Journal of Nuclear Research and Applications

Research Paper

Vol. 2, No. 4, Autumn (2022), P 32-35

Cited in: https://jonra.nstri.ir

Received: 26 May 2022, Accepted: 18 June 2022

Genetic Diversity in Gladiolus by Using Gamma Rays

M. R. Rahemi[1]*, M. Mohammadi[1]. M. H. Azimi[2], M. Amiripari[1], M. Nori[1]

[1]*Department Of Breeding, Nuclear Agriculture Research School, Nuclear Science and Technology Research Institute (NSTRI), P.O. Box: 3148-5498, karaj, Iran*

[2]*Department Of Breeding, Ornamental Plants Research Center (OPRC), P.O. Box: 3781-5137, Mahallat, Iran*

ABSTRACT

This investigation was carried out to determine the effects of gamma radiation on germination characteristics of gladiolus corms. This experiment was conducted through a factorial design in a randomized complete block with three replications. Two factors included cultivars of gladiolus (Red Advance, White Prosperity, Amsterdam, and Rose Supreme) and doses of gamma radiation (0, 15, 25, 35, 45, 55, 65, and 75 Gy). However, the results showed that corm weight, size, and the number of daughter corms decreased with increasing radiation doses in contrast to a low dose of (15 Gy) High doses of gamma irradiation (75 Gy) showed lethal effects on various vegetative traits. The low yield at high doses can be due to the reduced vegetative growth due to gamma treatments. The results of this study suggest a dose of 40-65 Gy as the optimal dose to improve the vegetative traits of gladiolus.

Keywords: Gladiolus, Genetic Diversity, Corm, Mutation

I. Introductions

Flowers and ornamental plants give color, beauty, and energy to the living environment as well as strengthen the immune system, brain, and lung function [1]. The most important ornamental plants in the world include rose, carnation, chrysanthemum, and gladiolus, which are currently being studied and researched by the Nuclear Agriculture Research Institute as a joint project [2, 3].

The production of flowers and ornamental plants is a profitable economy in most countries, including the Netherlands, Japan, China, and the US [2]. In Iran, studies have been done only in planting improvement, and not much work has been done in the field of breeding improvement [2]. The luxury and diverse flower and plant market is highly demanding new varieties [2, 3]. Due to Iran's non-membership in the Global Protocol UPOV (International Union for the Protection of New Varieties of Plants) and the easy reproduction of ornamental plants, Suitable quality cultivars are not given to Iran [2]. On the other hand, modification of new cultivars by classical methods is impossible

*. *Corresponding Author name*: M. R. Rahemi
E-mail address: mrrahemi@aeoi.org.ir

due to heterozygosity, flower structure, and physiological barriers. Therefore, mutation breeding is the most effective way to improve cultivars, and the need to pay attention to this industry and try to improve the different species of flowers and ornamental plants to increase marketability and exports [2, 3].

Modern breeding of flowers and ornamental plants, including somaclonal diversity in tissue culture and induced mutations, production of polyploid and haploid plants, as well as the use of markers, genetic engineering, and biotechnology techniques in the breeding of horticultural plants, to create diversity in color, shape, and structure and increasing marketability [1-5]. In any breeding program, genetic diversity is essential to improve plant characteristics [6, 7]. Mutation induction is one of the most effective ways to increase natural genetic resources and improve and introduce new cultivars among crops that are propagated by seed or unsexual methods [7, 8].

The persistence of climate change, and the reduction of water and soil resources [3], encourages scientists and the international community to find appropriate solutions to increase the efficiency of inputs and conservation of natural and environmental resources [5]. Currently, at the Faculty of Nuclear Agricultural Research, investigations are being done on some strategic flowers that have a high potential for monetization, income generation, and employment, including Anthurium, Orchids, roses, Chrysant hemume, Irises, Pot hos, Zamofilia, Sansevieria, Aglaonema, Succulents, and medicinal plants. This research describes gladiolus breeding methods and protocols. Gladiolus belongs to the Iridaceae family in temperate, arid, and summer regions. In gladiolus, reproduction can originate from seed, but heterozygosity does not lead to pure and desirable propagation; therefore, the corm is used for asexual reproduction. Gladiolus is one of the most important cut flowers, in terms of area under cultivation in Iran. It is the first among cut flowers and onion flowers and is one of the native plants of Iran and has a good place in production and introduction of new cultivars. Problems of imported cultivars' non-native cultivars, lack of adaptation to Iran's climate, and their exposure to fungal infections such as Fusarium, the increasing demand for new cultivars prompted us to design the breeding project.

