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Mutation in chrysanthemum through gamma irradiation

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ABSTRACT

Unrooted cuttings of chrysanthemum cultivar Red Gold were irradiated with 10,20 and 30 Gy gamma rays to induce favorable variation. Lower doses of gamma irradiation resulted in hormesis and induced encouraging novelties while the higher doses often induced high degree of abnormalities and consequent mortality. Colour novelties induced by the mutagens were isolated and purified in M_2 generation.

Key words: mutation, chrysanthemum, and gamma rays.

INTRODUCTION

Mutation breeding is one of the established methods to improve a crop. Generally, high degree of heterozygosity, which cause a complex inheritance of genetic factors, coupled with frequent polyploidy which pose serious handicap in conventional breeding are taken to advantage in mutation breeding, as large variation can often be observed in the irradiated plants. Chrysanthemum is easy to multiply through vegetative means and its higher ploidy level is suitable for inducing mutation through chemical as well as physical means. The present investigation was to study hormesis, morphoanatomical and biochemical changes associated with mutation and purification of novel types

MATERIALS AND METHODS

Unrooted cuttings of four to five centimeters long were irradiated with 10, 20 and 30 Gy doses of gamma rays from a ^{60}C source. Morphological observations in vM1 and vM2 generation were recorded from three randomly selected plants per treatment per replication. Any abnormality or variation observed in the plants in different treatments was also noted. Morphological characteristics and frequency of stomata were studied by microscopic observation of a replica of the leaf epidermal surface. The chlorophyll content (chlorophyll a, chlorophyll b and total chlorophyll) of the leaves was estimated as suggested by Barnes *et al*. (4).

RESULTS AND DISCUSSION

The percentage of plants that survived the irradiation was highest (74.44%) when the plants were exposed to 10 Gy gamma radiation. The survival declined (32.75 %) as the dose increased to 30 Gy. Gupta and Jugran (1978) and Datta and Banerji (1995) had observed similar outcome in chrysanthemum earlier. At higher doses of radiation degradation of auxins and other growth substances that affect cell division are adversely affected there by resulting in poor establishment and survival.

Abnormality of plant increased with increase in dose of gamma irradiation. Minimal abnormalities (8.50 %) were noticed when the plants were exposed to 10 Gy but nearly 99.17% plants exhibited abnormalities when the plants were treated with higher doses of gamma radiation. Stunted growth, thick stems, branches without buds and blind buds were observed at higher doses. Related observations were observed earlier by Gupta and Jugran (8), Wiosinka (12).

Significant reduction in plant height was observed when the plants were exposed to radiation from 10 Gy to 30 Gy. Banerji and Datta (2,3), reported reduction in plant height with increase in gamma radiation. Internodal length was also highly influenced by gamma rays. It was observed that when radiation dose was increased, the number of branches decreased significantly. This observation gets the support from the earlier irradiation studies of Datta (1), when the plants were treated with various doses of Gamma rays, varied effects were observed. Number of leaves, leaf area and leaf abnormalities were significantly reduced at higher (30 Gy) dose of Gamma irradiation. Foliage and canopy forms the important aspect of any plant and accordingly change in these characters effect the horticultural values. Foliage abnormalities are common and some times it may form the uniqueness of a genotype. Similarly, leaf area has a direct bearing on the vigor of the flowering plant and also its floriferousness. Earlier, Banerji and Datta (2) also recorded reduced leaf size and abnormalities with increasing irradiation doses.

Number of days required for flowering got delayed

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Table 1. Effect of Gamma irradiation on plant morphology and anatomy.

Observation	Control	γ Irradiation (Gy)			Mean
		10	20	30	
Survival (%)	99.50(86.15)*	92.85(74.44)*	75.55(60.33)*	32.75(34.88)*	75.16(63.95)*
Abnormality (%)	0.00(0.00)*	8.50(16.95)*	68.02(55.55)*	99.17(84.77)*	43.92(52.42)*
Plant height (cm)	50.06	48.75	45.05	34.14	44.50
Number of branches	5.65	4.65	4.26	3.82	4.59
Internodal length	5.05	4.14	3.99	2.88	3.89
Number of leaves	260.10	230.32	226.06	187.70	225.87
Leaf area	9.54	10.84	10.54	8.79	9.92
Leaf abnormality	0.00(0.00)*	10.63(18.63)*	22.33(28.14)*	44.22(41.62)*	19.18(25.92)*
Days for flowering	90.61	92.12	94.01	99.25	94.14
No .of flowers/plant	111.05	109.08	61.31	31.09	78.13
Flowerdiameter(cm)	6.06	6.11	6.00	5.30	5.86
Longevity of bloom	16.19	18.05	15.51	15.20	16.23
Number of ray floret	167.50	166.65	72.75	159.62	166.63
Number of stomata	150.00	110.66	76.00	52.33	97.24

*Angular transformed value, CD at 5%

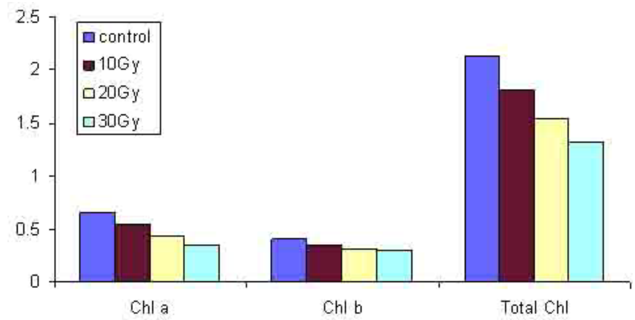

Fig. 1. Effect of gamma irradiation on chlorophyll content of Red Gold cultivar.

with increasing dose of gamma rays. Flowering in cv. Red Gold was delayed by 9 days (99.25) at 30 Gy. Significant reduction in flower diameter was found with increasing doses of gamma radiation. But slight increase in flower diameter was found over control with 10 Gy. Earlier Sparnaay *et al*. (10, 11); Nakajima (9); Datta (5); Datta and Banerji (6) also recorded similar observations. Changes in the chromosomal levels can drastically alter other characters and thus variations in few characters were noted, i.e. size, number etc. As a result of irradiation many biosynthetic pathways are believed to be altered, which are directly and indirectly associated with the flowering physiology.

The longevity of blooms under field conditions in irradiated plants was significantly increased over the control. The longevity was more when the plants were exposed to lower doses (10 Gy) when compared to higher doses. Bloom period is a genotypic character, greatly influenced by the existing environmental conditions. Number of flowers got significantly reduced with increasing rate of gamma irradiation and the reduction was more at higher doses. The results corroborate the earlier findings of Banerji and Datta (1). When the plants were treated with Gamma irradiation the number of petals decreased significantly over control. Significant reduction in stomatal density was observed when plants were treated with gamma irradiation. In the present study, irradiated plants showed that the chlorophyll level decreased with increase in dosage of Gamma irradiation and the plants became chlorotic higher doses of gamma irradiation. As the chlorophyll level in a plant indirectly point at the likely productivity of the plants it was obvious from the poor growth and development of such chlorotic plants that were observed at higher doses.

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