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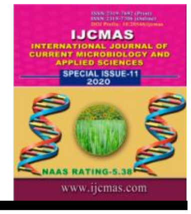

Original Research Article

Effect of Physical Mutagens on Reproductive and Flowering Characters of Tuberose (*Polianthus tuberosa* L.)

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A B S T R A C T

An investigation was carried out at the Department of Horticulture college of Agriculture Parbhani during 2016-2018 on the studies on mutation breeding in tuberose (*Polyanthus tuberosa* L.) was studied and isolation of promising mutants were done. The experimental material Phule Rajani of tuberose variety treated with five doses 0.5Kr, 1Kr, 1.5Kr, 2.0Kr, 2.5Kr along with untreated sample (control).in generation VM_1 . Results indicated that the mutagenic treatment at the maximum number of days for spike initiation was registered in 2.5 kR dose in VM_1 generation and minimum days for spike initiation was registered in 2.5 kR dose in VM_1 generation. The maximum length of floret was recorded at 0.5kR dose in VM_1 generation. The 0.5kR, 1.0kR, 1.5kR, 2.0kR and 2.5kR doses of gamma rays had induced stable and desirable mutants of commercial importance viz.,early mutant, tall mutant, dwarf mutant and late mutant respectively. Gamma rays 0.5kR and 1 kR had recorded maximum floret diameter

Keywords

Tuberose, Gamma radiation, Mutation, Isolation, Mutants, Reproductive characters, Flowering characters

Introduction

Floriculture is the ever evolving business having great potential for employment generation and economic development. Flowers help getting out of illness through psychological enchantment. Flower garden increase beauty of the house or an institution scent and perfumes are extracted from the fragrance of flowers e.g. Rose water, attar, flower is a national symbol water lily is the national flower of Bangladesh.

Flower increases the aesthetic sense of human being and satisfies demand of heart feelings. Flower gardening is good medium of passing leisure time and help keeping good health.

India's total export of floriculture was Rs.507.31 crores 78.73 USD Millions in 2017- 2018. The major importing countries were United States, Netherland, United Kingdom, Germany, and United Arab Emirates There are more than 300 export-oriented units in India. The production of flowers is estimated to be nearly 300,000 metric tones of loose flowers and over 500 million cut flowers with stem in the case of production also the estimates could be at variance from the actual figures as some of the flowers like rose, chrysanthemum and tuberose are used both as loose flowers and with stem More than 50% of the floriculture units are based in Karnataka, Andhra Pradesh, and Tamilnadu and area wise production in Karnataka 19,161 ha., Tamilnadu 14,194 ha ,West Bengal 12,285 ha. Andhra Pradesh 5,933 ha. and on Maharashtra 3,356 ha.

Mutation is a method by which novelty can be created in already well established cultivar. There is no visual difference between artificially produced induced mutants and spontaneous mutants found in nature. As in traditional cross breeding, propagation, usually through *in vitro* techniques and leads to fixation of mutation event. For the past 40 years, the International Atomic Energy Agency has sponsored extensive research and development activities on mutation induction to enhance the genetic diversity in the germplasm of food and industrial crops and these efforts have resulted in the official release of over 2,700 new crop varieties in some 170 species. This mutant has created tremendous economic impact in Agriculture throughout the world (Buiatti *et al.,* 1969). Thus, mutation induction has proven to be a workable, sustainable, highly-efficient, environmentally acceptable, flexible, unregulated, nonhazardous and a low-cost technology to enhance crop improvement.

Since self incompatibility exists in tuberose (Sreethramu *et al.,* 2000) so, there is limitation of conventional breeding methods involving hybridation in it. Mutation breeding appears to be well standardized, efficient and cost-effective breeding techniques that can be exploited for the creation of novel ornamental cultivars of commercial importance in tuberose. Although mutation breeding is a random (chance) process but reports are available that classical mutagenesis combined with management of chimera and *in vitro* mutagenesis can be used for inducing genetic variation in already adapted, modern genotypes resulting in developing new and novel varieties.

