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Effect of gamma radiation on vegetative and floral characters of commercial varieties of gladiolus (*Gladiolus hybrida* L.)

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Abstract
Corms of three cultivars of gladiolus (*Gladiolus hybrida* L.) were exposed to eight doses of gamma radiation from 1KR to 8KR for induction of genetic variability. Most of characters were stimulated till 4KR treatment but started to reduce at higher doses whereas treatment of 3KR proved better overall treatments including control. The doses of 7KR and 8KR proved injurious as the number of leaves, length of spike, number of florets reduced drastically in all three cultivars *viz*. Nova Lux, Sunset Sky and White Prosperity but least in Nova Lux as compared among three. No colour variation in florets and whole spike, decrease in the number of floral organs and their fasciation and spike bifurcation were also observed from 6KR to 8KR treatments in all varieties. Treatments of 7KR and 8K were observed to be highly reduced growth as far as its vegetative and floral characters are to be concerned. In the present investigations, treatment T_3 i.e., 3KR to be more prominent than other treatments and cultivar White Prosperity appeared to be more sensitive and cultivar Nova Lux more stable and responded positively to Gamma radiation treatment.

Keywords: Gamma rays, gladiolus, mutation, mutant

Introduction
Gladiolus (*Gladiolus hybrida L.*) belongs to the family iridaceae. It is principally native of south Africa and Europe, gladiolus is commonly called swords lily, the name gladiolus was originally claimed by Pliny the Elder (A.D 23-79) deriving from the Latin word gladius, meaning a sword on account of the sword like shape of the foliage. Now a days gladiolus become an Important flower mostly on plains of north India. It is a popular among cut flower for its attractive colour and shape, Flower are in a wide range of colour that is yellow, orange, cream, white, pink, blue, red, etc.

Gladiolus, the queen of bulbous flowers with its long flower spikes having rich variation of colours and long vase life, has ever increasing demand in the flower markets. Since garden varieties of today come from divers genetic parental that are heteroploids ranging from 2n=30 to 180 and hypoaneauploids so the reproduction by seeds in this case has no meaning to maintain the varietal identity, but for evolution of new forms. Due to its heterozygocity in genetic constitution this makes it promising test material for inducing physical mutagenesis. Where only one or a few characters' are to be improved upon without changing the entire genotype. Mutation breeding offers promising possibilities. Gladiolus is grown throughout India to perfection and so mutation breeding offers great potentialities as the mutated part can be conveniently perpetuated by vegetative means resulting in the development of new forms. Hence, the present investigation was conducted and the emphasis laid out for finding out desirable variations caused by gamma radiations on morphological characters and also to develop a new variety by fixing the induced variation in succeeding generations.

In plant breeding and genetics researches, Gamma rays have been used as ionizing radiation for a long time because it is one of the most energetic forms of electromagnetic radiation. This energy level perceived approximately from 10 kilo electron volts (keV) to several hundred keV. Therefore they are more penetrating than other types of radiation such as alpha and beta rays.

Moreover, ionizing radiations have been frequently utilized to induce mutations in plant breeding and classical genetic analysis. There are a few organisms have been analyzed in-depth at the molecular level. Based on the plant genomes, ionizing radiation usually induces rearrangements and deletions.

It has been demonstrated that the mutants in crop species created by ionizing radiation.

They are valuable in the two fields of genetics and mutational breeding. In agriculture field there are some usages of nuclear techniques. In plant improvement, the irradiation of seeds may cause genetic variability. It can enable plant breeders to select new genotypes with improved characteristics such as precocity, salinity tolerance, flower yield and quality (Ashraf *et al*., 2003).

Materials and Methods

The present experiment entitled "Effect of Gamma Radiation on Vegetative and Floral Characters of Commercial Varieties of Gladiolus (*Gladiolus hybrida* L.), was carried out at the experimental field, Department of Horticulture, Sam Higginbottom Institute of Agriculture Technology & Sciences during 2012-2013. The dormant corms (3.25 to 4.75cm. diameter) of three commercial varieties of gladiolus *viz*. Nova Lux, Sunset Sky and White prosperity were subjected to 1-8KR Gamma radiations at Central Institute of Medicinal and Aromatic Plants, Lucknow in October 2012. The corms were treated with 8 doses of Gamma radiations from 1KR to 8KR along with control (without treatment). The corms were planted in the field within 24 hours of treatments in Randomized Block Design with Factorial Concept (Panse And Sukhatme, 1967) [18] putting 25 corms per treatment per replication. Data were recorded in VM1 generations on different qualitative and quantitative parameters.

