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Effect of Gamma Irradiation on Vegetative Characters in various Cultivars of Gladiolus in vM_2 Generation

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ABSTRACT: The present investigation was undertaken entitled studies of gamma irradiation on vegetative characters in various cultivars of gladiolus in vM_2 generation. The experiment was carried out at Model Floriculture Centre (MFC), Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (Uttarakhand), India during winter season of 2018-2019. To conduct field experiment medium sized of corms were used as experimental material from the seven gladiolus varieties *viz.* "Nova Lux"(V_1), "Praha" (V_2), "Black Star" (V_3), "Nathan Red" (V_4), "Candyman" (V_5), "Punjab Dawn" (V_6) and "Tiger Flame" (V_7) irradiated with gamma rays of various doses *viz.* 0.0 Kr (G_0), 4.0 Kr (G_1), 4.5 Kr (G_2), 5.0 Kr (G_3), 5.5 Kr (G_4), 6.0 Kr (G_5) and 6.5 Kr (G_6) which were planted in the open field condition at 30 × 20 cm distance. Experiment was laid out in randomized block design with three replications. In this research experiment various vegetative characters i.e. days to 50 % sprouting of corms, number of leaves per plant, length and width of longest leaves 60 days after planting of corms were investigated. The observations were recorded from whole plant population. Data exhibited that earliest sprouting of 50% corms was found with untreated corms in cultivar Punjab Dawn and delayed sprouting was observed with 6.0 Kr in variety Praha. The interaction effect of different gamma ray doses and cultivars, days to sprouting was reduced whereas numbers of leaves and width of longest leaf were increased in untreated corms of cv. Punjab Dawn. It can be concluded that the treatment of gamma irradiation brought significant variation for different vegetative characters which was inducing for some characters and reducing for some characters. The prominent mutants were isolated for further stability and utilization in gladiolus improvement programme.

Keywords: Gladiolus, gamma rays, mutation breeding, vegetative traits.

INTRODUCTION

Gladiolus is a commercially important flower crop and very demanding cut flower in domestic and international market. It is relatively easy to grow and useful for bedding and exhibition. In India, gladiolus is commercially grown in Maharashtra, West Bengal, Uttar Pradesh, Uttrakhand, Punjab, Madhya Pradesh, Haryana, Delhi and Rajasthan (Anonymous, 2018). The increasing market demand especially in cities and megacities of India made it an important cut flower available round the year. Therefore, a lot of research had been done for the improvement of gladiolus in India and around the globe in past, subsequently resulted number of improved varieties. In nature mutation plays an important role to induced variability in various crops and artificial mutations by means of various mutagens such gamma rays, x-rays etc. can be used for further crop improvement for different plant characters. Through mutation breeding a huge number of varieties have been developed in flower and ornamental crops. Gladiolus is highly heterozygous in its genetic constitution which makes it promising test material for induced mutation. The effects of various physical mutagens on gladiolus have been studied by several workers in past. Therefore, present research experiment was carried out to study the performance various gladiolus cultivars in vM_2 generation which

were earlier treated with different doses of gamma radiation in vM_1 generations.

MATERIALS AND METHODS

The present research experiment was conducted at the Model Floriculture Centre (MFC), Department of Horticulture, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (Uttarakhand) during winter season of 2018-19 (October to April). The GBPUA & T is situated in the *tarai* region of Uttarakhand and geographical situation in 29º North latitude and 79º 3' East longitude at a latitude of 243.84 meters above mean sea level. the seven gladiolus varieties *viz.* "Nova Lux" (V_1), "Praha" (V_2), "Black Star" (V_3), "Nathan Red" (V_4), "Candyman" (V_5), "Punjab Dawn" (V_6) and "Tiger Flame" (V_7) irradiated with gamma rays of various doses *viz.* 0.0 Kr (G_0), 4.0 Kr (G_1), 4.5 Kr (G_2), 5.0 Kr (G_3), 5.5 Kr (G_4), 6.0 Kr (G_5) and 6.5 Kr (G_6) in vM1 generation. The harvested corms of vM_1 was used as base population in vM_2 generation which were planted in the open field condition at 30 × 20 cm distance. The irradiated planting material was evaluated by planting in Randomized Block Design (RBD) with two factorial concepts after exposing with gamma irradiation (Panse and Sukhatme, 1967). The gamma irradiation treatment of gladiolus corms of various cultivars were carried out in Gamma Chamber Facility of Radiations & Isotropic Tracers Laboratory (FRITL), CBSH, GBPUA&T, Pantnagar in October 2017.

