Mysore J. Agric. Sci., 56 (4) : 148-154 (2022)

Effect of Gamma Irradiation on Vegetative and Floral Traits in Gladiolus (*Gladiolus hybrida* L.)

DEEPA V. PAWADASHETTI, R. VASANTHA KUMARI, J. SHANTHALA AND M. THIMMARAYAPPA
Department of Horticulture, College of Agriculture, UAS, GKVK, Bengaluru - 560 065
e-Mail : deepapawadashetti5006@gmail.com

AUTHORS CONTRIBUTION

DEEPA V. PAWADASHETTI ; Execution of field experiment, data collection and analysis;
R. VASANATHA KUMARI : Contribution of experiment materials, designing and analysis;
J. SHANTHALA : Coneptualization of research and analysis of data
M. THIMMARAYAPPA : Prepration of manuscript.

Corresponding Author :
DEEPA V. PAWADASHETTI
Department of Horticulture, College of Agriculture, UAS, GKVK, Bengaluru

Received : July 2022
Accepted : October 2022

ABSTRACT

A study was carried out in the Floriculture unit,Department of Horticulture, UAS, GKVK Bengaluru from 2020-2022 on 'Investigation and identification of elite mutants induced through physical mutagen for floral traits in gladiolus (*Gladiolus hybrida* L.)'. The experiment was laid out in a factorial randomized complete block design with eighteen treatments replicated thrice. Six gamma doses *i.e.,* 15 Gy, 25 Gy, 35 Gy, 45 Gy, 55 Gy and control (untreated) as treatments were imposed on three varieties of gladiolus *viz.,* Arka Gold, Arka Pratham and Arka Amar. Number of days taken for sprouting was delayed with increased gamma dosage. Maximum days for sprouting (18.60) was observed in var. Arka Gold treated with 55 Gy and minimum days for sprouting was observed in untreated var. Arka Pratham (9.13). At lower dosage, plant height was increased and at higher dosage it was reduced. Maximum plant height was obtained in var. Arka Amar treated with 25 Gy (146.33 cm) and shorter plants were observed in var. Arka Pratham treated with 55 Gy (20.80 cm). Highest number of leaves were recorded in 25 Gy. Maximum rachis length (58.40 cm), length of the spike (120.07 cm), number of floret per spike (18.20) and floret diameter (11.13 cm) were recorded with 25 Gy . Among different treatments, corm treated with 25 Gy of gamma dosage had performed better over other treatments.

Keywords : Gladiolus, Physical mutagen, Gamma irradation, Vegetative, Floral traits

GLADIOLUS (*Gladiolus hybrida* L.) which occupies an important position in ornamental horticulture. It is one of the commercially exploited flower crop belonging to the family Iridiaceae and subfamily Ixoideae. Gladiolus also known as 'Queen of bulbous crops' with striking inflorescence, wide spectrum of attractive colors, size and shape of flowers coupled with long shelf life (Singh, 2006). It is mainly used as cut flower, ideal for herbaceous borders, bedding, pots, garden display and exhibition. Each bud has a potential to produce shoot and spike this enabled the farmers to shift from traditional crops to high value crop.

Conventional breeding is a time-consuming process for genetic improvement of the floriculture crops. Mutation breeding has emerged as an alternative, efficient and an innovative methodology to produce heritable changes particularly for flower color and quality. Genetic variation is essential in any plant breeding programme for crop improvement. Induced mutations are highly effective to enhance natural genetic resources (Jain, 2006).

Mutation is recognized as one of the most important breeding tool for the development of new varieties through genetic manipulation (Kumari and Kumar, 2015). Mutation breeding refers to the genetic improvement of crop plants for various economic characters through the use of induced mutations. Generally, mutagens are classified in two ways *i.e.*, physical mutagens and chemical mutagens. Mutation is cheap and rapid method of developing new varieties as compared to hybridization methods. It is more

effective for the improvement of oligogenic characters than polygenic traits. It is the simple, quick and best way when a new character is to be induced in vegetatively propagated crops. An induced mutation takes lesser time for release of new variety. New varieties developed through mutation breeding are identical to parent variety except for the character improved. Gamma rays are known to influence plant growth and development by inducing cytological, genetical, biochemical, physiological and morphogenetic changes in cells and tissues (Tiwari *et al*., 2010).

