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Effect of Gamma Irradiation on quality Parameters in Gladiolus (*Gladiolus hybrida* L.)

Deepa V. Pawadashetti**, R. Vasantha Kumari and M. Thimmarayappa
Department of Horticulture, College of Agriculture, UAS, GKVK, Bengaluru (Karnataka), India.

(Corresponding author: Deepa V. Pawadashetti)*
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ABSTRACT: The present investigation was carried out at the Floriculture and Ornamental section, Department of Horticulture, University of Agricultural Sciences, Gandhi Krishi Vignana Kendra, Bengaluru during 2020-22. The experiment was laid out in factorial randomized complete block design replicated thrice with eighteen treatment combinations of varieties and gamma irradiation doses. 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 Arka Gold, Arka Pratham and Arka Amar. Number of days taken for sprouting was delayed with increased gamma dosage. The results of two generations (2020-21 and 2021-22) data showed that 25 Gy gamma rays enhanced the most of the quality parameters. Arka Amar showed maximum variations it is on par with Arka Gold. Gamma doses of 55 Gy is not good for quality parameters.

Keywords: Gladiolus, Arka Gold, Arka Pratham, Arka Amar, gamma rays.

INTRODUCTION

Gladiolus is a delicate herbaceous perennial that is cultivated from seeds and corms. The Latin word gladius, which means sword, was coined by Pliny the Elder (A.D. 23–79) to describe the leaf shape which resemblance to a sword. This flower production has excellent potential for the European export market, particularly in the winter. It is also a well-liked decorative plant for growing in pots and bowls, herbaceous borders, and bedding. Primulinus varieties are preferable for cut flowers since they may be grown in solitary borders and have more spikes emerge frequently from a corm. Other varieties, such as grandiflorus, are more appreciated because they don't require staking and are therefore suitable for beddings. The most sensitive plants, pixiola, are best forced under glass or grown in containers. Due to their tiny spikes, which make them look lovely on tables, these blooms are especially wonderful for cutting.

The genetic development of floriculture crops through conventional breeding is labor-intensive. In order to create heritable alterations, particularly for flower colour and quality, mutation breeding has arisen as a viable, effective and novel technology. Any effort for breeding plants to improve crops must include genetic diversity. Induced mutations are highly effective to increase natural genetic resources (Jain, 2006). One of the most essential breeding tools for creating new types through genetic manipulation is mutation (Kumari and Kumar 2015).

Character variation within a population is a necessary feature for a breeding programme to be effective. This crop exhibits a great deal of variation in terms of shape, growth pattern, flowering behaviour, spike yield and quality. Understanding correlation studies enables plant breeders to recognize the real contributor to yield and offer an efficient selection basis. Heritability estimates provide a measurement of character transmission from one generation to another because the heritable component of variability determines how consistently the selection performs, allowing the plant breeder to isolate the crop's superior selections. Therefore, the size of the variance, estimates of heritability, and genetic advance were crucial factors in determining the chances of selection.

MATERIAL AND METHODS

The present investigation was carried out at the Floriculture and Ornamental section, Department of Horticulture, University of Agricultural Sciences, Gandhi Krishi Vignana Kendra, Bengaluru during 2020-22. The experiment was laid out in factorial randomized complete block design replicated thrice with eighteen treatment combinations of varieties and gamma irradiation doses.

The experiment was laid out in factorial randomized complete block design replicated thrice with eighteen

treatment combinations of varieties (Plate 1) 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, Bangalore. The corms were exposed to different doses of ^{60}Co gamma rays *viz.*, 15Gy, 25Gy, 35Gy, 45Gy and 55Gy at gamma chamber, ICAR-Indian Institute of Horticultural Research, Hesaraghatta, Bangalore. 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.

Plate 1: General view of the experimental plot.

RESULTS AND DISCUSSION

Length of spike. Length of spike was influenced by variety and treatment it is graphically depicted in Fig. 1. In M_1 generation the maximum length of spike was observed in corms treated with 25 Gy gamma ray doses (110.33 cm) followed by 15 Gy (107.56 cm), untreated corms (108.13 cm) and 35 Gy (104.13 cm).

