

Influence of Gamma Irradiation on Flowering of *Gladiolus (Gladiolus hybrida L.)*

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ABSTRACT

Keywords

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Influence of gamma irradiations was studied in ten varieties of gladiolus (*Gladiolus hybrida L.*) namely, Candyman Rose, American Beauty, Chandni, Red beauty, Punjab Morning, White Prosperity, Jester, Srijana, Psittacinous Hybrid and Priscilla were irradiated with 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5 and 5.0 kR doses. Earliest sprouting was recorded in 3.0 kr gamma treatment. Higher doses of gamma irradiation show lethal effect on various vegetative and floral traits. Maximum number of days taken to spike emergence was recorded with 3.5 kr dose of gamma irradiation. Earliest flowering was recorded with interaction of control with cv. Candyman Rose. Number of florets per spike reduced due to application of gamma doses, as doses increased and higher doses of gamma rays resulted in minimum number of florets per spike. Radiation treatments at higher doses caused delayed in spike initiation with decrease in spike length, number and size of florets.

Introduction

Among the commercial flowers, gladiolus is one of the most important flowers in India because of its majestic spikes containing attractive, elegant and delicate florets of various shades, sequential opening of flowers for a longer duration and good keeping quality of cut spikes (Singh, 2006). The demand of gladiolus is increasing therefore; it needs attention towards genetic improvement. These have mostly been evolved through conventional breeding but a few through mutation breeding. Mutations are induced in different crops to create variability for further improvement. In vegetatively propagated plants, mutation breeding offers great potentialities as the mutated part can be

conveniently perpetuated by vegetative means resulting in the development of new forms. Gladiolus is highly heterozygous in its genetic constitution which makes it promising test material for inducing physical mutagenesis.

The effects of gamma rays on gladiolus have been studied by several workers but very few varieties have been developed through gamma radiations. Hence, in the present investigation, emphasis was laid on finding out variations caused by gamma radiations in morphological characters including colour variations. An attempt was made to develop a variety by fixing the induced variation in succeeding generations.

Materials and Methods

The present experiment was carried out was at Horticulture farm, Rajasthan College of Agriculture, Udaipur (Rajasthan) during 2013-2014 and 2014-2015. The dormant corms (3.5 to 4.5 cm diameter) of ten commercial varieties of gladiolus viz., Candyman Rose, American Beauty, Chandni, Red beauty, Punjab Morning, White Prosperity, Jester, Srijana, Psittacinous Hybrid and Priscilla were subjected to gamma radiations. The corms were treated with eleven doses of gamma radiations viz 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5 and 5.0 kR along with control (without treatment).

The corms were planted in the field within 24 hours of treatment in Randomized Block Design with Factorial Concept (Panse and Sukhatme, 1967). Data were recorded in vM1 and vM2 generation on different flowering parameters.

Results and Discussion

Various doses of gamma rays exhibited significantly effect on sprouting of gladiolus corms (Table 1). Earliest sprouting was recorded in 3.0 kr gamma treatment followed by control (untreated) and 1.5 kr gamma treatment. Whereas, maximum days to sprouting was recorded with 5.0 kr (16.56 days) which was at par with gamma doses of 2.5 kr, 4.5 kr, 1.0 kr and 2.0 kr during first year. Pronounced effect of gamma irradiation treatments were observed during second year. Higher doses of gamma irradiation show lethal effect on sprouting of corms of some varieties results in no sprouting. In cultivar Psittacinous Hybrid corms were not sprouted at 2.5 kr, 3.0 kr, 3.5, kr, 4.0 kr, 4.5 kr and 5.0 kr dose of gamma irradiation. Dose 5.0 kr exhibited lethal effect on cvs. Chandni, Punjab Morning, Jester, Srijina and Psittacinous Hybrid however normal

sprouting was observed in other cultivars. 4.5 kr dose showed lethal effect on cvs. Psittacinous Hybrid, Punjab Morning and Chandni whereas 4.0 kr dose also showed lethal effect on cv. Punjab Morning. This early sprouting of gladiolus corms at lower dose of gamma rays was probably related with the increase in the activities of gibberellins and auxins and disappearance of inhibitors. Misra and Bajpai (1983), Awad and Elbahr (1986), Pranom *et al.*, (1986) and Karki and Srivastava (2010) also observed similar finding in slight earliness in sprouting of gladiolus corms when treated with lower doses of gamma rays. Patil *et al.*, (2009) and Patil *et al.*, (2014) reported that most of the characters were stimulated till 3.00 kr treatment and started to reduce on higher dose but treatment 2.00 kr has proved better treatment including control. Low level of mutagen itself is not responsible for early sprouting of gladiolus but it influences the activity of enzymes. Enzymes play an important role in plant metabolism to accelerate metabolism activities and consequently result in stimulating plant growth (Misra and Bajpai, 1983).

