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EFFECT OF GAMMA RAYS ON VEGETATIVE AND FLOWERING PARAMETERS OF GERBERA (*Gerbera jamesonii* Bolus Ex Hooker F.)

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ABSTRACT : The suckers of nine gerbera varieties namely RCGH-12, RCGH-22, RCG-12, RCG-18, RCG-7, RCG-19, RCGH-117, RCGH-38, and RCG-10 were exposed to gamma rays treatments (1.5 Kr; Source ^{60}Co).These gamma irradiated suckers along with untreated suckers were planted under low cost polyhouse. The radio- sensitivity of these varieties was determined on the basis of various vegetative and floral characteristics of the treated plants. The findings indicated that gamma radiation treatment @ 0.5 Kr had significantly detrimental effect on plant height, number of leaves, flower stalk length, flower duration and number of flowers per plant per year in all varieties studied.

Keywords: *Gerbera, gamma rays, irradiation, growth, flowering.*

Gerbera (*Gerbera jamesonii* Bolus Ex Hooker F.) is very popular and widely used as a decorative garden plant or as cut flower. It is ideal for growing in beds, borders, pots and rock garden. Cut gerberas have a long vase life and are suitable for different floral arrangement. Gerbera can be propagated by both sexual and asexual methods. Seed propagation, however is not satisfactory. It is a diploid species with the somatic chromosome number 2n=50. The modern gerbera arose from *G. jamesonii* hybridized with *G. viridifolia* and possibly other species (Leffring, 11). There is a wide range of variation available in this crop. Collection of germplasm and the search for desirable cultivars are of utmost importance in practical flower crop breeding.

There is always a craze for developing new varieties by replacing older varieties with newer ones. Since in flowers a specimen cannot maintain interest for a long time, people have the desire to develop newer forms through various methods of breeding. The possibilities of mutation breeding in vegetatively propagated species are favourable in general for various reasons such as the usually large heterozygosity of the material which allows direct detection of mutations in the irradiated material. In the vegetatively propagated material in which the intention is often improvement in visible characteristics, selection of potentially useful mutations is generally easy (Broertjes, 3). The main advantage of mutagenesis in gerbera is the ability to change one or a few characters of an excellent variety without changing rest of the genotypes. The present study was aimed to ascertain the radio- sensitivity of nine gerbera varieties as well as to induce somatic mutations.

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MATERIALS AND METHODS

The experiment was conducted at Model Floriculture Centre of Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand during 2009 and 2010.The experimental material comprised of the uniform sized suckers of the 9 gerbera varieties viz; RCGH-12, RCGH-22, RCG-12, RCG-18, RCG-7, RCG-19, RCGH-117, RCGH-38, and RCG-10.These suckers were exposed to 0.5 Kr of gamma rays doses at gamma chamber facility of NBRI, Lucknow.The gamma irradiated suckers along with the untreated suckers were planted in low cost polyhouse using factorial control randomized block design with three replications. Twenty suckers per variety were exposed to radiation treatment @ 10 suckers per treatment. All the recommended package of practices were followed throughout the year. The data were recorded on growth and flowering parameters and statistically analyzed (Table 1 and 2).

RESULTS AND DISCUSSION

Vegetative Characters

Table 1 indicated that all the morphological characteristics relating to vegetative growth of all gerbera varieties were significantly affected by the gamma radiation. Pooled data of two years envisage that maximum height was observed in plants given 0.5 Kr γ-rays treated while 1.5 Kr γ-treated plants recorded minimum height. Observation recorded for plant height irrespect of gamma rays radiation treatment, variety RCGH-12 had maximum plant height (30.18 cm) and variety RCG-10 had minimum plant height (14.43 cm). Maximum number of leaves per plant (21.27) recorded

Table 1 : Effect of gamma rays on vegetative characters of gerbera varieties. (Pooled over two years)

