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Evaluation of vM_2 Generation in *Gladiolus* (*Gladiolus grandiflorus* L.) for Identification and Isolation of Promising Mutants

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ABSTRACT

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The present investigation was carried out at Department of Floriculture and Landscape Architecture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur during 2017-18. The experiment was designed in Randomized Block Design with Factorial Concept using vM_2 generation of three *gladiolus* cultivars viz. Candyman, American Beauty, Her Majesty irradiated previous year with four doses of gamma radiations 15 Gy, 30 Gy, 45 Gy, 60 Gy along with 0 Gy (control) to investigate the effect of gamma radiations. The results revealed early spike initiation (77.80 days) in variety Her Majesty. Minimum days for opening of first floret (100.86 days) were observed in var. American Beauty whereas maximum leaf abnormality percentage was observed in var. Her Majesty. Leaf abnormality percentage and morphological abnormalities percentage were found maximum at higher dose 60 Gy. Two variants from var. Candyman irradiated at 45 Gy and 60Gy and one variant from var. Her Majesty irradiated at 30 Gy were identified and isolated for changes in floret color whereas one variant was identified and isolated from var. American Beauty having variation in floret arrangement.

Introduction

Gladiolus (*Gladiolus grandiflorus* L.), a member of the family Iridaceae, is one of the most popular ornamental bulbous plants grown commercially for its fascinating spikes as well as longer vase-life in many parts of the world including India. It is commercially cultivated in Maharashtra, Karnataka, West Bengal, Punjab, Himachal Pradesh and Uttar Pradesh (Anon. 2018). Mutation is recognized as one of the most important breeding tool for

the development of new varieties through genetic manipulation (Kumari and Kumar 2015). *Gladiolus* is highly heterozygous in its genetics constitution which makes it promising test material for inducing mutagenesis. Particularly where only one or a few characters are to be improved upon without changing the entire genotype, mutation breeding offers promising possibilities. As *gladiolus* are heterozygous and often propagated vegetatively thus allowing the detection, selection and

conservation of mutants within the M₁ generation. However, it has been observed and reported that the mutation frequency is higher in vM₂ generation (up to 60%) than vM₁ generation, whereas the rate of chimera is much lower in vM₂ generation and completely mutated spikes are often observed (Broertjes and Harten, 1988). Therefore, present investigation on evaluation of vM₂ generation in gladiolus for identification and isolation of mutants irradiated through gamma rays was carried out.

Materials and Methods

The present investigation was conducted at the Department of Floriculture and Landscape Architecture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur during winter season of the year 2017-2018. The experiment was laid out in Factorial randomized block design with 3 replication and 15 treatment combinations. The planting materials for experiment consisted of corms obtained from vM₁ generation irradiated previous year. Uniform corms of gladiolus were treated during the year 2016-17 with five different doses of gamma radiations i.e., 15Gy, 30Gy, 45Gy, 60Gy and no irradiation (control) in three varieties of gladiolus viz. Candyman, American Beauty and Her Majesty in the gamma chamber at Department of Nuclear Agriculture and Biotechnology Division (NABTD), BARC, Trombay, Mumbai. These corms were again planted as vM₂ generation in October 2017. Gladiolus corms were planted at spacing of 30x20 cm and recommended package of practice was followed. Data were recorded to evaluate different morphological and flowering characters influenced by gamma radiations and were subjected to statistical analysis using SPSS 10.0 statistical software (SPSS Inc.). Any abnormality or variation in plants in different treatments was recorded. Desirable variants were identified and isolated.

Results and Discussion

Floral characters

Table 1 shows there is significant effect of varieties, gamma treatments and their interaction on days taken to first floret opening. Among varieties early floret opening (100.86 days) was noted in variety American Beauty. Maximum days (111.40 days) taken by Candyman for 1st floret opening. Among all the radiation doses control (0 Gy) showed early opening of first floret with 95.44 days. Within their interaction variety Her Majesty with control showed earliest opening (88.66 days) of first floret. Maximum days taken for first floret opening were recorded in higher dose of 60 Gy. Patil (2014) reported that 1 kR and 3 kR treatments induced earliness as compared to control and other doses. Although opening of first floret was delayed with increase in doses which showed that maximum days taken by corms that treated with the dose of 5 kR gamma rays. Sahariya *et al.*, (2017) noted that earliest flowering with interaction of control with cv. Candyman Rose.

According to the data presented in Table 2, Variety Candyman resulted in the maximum spike length (67.75 cm.) whereas minimum spike length was observed in variety American Beauty (36.38 cm.). Among various radiation doses maximum length of spike (55.66 cm.) was observed with 15 Gy dose which was however at par with control (54.59 cm.) and 30 Gy (53.37 cm.) while the minimum (42.89 cm.) was observed with 60 Gy dose. Krishnan *et al.*, (2003) and Kainthura and Srivastava (2015) had reported in Tuberose that higher doses of gamma rays recorded minimum spike and rachis length.