Days to spike emergence was influenced significantly due to gamma irradiation treatment and varieties during both the years of investigation (Table 2). Some varieties did not show any sprouting resulted in no spike emergence during both years. Gamma doses at 4.0 kr, 4.5 kr and 5.0 kr were found lethal in case of cv. Punjab Morning and Psittacinous Hybrid while cv. Chandni failed to produce any spike at 4.5 kr and 5.0 kr treatment during 1st year. Maximum number of days taken to spike emergence was recorded with 3.5 kr dose of gamma irradiation followed by 1.5 kr, 1.0 kr, 2.0 kr and 0.5 kr. Earliest spike emergence was recorded with interaction of 5.0 kr with cv. Candyman Rose during both years of investigation.

Table.1 Effect of gamma irradiation on days to sprouting in different varieties of gladiolus

Varieties		Treatment	control	0.5 Kr	1.0 Kr	1.5 Kr	2.0 Kr	2.5 Kr	3.0 Kr	3.5 Kr	4.0 Kr	4.5 Kr	5.0 Kr	Mean
Candyman Rose	I Year		12.11	13.44	12.56	12.55	11.89	13.33	13.55	11.00	10.55	11.33	17.33	12.69
	II Year		17.67	13.56	14.67	19.56	15.89	13.44	19.67	14.67	12.67	15.44	19.56	16.07
American Beauty	I Year		10.56	11.78	12.34	18.33	15.22	17.66	13.45	13.56	13.78	17.78	13.22	14.33
	II Year		10.67	15.22	17.56	18.56	15.00	17.67	12.22	13.44	13.78	17.78	13.33	15.02
Chandni	I Year		14.55	14.22	17.00	12.00	19.11	16.11	12.67	15.89	18.66	18.78	19.56	16.23
	II Year		14.56	18.56	16.78	12.67	18.00	15.33	12.44	15.78	19.11	-	-	13.02
Red beauty	I Year		20.11	17.11	19.22	17.22	15.89	14.55	15.11	18.00	14.22	14.33	18.33	16.74
	II Year		20.78	17.44	13.33	17.00	15.67	14.89	15.00	18.56	13.89	14.78	18.11	16.31
Punjab Morning	I Year		15.33	15.33	20.22	15.78	13.89	16.22	17.78	19.44	17.89	19.78	19.45	17.37
	II Year		15.67	15.56	20.33	15.78	13.56	15.89	18.11	14.67	-	-	-	11.78
White Prosperity	I Year		14.78	19.78	17.33	15.44	17.55	17.56	14.56	19.67	16.78	19.33	14.22	17.00
	II Year		14.89	20.00	17.33	16.00	17.78	17.56	14.78	15.78	17.11	20.00	14.33	16.87
Jester	I Year		13.00	20.11	17.44	12.89	15.67	16.56	13.00	18.00	18.22	15.56	17.11	16.14
	II Year		16.56	19.78	13.89	16.67	15.67	16.22	13.00	17.33	17.33	15.22	-	14.70
Srijana	I Year		19.89	17.55	16.78	13.78	14.78	13.78	14.89	13.56	11.67	14.89	15.33	15.17
	II Year		19.56	17.67	12.78	14.56	14.33	13.11	15.33	13.78	12.00	15.33	-	13.50
Psittacinous Hybrid	I Year		15.56	15.00	12.89	13.67	15.00	14.44	11.56	15.33	16.66	15.89	16.56	14.78
	II Year		15.00	14.89	12.89	14.44	14.67	-	-	-	-	-	-	6.54
Priscilla	I Year		13.00	11.56	11.33	18.33	14.89	19.67	15.78	11.45	15.44	11.33	14.44	14.29
	II Year		13.11	13.67	14.78	18.89	14.56	18.00	15.56	12.00	14.22	13.22	16.44	14.95
Mean	I Year		14.89	15.59	15.71	15.00	15.39	15.99	14.24	15.59	15.39	15.90	16.56	
	II Year		15.84	16.63	15.43	16.41	15.51	14.21	13.61	13.60	12.01	11.18	8.18	
C.D. (0.05)			I Year	II Year										
Treatment			0.73	0.44										
Variety			0.77	0.46										
T reatment× Variety			2.43	1.45										

Table.2 Effect of gamma irradiation on days taken to spike emergence in different varieties of gladiolus