Results and Discussion

The data on different vegetative characters are presented in Table 1. The data revealed that minimum days required for sprouting (12.15 and 14.23) was observed at treatment 3KR and variety Nova Lux respectively. Days required for sprouting were negatively significant under 6KR and 7KR treatments but non-significantly affected by varieties. These results are in agreement with those reported by Misra and Mahesh (1993) [15] and Misra and Bajpai (1983) [16]. The plant height as expressed in Table 1. revealed that it is striking to note that the plant height is maximum at T3 i.e., in 3KR as 96.14 cm. In spite of these the 3KR treated plants are taller than other treated plants including control one. The shortest plant among treated is treatment 2KR (63.57cm). Similar results were found by Dhaduk (1992) [9]. The lower levels of mutagens are themselves not responsible for stimulating sprouting but the substances such as enzymes that are set free by irradiation and low doses cause stimulation as the enzymes play pivotal role in plant metabolism (Cantor *et al*., 2002) [6]. Higher irradiation doses might have harmful effect on auxins and other growth substances influencing the chromosomes and the plant tissue (Srivastava *et al*., 2007) [22]. Among all varieties, cv. Nova Lux had produced taller plants (86.47cm) while shortest plants were observed in cv. White prosperity (76.44 cm). Under different irradiation treatments, as shows in Table1. that the number of leaves was significantly affected and maximum number of leaves was produced by the corms treated with 1KR doses of gamma rays (6.51) which was followed by T0 and 3KR (6.44) treatment. Number of leaves started to decreased as the dose of gamma rays increases up to 8KR irradiation (4.57) produced minimum number of leaves per plant. Such results have also been reported by Misra (1998) and Misra and Mahesh (1993) [15] which may be due to activation of physiological substances present in corms at lower doses, while higher doses retard cell division and causes ill effect on auxin variety Nova Lux showed superiority in this regard, as it produced highest number of leaves (6.11) because more number of sprouts per corm as compared to other two varieties and minimum number of leaves produced by White Prosperity (5.48). Table1. also it reveals that the number of sprouts per plant is maximum (2.04) produced by the corms treated with 3KR i.e. T_3 and minimum number of corms produced under the treatment of T_5 (5KR) i.e.1.55. Number of sprouts per plant in Nova Lux is maximum (1.76) among three varieties and minimum in case of White Prosperity (1.68). Similar results were found by Dhaduk (1992) [9] in cv. Melody at 1 KR treatment.

Table 1: Important vegetative variations observed in vM1 generation of gladioli following gamma ray treatments

Treatment combination		Days req. for corm sprouting	Plant height (cm)	No. of leaves per plant	No. of sprouts/plant
T_0 = (Control)		13.40	95.27	6.44	1.86
T_1 = 1KR		14.46	85.38	6.51	1.62
T_2 = 2KR		17.44	63.57	5.75	1.64
T_3 = 3KR		12.15	96.14	6.44	2.04
T_4 = 4KR		14.31	81.52	5.88	1.64
T_5 = 5KR		17.24	84.75	4.93	1.55
T_6 = 6KR		12.77	92.10	6.22	1.88
T_7 = 7KR		14.80	88.31	5.77	1.57
T_8 = 8KR		18.37	63.75	4.57	1.64
NOVA LUX		14.23	86.47	6.11	1.76
SUNSET SKY		14.97	80.66	5.91	1.71
W.PROSPERITY		15.78	76.44	5.48	1.68
	C.D(0.05)-T	0.72	5.16	0.59	0.19
	C. D(0.05)-V	0.41-	2.98	0.34	-

Table 2. shows that the treatments with 3KR Gamma radiation does induced fast initiation of spike as it required only 56.91 days. Spike initiation was delayed at higher dose of Gamma radiation and maximum number of days was taken by corms which were treated with the dose of 8KR Gamma rays (70.40). Number of days required for spike initiation in Nova Lux is minimum (62.95) and maximum in White Prosperity (71.4). Similar type of stimulatory effect was observed earlier by Misra and Bajpai (1983) [16] with 2KR and 3KR doses in nine varieties of gladiolus that used for study and by Dhaduk (1992) [9] with 3KR and 5KR in four varieties of gladiolus. Raghava *et al*. (1988) [17, 19] and Negi *et al*. (1983) [17, 19, 21] noted that the flowering was delayed significantly at 5KR treatment in various varieties used in their studies. Table 2. Also reveals that the number of spikes per plant is significantly increased in corms after treated with lower doses of Gamma radiations i.e. 3KR (1.93) including control treatment and minimum number of spike per plant was observed under the treatment of T_8 (8KR) i.e. 1.41. And cv. Novalux has produced maximum number of spikes (1.77)