Induced mutations in ornamentals comprise traits such as altered flower characters (color, size, morphology, fragrance), leaf characters (form, size, pigmentation), growth habit (compact, climbing, branching) and physiological traits such as changes in photoperiodic response, early flowering, free flowering, improved keeping quality and tolerance to biotic and abiotic stresses. The main advantage of mutation breeding in vegetatively propagated crops is the ability to change one or a few characters of an outstanding variety without altering the unique part of the genotype (Datta, 2014). Induced mutation may produce new genetic variation for plant types in the existing varieties (Anita *et al.,* 2011).

Material and Methods

The present investigation was carried out at the Floriculture and Ornamental Section, Department of Horticulture, University of Agricultural Sciences, Gandhi KrishiVignana Kendra, Bengaluru during 2020-22. Geographically the place is located in Eastern dry zone (Zone-5) of Karnataka state at 13Ú05" at North latitude and $77^0$34" East longitude with an elevation of about 924 meters above mean sea level. The experiment was laid out in factorial randomized complete block design replicated thrice with eighteen treatment combinations of varieties and gamma irradiation doses *viz.,* T_0V_1 (control+Arka Gold), T_1V_1 (15 Gy +Arka Gold), T_2V_1 (25 Gy +Arka Gold), T_3V_1 (35 Gy +Arka Gold), T_4V_1 (45 Gy +Arka Gold), T_5V_1 (55 Gy +Arka Gold), T_0V_1 (control+Arka Pratham), T_1V_1 (15 Gy +Arka Pratham), T_2V_1 (25 Gy +Arka Pratham), T_3V_1 (35 Gy +Arka Pratham), T_4V_1 (45 Gy +Arka Pratham), T_5V_1 (55 Gy +Arka Pratham), T_0V_1 (control+Arka Amar), T_1V_1 (15 Gy +Arka Amar), T_2V_1(25 Gy+Arka Amar), T_3V_1 (5 Gy+Arka Amar), T_4V_1 (45 Gy +Arka Amar), T_5V_1 (55 Gy+Arka Amar).

The corms of different varieties were collected from ICAR - Indian Institute of Horticultural Research, Hesarghatta, Bengaluru. The corms were exposed todifferent doses of ^{60}Co gamma rays *viz.,*15Gy, 25Gy, 35Gy, 45Gy and 55Gy at gamma chamber, ICAR - Indian Institute of Horticultural Research, Hesaraghatta, Bengaluru. Untreated corms were used as control.Field planting was done during 2020 with a spacing of 30 cm between rows and 20 cm between corms and followed recommended package of practices.

Results and Discussion

Number of Days to Sprouting

The effects of gamma irradiation during M_1 generation on the number of days required for corm sprouting were recorded (Table 1). Maximum number of days for sprouting was recorded in Arka Gold (18.60 days) and minimum of days for sprouting was recorded in Arka Pratham (9.13 days).Treatments with gamma irradiation had a significant effect on corms sprouting. Minimum days for corm sprouting was recorded in untreated corms (10.89 days) and maximum number of days for corm sprouting was recorded in corms treated with 55 Gy gamma irradiation doses (17.62 days) which was followed by corms treated with 45 Gy gamma irradiation doses (16.11 days). Days required for sprouting were greatly affected by a combination of cultivars and treatments. In untreated corms minimum number of days taken for sprouting was recorded in Arka Pratham (9.13 days) and maximum number of days for sprouting was recorded in Arka Gold corms treated with 55 Gy gamma irradiation doses (18.60 days).