Materials and Methods

A study was conducted at the department of Horticulture. Vasantrao Naik Marathwada Krishi Vidyapeeth Parbhani during 2016-2018 on the studies on mutation breeding in tuberose variety Phule Rajni. The experimental site is geographically situated 19° North Altitude and 76.4° East Longitude bulb of tuberose were subjected to gamma radiation treatment.

Phule Rajni This cultivar is single type with high superior quality of loose and cut flower production. Bulb of cultivar were collected from Mahatma Phule Krishi Vidhyapeeth Rahuri (Maharashtra). Bulb was treated gamma radiation from Bhabha Atomic Research Centre Trombay Mumbai.

Results and Discussions

The data presented in Table 1 shows significant effect of gamma radiation on number of days for spike initiation all the gamma rays significantly increased number of days for spike initiation treatment control had recorded T_6 (107.07 days) for spike initiation. Maximum number of days for spike initiation (170.07 days) had recorded in treatment T_5 which was at par with T_4 (168.7 days), T_3 (166.05 days), and T_2 (157.19 days) However , minimum number of days for spike (144.56 days) initiation was recorded T_1 Number of days for spike initiation increased with increase dose of irrespective of treatment when compared to control. Increase in days taken to spike initiation was lesser in lower doses as compared to higher dose of mutagenic treatments. Similar results were obtained by Patil and Dhaduk (2009) in gladiolus where they observed an increase in number of days taken for bud formation by gamma rays treated plants as compared to control. Delay in spike emergence might be due to disturbance in biochemical pathway which assists in flower induction pathway Kaithura and Shrivastva (2015).

The data furnished in Table 1 shows that significant influence of the gamma radiation on duration of flowering. All the gamma rays treatments significantly decreased duration of flowering over the control (12.62days) Maximum duration of flowering was recorded with treatmentT_1 (15.50 days). significantly minimum days for flowering (12.00 days) was recorded with treatmentT_5 which was followed by T_4 (14.00 days). There was a differential response on flowering duration for different mutagenic treatments. In general there was decrease in flowering duration with increased doses of mutagen as compared to control.. Similar results were also reported by Meshitsuka *et al.*, (2005) while studying effect of gamma rays on gladiolus

Duration of flowering the result in congruence with the observation made by Patil and Dhaduk (2010) who noticed that lower dose of gamma irradiation found beneficial in improving some floral parameters and higher dose found injurious for most of the flowering parameters in gladiolus.

The data presented in Table 1 with respect to days taken for opening of first floret revealed that there was significant effect of mutagenic treatments. All the gamma rays treatments significantly increased days to opening of first florets over the control (18.40 days). Among the various gamma rays significantly minimum days for opening of first florets was recorded in treatment T_5 (19.80 days) whereas maximum days to opening of first floret was recorded with treatment T_4 (27.00 days).

Gupta *et al.*, (1984) studied cytomorphological studies on control and gamma induced mutant viz., RajatRekha and Swarna Rekha and found significant difference between control and mutants for various characters.

Delay in opening of floret might be due to disturbance in biochemical pathway which assists in flower response to altered expression of phytochroms in mutants and transgenic lines of Arabidopsis. Srivastva and Singh (2002) reported that treatment 20 and 40 Gy of ^{60}CO gamma irradiation treatments on gladiolus cultivars Sylvia, Eurovision decreased the number of days for heading and day for first flower opening.

Table.1 Effect of gamma radiation on reproductive characters of tuberose in VM_1 generation

Treatment No.	Treatment Detail	Number of days for spike Initiation	Duration of flowering(Days)	Days taken to first floret opening
T_1	0.5 kR	96.8	15.5	23.5
T_2	1 kR	111.6	14.4	25
T_3	1.5 kR	139.5	14.2	26.4
T_4	2.0 kR	116.7	14	27
T_5	2.5 kR	178.9	12	19.8
T_6	Control	61.7	12.62	18.4
	SE(m)±	0.77	0.44	0.52
	CD at 5%	11.66	1.31	1.54

