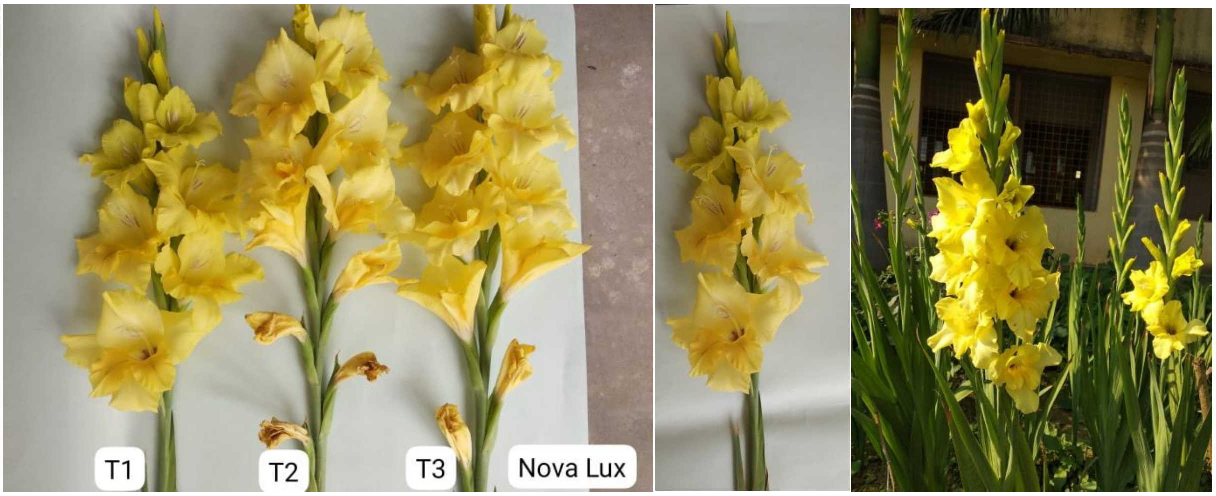
Fig 2. Effect of varied doses of Gamma irradiations and EMS treatments on floral characters of vM1 Generation of cultivar American Beauty

Vase life of cut spikes

The set of observationstabulatedin Table 1 abounding with vase life of cut spikeshowed a significant effect under the influence of physical and chemical mutagens in cultivar American beauty and Nova Lux. Longer vase life of 9.14 days was noted in American beauty cultivar from the plots when corms were treated with physical mutagen of Gamma irradiation @2kR (T_3) which surpassed other treatments. T_4 followed. Shorter vase life of 7.78 days was noted from plots with untreated corms T_6 (Gamma dosage @ 5kR) in M1 generation of American beauty. Higher doses of mutagens reduced the case life of cut spikes.

Statistically significant differences were observed in vase life of cut spike subjected to physical and chemical mutagens. The results expressed in the table 2, revealed that longer vase life of 10.87 days was registered from the plots when corms were treated with physical mutagen of Gamma irradiation @2kR (T_3)which was followed by treatment T_7 (EMS @ 0.4%) with vase life of 10.63 daysand showed numerical difference with the former in Nova Lux cultivar in M1 generation. Shorter vase life of 9.36 days was recordedfrom the plots with physical mutagen Gamma irradiation @ 5kR (T_6) in Nova Lux cultivar. The enhanced vase life of flowers in gladiolus could be attributed to elevated sugar content due to induced radiation. Thus it played a critical role in extending vase life and increased longevity of the flowers. This rise in the sugar content potentially stimulated various metabolic processes which enhanced vase life (Sathyanarayana*et al.*, 2019). Elevated levels of chemical mutagens is harmful as it leads to physiological disruptions and hampers cell mitosis which negatively impacts the quality of vase life of flowers as noted by Ghormade (2020). These findings align with the research conducted by Patil *et al.* (2019)on carnations and Vinod and Kannan (2020) on crossandra, Nath *et al.,(*2020) in gladiolus and Proietti*et al.,(*2022).