As the gamma irradiation doses increased the days taken for sprouting also increased in all the cultivars. Lower mutagen concentrations alone do not play any

The Mysore Journal of Agricultural Sciences

TABLE 1

Effect of gamma dose on number of days taken for sprouting in different varieties of gladiolus

Gamma ray doses	vM1 generation (Cultivars)			
	Arka Gold	Arka Pratham	Arka Amar	Mean
T1 - Control	11.87	9.13	11.67	10.89
T2 - 15 Gy	12.73	10.93	12.00	11.89
T3 - 25 Gy	14.20	12.20	12.87	13.09
T4 - 35 Gy	15.13	13.20	13.93	14.09
T5 - 45 Gy	16.47	15.60	16.27	16.11
T6 - 55 Gy	18.60	16.60	17.67	17.62
Mean	14.83	12.94	14.07	
	S. Em.±	**C.D. (5%)**	**CV%**	
Variety	0.60	1.73		
Treatment	0.85	2.44	6.10	
Variety ×Treatment	0.49	1.41		

role in sprouting however the enzymes may play crucial role in plant metabolism, chemicals like those released by irradiation and low doses induce stimulations (Cantor *et al.,* 2002). Auxins and other growth factors that affect chromosomes and plant tissue may be harmed by higher irradiation dosages (Srivastava *et al.,* 2007).

Plant Height (cm)

Plant height was recorded at 30, 60 and 90 days after planting, which was significantly influenced by variety and treatment it is graphically depicted in Fig. 1. The varieties and treatment had significant effect on plant height.

The tallest plant was recorded in cv. Arka Gold (59.00 cm) and shortest plant height was recorded in cv. Arka Pratham (34.63 cm). The maximum plant height was recorded in corms treated with 25 Gy (59.00 cm) and the minimum was recorded with 55 Gy (34.63 cm). The minimum plant height was recorded in Arka Pratham (34.63 cm) corms treated with 55 Gy and maximum plant height was recorded in Arka Gold corms treated with 25 Gy (59.00 cm).

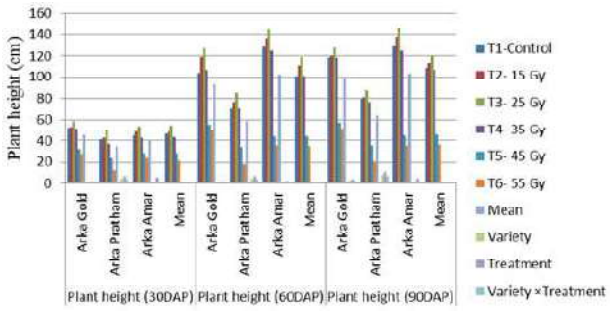

Fig. 1 : Influence of gamma dose on plant height (cm) in different varieties of gladiolus

At 60 days after planting, maximum plant height was recorded in cv. Arka Amar (144.53 cm) and minimumin cv. Arka Pratham (18.27 cm). The tallest plant was recorded in the corms treated with 25 Gy (144.53 cm) and the smallest plant was recorded in corms treated with 55 Gy (18.27 cm). Among, cultivar, the tallest plant was recorded in cv. Arka Amar (144.53 cm) corms treated with 25 Gy and shortest plant was recorded in cv. Arka Pratham (18.27 cm) corms treated with 25 Gy.

At 90 days after planting, the shortest plant height was recorded in cv. Arka Pratham (20.80 cm) and the tallest plant was recorded in cv. Arka Amar (146.33 cm). The corms treated with 25 Gy produced tallest plants (146.33 cm), similarly, the corms treated with 55 Gy produced shortest plants (20.80 cm). Arka Pratham corms treated with 55 Gy had smallest plant height (20.80 cm), whereas, Arka Amar corms treated with 25 Gy had the highest plant height (146.33 cm).

The plant height gradually reduced as the gamma ray doses increased beyond 25 Gy.

The increase in growth rate at lower dosages are due to the fact that some chemical mutagens result in single base changes with various mutation spectra, which create broad variance (Abdullah *et al.,* 2009). Higher mutagen doses results in reduction in plant development, which may affected by the elimination of growth inhibitors, a decrease in auxin levels or an inhibition of auxin production and assimilation mechanisms such results have also been reported by Misra (1998) and Misra & Mahesh (1993). A gradual decrease in the mean plant height was observed with the increase in treatment dose (Anita *et al.,* 2012).

