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Mutation breeding in chrysanthemum (*Dendranthema grandiflora* T.)

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Abstract
The present experiment was conducted on chrysanthemum cultivar 'Local Golden' which was irradiated with 0.5, 1.0, 1.5, 2.0, 2.5 and 3.0 Krad of gamma radiation. Reduction in survival percentage, plant height, number of branches, number of suckers per plant was observed after irradiation and with increase in dose of gamma rays. The LD_{50} is between 2.5 and 3.0 Krad. Plant height at time of bud initiation and flowering was maximum in control (45.29 cm and 79.90 cm, respectively), while minimum in 2.5 and 3.0 Krad treatments. Chimera in ray florets of flower was observed in one plant after 1.5 Krad treatment. The original shape of ray florets was flat with small tube at the base whereas in case of tubular mutant, shape at tip was spoon type and basal portion showed pipe or tube like appearance.

Keywords: Gamma irradiation, mutation, chrysanthemum

Introduction
Chrysanthemum (*Dendranthema grandiflora* Tzvelve syn. *Chrysanthemum morifolium* Ramat.) is one of the most important floricultural (cut and loose flower) and ornamental (pot and garden flower) crop in the world. Wide variation exhibited in respect of growth, habit, size, colour and shape of bloom make the chrysanthemum suitable for every purpose for a flower crop.

Its having second position in cut flower ranking after rose. In India, it is commercially cultivated in Karnataka, Maharashtra, Tamil Nadu, Andhra Pradesh, and West Bengal. The major objective of any mutation breeding programme is to obtain new and better genotype through the creation of genetic variability in the existing gene pool. The main advantage of mutagenesis in chrysanthemum is the ability to change one or a few characters of an excellent cultivar without changing rest of the genotype. The gamma rays have been used effectively for induction of mutation in chrysanthemum and the optimum dose range from 1.0 to 3.0 Krads depending upon the genotypes (Dilta *et al*., 2003) [5].

Material and Methods
The experimental material i.e. rooted suckers of chrysanthemum cv. 'Local Golden' were procured from the progressive farmer from village Akolner-Kedgaon Dist. Ahmednagar. Rooted suckers of yellow flower chrysanthemum cultivar were packed in polyethylene bags. A set of each containing 25 suckers was irradiated with gamma rays of 0.5, 1.0, 1.5, 2.0, 2.5 and 3.0 Krad at Chemistry Department of Pune University. A set of suckers without any irradiation was used as control.

The experimental was laid out in Randomized Block Design with seven treatment replicated three times. The layout of the experiment is depicted in Fig.1. The spacing of 45 cm x 30 cm was maintained among experimental plant. All the cultural practices were followed as per package of practices. Drenching of Bavistin (0.1%) was done 10 days after planting to prevent soil borne disease like root rot. Observations on twenty five randomly selected plants from each treatment in each replication were recorded during the course of experiment for vegetative growth characters and flower characters. The statistical analysis was done by standard statistical method suggested by Panse and Sukhatme (1985) [8].

Table 1: Effect of gamma irradiation on vegetative characters of chrysanthemum

S. No	Treatment		Survival percentage			Days required for sprouting	Plant height (cm) at			Internodal distance (cm)	Number of branches/ plant	Number of suckers/ plant
	Code	Dose (Krad)	30 DAP	60 DAP	90 DAP		Planting	Bud initiation	Flowering			
1	T_1	0.5	98.6	98.6	62.6	8.30	10.99	43.18	76.27	1.95	19.33	16.62
2	T_2	1.0	96.0	94.6	81.3	11.16	10.87	43.08	74.75	2.15	18.20	17.22
3	T_3	1.5	94.6	94.6	82.6	9.45	11.00	44.5	74.59	1.89	28.29	12.5
4	T_4	2.0	93.3	90.6	82.6	11.6	10.68	45.45	73.85	2.12	28.88	15.74
5	T_5	2.5	93.3	90.6	50.6	14.46	10.88	43.88	72.62	1.70	19.39	14.76
6	T_6	3.0	86.6	76.0	37.3	16.9	10.72	42.80	69.16	1.80	19.2	11.56
7	T_7	control	100	88.0	86.6	7.6	12.52	45.29	79.90	1.64	21.85	20.6
		SEm±	1.44	1.58	8.62	0.613	0.102	1.422	1.400	0.092	2.53	0.820
		C.D. at 5 %	4.43	4.87	26.57	1.89	0.31	NS	4.13	0.283	7.86	2.5