Varieties		Treatment	control	0.5 Kr	1.0 Kr	1.5 Kr	2.0 Kr	2.5 Kr	3.0 Kr	3.5 Kr	4.0 Kr	4.5 Kr	5.0 Kr	Mean
Candyman Rose	I Year		64.44	65.00	72.22	97.89	71.22	83.00	86.33	71.78	64.89	87.22	63.33	75.21
	II Year		64.89	66.11	72.00	97.11	71.00	81.78	86.22	71.33	64.78	87.00	62.67	74.99
American Beauty	I Year		66.78	71.78	96.89	72.11	83.89	87.34	66.56	70.44	98.56	66.22	67.11	77.06
	II Year		66.89	72.56	98.78	72.44	84.67	87.45	66.44	70.89	98.33	65.22	66.56	77.29
Chandni	I Year		66.67	95.00	66.34	87.22	98.44	66.56	66.00	87.22	65.89	-	-	63.58
	II Year		67.33	96.33	66.89	87.22	98.22	66.89	65.45	87.22	65.67	-	-	63.75
Red beauty	I Year		96.33	67.00	87.34	98.67	67.00	66.22	87.34	67.55	67.45	66.44	95.67	78.82
	II Year		97.55	67.78	87.78	98.67	67.78	65.45	87.78	67.56	67.44	66.45	95.67	79.08
Punjab Morning	I Year		66.00	86.56	98.89	66.00	67.45	86.56	67.11	66.89	-	-	-	55.04
	II Year		66.00	86.55	98.89	66.00	67.44	86.55	66.22	66.78	-	-	-	54.95
White Prosperity	I Year		86.56	98.67	66.33	66.89	86.56	67.56	66.67	67.45	97.78	66.33	86.11	77.90
	II Year		86.78	98.66	66.67	66.78	86.78	67.33	66.67	67.22	97.89	66.33	86.44	77.96
Jester	I Year		97.45	66.56	66.78	86.55	68.67	67.33	66.11	97.45	65.67	86.22	98.78	78.87
	II Year		98.56	66.33	66.67	86.44	68.67	67.33	66.11	97.45	65.67	86.22	-	69.95
Srijana	I Year		65.67	67.33	86.22	68.00	67.00	66.67	97.67	66.00	86.33	98.67	66.00	75.96
	II Year		65.67	67.33	86.22	66.67	66.33	67.78	98.11	66.67	86.56	98.44	-	69.98
Psittacinous Hybrid	I Year		67.00	86.33	70.00	68.00	65.00	97.00	65.00	86.00	-	-	-	54.94
	II Year		66.33	86.56	70.00	68.00	65.00	-	-	-	-	-	-	32.35
Priscilla	I Year		86.00	68.00	67.00	66.67	97.67	66.00	86.33	98.67	66.00	67.00	86.33	77.79
	II Year		86.00	68.00	67.00	66.67	97.67	66.00	86.33	98.67	66.00	67.00	86.33	77.79
Mean	I Year		76.29	77.22	77.80	77.80	77.29	75.42	75.51	77.95	61.26	53.81	56.33	
	II Year		76.60	77.62	78.09	77.60	77.36	65.66	68.93	69.38	61.23	53.67	39.77	
C.D. (0.05)			I Year	II Year										
Treatment			0.42	0.56										
Variety			0.44	0.59										
T reatment× Variety			1.38	1.85										

Table.3 Effect of gamma irradiation on days taken to flowering in different varieties of gladiolus