Data on the number of leaves per plant graphically represented in Fig.2. Leaf production was greatly influenced by plant variety gamma irradiation exposure and their interactions. The varieties and

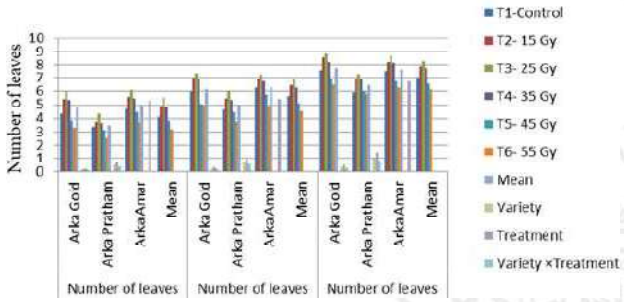

Fig. 2 : Gamma dose influence on number of leaves in different varieties of gladiolus

treatment have significant effect on number of leaves per plant (30 days after planting). The highest numbers of leaves were observed in cv. Arka Amar (6.13) and lowest were observed in cv. Arka Pratham (2.53). The maximum number of leaves per plant was recorded in corms treated with 25 Gy (6.13) and the minimum number of leaves per plant was recorded in corms treated with 55 Gy (2.53). The number of leaves per plant was increased in Arka Amar (6.13) corms treated with 25 Gy and reduced in Arka Pratham corms treated with 55 Gy (2.53).

At 60 days after planting, maximum number of leaves per plant observed in cv.Arka Gold (7.33) and minimumn in cv Arka Pratham (3.80). The more number of leaves per plant was recorded with 25 Gy (7.33) than 55 Gy (3.80). The maximum number of leaves per plant recorded in cv. Arka Gold (7.33) corms treated with 25 Gy and minimum was recorded in cv. Arka Pratham (3.80) corms treated with 55 Gy.

At 90 days after planting, lesser number of leaves per plant was observed in cv. Arka Pratham (5.80) than cv. Arka Gold (8.80). The corms treated with 25 Gy gamma ray doses produced maximum number of leaves per plant (8.80) than to 55 Gy (5.80). Arka Pratham corms treated with 55 Gy had reduced number of leaves per plant (5.80), whereas, Arka Gold corms treated with 25 Gy had enhaced number of leaves per plant (8.80). The plant height gradually reduced as the gamma ray doses increased beyond 25 Gy.

These findings were also reported by Misra (1998) and Misra & Mahesh (1993). Lower concentrations of these compounds may activate physiological chemicals found in corms, whereas greater dosages slow down cell division by stopping mitotic cell division and having negative effects on auxins.

The difference in rachis length caused by variety, gamma irradiation dosages and their interactions are presented in Table 2.

The reduction in rachis length was observed in cv. Arka Pratham (35.47 cm) corms treated with 55 Gy and increment in rachis length was observed in Arka Gold (58.40 cm) corms treated with 25 Gy.

Variation in spike length significantly affected by gamma irradiation dosages and their interactions (Table 3). The lowest spike length was recorded in cv. Arka Pratham corms treated with 55 Gy (78.20 cm) and highest spike length was recorded in var. Arka Gold corms treated with 25 Gy (120.07 cm).

The flower spike elongated and differentiation of the individual flower occurred as a result of low doses of gamma dose in gladiolus (Awad and Harried, 1985).

The treatment and plant variety had a significant impact on the number of flowers per spike (Table 4). In cv. Arka Pratham (7.33), lesser number of flowers per spike were recorded and more number of flowers per spike were observed in cv. Arka Gold (18.20).

