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EFFECT OF GAMMA IRRADIATION ON MORPHOLOGICAL CHARACTERS OF MARIGOLD (*Tagetes erecta* L.)

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ABSTRACT

Seeds of marigold cv. 'Pusa Narangi Gainda' were treated with different gamma irradiation treatments viz, control, 25 Gy, 50 Gy, 75 Gy, 100 Gy, 125 Gy and 150 Gy and evaluated for various morphological characters. Reduction in survival percentage, plant height, number of branches and plant spread was observed after irradiation and with increase in exposure of gamma rays. Early flower bud initiation and flower opening was observed in lower dose of gamma rays. Flower diameter, number of flowers and length of peduncle was significantly highest at the lowest dose of gamma irradiation. The stimulatory effect of gamma irradiation was observed at 25 Gy in almost all the characters, though the intensity of inhibition increased with increasing exposures of gamma rays. On the basis of present observation, it may be concluded that irradiation of gamma rays of 25 Gy was found to be beneficial for growth and flowering characters in African marigold cv. Pusa Narangi Gainda.

Key word: Marigold, *Tagetes erecta*, gamma irradiation.

INTRODUCTION

Out of leading loose flowers, marigold (*Tagetes erecta* L.) is one of the important popular commercial flowers widely grown throughout the world. It belongs to family Compositae and genus Tagetes. Origin of marigold is Central and South America, especially Mexico (Kaplan, 1960). It is universally a popular seasonal flower grown as an ornamental, lose or cut flower, bedding, pot or landscape plant, easy to cultivate with worldwide adaptability to varying soil and climatic conditions. Marigold with its bright colors ranging from yellow to orange is the best for combination in any color scheme. The attractive and brilliantly colored flowers are the most valuable economic part of the plant, used for garland making, religious offerings, exhibitions, decorations, etc. Apart from this, 'Thiopenes', a chemical compound extracted from the leaves of marigold is used as mosquito repellent. The whole plant is a source of an essential oil used in perfume industry; the roots of *Tagetes* sp. secrete an alkaloid which has the strong nematicidal property (Bose and Yadav, 1989). The major problem in its cultivation is lack of standard varieties with this objective so many workers have tried to improve marigold by breeding, resulting in novel cultivars but very meagre little work has been reported on mutation breeding. Therefore, it has now become imperative to concentrate on research and to develop our own and new genotypes by making a change in the genetic makeup of existing cultivars, to make the technology cheap and cost effective. Conventional breeding is a time consuming process for genetic improvement of the floricultural crops. Mutation breeding is also an efficient way to produce heritable changes, particularly for flower colors. Induced mutations are highly effective to enhance natural genetic resources (Jain, 2006). Singh *et al.* (2016) studied the effect of irradiation on Pusa Narani Gainda with different doses i.e. 0,100, 200, 300, 400 grays for induction of mutation. The effects seen were reduction in survival percentage, plant height, number of branches, leaf number, plant spread, size of leaves and diameter of stem, increased foliage and floral abnormalities in higher doses of gamma irradiation. Therefore the present investigation on the effect of gamma irradiation on morphological characters of African marigold was carried out.

OBJECTIVES

Taking lower doses of gamma irradiation with the objective to explore the possibilities of physical mutagens to create variability in marigold and to study the morphological changes in African marigold as a result of mutagenesis.

MATERIAL AND METHODS

The seeds were irradiated with different doses of gamma rays (^{60}Co) having strength of 25 Gy, 50 Gy, 75 Gy, 100 Gy, 125 Gy and 150 Gy at Nuclear Agriculture and Biotechnology Division, Bhabha Atomic Research Centre, Trombay, Mumbai, India. The experiment was conducted at Modibaug, College of Agriculture, Pune, during 2013-14. Seedlings of treated seeds were raised on raised beds. Five weeks old seedlings were transplanted at 45cm X 45cm distance on ridges and furrows. The experiment was laid out in randomized block design with seven treatments and three replications. Data were recorded on various growth characters viz. survival percentage, plant height, number of branches per plant, plant spread and flowering characters such as days required for flower bud initiation, days required for flower opening, diameter of flower, length of the peduncle and the number of flowers per plant.

RESULTS AND DISCUSSION

Significant reduction in plant height, number of branches per plant, plant spread, and days required for flower bud initiation, days required for flower opening, diameter of flower, length of the peduncle and the number of flowers per

plant were observed by gamma irradiation and their different dozes (Table 1). The maximum reduction in these traits was observed in the highest dose (150 Gy).