Results and Discussion

Effects of gamma irradiation on suckers of chrysanthemum were studied and it was found that survival percent reduced with increased in dose of gamma rays. Similar result were obtained by Banerji and Datta (1992, 2002) [2, 3] who observed reduction in survival percentage with increasing dose of gamma irradiation in chrysanthemum cv. 'Jaya and Lalima'. Due to effect of higher dose 3.0 Krad of gamma radiation the sprouting of suckers was delayed up to 9 days while early sprouting of suckers occurred in control (T7). This is in concurrence with finding of Datta (1997) [4]. Effects of gamma irradiation on suckers of chrysanthemum were studied and it was found that plant height, yield of flower per plant and number of flowers per plant reduced with increased in dose of gamma rays. Singh *et al*. (2009) [9] reported reduction of plant height with increasing dose of gamma rays at 200 Grays. Increased tendency in the number of branches was noticed at treatment 1.5 Krad and 2.0 Krad of gamma rays. Higher dose of gamma rays i.e. 3.0 Krad drastically reduced the number of branches per plant by 12.12 percent in comparison with control. Reduction in number of suckers per plant due to higher gamma dose on cytological change which included mitotic cycle delay, chromosomal aberrations and loss of proliferative capacity of cell. The appearance of flowering was significantly delayed in all the dose of gamma rays over untreated control treatment. Days required for bud to full bloom was noticed 45 days in the control population which was significantly delayed with exposure gamma rays at 0.5 Krad. Maximum delay of 9 days was observed in the 2.5 Krad dose of gamma rays. Similar results obtained by Misra *et al*. (2009) [7] in chrysanthemum cv. Pooja.

Table 2: Effect of gamma irradiation on flower characters of chrysanthemum.

S. No	Treatment		Days required for		Number of flower/ plant	Yield of flower/ plant (kg)	Total crop duration (days)	Colour of ray florets	Colour of disc florets	Diameter of flower (cm)	Number of ray florets/ flower
	Code	Dose (Krad)	Bud initiation	Flowering							
1	T_1	0.5	91.75	49.17	146.95	0.428	140.3	Aureolin (3/1)	Lemon yellow (4)	5.68	195.78
2	T_2	1.0	92.48	48.51	162.16	0.465	139.59	Aureolin (3/1)	Lemon yellow (4)	5.55	189.24
3	T_3	1.5	93.27	50.39	143.37	0.418	143.25	Aureolin (3/1)	Lemon yellow (4)	5.70	186.42
4	T_4	2.0	91.59	49.12	131.22	0.382	141.76	Aureolin (3/1)	Lemon yellow (4)	5.77	197.83
5	T_5	2.5	105.63	54.72	129.05	0.379	158.57	Aureolin (3/1)	Lemon yellow (4)	6.04	195.5
6	T_6	3.0	108.67	52.99	127.57	0.377	174.09	Aureolin (3/1)	Lemon yellow (4)	6.31	201.7
7	T_7	control	89.63	45.60	186.00	0.551	135.07	Aureolin (3/1)	Lemon yellow (4)	5.22	183.61
		SEm±	1.41	0.907	17.05	0.010	3.59	-	-	0.010	3.54
		C.D. at 5%	4.35	2.79	52.56	0.032	11.06	-	-	0.032	10.93

Effects of gamma irradiation on suckers of chrysanthemum were studied and it was found that total crop duration increased with increase in dose of gamma rays. Also, it was found that diameter of flower, number of ray florets increased with increase in dose of gamma rays. Somatic mutation in flower colour was not detected in treated plants. Colour of ray and disc florets as a result of mutagenesis was found to be non significant. The original colour of ray florets and disc florets is Aureolin (3/1) and Lemon Yellow (4) respectively while the no colour change was detected after gamma irradiation treatments. Shoot or tissue without chemeric growth lead to non formation different colour variation in petals reported by Longton (1980) in chrysanthemum. Somatic mutation in ray florets shape was detected in sectorial chimeric form in one branch of a plant treated with 1.5 Krad of gamma rays. The florets of original flower were flat with a small tube at the base where as in case of tubular mutant shape at tip spoon type but the basal portion gave pipe or tube like appearance to the ray florets.

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