Statistical analysis: The data generated from the current experiment for vegetative parameters were analysed statistically by SPSS statistical software.

RESULTS AND DISCUSSION

A. Days taken for 50 per cent sprouting

In respect to gamma ray doses, the least days taken for sprouting was observed in non-irradiated corms (7.33 days) which was statistically at par with 4.5 Kr (7.24 days) whereas maximum days (8.57 days) were taken for spouting in 6.5 Kr dose which was at par with 6.0 Kr (8.57 days). Irrespective to varieties, variety Punjab Dawn took minimum days (6.23 days) to sprouts which was significantly lower than rest of the varieties while maximum days was took by "Praha" (9.19 days) which was at par with "Nova lux" (9.09 days). The interaction effect, days to 50 per cent sprouting was minimum in non-irradiated corms of cv. "Punjab Dawn" (5.66 days) while lowest in "Praha' at 6.0 Kr dose (10.33 days) which was at par with V_4G_6 (10 days) (Table 1). At higher irradiation doses had a reducible effect on days required for sprouting. Mutagens influence the activity of enzymes Srivastava *et al.,* (2007); Patil and Dhaduk (2009). Enzymes play a pivotal role in various plant metabolism activities consequently result in stimulating plant growth (Misra and Bajpai, 1983). The time taken for sprouting of corms depends on the applied dose of radiation irrespective of the varieties and this result was supported by Dhara and Bhattacharya (1972).

Table 1: Effect of gamma irradiation on days taken for 50 percent sprouting in different gladiolus varieties.

Gamma rays / Varieties	4.0 Kr (G_1)	4.5 Kr (G_2)	5.0 Kr (G_3)	5.5 Kr (G_4)	6.0 Kr (G_5)	6.5 Kr (G_6)	Control (G_0)	Mean
Nova Lux (V1)	9.667	9.333	9.667	9.333	9.000	9.667	7.000	9.095
Praha (V2)	9.000	9.000	9.667	9.667	10.333	9.333	7.333	9.190
Black Star (V3)	8.333	7.333	7.667	8.000	7.667	9.000	7.333	7.905
Nathan Red (V4)	9.333	7.333	8.000	8.000	9.667	10.000	7.667	8.571
Candyman (V5)	7.000	6.00	9.667	8.000	8.333	7.333	6.333	7.24
Punjab Dawn (V6)	6.000	6.333	6.000	6.333	6.667	6.667	5.667	6.238
Tiger Flame (V7)	7.667	7.333	7.000	7.667	8.000	8.000	10.000	7.952
Mean	8.143	7.24	8.238	8.143	8.524	8.571	7.333	
Factors			**CD at 5%**				**SEm±**	
Varieties (V)			0.321				0.114	
Gamma Rays (G)			0.321				0.114	
Interaction (V X G)			0.850				0.302	

