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INDUCTION OF SOMATIC MUTATION IN CHRYSANTHEMUM CULTIVAR 'LOCAL GOLDEN'

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ABSTRACT
The rooted sucker of chrysanthemum cultivar "Local Golden" was treated with 0.5, 1.0, 1.5, 2.0, 2.5 and 3.0 Krad of gamma rays. Each treatment consisted of 25 suckers. The data were recorded on vegetative and flower traits *i.e.* survival percent, days for sprouting, plant height, internodal distance, number of branches per plant, number of sucker per plant, total crop duration. Flowering behavior (days to bud initiation, days to full bloom, diameter of flower, number of ray florets per flower, number of flower per plant, colour of ray and disc florets). There were no leaf and floral abnormalities in treated plants. LD_{50} was determined in between 2.5 and 3.0 Krad dose of gamma rays. There was no significant difference in colour of florets of treated and control plants. Chimera in ray florets of flower was observed in one plant after 1.5 Krad treatments. 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.

INTRODUCTION

Chrysanthemum (*Dendranthema grandiflora* Tzvelve synonymous *Chrysanthemum morifolium* Ramat.) is one of the most important floricultural (cut and loose flower) and ornamental (pot and garden flower) crop in the world. The genus chrysanthemum belong to family Asteraceae. 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. It is one of the most important loose flower crop grown commercially in many part of the country. The maximum area under chrysanthemum cultivation is in Ahmednagar and Solapur district (Bhalsing *et al.*, 2012). Flower of chrysanthemum used for garland making, wreath as religious offering in hall decoration etc. Mutation breeding is an important tool in the hands of a breeder for inducing heritable variations in plants and has been successfully used for obtaining desirable mutations in various crops. Both physical and chemical mutagens has successfully produced quite a large number of new and promising varieties in different ornamental plants, and is considered to be one of the most successfully tool for breeding ornamental plants (Datta, 1997). Many new and novel cultivars of chrysanthemum were evolved by induced mutation. However, chemical mutagens are not widely used in vegetatively propagated plants due to their low penetration into plant tissue. Mutation techniques are used because chrysanthemum is hexaploid plant and vegetative propagated which make it difficult to conduct the hybridization (Dwimahyani and Widiarsih, 2010).

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). Thus the genetic variability created by mutation was studied for development of new cultivar in chrysanthemum having significant consumer preference. Therefore, with consideration to above factors the present investigation entitled 'Mutation breeding in chrysanthemum (*Dendranthema grandiflora* Tzvelve)' was undertaken with following objectives: To study the morphological changes in chrysanthemum due to mutagenesis and to explore the possibility of physical mutagens to create genetic variability.

MATERIALS 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. Treated suckers were planted on 20th June 2011. The experimental was laid out in

Randomized Block Design with seven treatments replicated three times. The spacing of 45x 30cm was maintained among experimental plant. After the planting of suckers the field was watered as and when necessary with a open channel system. Uniform dose of fertilizer and manure was applied to the field for conducting the experiment. 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).

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 (Graph-1). The control treatment (T_7) gave significantly maximum survival percentage (100%) at 30 DAP (Days after Planting) and later on 88.0% and 88.6% at 60 and 90 DAP respectively. In the treatments T_5 and T_6 increased gamma irradiation dose caused decrease in survival percentage at 30 DAP, 60 DAP and 90 DAP. The mean days required for sprouting were significantly influenced by different mutagenic treatments. Treatment T_6 required maximum days for sprouting (16.9 days) and treatment T_7 required minimum days for sprouting (7.6 days). The data on number of suckers per plant revealed that there was significantly difference in different treatment. Treatment T_7 (control) recorded highest number of suckers (20.5) and lowest in T_6 treatment (11.56). Similar result were obtained by Banerji and Datta (1992, 2002) who observed reduction in survival percentage with increasing dose of gamma irradiation in chrysanthemum cultivar '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 (T_7). This is concurrence with finding of Datta (1997). Effects of gamma irradiation on suckers of chrysanthemum were studied and it was found that, plant height at the time of bud initiation was non-significant at different doses of gamma radiation and control and it was maximum in treatment 2.0 Krad of gamma rays (45.45 cm) while minimum in treatment 3.0 Krad of gamma rays (42.80 cm), while at time of flowering, plant height was significantly influenced by gamma irradiation. Control plants (T_7) recorded significantly highest plant height (79.90 cm) over rest of treatments while treatment T_6 recorded lowest plant height (69.16 cm) (Graph-2). Yield of flower per plant was found significantly highest in treatment T_7 (control) (0.551 kg), while treatment T_4, T_5 and T_6 recorded significantly lowest mean yield of flower per plant 0.382 kg, 0.379 kg and 0.377 kg respectively. Number of flowers per plant reduced with increased in dose of gamma rays. Treatment T_6 and T_5 produced significantly least number of flowers per plant (127.57) and (129.05) while T_7 (control) produced significantly maximum number of flowers per plant (186.0). Singh *et al.* (2009) 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. 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) in chrysanthemum cultivar Pooja.