Minimum length of spike was noticed in corms treated with 55 Gy gamma ray doses (89.02 cm) followed by 45 Gy (95.84 cm). In M_2 longer spike observed in corms treated with 25 Gy gamma ray doses (116.27 cm) followed by 35 Gy (110.93 cm), 15 Gy (108.18 cm) and untreated corms (103.47 cm). Shorter spike was observed in corms treated with 55 Gy gamma ray doses (95.50 cm) followed by 45 Gy (103.70 cm).

Among the varieties increased length of spike observed in cv Arka Gold (111.13 cm) followed by cv Arka Amar (102.44 cm) and decreased length of spike was recorded in cv Arka Pratham (90.57 cm) in M_1 generation. In M_2 generation lowest length of spike was noticed in cv Arka Pratham (95.44 cm) and highest length of spike noticed in cv Arka Gold (112.67 cm) followed by cv Arka Amar (103.48 cm).

In M_1 generation minimum length of spike was recorded in Arka Pratham (78.20 cm) corms treated with 55 Gy and maximum length of spike was recorded in Arka Gold corms treated with 25 Gy (120.07 cm). In M_2 generation highest length of spike was recorded in Arka Gold corms treated with 25 Gy (120.87 cm) and lowest length of spike was recorded in untreated corms of Arka Pratham (94.00 cm).

Dryagina and Akhramova (1962) recorded with greater doses of 10 kR to 28 kR, the growth of the flower stalk was generally reduced in the cv Zommer Florida. According to Kaicker and Singh (1973); Kaiker (1975) observed cv Jo Wagenaar showed more spike length than the other cultivars under observation. Gupta and Banerji (1977) discovered spike length reduction in cv Oscar, started with a 3 kR dosage. Misra and Chaudhary (1979) noted that with respect to spike length, cv White Frosting was more irradiation sensitive than Dixiland.

Gladiolus spike lengths clearly indicate that gamma radiation treatments have a detrimental effect on growth. When compared to the control, the values were lower with higher gamma radiation exposure, which could be explained by negative physiological consequences that slow down cell division and reduce cellular activity (Raghava *et al*., 1981). Misra and Bajpai (1983a) noted lower kinetin concentrations and lower doses were used in all treatments, which led to the lengthening of the flower spikes and the differentiation of individual flowers. Radiation may have an indirect impact on flowering days by delayed sprouting and poor growth rates during the early stages of growth or it may be caused by the harmful effects of radiation on growth agents that resulted in photo in

sensitivity in plants. Raghava *et al.* (1981); Negi *et al.* (1983) discovered that spike length was increased up to 3 kR but that plants remained blind at dosages of 10 kR and above in cvs Little Giant, Monsoer and Wild Rose. Data from Banerji *et al* (1981); Banerji *et al.* (1994); Awad and Hamied (1985); Srivastava *et al.* (2007) all confirmed the earlier research in a positive way. Four cultivars, namely *Gladiollus callianthus* var. Murielae, Christian Jane, Psittacinus Hybrid and Oscar were shown to have the longest spikes at 1 kR gamma ray exposure (Misra and Mahesh, 1993). In comparison to the control in cv Sylvia and Eurovision, found increased spike length at 20 Gy (Srivastava and Singh, 2002). M_1V_3 flower stalk length increased due to gamma ray-induced mutation (Anwar *et al.*, 2020).