Table.2 Effect of gamma rays on flowering characters of tuberose in VM_1 generation

Treatment No.	Treatment Detail	No. of florets open at time	No. of florets per spike	Floret length (cm)	Diameter of florets (mm)	Flower length (cm)	Flower diameter (mm)
T_1	**0.5 kR**	2.00	43.20	5.57	6.77	3.50	5.04
T_2	**1 kR**	2.00	39.75	5.21	5.45	3.90	4.75
T_3	**1.5 kR**	2.00	36.60	4.83	6.81	3.40	3.76
T_4	**2.0 kR**	2.00	24.00	4.58	7.40	2.72	3.48
T_5	**2.5 kR**	1.00	16.20	4.05	4.63	4.00	4.04
T_6	**Control**	2.00	38.20	4.58	7.53	3.60	4.92
	SE(m)±	0.03	1.12	0.05	0.024	0.17	0.23
	CD at 5%	0.10	3.34	0.16	0.072	0.51	0.71

The data furnished in Table 2 on shows significant influence due to gamma radiation treatments on number of florets open at time. Among the various gamma rays, significantly maximum florets open at time was observed in treatment T_1 (2.00) which was followed by T_2 (2.00), T_3 (2.00) and T_4 (2.00) time minimum number of florets open at time was observed in treatment T_5 (1.00). Among the various gamma rays significantly maximum florets open at time was observed in treatment T_1 and minimum number of florets open at time was observed in Treatment T_5. It was sustained by Banerji et al., (1981) reported that floret opening, and flowering was influenced due to various gamma doses they further reported that flowering was completely caused at highest doses of gamma doses when conducted a trial on gladiolus psittacinus Barn Hookeri av. Red and Orange. Floret length, Size of flower, Spike length influenced significantly with application of gamma doses and varieties in tuberose Anu *et al.,* (2003).

The data presented in Table 2 had shown the significant influence of gamma radiation on the number of florets per spike. Among the various gamma rays treatments significantly maximum number of floret per spike (43.20) it was recorded with treatment T_1 and which was followed by T_2 (39.75) and T_3 (36.60). Minimum number of florets per spikes was observed in treatment T_5 (16.20) it was followed by T_4 (24.00). The data presented in Table 2 had shows the significant influence of gamma radiation on the number of florets per spike. All the gamma rays treatments significantly reduced number of floret per spike over the control (38.20). Among the various gamma rays treatments significantly maximum number of florets per spike it was recorded with treatment T_1 and minimum number of florets per spikes was observed in treatment T_5. Dobanda (2004) found increase in number of florets at lower doses of gamma irradiation, whereas number of florets reduced drastically at higher dose of gamma rays in gladiolus. Significant reduction in the number of flowers per plant in the treated plant material with 2 Krad gamma rays as compared to untreated plants were reported by Banerji and Datta (1996) also observed decrease in number of flowers per plant while working with chrysanthemum cultivar “Surekha”. The decrease in flower head production with higher doses is mainly due to decrease in plant growth as reported by Dwivedi and Banerji (1996). Similar result was also observed by Datta and Banerji (1994) reduction in flower number per plant was recorded after irradiation on rooted cutting of chrysanthemum cv. "Kalyani mauve" Singh et al., (2010) said that, as the doses or treatment increase the number of floret decreases. Similar result is reported by Gupta et al., (1974). 5

The data presented in Table 2 had shown significant influence of the gamma radiation on length of floret. All the gamma rays significantly reduced the length of floret than the control T_6 (4.58 cm). Among the various gamma rays significantly maximum length of floret (5.57 cm) was recorded with treatment T_1 however significantly minimum length of floret (4.05 cm) was recorded in treatment T_5 it was followed by T_4 (4.58 cm). The data presented in Table 2 shows significant influence of the gamma radiation on length of floret. All the gamma rays significantly reduced the length of floret than the control $T_{6.}$ significantly minimum length of floret was recorded in treatment T_5. The length of floret in VM2 generation was not significantly affected due to gamma irradiation. The length of floret was maximum at treatment 0.5 kR. and the minimum length of floret was noticed in treatment 2.5 kR. treatment of gamma irradiations. Similar results were also reported by Abraham and Desai (1976) while working in tuberose. Krishna et al., (2003) also reported similar result in tuberose.