TABLE 2

Effect of gamma dose on rachis length (cm) in different varieties of gladiolus

Gamma ray doses	vM1 generation (Cultivars)			
	Arka Gold	Arka Pratham	Arka Amar	Mean
T1-Control	53.07	44.00	50.07	49.04
T2- 15 Gy	56.73	47.13	52.87	52.24
T3- 25 Gy	58.40	48.67	55.47	54.18
T4- 35 Gy	54.67	45.73	51.53	50.64
T5- 45 Gy	50.07	40.07	44.20	44.78
T6- 55 Gy	48.20	35.47	42.60	42.09
Mean	53.52	43.51	49.46	
	S. Em.±	C.D. (5%)	CV%	
Variety	2.80	8.06		
Treatment	3.96	11.39	8.12	
Variety ×Treatment	2.29	6.58		

The number of flowers per spike in the Arka Pratham corms treated with 55 Gy was lower (7.33), whereas, number of flowers per spike in the Arka Gold corms treated with 25 Gy was higher (18.20). As the gamma irradiation doses exceeded 25 Gy, the number of flowers per spike gradually reduced.

Dobanda (2004) further claimed that because the length of the gladiolus phenological phases lengthened, which was directly related to the applied irradiation doses, that higher doses of gamma irradiation caused a decline in the number of flowers opening simultaneously.

Flower diameter was significantly influenced by variety and treatment (Table 5). The smallest flower was recorded in cv. Arka Pratham (7.07 cm) and the largest flower was recorded in cv. Arka Amar (11.13

TABLE 3

Impact of gamma dose on spike length (cm) in different varieties of gladiolus

Gamma ray doses	vM1 generation (Cultivars)			
	Arka Gold	Arka Pratham	Arka Amar	Mean
T1 - Control	113.73	90.20	108.33	101.40
T2 - 15 Gy	118.13	96.20	110.87	107.56
T3 - 25 Gy	120.07	100.07	104.13	110.33
T4 - 35 Gy	115.33	92.93	100.73	104.13
T5 - 45 Gy	101.00	85.80	90.33	95.84
T6 - 55 Gy	98.53	78.20	108.33	89.02
Mean	111.13	90.57	102.44	
	S. Em.±	C.D. (5%)	CV%	
Variety	3.25	9.34		
Treatment	4.60	13.21	4.54	
Variety ×Treatment	2.65	7.63		

TABLE 4

Effect of gamma doses on number of floret per spike in different varieties of gladiolus

Gamma ray doses	vM1 generation (Cultivars)			
	Arka Gold	Arka Pratham	Arka Amar	Mean
T1-Control	12.33	10.00	16.13	12.82
T2- 15 Gy	14.60	12.07	17.13	14.60
T3- 25 Gy	16.13	14.07	18.20	16.13
T4- 35 Gy	13.53	11.00	16.40	13.64
T5- 45 Gy	10.07	8.07	12.27	10.13
T6- 55 Gy	9.00	7.33	8.07	8.13
Mean	12.61	10.42	14.70	
	S. Em.±	C.D. (5%)	CV%	
Variety	1.19	3.42		
Treatment	1.68	4.83	13.37	
Variety ×Treatment	0.97	2.79		

cm). The corms treated with 25 Gy gamma ray doses produced the bigger flowers (11.13 cm) and the corms exposed to 55 Gy gamma ray doses produced the smaller flowers (7.07 cm). Arka Pratham corms treated with 55 Gy had the minimum flower size (7.07 cm), whereas, Arka Amar corms treated with 25 Gy had the maximum flower size (146.33 cm).

The higher doses of irradiation decreased the floret size and had negative effects, which may have been caused by auxin destruction, irregular auxin synthesis, failure to assimilate, mechanisms that inhibited mitotic and chromosomal changes, or damage with secondary physiological damage (Banerji *et al.,* 1996) which supports the present findings.