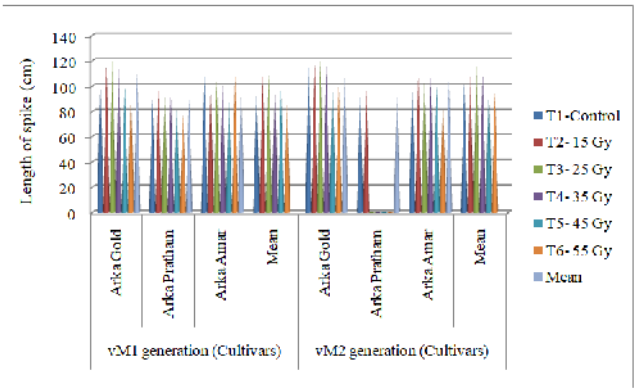

Fig. 1. Effect of gamma irradiation on length of spike (cm) in the different varieties of gladiolus.

Floret diameter. Floret diameter was influenced by variety and treatment, data presented in Table 1. In M_1 generation the highest floret diameter was observed in corms treated with 25 Gy gamma ray doses (10.56 cm) followed by 15 Gy (10.29 cm), 35 Gy (10.04 cm) and untreated corms (9.91 cm). Lowest floret diameter was noticed in corms treated with 55 Gy gamma ray doses (7.62 cm) followed by 45 Gy (8.58 cm). In M_2 maximum floret diameter was observed in corms treated with 25 Gy gamma ray doses (10.90 cm) followed by 35 Gy (10.47 cm), 15 Gy (10.29 cm) and untreated corms (9.91 cm). Minimum floret diameter was observed in corms treated with 55 Gy gamma ray doses (7.90 cm) followed by 45 Gy (8.83 cm).

Table 1: Effect of gamma irradiation on floret diameter (cm) in the different varieties of gladiolus.

Gamma ray doses	vM_1 generation (Cultivars)				vM_2 generation (Cultivars)			
	Arka Gold	Arka Pratham	Arka Amar	Mean	Arka Gold	Arka Pratham	Arka Amar	Mean
T1-Control	10.07	9.07	10.60	9.91	10.07	9.07	10.60	9.91
T2- 15 Gy	10.27	9.67	10.93	10.29	10.27	9.67	10.93	10.29
T3- 25 Gy	10.67	9.87	11.13	10.56	10.67	0.00	11.13	10.90
T4- 35 Gy	10.13	9.20	10.80	10.04	10.13	0.00	10.80	10.47
T5- 45 Gy	8.53	8.07	9.13	8.58	8.53	0.00	9.13	8.83
T6- 55 Gy	7.53	7.07	8.27	7.62	7.53	0.00	8.27	7.90
Mean	9.53	8.82	10.14		9.53	9.37	10.14	
F test	*	*	*	*	*	*	*	*
	S. Em.±	C.D. (5%)	CV%		S. Em.±	C.D. (5%)	CV%	
Variety	0.20	0.59	3.04		0.47	1.36	8.83	
Treatment	0.29	0.83			0.67	1.93		
Variety × Treatment	0.17	0.48			0.39	1.11		

Among the varieties bigger florets was observed in cv Arka Amar (10.14 cm) followed by cv Arka Gold (9.53 cm) and smaller floret was recorded in cv Arka Pratham (8.82 cm) in M_1 generation. In M_2 lowest generation floret diameter was noticed in cv Arka Pratham (9.37 cm) and highest floret diameter noticed in cv Arka Gold (15.80 cm) followed by cv Arka Amar (10.14 cm).

In M_1 generation minimum floret diameter was recorded in Arka Pratham (7.07cm) corms treated with 55 Gy and maximum floret diameter was recorded in Arka Gold corms treated with 25 Gy (11.13 cm). In M_2 generation more floret diameter was recorded in Arka Gold corms treated with 25 Gy (11.13 cm) and less floret diameter was recorded in untreated corms of Arka Pratham (9.07 cm). The findings of Srivastava *et al* (2002) were supported by their observation of the highest floret size (9.0 cm) at 20 Gy radiations. Bosila, *et al.* (2019) demonstrated that the usage of Gamma at 5 Gy led to much greater development in diameter of flower. When compared to untreated plants, the size of the flower (78.45 mm) were marginally larger after 15 Gy treatment (Sathyanarayana *et al*., 2019).

Durability of spike in field (days). Durability of spike in field was influenced by variety and treatment it is presented in Table 2.