II. Experimental

Gladiolus corms intended for mutation breeding experiments should be the same size grown and stored under similar conditions. Effects of gamma-ray treatments were studied on four varieties of *Gladiolus hybrida* L. (Red Advance, White Prosperity, Amsterdam & Rose Supreme) to determine their radiosensitivity and choose the optimal dose for induction genetic diversity. Therefore, corms were placed in gamma-cell (which results in a dose rate of 15.7 Gy/min) and irradiated at eight levels of gamma-ray (0, 15, 25, 35, 45, 55, 65, and 75 Gy) and planted in the greenhouse under a factorial design in the randomized complete block with three replications in Nuclear Agriculture Research Institute, Karaj, Iran. Gamma rays were generated from ^{60}Co. The optimal dose was determined based on a 50% reduction in plant growth (LD_{50}) [1-5]. Corm weight, corm size, and number of daughter corms were measured.

III. Results and Discussion

The results showed that corm weight, size, and the number of daughter corms were decreased with increasing radiation doses [figure 1]. However, low doses (15 Gy) caused stimulation effects. This may be due to stimulation of enzyme activity at low doses. High doses of gamma irradiation (75 Gy) showed lethal effects on various vegetative traits. The low yield at high doses can be due to the reduced vegetative growth as a result of gamma treatments.

Research has shown that in short-term breeding programs, mutation induction techniques can increase the frequency of gene mutations and the formation of new germplasm and cultivars [2,3]. As a result of these works, a series of gladiolus cultivars have been obtained that need to be evaluated and introduced into the market [figure 2].

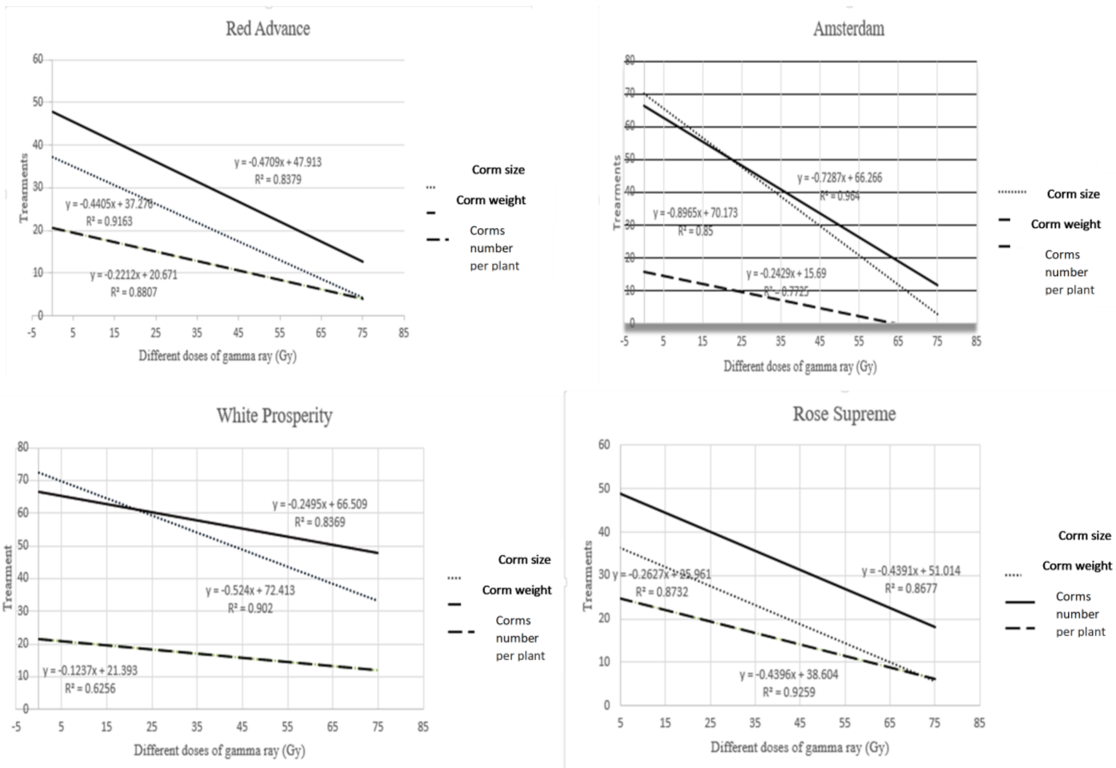

Figure 1. Effect of cultivar and radiation dose on corm weight, size, and the number of daughter corms in gladiolus.