Parameters → Variety ↓	Plant height (cm)				Number of leaves/plant				Number of suckers/plant			
	T_0	T_1	T_2	Mean	T_0	T_1	T_2	Mean	T_0	T_1	T_2	Mean
RCGH-12	30.66	31.30	28.58	30.18	32.83	33.16	27.16	31.05	16.00	16.66	13.33	15.33
RCGH-22	24.91	25.41	23.30	24.54	25.50	25.83	20.33	23.88	18.66	21.33	17.00	19.00
RCG-12	20.36	21.00	18.31	19.89	23.00	23.50	18.33	21.61	14.33	15.00	12.00	13.77
RCG-18	21.46	22.26	20.13	21.28	22.50	23.16	17.33	21.00	13.00	14.66	10.66	12.77
RCG-7	19.56	20.05	18.38	19.33	20.50	21.16	16.16	19.27	12.33	13.00	11.00	12.11
RCG-19	17.11	17.51	15.16	16.60	17.50	17.66	13.83	16.33	14.66	16.00	11.66	14.11
RCGH-117	16.88	17.33	15.71	16.64	14.00	14.66	11.16	13.27	12.00	15.00	11.00	12.66
RCGH-38	22.30	22.73	20.73	21.92	19.83	20.16	13.50	17.83	15.66	15.66	12.33	14.61
RCG-10	14.60	15.33	13.38	14.43	11.66	12.16	7.33	10.38	9.33	9.66	7.66	8.88
Mean	20.87	21.43	19.30	20.53	20.81	21.27	16.12	19.40	14.00	15.24	11.85	13.69
	CD (P = 0.05)											
Treatment	0.106				0.227				0.241			
Variety	0.183				0.394				0.418			
Interaction	0.318				0.683				0.725			

T_0=Control, T_1=0.5 Kr, T_2=1.5Kr

in T_1 and minimum number of leaves (16.12) in T_2. Observations recorded for number of leaves irrespect of γ- ray radiation treatment minimum leaves per plant were observed in variety RCG-10 (10.38) and maximum numbers of leaves per plant were observed by variety RCGH-12 (31.05).Low levels of mutagens themselves are not responsible for stimulated growth but the substances such as enzymes which are set free by irradiation at low doses cause stimulation (Misra and Bajpai, 13). Karki and Srivastava (9) in gladiolus and Tiwari and Kumar (16) in calendula had also reported similar slight stimulated vegetative growth irradiated with lower level of gamma-rays doses. Dilta *et al.* (5) in chrysanthemum reported poor height of plants, reduced number of leaves with increasing doses of gamma irradiation. These results can be attributed to changes in auxin levels, might be due to inactivation of auxin (Datta and Datta, 4), or destruction of enzyme system (Bairagi, 2), or inhibition of mitotic activities and chromosome damage associated with secondary physiological damage (Sparrow and Evan, 14).

Minimum number of suckers per plant were observed in 1.5 Kr γ-rays irradiated plants i.e. 11.85 while plants irradiated with 0.5 Kr of γ-rays recorded maximum number of suckers per plant i.e. 15.24. Among the varieties RCGH-22 recorded maximum number of suckers per plant whereas minimum numbers of suckers were observed in variety, RCG-10. More production and bigger size of corms at lower doses of gamma-rays but less and a smaller sized corm in higher doses than control was reported by Ali (1) in tuberose.

The explanation for multiplication may be attributed to the fact that due to treatment damage, physiology of the plant in higher doses was disturbed which affected photosynthesis and respiration resulting in the improper growth of the plant and hampered root system (Grabowska and Mynett, 8) whereas at lower doses some of the substances like enzymes are set free which play an important role in plant metabolism (Gordon, 7).

Floral Characters

Table 2 revealed that all the floral characters significantly affected by gamma radiation treatments among all gerbera varieties studied. Suckers treated with 0.5 Kr of γ-rays exhibited maximum flower diameter similarly T_2 *i.e.,* suckers treated with 1.5 Kr of γ-ray treatment recorded minimum flower diameter. Among the variety minimum flower diameter observed in variety RCG-10 (6.90 cm) whereas variety RCGH-22 had maximum flower diameter (9.43 cm).0.5 Kr γ-rays treated corms recoded maximum flower stalk length (37.42 cm).Varietal differences on flower stalk length exhibited maximum flower stalk length in Variety RCGH-22 (53.21 cm). Misra (12) in dahlia reported an increase in floral parameters after 0.5 Kr treatment.

A perusal of the data reveals that untreated plants took less time for first floret opening. Plants raised from suckers treated with 1.5 Kr of γ-rays (T_2) took

Table 2 : Effect of gamma rays on floral characters of gerbera varieties.(Pooled over two years).