Data presented in Table 3 showed that number of florets per spike is significantly influenced by variety, radiation doses and their

interaction. Maximum number of florets per spike (11.62) was reported in variety Candyman while the least (5.86) was observed in variety American Beauty.

Among the various dose of radiation control had maximum number of florets per spike (9.75) which was whoever at par with 15 Gy (9.71) and 30 Gy (9.00) whereas minimum (6.96) was observed with 60 Gy. Within their interaction Candyman with 15 Gy showed maximum number of florets per spike (12.86) which was however *at par* with control (12.46) and 30 Gy (11.63).

Patil (2014), Sahariya *et al.*, (2017) noticed number of florets per spike reduced due to higher doses.

Table 4 reveals that there is significant effect of variety, radiation doses and their treatment

on yield of spikes/plot and vase life of spikes. Maximum yield of spikes/plot (32.53) was observed with variety American Beauty and Maximum vase life (7.24 days) was recorded in variety Candyman which was however *at par* with Her Majesty (7.06 days). Among radiation doses, control had maximum yield (30.11 spikes/plot) and vase life (7.73 days). Among interaction, variety American Beauty with 0 Gy had maximum yield with 40.33 spikes/plot and variety Her Majesty with control had maximum vase life (8.13 days) whereas yield and vase life both were reduced at higher doses. The production of spikes was enhanced which might be due to slight increase in photosynthetic activities that encouraged by irradiations. There was no or less flower observed at higher doses because of changes in plant metabolic activities and negative response of plant hormones to irradiations (Misra *et al.*, 2006).

Table.1 Effect of treatments on number of days to first floret opening

Variety ↓	Number of days to first floret opening					
Doses →	0Gy	15Gy	30Gy	45Gy	60Gy	Mean
Candyman	102.67	108.33	109.67	117.00	119.33	111.40
American Beauty	95.00	99.00	96.67	103.33	110.33	100.86
Her Majesty	88.67	94.00	98.00	107.33	141.67	105.93
Mean	95.44	100.44	101.44	109.22	123.77	
	Varieties	Gamma doses	Interaction			
C.D. (0.05)	3.77	4.87	8.43			

Table.2 Effect of treatments on length of spike

Variety ↓	Length of spike (cm)					
Doses →	0Gy	15Gy	30Gy	45Gy	60Gy	Mean
Candyman	70.48	71.58	68.61	64.15	63.94	67.75
American Beauty	37.13	37.81	36.71	36.51	33.76	36.38
Her Majesty	57.17	57.60	54.80	53.38	30.98	50.58
Mean	54.59	55.66	53.37	51.34	42.89	
	Varieties	Gamma doses	Interaction			
C.D. (0.05)	2.43	3.14	5.44			

Table.3 Effect of treatments on number of florets per spike:

Variety ↓	Number of florets per spike					
Doses →	0Gy	15Gy	30Gy	45Gy	60Gy	Mean
Candyman	12.46	12.86	11.73	11.33	9.73	11.62
American Beauty	6.53	5.93	5.80	5.53	5.50	5.86
Her Majesty	10.26	10.33	9.46	9.13	5.66	8.97
Mean	9.75	9.71	9.00	8.66	6.96	
	Varieties	Gamma doses	Interaction			
C.D. (0.05)	0.65	0.84	1.47			

Table.4 Effect of treatments on yield of spikes and vase life

Variety ↓	Yield of spikes per plot						Vase life (days)					
Doses →	0Gy	15Gy	30Gy	45Gy	60Gy	Mean	0Gy	15Gy	30Gy	45Gy	60Gy	Mean
Candyman	23.33	20.66	18.66	18.33	15.66	19.33	7.80	7.73	7.53	6.66	6.46	7.24
American Beauty	40.33	37.00	33.33	32.66	19.33	32.53	7.26	7.26	6.66	5.80	5.20	6.44
Her Majesty	26.66	23.66	19.66	18.66	5.66	18.86	8.13	7.73	7.40	6.60	5.46	7.06
Mean	30.11	27.11	23.88	23.22	13.55		7.73	7.57	7.20	6.35	5.71	
	Varieties	Gam-ma doses	Inter-action					Varieties	Gam-ma doses	Inter-action		
C.D. (0.05)	1.16	1.50	2.60				C.D. (0.05)	0.21	0.27	0.47		

Table.5 Effect of treatments on morphological changes

Variety ↓	Percentage leaf abnormalities						Morphologically abnormal plant (%)					
Doses →	0Gy	15Gy	30Gy	45Gy	60Gy	Mean	0Gy	15Gy	30Gy	45Gy	60Gy	Mean
Candyman	1.00	1.16	2.08	2.42	2.62	1.86	1.00	1.52	2.06	1.48	3.29	1.87
American Beauty	1.00	1.00	1.31	2.24	2.44	1.60	1.00	1.00	1.54	2.39	3.40	1.86
Her Majesty	1.00	1.48	2.84	3.09	3.32	2.34	1.00	1.50	2.04	2.17	3.83	2.11
Mean	1.00	1.21	2.08	2.59	2.79		1.00	1.34	1.88	2.02	3.51	
	Varieties	Gam-ma doses	Inter-action					Varieties	Gam-ma doses	Inter-action		
C.D. (0.05)	0.15	0.20	0.35				C.D. (0.05)	NS	0.72	NS		