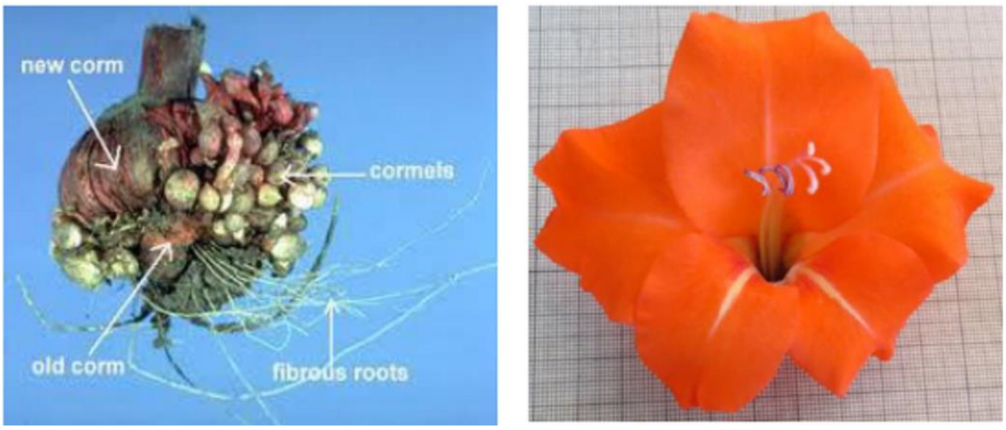

Figure 2. Gladiolus corm and mutant gladiolus flower.

IV. Conclusions

Mutations of breeding and producing cultivars in this way in gladiolus is the first time in the country. Doses of 40-65 Gy were appropriate in gladiolus to maximize genetic diversity. Corm weight, size, and the number of daughter corms decreased with increasing radiation doses. It is suggested that future studies investigate the development of some characteristics such as winter flowering ability, floral aroma, and resistance to major significant pathogens using the optimal dose.

V. Acknowledgments

A big thanks to all the esteemed members of the Ornamental Plants Research Center for their cooperation.

References

1. M. Mohammadi and M.R. Rahemi, *Healthy and very effective technologies in agriculture and human life*, Core Scientific-Extensive Journal, Nuclear Science and Technology Research Institute, N5-page: (2021).

2. IAEA, *Climate Change and Nuclear Power*, *International Atomic Energy Agency*, Vienna International Centre, p. 114 pages (2019).

3. FAO/IAEA, *Landscape Salinity and Water Managment For Improving Agricultural Productivity*. (2020).

4. J. F. Leslie, and B. A., *Summerell*, *Fusarium laboratory workshops--A recent history*. Mycotoxin Research, **22**(2), p.73, (2006).

5. M. H Azimi. Z. Tahernezhad and M. J. Zamani, *Genetic Variation within Iranian Iris Species Using Morphological Traits*. International Journal of Horticultural Science and Technology, **3**(1), 89-98, (2016).

6. Cantor, M., I. Pop and S. Korosfoy, *Studies concerning the effect of gamma radiation and magnetic field exposure on gladiolus*. Journal of Central European Agriculture, **3**(4): 277-284, (2002).

7. M. R., Rahemi, A.,Yamchi, S., Navabpour, H. Soltanloo, and P., Roepstorff,. *Gamma ray effect on traits related to wheat bakery quality in Roshan cultivar*. Journal of Crop Breeding, **10**(26), pp. 120-127, (2018).

8. M. R., Rahemi, A.,Yamchi, S., Navabpour, H. Soltanloo, and P., Roepstorff,. *Evaluation of gamma ray effect on wheat bakery properties in Omid, Roshan and Tabasai cultivars by artificial neural network*. Journal of Nuclear Science and Technology (JonSat), **40**(4), pp.119-127, (2020).

How to cite this article
M. R. Rahemi, M. Mohammadi, M. H. Azimi, M. Amiripari, M. Nori,* Genetic Diversity in Gladiolus by Using Gamma Rays, *Journal of Nuclear Science and Applications,* Vol. **2,** No. **4,** Autumn **(2022),** P **32-35, Url:** https://jonra.nstri.ir/article_1438.html, **DOI**: 10.24200/jon.2022.1031