In M_1 generation the highest durability of spike in the field was observed in corms treated with 25 Gy gamma ray doses (14.84 days) followed by 15 Gy (14.02 days), 35 Gy (13.80 days) and untreated corms (12.76 days). Lowest durability of spike in the field was noticed in corms treated with 55 Gy gamma ray doses (9.16 days) followed by 45 Gy (10.80 days). In M_2 maximum durability of spike in the field was observed in corms treated with 25 Gy gamma ray doses (16.90 days) followed by 35 Gy (15.24 days), 15 Gy (14.87 days) and untreated corms (13.71 days). Minimum durability of spike in the field was observed in corms treated with 55 Gy gamma ray doses (11.54 days) followed by 45 Gy (13.14 days).

Among the varieties higher durability of spike in the field was observed in cv Arka Gold (15.18 days) followed by cv Arka Amar (12.52 days) and lower durability of spike in the field was recorded in cv Arka Pratham (9.99 days) in M_1 generation. In M_2 generation lowest durability of spike in the field was noticed in cv Arka Pratham (11.57 days) and highest durability of spike in the field noticed in cv Arka Gold (15.79 days) followed by cv Arka Amar (13.58 days).

In M_1 generation minimum durability of spike in the field was recorded in Arka Pratham (6.53 days) corms treated with 55 Gy and maximum durability of spike in the field was recorded in Arka Amar corms treated with 25 Gy (17.20 days). In M_2 generation more durability of spike in the field was recorded in Arka Amar corms treated with 25 Gy (17.67 days) and less durability of spike in the field was recorded in untreated corms of Arka Pratham (11.07 days).

Table 2: Effect of gamma irradiation durability of spike in field (days) in the different varieties of gladiolus.

Gamma ray doses	vM_1 generation (Cultivars)				vM_2 generation (Cultivars)			
	Arka Gold	Arka Pratham	Arka Amar	Mean	Arka Gold	Arka Pratham	Arka Amar	Mean
T1-Control	13.13	10.13	15.00	12.76	14.07	11.07	16.00	13.71
T2- 15 Gy	14.00	11.53	16.53	14.02	15.33	12.07	17.20	14.87
T3- 25 Gy	15.07	12.27	17.20	14.84	16.13	0.00	17.67	16.90
T4- 35 Gy	14.13	11.20	16.07	13.80	14.27	0.00	16.20	15.24
T5- 45 Gy	10.00	8.27	14.13	10.80	11.40	0.00	14.87	13.14
T6- 55 Gy	8.80	6.53	12.13	9.16	10.27	0.00	12.80	11.54
Mean	12.52	9.99	15.18		13.58	11.57	15.79	
F test	*	*	*	*	*	*	*	*
	S. Em.±	C.D. (5%)	CV%		S. Em.±	C.D. (5%)	CV%	
Variety	1.08	3.11	12.17		3.41	9.80	11.05	
Treatment	1.53	4.39			4.82	13.86		
Variety × Treatment	0.88	2.54			2.78	8.00		

Diameter of corms (cm). Diameter of the corms was influenced by variety and treatment it is depicted in Table 3 and Plate 2. In M_1 generation the maximum diameter of the corm was observed in corms treated with 25 Gy gamma ray doses (8.96 cm) followed by 15 Gy (7.98 cm), 35 Gy (7.36 cm) and untreated corms (7.31 cm). Minimum diameter of the corm was noticed in corms treated with 55 Gy gamma ray doses (5.78 cm) followed by 45 Gy (7.02 cm). In M_2 biggest corms was observed in corms treated with 25 Gy gamma ray doses (10.53 cm) followed by 35 Gy (9.07 cm), 15 Gy (8.38 cm) and untreated corms (7.67 cm). Smallest corms per plant was observed in corms treated with 55 Gy gamma ray doses (7.04 cm) followed by 45 Gy (8.54 cm).