Number of leaves per plant: In respect to varieties, maximum number of leaves at 60 days was recorded in cv. "Nova Lux" (10) while minimum (8.89) was in cv. "Candyman". Irrespective of varieties, among all the gamma dose, the maximum number of leaves were found at 0.0 Kr (10.47) and minimum was at 6.5 Kr (8.43). Interaction effect of varieties and gamma rays doses, the highest number of leaves (11.41) were found in V_6G_0 whereas, V_4G_6 produces lowest number of leaves (6.66) (Table 2). The numbers of leaves at 60 days does exhibited specific pattern for increase or decrease in number of leaves per plant in respect to increasing doses of gamma rays. Minor improvement in leaf number with lower doses of gamma irradiation in some cases may be due to synthesis of substances such as bio-chemicals and other enzymes that gets freed and hence play an important role in metabolism and plant growth therefore resulting in increased plant growth (Misra and Bajpai, 1981; Cesarett, 1968). It could also be possibly causes due to hindrance in mitosis which resulted in mitotic aberrations frequently. Changes in level of nutrients in the plant due to disturbance in its

assimilation rate (Sparrow, 1961). The similar effect of mutagenic treatments also reported by Kumar and Tejavathi, (2011). Differential effect of gamma radiation doses may be attributed to modifications of cell anatomy, components, morphology and ultimately physiology of the plants (Wi *et al*., 2007).

Table 2: Effect of gamma irradiation on number of leaves at 60 days in different gladiolus varieties.

Gamma rays / Varieties	4.0 Kr (G_1)	4.5 Kr (G_2)	5.0 Kr (G_3)	5.5 Kr (G_4)	6.0 Kr (G_5)	6.5 Kr (G_6)	Control (G_0)	Mean
Nova Lux (V1)	10.667	9.8	10.133	9.067	9.267	10.033	10.6	9.938
Praha (V2)	9.867	10.8	10.6	9.2	9.4	8.933	11.2	10.00
Black Star (V3)	9.867	9.267	9.633	9.733	9.6	7.867	10.733	9.529
Nathan Red (V4)	9.467	8.933	9.867	9.2	8.167	6.667	10.75	9.007
Candyman (V5)	9.6	8.3	9.033	8.933	8.267	8.5	9.6	8.89
Punjab Dawn (V6)	9.367	9.0	9.667	8.333	9.533	8.283	11.4	9.369
Tiger Flame (V7)	9.3	9.0	8.673	9.333	9.667	8.783	9.023	9.111
Mean	9.733	9.3	9.658	9.114	9.129	8.438	10.472	
Factors			**CD at 5%**			**SEm±**		
Varieties (V)			0.634			0.225		
Gamma Rays (G)			0.634			0.225		
Interaction (V × G)			N/A			0.597		

Length of longest leaf: Among the gamma doses, the longest leaf length was noticed in untreated corms (37.73 cm) which was significantly different from all other treatments whereas, the shortest leaf length was recorded at 6.5 Kr (19.75 cm). The cultivar "Praha" exhibited the highest length of longest leaf (34.57 cm) while the lowest leaf length was in cv. "Nova Lux" (23.76 cm). The longest leaf length (43.33 cm) was observed in V_2G_0 and minimum was recorded in V_3G_6 (13.89 cm) (Table 3). Decrease in length leaf after exposer with gamma rays might have been probably due to interference in chromosomal aberrations mitotic activities and which lead to physiological damage (Gunckal, 1957). Datta and Datta (1953) hypothesized it to be due to inactivation of auxin whereas inhibition in synthesis of auxin was opined by Bunning (1948); Gordon and Weber (1950); Gordon (1954).

Table 3: Effect of gamma irradiation on longest leaves length (cm) at 60 days in various gladiolus varieties.

Gamma rays / Varieties	4.0 Kr (G_1)	4.5 Kr (G_2)	5.0 Kr (G_3)	5.5 Kr (G_4)	6.0 Kr (G_5)	6.5 Kr (G_6)	Control (G_0)	Mean
Nova Lux (V1)	33.067	23.267	23.467	22.933	17.867	15.75	30.017	23.767
Praha (V2)	35.867	35.8	35.4	32.8	26.133	26.667	43.333	34.571
Black Star (V3)	27.267	25.433	34.367	27.667	25.133	13.893	41.8	27.937
Nathan Red (V4)	32.8	29.867	32.8	32.2	18.0	16.11	38.717	28.642
Candyman (V5)	28.533	31.533	26.5	27.933	28.467	25.987	31.9	28.693
Punjab Dawn (V6)	29.733	30.467	23.0	18.25	19.753	16.613	38.0	25.117
Tiger Flame (V7)	30.667	29.617	30.223	24.933	22.733	23.283	34.4	27.98
Mean	31.133	29.426	29.394	26.674	22.584	19.758	37.738	
Factors			**CD at 5%**			**SEm±**		
Varieties (V)			2.304			0.819		
Gamma Rays (G)			2.304			0.819		
Interaction (V × G)			6.096			2.168		