The data furnished in Table 2 had shown the significant influence of the gamma radiation treatment on the floret diameter. Amongst the radiation treatment maximum floret diameter was recorded with treatment T_6 (7.53 mm) which was followed by T_4 (7.40 mm) T_3 (6.81 mm) and T_1 (6.77 mm) while minimum floret diameter was (4.63 mm) recorded with treatment $T_{5.}$ Significant influence of the gamma radiation on the floret diameter was observed significantly maximum florets diameter was recorded with treatment T_4 and minimum floret diameter was recorded in treatment $T_{5.}$ Floret diameter was reduced significantly with increasing rate of gamma irradiation and the reduction was more in higher doses. In higher doses the beneficial effect of gamma radiation on flower characters were reported by few workers. Singh et al., (2010) reported that there was significant reduction in diameter of floret with higher doses of gamma irradiation in tuberose. Abraham and Desai (1976) and Zakote and Murin (1994) found that lower doses of radiation produced bigger flower than the control. Dhaduk (1992) found similar result in which florets of whole spike enlarged at 1.0 Krad treatment in Cv. Pusa Suhagin while in other varieties, size of florets was reduced than that of control.

The data furnished in Table 2 had shown that significantly increase was found length influence of the gamma radiation on the length of flower. The gamma rays treatments significantly increase length of flower in treatment T_1, T_2 and T_4.

Among the gamma rays maximum length of flower was recorded with treatment T_5 (4.00 cm) which was followed by treatment T_2 (3.90 cm), and T_1 (3.50 cm) however significantly minimum length of flower was (2.72 cm) recorded with treatment T_4 it was followed by treatment T_3 (3.40 cm) . significantly increase was flower length influence of the gamma radiation on the length of flower. The gamma rays treatments significantly increase length of flower in treatment T_1, T_2 and T_4. Among the gamma rays maximum length of flower was recorded with treatment T_5 minimum length of flower was recorded with treatment T_4.

The data furnished in Table 2 had shown the significant influence of gamma radiation treatments on the flower diameter. All the gamma rays treatments significantly reduced the diameter of flower compared to the control (4.92 mm) maximum flower diameter with treatment T_1 (5.04 mm) followed by T_2 (4.75 mm) and T_5 (4.04 mm) while minimum flower diameter (3.48 mm) was treatment T_4 was recorded. significant influence of gamma radiation treatments on the flower diameter. All the gamma rays treatments significantly reduced the diameter of flower as compared to the control (4.92 mm). Significantly maximum flower diameter (5.04 mm) was observed with treatment T_1 while minimum flower diameter was recorded by treatment T_4. In VM_1 generation the diameter of flower is a quantitative character of flower. It is an important character for the increasing yield of flower. Diameter of flower increased with increases in gamma radiation dose and was significant at 2.5 kRad and also increased in 0.5 kRrad gamma rays dose. It was sustained result for VM2 generation. Similar results have been reported by Dilta et.al. (2003) who observed significant reduction in flower head size in treated plant material as compared to untreated chrysanthemum plants. Venkatachalam and Jayabalan (1997) observed increase in flower diameter of zinnia at lower doses that is 2.5 to 7.5 kRad whereas at higher dose 10 and 12.5 kRad diameter was decreased. Banerji and Datta (2002) reported reduction in flower size of chrysanthemum cv. Jaya and Lalima after higher doses of gamma irradiation to rooted cutting.

The 0.5kR,1.0kR,1.5kR,2.0kR and 2.5kR doses of gamma rays had induced stable and desirable mutants of commercial importance viz., early mutant, tall mutant, dwarf mutant, and late mutant respectively. gamma rays 0.5kR and 1 kR had recorded maximum floret diameter.

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