Fig 3. Effect of varied doses of Gamma irradiations and EMS treatments on floral characters of vM1 Generation of cultivar Nova Lux



Conclusion

Higher radiation exposure had a detrimental effect on the reproductive processes which led to a reduction in floret number, spike length, blooming period, vase life, and blooming period. These adverse effects may be attributed to destruction of auxin, irregular synthesis of auxin, failure of assimilation mechanism, inhibition of mitotic and chromosomal changes and occurrence of secondary physiological damage. The findings revealed that the initiation of spike occurred significantly faster (56.13 and 64.46 days), with a higher number of spikes (2.20 and 1.86), longer spike length (71.68 cm and 76.65 cm), more florets per spike (13.82 and 14.48), larger diameter (10.23 cm and 10.74 cm), longer floret length (9.41 cm and 10.58 cm), and extended vase life (9.14 and 10.87 days) in the M1 generation of American beauty and Nova lux gladiolus cultivars under the treatment involving corms treated with gamma dosage @ 2kR (T3), respectively. Conversely, the minimum number of spikes, spike length, floret diameter, and vase life of cut spikes were observed in treatment T6 (gamma irradiation @ 5kR) in vM1 for American beauty and Nova Lux cultivars. Hence, it can be inferred that floral characteristics were enhanced with the use of lower doses of gamma radiation.

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References

1. Belwal, S., Srivastava, R., Singh, N.K., Bhuj, B.D., Kumar, A., Chand, S., and Karki, K.(2023). Screening of mutants of gladiolus cultivar prince of orange in M1 and M2 generations. *The Pharma Innovation Journal*.12(3), 5820-5823
2. Deepa V. Pawadashetti, R. Vasantha Kumari and M. Thimmarayappa (2022). Effect of Gamma Irradiation on quality Parameters in Gladiolus (Gladiolus hybrida L.). *Biological Forum – An International Journal.* 14(4), 882- 888.
3. Devi, N.S., Jamja, T., Tabing, R. and Tagi, N. (2023). Influence of gamma radiation on growth, flowers and morphological changes in Gladiolus. *Environment Conservation Journal*.24 (2),301-310.
4. Ghormade GN, Tambe TB, Patil UH, Nilima G.(2020) Yield and quality of chrysanthemum varieties as influenced by chemical mutagens in VM1 generation. *J Pharmacogn. Phytochem.* 9(4),3100-3104.
5. Kumar P, Verma LS, Sharma G, Netam M, Kumar H. (2021). Study the effect of plant growth regulators on vase-life of gladiolus. *Res. J Phar. Phyto*.10(1),849-853.
6. Kumari, K. and 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.
7. Nath V, Sharma S, Singh A. (2020). Response of different preservatives on vase life and quality of gladiolus flower cv. yellow stone. *Plant. Arch*..20(1),1615-1618.
8. NHB; c2021. https://www.agrihortico.com/pdf/freepdf/gladiolus.pdf.
9. Palekar, A.R, Tambe., T.B. and Ghormade, G.N. (2022). Effect of induced mutagenesis on growth, flowering and quality of chrysanthemum varieties in M1 generation. *The Pharma Innovation Journal.* 11(2), 741-744.
10. Patel,D., Patil, S., More S.J and Dohiya T.P. (2018). Comparative Effect of Physical and Chemical Mutagens in Inducing Variability in Gladiolus Variety ‘Psittacinus Hybrid’. *Int.J.Curr.Microbiol.App.Sci.* 7(01), 645-652.
11. Patil UH, Masalkar SD, Patil AH.(2019). Effect of chemical mutagens on growth and flowering of carnation. *Jof Pharmacognosy and Phytochemistry*.8(2),1982-1984.
12. Proietti S, Scariot V, De Pascale S, Paradiso R.(2022). Flowering mechanisms and environmental stimuli for flower transition: Bases for production scheduling in greenhouse floriculture. *Plants.*11(3),432.