Parameters → Variety ↓	Flower diameter (cm)				Stalk length (cm)				Days to first floret opening (days)				Flower duration (days)				Number of flowers/plant/year			
	T_0	T_1	T_2	Mean	T_0	T_1	T_2	Mean	T_0	T_1	T_2	Mean	T_0	T_1	T_2	Mean	T_0	T_1	T_2	Mean
RCGH-12	9.21	9.46	8.73	9.13	50.23	51.43	49.46	50.37	14.50	15.16	17.50	15.72	15.33	16.33	11.50	14.38	33.16	34.50	22.66	30.11
RCGH-22	9.50	9.85	8.96	9.43	53.13	53.91	52.58	53.21	15.50	15.83	18.33	16.55	17.66	18.50	12.50	16.22	32.66	33.33	21.16	29.05
RCG-12	8.06	8.40	7.60	8.02	35.33	36.43	34.38	35.38	12.66	13.33	18.00	14.66	12.16	12.50	11.16	11.94	27.83	28.66	17.33	24.61
RCG-18	8.33	8.70	7.86	8.30	32.98	34.45	32.11	33.18	14.16	14.33	19.16	15.88	15.33	16.16	11.83	14.44	31.00	31.33	21.00	27.77
RCG-7	7.48	7.95	7.08	7.50	29.43	30.53	28.68	29.55	11.83	12.50	15.16	13.16	11.33	11.18	7.16	10.11	25.16	26.16	15.33	22.22
RCG-19	8.46	8.98	7.93	8.46	37.78	38.75	36.48	37.67	16.83	17.16	20.83	18.27	14.16	14.83	9.66	12.88	26.50	27.83	15.83	23.38
RCGH-117	7.08	7.46	6.68	7.07	32.90	33.90	31.60	32.80	14.16	15.00	16.33	15.16	11.33	13.16	7.00	10.50	18.83	19.50	9.66	16.00
RCGH-38	8.93	9.33	8.43	8.91	24.75	25.46	23.75	24.65	13.16	13.83	17.16	14.72	15.00	16.50	11.33	14.27	21.16	21.50	11.83	18.16
RCG-10	6.90	7.28	6.51	6.90	31.23	31.90	30.03	31.05	8.33	8.83	12.66	9.94	8.66	9.16	6.16	8.00	23.33	23.83	12.66	19.94
Mean	8.22	8.60	7.76	8.19	36.42	37.42	35.45	36.43	13.46	14.00	17.24	14.90	13.44	14.33	9.81	12.53	26.62	27.40	16.38	23.47
CD (P = 0.05)																				
Treatment		0.046				0.083				0.169				0.223				0.254		
Variety		0.080				0.145				0.294				0.387				0.440		
Interaction		0.139				0.251				0.509				0.671				0.762		

T_0=Control, T_1=0.5 Kr, T_2=1.5Kr

maximum number of days for first floret opening. Among the varieties variety RCG-10 took minimum number of days for first floret opening (9.94 days) while variety RCG-19 recorded maximum days to first floret opening (18.27 days). Plants treated with 0.5 Kr of gamma rays maintained freshness for maximum duration (14.33 days) whereas 1.5 Kr γ-rays treatment exhibited shortest flower duration (9.81 days).Among the different varieties irrespect of g-rays treatment doses, variety RCGH-22 maintained freshness for maximum duration. The results obtained by Dilta *et al.* (5) in chrysanthemum who observed an increase in number of days taken for bud formation were taken by gamma rays treated plants as compared to control. Increase in floret longevity at lower doses of gamma rays but decreased with higher doses of gamma rays were recorded by Srivastava and Singh (15) in gladiolus.

Maximum number of flowers per plant per year were recorded by plants with 0.5 Kr γ-rays treatment (27.40) while Plants treated with 1.5 Kr of γ-rays exhibited minimum number of flowers per plant per year (16.38). Varietal differences on number of flowers per plant per year exhibited maximum number of flowers per plant per year in Variety RCGH-12 and minimum in variety RCGH-117.Similar results reported by Dwivedi and Banerji (6) in dahlia cv. 'Pinki'.

The differences in the radio sensitivity of the cultivars may be due to the effect of genotypes. However, the stimulatory effects observed may be due to acceleration in the release of certain enzymes or the biological compounds from its bound form to scavenge or due to enhanced biosynthesis of ascorbic acid and sulfhydryl compounds (Khan, 10).The cause of inhibitory effect can be attributed to the fact that biochemical active substances after a certain dose level may form certain toxic substances (Gordon, 7) which may cause death of the cells ultimately resulting in the death of the plants. Higher dosages cause harmful effects on auxin and other growth substances,

chromosome and cell division therefore, such deleterious effects were observed.

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