In the present investigation gamma irradiation had exerted the significant effect on vegetative and floral traits in all three cultivars of gladiolus. Gamma irradiation doses at 25 Gy and 15 Gy found beneficial

TABLE 5

Effect of gamma dose on floret diameter (cm) in different varieties of gladiolus

Gamma ray doses	vM1 generation (Cultivars)			
	Arka Gold	Arka Pratham	Arka Amar	Mean
T1 - Control	10.07	9.07	10.60	9.91
T2 - 15 Gy	10.27	9.67	10.93	10.29
T3 - 25 Gy	10.67	9.87	11.13	10.56
T4 - 35 Gy	10.13	9.20	10.80	10.04
T5 - 45 Gy	8.53	8.07	9.13	8.58
T6 - 55 Gy	7.53	7.07	8.27	7.62
Mean	9.53	8.82	10.14	
	S. Em.±	C.D. (5%)	CV%	
Variety	0.20	0.59		
Treatment	0.29	0.83	3.04	
Variety ×Treatment	0.17	0.48		

for various growth, flowering traits in gladiolus. Medium to higher doses of gamma rays *i.e.,* 15 Gy, 25 Gy and 35 Gy can be applied in gladiolus corms for improvement. In general, the expressions of vegetative and floral characters were decreased and retarded.with 55 Gy.

Acknowledgement : The authors gratefully acknowledge the ICAR - Indian Institute of Horticultural Research, Hesaraghatta, Bengaluru.

References

Abdullah, T. E., Endan., J. and Mohd, N. B., 2009, Changes in flower development, chlorophyll mutation and alteration in plant morphology of *Curcuma alismatifolia* by gammadose. *American J. Applied Sci.,* **6** (7) : 1436 - 1439.

Anita, V., Chikkadevaiah and Nandini, R., 2012, Induction of genetic variation in winged bean [*Psophocarpus tetragonolobus* (L.) DC] using gamma Rays. *Mysore J. Agric, Sci.,* **46** (2) : 286 - 292.

Anita, V., Nandini, R. and Chikkadevaiah, 2011, Useful mutants recovered through gamma dose in winged bean (*Psophocarpus tetragonolobus* (L.) DC). *Mysore J. Agric, Sci.,* **45** (1) : 90 - 93,

Awad, A. R. and Harried, A. A., 1985, Anatomical studies on gladiolus stem apex as affected by kinetin giberellin, ethephon concentration and gamma dose doses. *Acta Hortic.,* **167** : 177 - 185.

Banerji, B. K., Dwivedi, A. K. and Datta, S. K., 1996, Gamma dose studies on gladiolus. *J. Nucl. Agric. Bio.,* **25** (2) : 63 - 67.

Cantor, M., Pop, I. and Korosfoy, S., 2002, Studies concerning the effect of gamma irradiation and magnetic field exposure on gladiolus. *J. Cent. Eur. Agric.,* **3** (4) : 277 - 284.

Datta, S. K., 2014, Induced mutagenesis : basic knowledge for technological success. National Botanical Research Institute (NBRI-CSIR), Lucknow, Uttar Pradesh, India, pp.: 97 - 139.

Dobanda, E., 2004, Evaluation of variability induced by gamma irradiation on quantitative and qualitative traits in gladiolus. *Cerc. Genet. Veg. Anim.,* **8** : 149 - 156.

Jain, S. M., 2006, Mutation assisted breeding for improving ornamentals plants. *Acta Hortic.,* **714** : 85 - 98.

Kumari, K. and Kumar, S., 2015, Effect of gamma dose on vegetative and propagule character in gladiolus and induction of homeotic mutants. *Int. J. Agric. Environ. Biotech.,* **8** (2) : 412 - 422.

Misra, R. L. and Mahesh, K. S., 1993, Studies on mutation induction in gladioli through ^{60}Co gamma rays. *J. Ornam. Hortic.,* **1** (2) : 42 - 46.

Misra, R. L., 1998, Irradiation induced variability in gladioli. *Indian J. Genet. Plant Breed.,* **58** (2) : 237-239.

Srivastava, P., Singh, R. P. and Tripathi, V. R., 2007, Response of gamma irradiation on vegetative and floral characters of gladiolus. *J. Ornam. Hortic.,* **10** (2) : 135 - 136.

Singh, A. K., 2006, Flower crops cultivation and management, New India Publishing Agency, New Delhi, India, pp. : 97 -104.

Tiwari, A. K., Srivastava, R. M., Vijai Kumar, Yadav, L. B. and Misra, S. K., 2010, Gamma-rays induced morphological changes in gladiolus. *Prog. Agric.,* **10** : 75 - 82.