13. Rawat, A.S., Bhuj, B.D., Srivastava, R., Chand, S. and Singh, N.K. (2021). Effect of Gamma Irradiation on Vegetative Characters in various Cultivars of Gladiolus in vM2 Generation. Biological Forum – *An International Journal*. 13(3a),25-28.
14. Sahariya, K., Kaushik, R.A., Rashid Khan and Deepak Sarolia (2017). Influence of Gamma Irradiation on Flowering of Gladiolus (Gladiolus hybrida L.). *International Journal of Current Microbiology and Applied Sciences*. 6(11), 1362- 1368.
15. Sathyanarayana, E., Gaurav Sharma, Tirkey, T., Das, B.K. and Divya, K. (2019). Studies of gamma irradiation on vegetative and floral characters of gladiolus (Gladiolus grandiflorus L.). *Jof Pharmacognosy and Phytochemistry*.8(5),227-230.
16. Singh, A.K., Raju Sah, Anjana Sisodia, and Pal, A.K. (2017). Effect of Gamma Irradiation on Growth, Flowering and gladiolus. *Journal of Ornamental Horticulture*. 10 (2), 135- 136.
17. Tiwari, A., Pal, S.,Singh, A. (2018). Effect of gamma irradiation on growth and floral characters of gladiolus varieties. *Int. J. of Chemical studies.* 6(6), 1277-1282.
18. Vinodh S, Kannan M. (2020). Effects of ethyl methane sulphonate on the yield and qualtiy of crossandra (Crossandrainfundibuliformis (L.) Nees). *Int. J Chem. Stud.*8(1),539-541
19. Yadav, M., Rajput, V., Saharan, R.S., Sehrawat, S.K. and Ravika (2016). Influence of gamma radiations and EMS on morphological characteristics of gladiolus cv. PINK BEAUTY. *Asian J. Hort.* 11(1), 114-118, DOI : 10.15740/HAS/TAJH/11.1/114-118.

Treatments	**vM1 Generation of cultivar American Beauty**					
	Number of spikes per plant	**Length of spike (cm)**	**Number of florets per spike**	**Length of floret (cm)**	**Diameter of floret (cm)**	**Vase life of cut spike**
T1-Control	1.97	62.13	10.86	8.55	9.55	8.36
T2-1 kR	1.80	67.21	11.84	8.71	9.77	8.69
T3-2 kR	2.20	71.68	13.82	9.41	10.23	9.14
T4-3 kR	1.70	71.21	13.40	9.18	10.04	8.83
T5-4 kR	1.35	66.80	12.11	8.89	9.83	8.08
T6-5 kR	1.26	59.81	11.66	8.73	8.83	7.78

T7- 0.4 %	1.70	68.36	13.78	9.26	10.01	8.58
T8- 0.6 %	1.46	65.73	13.43	8.81	9.74	8.18
T9- 0.8 %	1.30	61.13	11.96	8.45	9.37	7.93
Mean	1.64	66.01	12.54	8.89	9.71	8.39
SD	0.42	4.10	1.05	0.32	0.41	0.43
S.Em.±	0.08	0.79	0.20	0.06	0.08	0.08
CV %	25.78	6.22	8.38	3.64	4.31	5.15

Table 1 Effect of varied doses of Gamma irradiations and EMS treatments on floral characters of vM1 Generation of cultivar American Beauty

Treatments	**vM1 Generation of cultivar Nova Lux**					
	Number of spikes per plant	**Length of spike (cm)**	**Number of florets per spike**	**Length of floret (cm)**	**Diameter of floret (cm)**	**Vase life of cut spike**
T1-Control	1.76	72.62	13.68	9.03	9.89	9.71
T2-1 kR	1.43	72.79	14.03	9.60	10.49	10.34
T3-2 kR	1.86	76.65	14.48	10.58	10.74	10.87
T4-3 kR	1.70	76.36	13.24	10.23	10.47	10.55
T5-4 kR	1.50	72.34	12.72	9.14	9.32	9.89
T6-5 kR	1.33	66.74	12.02	8.54	9.15	9.36
T7- 0.4 %	1.80	72.59	13.66	9.62	10.27	10.63
T8- 0.6 %	1.53	75.37	13.60	9.85	9.96	10.49
T9- 0.8 %	1.56	73.09	12.50	8.93	9.45	9.46
Mean	1.61	73.17	13.32	9.50	9.97	10.14
SD	0.30	2.84	0.77	0.63	0.55	0.53
S.Em.±	0.05	0.54	0.14	0.12	0.10	0.10
CV %	18.88	3.89	5.81	6.71	5.55	5.29

Table 2 Effect of varied doses of Gamma irradiations and EMS treatments on floral characters of vM1 Generation of cultivar Nova Lux