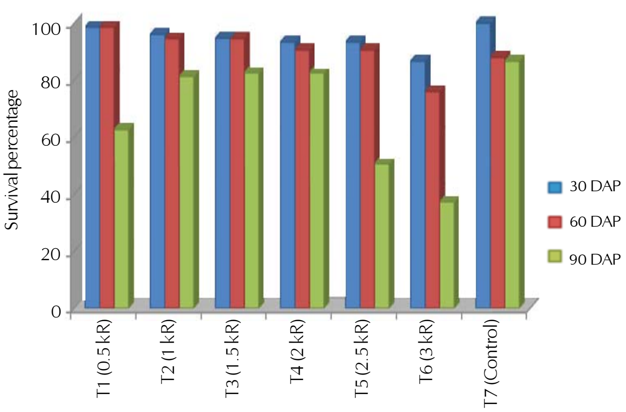
Effects of gamma irradiation on suckers of chrysanthemum were studied and it was found that total crop duration increased with increase in dose of gamma rays. Treatment T_6 and T_5 required significantly more duration (174.09 days) and (158.57 days) respectively, while T_3, T_4, T_1 and T_2 were at par to each other and T_7 (control) took significantly less crop duration (135.07 days). It was found that, there was significant difference in flower diameter of treated and control plants. Treatment T_7 (control) recorded lowest (5.22cm) flower diameter. Treatment T_5 and T_6 recorded significantly highest diameter of flower (6.04cm and 6.31cm respectively). Number of ray florets increased with increase in dose of gamma rays. Number of ray florets per flower was lowest in T_7 (control) and recorded significantly lowest mean number of ray florets per flower (183.61), while T_6 recorded highest mean number of ray florets per flower (201.7). 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.

Table1: Effect of gamma irradiation on vegetative growth characters of Chrysanthemum.

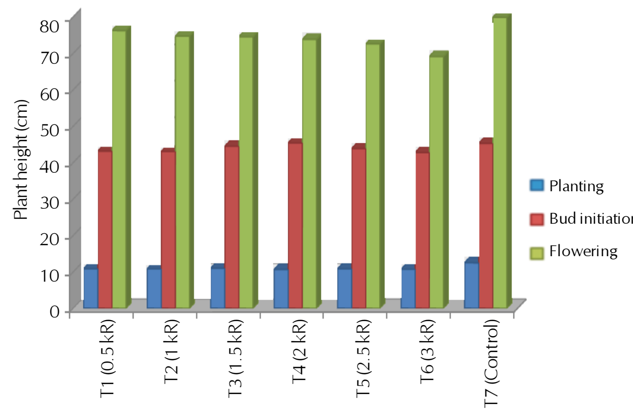
Sr.No	Treatment		Survival percentage			Days required for sprouting	Plant height (cm) at			Internodal distance (cm)	No. of branches per plant	No. of suckers per plant
	Code	Dose (Krad)	30 DAP	60 DAP	90 DAP		Planting	Bud initiation	Flowering			
1	T_1	0.5	98.6	98.6	62.6	8.30	10.99	43.18	76.27	1.95	19.33	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	

Table 2: Effect of gamma irradiation on vegetative growth and flower characters of Chrysanthemum

Sr.No	Treatment Code	Dose (Krad)	Days required for Bud initiation	Flowering	Number of flower per plant	Yield of flower per plant (kg)	Total crop duration (days)	Colour of ray florets	Colour of disc florets	Diameter of flower (cm)	No. of ray florets per flower
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	



Graph 1: Effect of gamma irradiation on survival percentage



Graph 2: Effect of gamma irradiation on plant Height (cm)

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 chimerical 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.

Based on findings of the present investigation, it is concluded that different doses of gamma rays significantly affected the vegetative growth and flower characters of Chrysanthemum cultivar 'Local Golden'. Reduction in survival percent, plant height, number of branches, number of suckers, and number of flowers per plant and yield of flower per plant and increase in internodal distance were observed after irradiation and with increase in dose of gamma rays. Due to higher dose of gamma rays days to bud initiation, bud to full bloom, day required for sprouting and total crop duration were significantly delayed. Overall the best performance was given by treatment 3.0 Krad in flower diameter and number of ray florets per flower followed by treatment 2.5 Krad. In the present study induction of tubular ray florets were observed as it has given new dimension to the flower head. This research can be used in future to study the stability of selected mutants and molecular characterization of identified mutants in Chrysanthemum.

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