Treatment		control	0.5 Kr	1.0 Kr	1.5 Kr	2.0 Kr	2.5 Kr	3.0 Kr	3.5 Kr	4.0 Kr	4.5 Kr	5.0 Kr	Mean
Candyman Rose	I Year	69.44	73.89	77.67	102.89	76.11	88.78	90.89	78.22	70.22	91.67	69.56	80.85
	II Year	71.22	74.66	76.89	103.22	75.78	89.67	92.89	77.66	70.33	91.22	70.89	81.31
American Beauty	I Year	71.67	76.56	100.44	76.89	89.33	92.56	71.89	75.56	103.56	72.22	72.11	82.07
	II Year	71.56	75.44	98.22	77.00	87.44	92.67	71.78	75.00	103.78	72.45	73.33	81.70
Chandni	I Year	71.78	100.22	71.44	92.22	103.22	71.78	71.22	91.78	71.22	-	-	67.72
	II Year	71.00	97.78	71.45	93.33	103.67	73.22	71.11	92.67	70.56	-	-	67.71
Red beauty	I Year	102.78	71.22	91.89	102.67	71.33	71.33	91.33	72.33	72.22	72.44	102.33	83.81
	II Year	102.89	72.11	92.00	103.22	71.45	71.11	92.00	73.00	73.00	71.44	102.00	84.02
Punjab Morning	I Year	71.44	91.56	103.44	71.11	71.56	90.89	72.56	71.78	-	-	-	58.58
	II Year	71.67	91.78	103.89	71.00	72.34	91.11	73.44	72.33	-	-	-	58.87
White Prosperity	I Year	90.78	103.33	71.67	71.78	91.22	72.89	71.89	72.78	102.44	71.44	90.22	82.77
	II Year	90.67	103.67	71.00	72.33	91.33	74.22	71.67	73.44	102.44	71.67	89.78	82.93
Jester	I Year	101.78	71.89	72.22	90.78	74.11	72.67	71.22	101.67	70.78	90.22	103.11	83.68
	II Year	99.78	72.56	72.11	91.34	75.00	73.00	70.33	101.44	70.33	89.78	-	74.15
Srijana	I Year	70.78	72.44	90.44	73.89	72.56	71.22	102.11	70.67	90.67	103.56	70.89	80.84
	II Year	70.67	73.00	90.55	74.11	72.78	71.78	102.45	70.33	90.22	103.78	-	74.52
Psittacinous Hybrid	I Year	72.33	90.67	74.56	72.44	70.22	101.56	70.44	90.22	-	-	-	58.40
	II Year	72.33	90.55	74.55	72.33	70.00	-	-	-	-	-	-	34.52
Priscilla	I Year	91.22	74.22	72.44	72.33	102.67	71.78	91.56	102.56	71.44	71.67	91.56	83.04
	II Year	90.56	75.11	73.00	71.67	102.67	71.00	91.33	102.78	71.67	72.00	91.33	83.01
Mean	I Year	81.40	82.60	82.62	82.70	82.23	80.55	80.51	82.76	65.26	57.32	59.98	
	II Year	81.23	82.67	82.37	82.96	82.24	70.78	73.70	73.87	65.23	57.23	42.73	
C.D. (0.05)		I Year	II Year										
Treatment		0.53	0.53										
Variety		0.55	0.55										
T treatment× Variety		1.75	1.75										

Table.4 Effect of gamma irradiation on number of florets per spike in different varieties of gladiolus

Treatment		control	0.5 Kr	1.0 Kr	1.5 Kr	2.0 Kr	2.5 Kr	3.0 Kr	3.5 Kr	4.0 Kr	4.5 Kr	5.0 Kr	Mean
Candyman Rose	I Year	14.67	14.22	10.33	13.33	12.89	13.00	14.11	12.44	13.33	14.22	14.33	13.35
	II Year	14.89	13.78	10.89	13.22	13.00	13.22	13.89	13.11	13.33	14.00	14.22	13.41
American Beauty	I Year	13.33	11.33	13.78	12.89	13.11	14.11	12.44	13.11	14.45	14.67	13.78	13.36
	II Year	13.22	12.67	14.34	12.66	13.22	14.44	12.33	12.78	14.56	14.89	13.67	13.53
Chandni	I Year	12.00	14.00	13.33	13.67	12.22	13.67	13.22	13.22	14.00	0.00	0.00	10.85
	II Year	11.45	14.22	13.89	13.78	11.00	14.00	13.89	12.67	13.67	0.00	0.00	10.78
Red beauty	I Year	14.56	14.56	13.45	12.44	13.89	14.56	14.67	13.78	11.89	13.89	13.44	13.74
	II Year	14.78	14.78	13.78	12.67	13.67	14.44	14.44	13.44	12.33	14.33	13.22	13.81
Punjab Morning	I Year	13.56	12.00	14.11	13.55	12.89	14.00	13.00	14.67	0.00	0.00	0.00	9.80
	II Year	13.44	12.33	14.33	13.22	13.00	14.33	12.67	14.44	0.00	0.00	0.00	9.80
White Prosperity	I Year	14.00	14.67	14.11	13.67	11.89	14.33	13.67	13.44	11.89	10.11	13.22	13.18
	II Year	14.22	14.67	14.67	13.67	10.89	14.22	14.00	13.67	10.89	9.89	13.22	13.09
Jester	I Year	13.00	12.78	13.89	12.78	13.11	14.33	13.89	13.56	10.78	13.33	13.55	13.18
	II Year	12.67	12.89	13.89	12.45	13.11	14.33	14.33	13.33	10.00	13.33	0.00	11.85
Srijana	I Year	12.67	13.78	14.33	12.33	13.44	13.33	14.78	13.00	13.11	14.56	13.44	13.52
	II Year	12.78	13.78	14.22	12.67	13.22	14.00	14.67	13.22	13.22	14.78	0.00	12.41
Psittacinous Hybrid	I Year	12.89	13.89	12.89	14.22	12.67	13.44	13.78	14.33	0.00	0.00	0.00	9.83
	II Year	13.00	14.33	12.67	14.22	13.11	0.00	0.00	0.00	0.00	0.00	0.00	6.12
Priscilla	I Year	13.22	12.56	14.11	12.44	12.78	13.78	12.89	14.56	14.78	13.78	11.44	13.30
	II Year	13.22	12.78	14.55	12.22	12.45	13.55	12.89	14.78	14.78	13.78	10.45	13.22
Mean	I Year	13.39	13.38	13.43	13.13	12.89	13.86	13.65	13.61	10.42	9.46	9.32	13.39
	II Year	13.37	13.62	13.72	13.08	12.67	12.66	12.31	12.14	10.28	9.50	6.48	13.37
C.D. (0.05)		I Year	II Year										
Treatment		0.23	0.24										
Variety		0.24	0.25										
T treatment× Variety		0.76	0.79										