Width of longest leaf: The data reveal that the widest leaf width (23.98 mm) was observed in untreated corms (control), whereas the narrowest leaf width was found at 6.0 Kr (16.73 mm) which was at par with 6.5 Kr (16.87 mm). Among the cultivars, broadest leaf width was recorded in cv. "Candyman" (20.76 mm) whereas, narrowest (15.40 mm) was observed in cv. "Punjab Dawn". Interaction effect of gamma doses and varieties showed that widest leaf width was noticed in V_6G_0 (28.91 mm) while the narrowest was in V_6G_4 (14.20 mm) which was at par with V_6G_5 (14.35 mm) (Table 4). The reduction in leaf width and length of "Dutch Iris" with increasing doses of gamma irradiation Rather and Jhon (2000). Noticeable changes in nutrient assimilation rate resulting alternation in level of nutrient on plants (Ehrenberg, 1955), or anatomical, physiological and cytological variation in plants could be the probable reason for plant reduction of plant growth. The stimulatory effect of gamma doses in some varieties can be associated with the release of enzymes by irradiation that plays a vital role in metabolism and hence increasing the metabolic activities resulting in stimulated growth of plants (Misra and Bajpai, 1983). Reduction in longest leaf width in irradiating corms to higher doses was also observed by Dhara and Bhattacharya (1972).

Table 4: Effect of gamma irradiation on longest leaves width (mm) at 60 days in various gladiolus varieties.

Gamma rays / Varieties	4.0 Kr (G_1)	4.5 Kr (G_2)	5.0 Kr (G_3)	5.5 Kr (G_4)	6.0 Kr (G_5)	6.5 Kr (G_6)	Control (G_0)	Mean
Nova Lux (V1)	22.637	19.413	18.82	19.867	17.86	17.813	28.913	20.76
Praha (V2)	18.82	17.57	17.443	17.167	16.067	16.32	25.757	18.449
Black Star (V3)	20.113	19.02	18.337	18.047	16.193	17.143	25.71	19.223
Nathan Red (V4)	18.287	18.117	18.18	17.097	16.093	15.133	23.91	18.117
Candyman (V5)	24.853	20.303	20.103	18.897	18.62	19.24	24.64	20.951
Punjab Dawn (V6)	16.243	15.153	15.503	14.207	14.353	15.29	17.097	15.407
Tiger Flame (V7)	21.11	19.173	18.077	19.22	17.96	17.193	21.87	19.229
Mean	20.295	18.393	18.066	17.786	16.735	16.876	23.985	
Factors			**CD at 5%**			**SEm±**		
Varieties (V)			0.616			0.219		
Gamma Rays (G)			0.616			0.219		
Interaction (V × G)			1.631			0.580		

CONCLUSION

On the basis of findings observed in current investigation, it can be concluded that the treatment of gamma irradiation brought significant variation for different vegetative characters which was inducing for some characters and reducing for some characters. The earliest sprouting, numbers of leaves per plant, length of longest leaves and width of longest were found highest in untreated corms. The interaction effect of gamma rays and varieties, days to sprouting was reduced whereas numbers of leaves and width of longest leaf were increased in untreated corms of cv. Punjab Dawn. The prominent mutants were isolated for further stability and utilization in gladiolus improvement programme.

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Conflict of Interest: No conflict of interest.

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