Among the varieties high diameter of the corm was observed in cv Arka Gold (10.24 cm) followed by cv Arka Amar (6.91 cm) and low diameter of the corm was recorded in cv Arka Pratham (5.04 cm) in M_1 generation. In M_2 generation lowest diameter of the corm was noticed in cv Arka Pratham (5.84 cm) and highest diameter of the corm noticed in cv Arka Gold (10.64 cm) followed by cv Arka Amar (7.16 cm).

Table 3: Effect of gamma irradiation on diameter of corms in the different varieties of gladiolus.

Gamma ray doses	vM_1 generation (Cultivars)				vM_2 generation (Cultivars)			
	Arka Gold	Arka Pratham	Arka Amar	Mean	Arka Gold	Arka Pratham	Arka Amar	Mean
T1-Control	10.33	5.07	6.53	7.31	10.80	5.67	6.53	7.67
15 Gy	11.00	5.53	7.40	7.98	11.47	6.00	7.67	8.38
T3- 25 Gy	12.07	6.07	8.73	8.96	12.60	0.00	8.47	10.54
T4- 35 Gy	10.53	5.07	6.47	7.36	11.07	0.00	7.07	9.07
T5- 45 Gy	9.33	4.47	7.27	7.02	9.47	0.00	7.60	8.54
T6- 55 Gy	8.20	4.07	5.07	5.78	8.47	0.00	5.60	7.04
Mean	10.24	5.04	6.91		10.64	5.84	7.16	
F test	*	*	*	*	*	*	*	*
	S. Em.±	C.D. (5%)	CV%		S. Em.±	C.D. (5%)	CV%	
Variety	0.54	1.56	10.40		0.35	1.01	7.59	
Treatment	0.77	2.21			0.50	1.43		
Variety ×Treatment	0.44	1.28			0.29	0.83		

Corm diameter vM_1 generation

Corm diameter vM_2 generation

Plate 2: Effect of gamma irradiation on corm diameter in the different varieties of gladiolus.

In M_1 generation minimum diameter of the corm was recorded in Arka Pratham (4.07 cm) corms treated with 55 Gy and maximum diameter of the corm was recorded in Arka Gold corms treated with 25 Gy (12.07 cm). In M_2 generation more diameter of the corm was recorded in Arka Gold corms treated with 25 Gy (12.60 cm) and less diameter of the corm was recorded in corms treated with 55 Gy of Arka Amar (5.60 cm).

Spike longevity (days). Spike longevity was influenced by variety and treatment it is depicted in Table 4 and Plate 3. In M_1 generation the highest spike longevity was observed in corms treated with 25 Gy gamma ray doses (9.07 days) followed by 15 Gy (8.62 days), 35 Gy (8.20 days) and untreated corms (7.73 days). Lowest spike longevity was noticed in corms treated with 55 Gy gamma ray doses (6.91 days) followed by 45 Gy (7.44 days). In M_2 maximum spike longevity was observed in corms treated with 25 Gy gamma ray doses (10.03 days) followed by 35 Gy (9.30 days), 15 Gy (9.07 days) and untreated corms (8.49 days). Minimum spike longevity was observed in corms treated with 55 Gy gamma ray doses (7.80 days) followed by 45 Gy (8.44 days).

Among the varieties higher spike longevity was observed in cv Arka Gold (8.77 days) followed by cv Arka Amar (8.16 days) and lower spike longevity was recorded in cv Arka Pratham (7.07 days) in M_1 generation. In M_2 generation lowest spike longevity was noticed in cv Arka Pratham (7.70 days) and highest spike longevity was noticed in cv Arka Gold (9.31 days) followed by cv Arka Amar (8.76 days).

In M_1 generation minimum spike longevity was recorded in Arka Pratham (6.07 days) corms treated with 55 Gy and maximum spike longevity was recorded in Arka Amar corms treated with 25 Gy (10.00 days). In M_2 generation more spike longevity was recorded in Arka Amar corms treated with 25 Gy (10.53 days) and less spike longevity was recorded in untreated corms of Arka Pratham (7.40 days). Higher doses of radiation resulted in decreased vase life but lower doses had a beneficial effect (Sudha, 2014).