Present results were also in accordance with Cantor *et al.*, (2002) who observed that gamma doses increased root and shoot length, which probably absorb more nutrient and improved photosynthesis and ultimately resulted in early spike emergence and flowering. Rather and John (2000) also studied days to floret emergence in Dutch iris. Some doses of gamma rays resulted in early floret emergence; however, difference was not significant to the control.

In respect of varieties data presented in Table 3 exhibited significant effect on days taken to flowering during both years of investigation. Days taken to flowering were recorded highest in cv. Red Beauty during both the year of investigation. Earliest flowering was recorded with interaction of control with cv. Candyman Rose (69.44 days) during first year while during second year interaction of gamma dose at 2.0 kr with cv. Psittacinous Hybrid (70.00 days) resulted in earliest flowering. Present findings were in agreement with that of Seilleur (1975), who irradiated corms of gladiolus and observed that corms treated with lower doses resulted in early flowering. Similar observation has also been made by Misra *et al.*, (2009) who got early bud initiation in chrysanthemum when various gamma doses were applied. The present findings were also in line for days to flowering in gladiolus cv. Sylvia and Eurovision (Srivastava *et al.*, 2007). They recorded early flowering with 20 Gy and 40 Gy in comparison to control on days to flowering. Similar type of stimulatory effect was observed earlier by Misra and Bajpai (1983) with 2 kR and 3 kR doses in nine varieties of gladiolus that used for study and by Dhaduk (1992) with 3 kR and 5 kR in four varieties of gladiolus. Raghava *et al.*, (1988) and Negi *et al.*, (1983) noted that the flowering was delayed significantly at 5 kR treatment in various varieties used in their studies. The present findings are also in line

with the observations of Mahure *et al.*, (2010) observed that lower dose proved favourable for early flowering in chrysanthemum.

Number of florets per spike reduced due to application of gamma doses (Table 4), as doses increased and higher doses of gamma rays resulted in minimum number of florets per spike. During first year maximum number of floret was recorded with 2.5 kr (13.86) dose of gamma irradiation. However, during second year maximum number of florets per spike were registered with 1.0 kr dose of gamma irradiation which was at par with 0.5 kr, control and 1.5 kr and significant to other gamma irradiation doses on number of florets per spike, whereas these treatments were significant to the higher doses of gamma irradiation. Due to interaction of gamma doses and different varieties number of flowers/spike found significant. Treatment combination of 4.5 kr with cv. White Prosperity resulted in minimum number of florets per spike during both the year of investigation. Present findings are in conformity with several workers who recorded positive response of gamma irradiation at lower doses and higher doses were found detrimental and showed negative response. In a study Venkatchalan and Jayabalan (1992) observed that the number of flowers in zinnia increased with the lower dose of gamma irradiation from 2.5 to 5 kr and decreased thereafter at higher doses of 7.5 kr to 12.5 kr. Kole and Meher (2005) observed increase in the flower number at lower doses of gamma irradiation, whereas, number of flower reduced drastically at higher dose of gamma rays in zinnia. They further observed that due to application of gamma doses percentage of double flowers increased significantly compared to control. Arnold *et al.*, (1998) stated that number of petals increased with application of gamma doses in two varieties, i e Potluck and Dark Red Mountie, whereas, it decreases in other

two varieties Blood Red and Mountie due to gamma doses at 50, 100 and 200 Gy. They further stated that dose response relationship often showed erratic results because gamma rays photons may miss the targets necessary to generate mutation and radio sensitivity depends on the variety.

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