whereas minimum number of spikes produced by cv. Sunset sky (1.56)). Similar results were obtained by Raghava *et al*. in 1998 cvs. Little Giant, Mans oer and Wild Rose, which did not flower at 10KR and 15KR doses of gamma radiations. Table2. Shows the length of spike revealed significant differences due to varieties and treatments. Corms treated with 3KR and 5KR produced more spike length i.e. both of 97.36 cm than control i.e. (86.96 cm) whereas minimum spike length observed in T_2 i.e. 2KR (46.91cm) in case of varieties length spike was observed in Nova Lux (77.34 cm) and minimum in case of white prosperity (56.24 cm). Such changes may occur due to physiological disturbances as has been reported by Banerji and Datta (2002) [1-3, 7, 8] that may be because of reshuffling of histogen layers. Table 2. Described the treatment 3KR had produced maximum number of florets per spike (16.60) followed by control (15.73) whereas treatment 1KR and 7KR also proved better to increase number of florets per spike 13.88 and 14.57 respectively. Among varieties maximum number of florets in Nova Lux (13.69) and minimum in case of White Prosperity (11.87). which support the present findings (Banerji *et al*., 1996) [1-3, 7, 8].

Table 2: Important floral variations observed in vM1 generation of gladioli following gamma ray treatments

Treatment combination		Days req. for spike initiations	No. of spike/plant	Length of soike (cm)	No. of florets/spike
T_0 = (Control)		61.08	1.71	86.96	15.73
T_1 = 1KR		65.11	1.48	77.72	13.88
T_2 = 2KR		68.88	1.42	46.91	10.22
T_3 = 3KR		56.91	1.93	97.36	16.60
T_4 = 4KR		61.88	1.71	66.89	13.08
T_5 = 5KR		63.80	1.68	97.36	8.77
T_6 = 6KR		63.91	1.82	69.38	13.55
T_7 = 7KR		65.53	1.62	86.37	14.57
T_8 = 8KR		70.40	1.41	69.70	8.74
NOVA LUX		62.95	1.77	77.34	13.69
SUNSET SKY		64.13	1.56	72.03	12.83
W.PROSPERITY		71.40	1.60	56.24	11.87
	C.D(0.05)-T	3.78	0.26	8.31	1.39
	C. D(0.05)-V	-	0.15	4.79	0.80

Table 3. shows that the number of florets open at a time is maximum (8.85) under the treatment of 3KR including controls one, whereas minimum number of florets opens at a time under the treatment of T8 i.e.8KR (4.62). Among varieties there is no significant difference on account of number of florets open at a time. Variety Nova Lux produced highest number of florets (13.69) and maximum florets remaining open at a time (6.64), whereas minimum number in variety White Prosperity (5.85) (Dobanda 2004) [10]. Table3. Reveals that lower doses shows longer vase life in comparison to higher dose. The maximum days of longevity of flower retention was observed under the treatment of T_3 (3KR) i.e. 17.40, whereas minimum vase life observed at T_2 (2KR) i.e. 9.77. Among all three varieties in Nova Lux the longest vase life observed (14.52) and minimum vase life observed in White Prosperity (12.57). Similar results were obtained by Rahava *et al*. (1981) [21] in cvs. Little Giant, Mansoer and Wild Rose. Number of corms per plant as depicted in Table3. shows that the maximum number of corms were produced by the corms treated with Gamma radiation at 3KR, which is 1.80 and minimum number of corms per plant were obtain under the treatment of T_7 i.e. 7KR (1.37) and cv. White Prosperity shows the maximum number of corms per plant (1.51) little more than that of other two varieties (1.49, 1.49), (Nova Lux and White Prosperity respectively). Such changes may occurs due to physiological disturbances as has been reported by Banerji and Datta (2002) [1-3, 7, 8] that may be because of reshuffling of histogen layers.

Table 3: Important floral variations observed in vM1 generation of gladioli following gamma ray treatments

Treatment combination		No. of florets open at a time	Vase life of cut spikes (D)	No. of corms/plant
T_0 = (Control)		6.55	15.66	1.44
T_1 = 1KR		6.04	12.46	1.51
T_2 = 2KR		4.97	9.77	1.46
T_3 = 3KR		8.85	17.40	1.80
T_4 = 4KR		6.80	13.60	1.44
T_5 = 5KR		4.92	10.51	1.44
T_6 = 6KR		7.75	16.40	1.60
T_7 = 7KR		7.11	14.62	1.37
T_8 = 8KR		4.62	11.40	1.44
NOVA LUX		6.64	14.52	1.49
SUNSET SKY		6.60	13.51	1.49
W.PROSPERITY		5.85	12.57	1.51
	C.D(0.05)-T	1.30	0.27	0.15
	C. D(0.05)-V	-	0.16	-

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