Table 4: Effect of gamma irradiation on spike longevity (days) in the different varieties of gladiolus.

Gamma ray doses	vM_1 generation (Cultivars)				vM_2 generation (Cultivars)			
	Arka Gold	Arka Pratham	Arka Amar	Mean	Arka Gold	Arka Pratham	Arka Amar	Mean
T1-Control	7.87	6.93	8.40	7.73	9.00	7.40	9.07	8.49
T2- 15 Gy	8.80	7.40	9.67	8.62	9.20	8.00	10.00	9.07
T3- 25 Gy	9.13	8.07	10.00	9.07	9.53	0.00	10.53	10.03
T4- 35 Gy	8.40	7.33	8.87	8.20	9.00	0.00	9.60	9.30
T5- 45 Gy	7.67	6.60	8.07	7.44	8.20	0.00	8.67	8.44
T6- 55 Gy	7.07	6.07	7.60	6.91	7.60	0.00	8.00	7.80
Mean	8.16	7.07	8.77		8.76	7.70	9.31	
F test	*	*	*	*	*	*	*	*
	S. Em.±	C.D. (5%)	CV%		S. Em.±	C.D. (5%)	CV%	
Variety	0.18	0.52	3.22		0.40	1.14	8.17	
Treatment	0.26	0.74			0.56	1.62		
Variety ×Treatment	0.15	0.43			0.32	0.93		

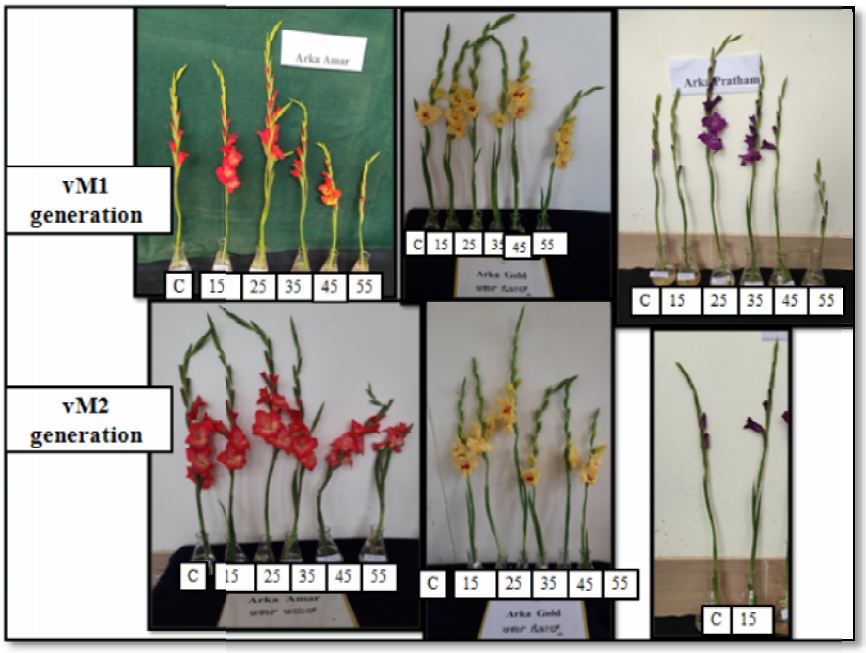

Plate 3: Effect of gamma irradiation on vase life (days) in the different varieties of gladiolus.

CONCLUSION

In the present investigation gamma irradiation had exerted the significant effect on quality parameters in all three cultivars of gladiolus Gamma irradiation doses at 25 Gy and 15 Gy found beneficial for various traits in gladiolus. Medium to higher doses of gamma rays *i.e*., 15 Gy, 25 Gy and 35 Gy can applied in gladiolus corms for improvement. In general, the expressions of characters were decreased and retarded with 55 Gy.

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Conflict of interest. None.

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