*Figures are in square root transformed value

Table.6 Characteristics of mutants of Candyman

Candyman	Parent	Variant	Variant
Identification purpose	-	Floret color	Floret color
Gamma ray dose	-	45 Gy	60 Gy
Plant height (cm)	90 cm	86 cm	82 cm
Length of leaf (cm)	45 cm	43 cm	42 cm
Spike length (cm)	66 cm	64.9 cm	74.6 cm
Rachis length (cm)	46 cm	44.4 cm	57.3 cm
Floret diameter (cm)	10.6 cm	11.1 cm	10.2 cm
Number of florets	13	12	13
Throat color	N66A	N66A	N57B
RHC	52A	51A, 62B	49B, 52A

Table.7 Characteristics of mutants of American beauty

American Beauty	Parent	Variant
Identification purpose	-	Floret arrangement
Gamma ray dose	-	30 Gy
Plant height (cm)	60 cm	50.2 cm
Length of leaf (cm)	36.5 cm	34.4 cm
Spike length (cm)	46.2 cm	38 cm
Rachis length (cm)	20.2 cm	16.6 cm
Floret diameter (cm)	8.00 cm	7.46 cm
Number of florets	11	08
Throat color	Pinkish white	Pinkish white
RHC	41C	41C

Table.8 Characteristics of mutants of Her Majesty

Her Majesty	Parent	Variant
Identification purpose	-	Floret color
Gamma ray dose	-	30 Gy
Plant height (cm)	77.30 cm	85 cm
Length of leaf (cm)	46.5 cm	45 cm
Spike length (cm)	45.3 cm	44.1 cm
Rachis length (cm)	25 cm	27 cm
Floret diameter (cm)	8.9 cm	8.9 cm
Number of florets	11	8
Floret color	Blue violet	Purple and blue violet
Throat color	White with purple tinges	White with tinges
RHC	N88B	71B and N88A

Morphological changes due to gamma radiations

The data presented in Table 5 shows that Variety Her majesty was noticed significantly maximum leaf abnormalities percentage (5.41%) while minimum in variety American Beauty (2.91%). Among various doses of gamma radiation maximum leaf abnormality was reported with 60 Gy (6.98 %) whereas no leaf abnormality was observed with control. Within their interaction highest leaf abnormality percentage (10.10%) was recorded in variety Her Majesty with 60 Gy. No leaf abnormality was found with control of all the three varieties.

Table 5 also shows that radiation doses had significant influence on morphological changes whereas varieties and their interaction were found to be non-significant. 60 Gy (11.55%) had highest percentage of morphologically abnormal plant while control had no any morphologically abnormal plant. Singh and Kumar (2013) reported in gladiolus that morphological abnormalities in florets were increased in the irradiated corms with increase in gamma rays. The abnormalities in various plant parts might be caused due to chromosomal aberration, disturbances in the production and/or distribution of growth substances caused by the mutagens (Gunckel, 1957).

Isolation of mutants

In variety Candyman, two variants were isolated for their floret color, one variant with 45 Gy radiation dose which was having dark pink red (51 A) in upper portion and light pink (62 B) in lower portion. Another variant with 60 Gy radiation dose was having light red pink (49 B) in upper portion and dark pink red (52A) in lower portion whereas Control is having dark pink red (52A) floret color. One sectoral chimera was also observed in 30 Gy

radiation dose. In variety American beauty, one variant with 30 Gy was isolated which was having different type of floret arrangement as compared to control whereas one sectoral chimera was observed in 60 Gy dose (Table 6–8).

In variety Her Majesty, a variant with 30 Gy radiation dose was isolated for floret color this was having purple (71B) in upper portion and blue violet (N88A) in lower portion whereas control is having blue violet (N88B) floret color. Misra and Bajpai (1983) treated gladiolus varieties at 3, 4, 5, 7 and 10 kR doses of gamma rays. They have found stable mutation one each in the gladiolus varieties Picardy, Sans Sauci, Himprabha and Ratna's Butterfly in vM₁ and vM₂ generation. Sisodiya and Singh (2014) reported a creamish white mutant in cv. Jyotsana at 2.5 kR of gamma doses along with one sectoral chimera on the lower portion of the florets. A color mutant was observed in var. Tiger Flame.

From the overall assessment of the data and results it can be concluded that lower doses *i.e.* 15 Gy and 30 Gy were beneficial for the many of floral characters. Variety Candyman was found superior over other two varieties in various floral characters.

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