Survival of plants was 100% upto 75 Gy and decreased with increase in dose. Datta and Banerji (1995) had observed similar outcomes in chrysanthemum earlier. At higher doses of radiation degradation of auxins and other growth substances that affect cell division are adversely affected thereby resulting in poor establishment and survival.

Table 1: Effect of different gamma irradiation treatments on morphological characters of marigold.

Treatments	Survival %	Plant Height (cm)	No. of branches /plant	Plant spread		Days for first Bud initiation	Days for flower opening	Diameter Of flower	No of flowers / plant	Length of peduncle
				N-S	E-W					
T1 (Control)	100.00	57.39	4.53	23.25	25.84	34.80	10.80	4.91	31.13	6.42
T2 (25Gy)	100.00	55.68	6.13	24.47	26.30	30.33	10.40	5.14	37.20	6.57
T3 (50Gy)	100.00	54.31	5.33	22.58	24.96	31.47	11.00	4.84	34.67	6.36
T4 (75Gy)	100.00	54.06	5.13	21.78	23.89	31.73	11.40	4.79	30.87	5.65
T5 (100Gy)	96.00	53.02	4.87	20.89	23.66	32.33	11.47	4.73	29.40	5.64
T6 (125Gy)	96.00	52.62	4.80	20.04	22.67	33.40	11.67	4.64	28.80	5.59
T7 (150Gy)	92.00	52.10	4.20	18.06	20.87	34.13	12.07	4.58	27.53	5.48
GM	**97.71**	**54.17**	**5.00**	**21.58**	**24.03**	**32.60**	**11.26**	**4.81**	**31.37**	**5.96**
SE(+)	2.54	0.7962	0.2968	0.9083	0.7991	0.8609	0.1632	0.1024	0.5945	0.1911
CD @5%	NS	2.4534	0.9148	2.7987	2.4623	2.6527	0.5031	0.3156	1.8318	0.5889

Significant reduction in plant height was observed to increase in the dose of gamma irradiation. The maximum height in the control (57.39cm) and the minimum in 150 Gy (52.10cm) were recorded. Banerji and Datta (2002) observed similar observations in 'Lalima' chrysanthemum. Reduction in height depends on the nature and extent of chromosomal damage after gamma irradiation. Number of branches per plant and a plant spread significantly declined upon irradiation and with increased dose of gamma irradiation at 50 Gy. At the lowest dose of 25 Gy, an increase in the number of branches and plant spread was recorded (Table 1). The results corroborate the earlier findings of Singh *et al.* (2016) in marigold. Reduction in plant height, number of branches per plant and plant spread with higher doses of gamma rays may be due to inactivation or decrease in auxin content or disturbances in auxin synthesis (Gordon, 1957).

The results indicate that flower bud initiation was earlier in 25 Gy (30.33 days) while those irradiated with 150 Gy took longer time (34.13 days) for bud initiation. These results corroborate the findings of Datta and Gupta, (1981) and Singh *et al.* (2016). As a result of irradiation many biosynthetic pathways are altered, which are directly and indirectly associated with the flowering physiology (Mahure *et al.*, 2010). The diameter of the flower was also influenced significantly by irradiation. Flower diameter decreased with increase in gamma rays at 50 Gy. Smaller flower diameter (4.58cm) was recorded at 150 Gy of gamma rays. Reduction in length of peduncle with increase in dose of gamma irradiation was recorded except in lower treatment dose 25 Gy where increase in the length of peduncle was observed in comparison with control. Earlier, Kumari *et al.* (2013) also recorded reduction in flower bud initiation, flower diameter and length of peduncle in chrysanthemum and concluded that the reduction could be due to physiological, morphological and cytological disturbances caused by gamma irradiation. The maximum number of flowers per plant (37.20) was recorded in 25 Gy which was significantly superior to the remaining doses and control. The number of flowers per plant was found to be minimum (27.53) in 150 Gy. The decreased in number of flowers per plant with increased dose may be due to decrease in plant height, plant spread and number of branches per plant.

Plant survival, height, spread and number of branches declined upon irradiation. The reduction was highest mostly at higher doses. Flowering characters also affected after gamma irradiation. Stimulatory effect has been recorded at lower dose *i.e.* 25 Gy where plant height, spread, branch number, diameter of flower, number of flowers per plant and length of peduncle increased. Sax (1963) reported stimulation of plant-growth with lower doses of ionizing radiation. In case of marigold the intensity of inhibition increased with increasing exposures though lower exposure in some cases was stimulatory. Sparrow (1954) reported inhibition of plant growth by ionizing radiation.

CONCLUSION

On the basis of present observation, it may be concluded that irradiation of gamma rays of 25 Gy was found to be beneficial for growth and flowering characters in African marigold cv. Pusa Narangi Gainda.

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