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ORIGINAL ARTICLE

Studies on effect of Gamma irradiation on Survival and growth of Tuberose (*Polianthes tuberosa* L.)

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ABSTRACT
Tuberose belonging to family Asperagaceae is one of the commercially cultivated bulbous crops which is highly valued for its loose flowers and essential oils. Due to non-availability of genetic variability, there has been a major constraint in conventional breeding of tuberose. Hence, the present experiment was undertaken at College of Horticulture, Anantharajupeta to find out the effect of gamma irradiation on sprouting percentage, survival and growth of tuberose variety "Hyderabad Single". The bulbs of Hyderabad Single were exposed to different doses of gamma rays viz., 0, 5, 10, 15, 20, 25 and 30 Gy representing treatments with four replications under Completely Randomised Design. Sprouting percentage was recorded 100% for control (T_7) and 5 Gy (T_1). Maximum plant height, number of leaves, leaf width and number of tillers were recorded for bulbs treated with 5 Gy followed by control. Control plants recorded maximum leaf area, Chlorophyll content. All the bulb parameters (bulb weight, number of bulbs and bulb diameter) were recorded maximum for control. By increasing the dose of gamma rays from 10 Gy there was a significant reduction in vegetative growth in Tuberose. Variegated leaves and albino mutants were recorded for bulbs treated with 20Gy.It can be concluded that T_1 (5 Gy) was found best based on its effect on vegetative Growth of Tuberose Variety "Hyderabad Single".
Keywords: *Gamma rays, Tuberose, Growth, Leaf variegation*

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INTRODUCTION

Floriculture is a fast emerging major commercial venture growing at the rate of 10-15 per cent. Tuberose (*Polianthes tuberosa* Linn.) belonging to family Asperagaceae is one of the most important bulbous perennial flowering plant of tropicaland sub-tropical areas belonging to monocots and originated at Mexico. The genus *Tuberosa* contains 12 species of which nine have white flower [9]. Tuberose is used as cut flower, loose flower and also raw material for extraction of the highly valued natural flower oil. The loose flowers of Single type are used for making garlands and floral decorations and extraction of concrete, while the cut flowers of Double type are used in vase decoration, hand bunches and bouquets. The essential oil of Tuberose is one of the most expensive perfume [10].
There is limited genetic variability in tuberose [1] and it has narrow genetic base. In any plant breeding programme for crop improvement, genetic variability is necessary and due to non-availability of genetic variability, there has been a major constraint in conventional breeding of tuberose. Genetic improvement of tuberose is hampered by meager genetic variability, self incompatibility [12] and seed sterility. These factors impair the conventional improvement programme.

Mutation breeding appears to be well standardized, efficient and cost-effective breeding techniques that can be exploited for the creation of novel ornamental cultivars having aesthetic value and also commercial cultivars having high demand for their flowers and oils extracted from tuberose. It is more effective method for the improvement of oligogenic characters than polygenic traits. It is the simple, quick and best way to induce new characters in vegetatively propagated crops. Induction of mutations has proven to be sustainable, highly-efficient, environmentally acceptable, flexible, unregulated, nonhazardous and a low-cost technology to enhance crop improvement. Mutation is a single cell event and can be induced by both by physical and chemical mutagens. Among various mutagens, gamma radiation has provided a large number of useful mutants [8] and is still showing a higher potential for improving vegetatively propagated plants.

At present only few studies were recorded on the mutation breeding in tuberose. Hence, the present investigation was carried out with the an objective to study the effect of gamma irradiation on survival and growth of Tuberose var 'Hyderabad Single'

MATERIAL AND METHODS

The present investigation on "Studies on Mutagenic effect of Gamma irradiation in Tuberose (*Polianthes tuberosa* L.)" was carried out at College of Horticulture, Anantharajupeta, Dr. Y.S.R. Horticultural University, Andhra Pradesh. Bulbs of Tuberose var 'Hyderabad Single was procured from AICRIP on Flower crops, Rajendranagar, Hyderabad. These were irradiated at BARC, Mumbai using gamma rays at doses5 Gy (T_1), 10 Gy (T_2), 15 Gy (T_3), 20 Gy (T_4), 25 Gy (T_5), 30 Gy (T_6) with untreated (T_7). The treated bulbs were planted in polybags of size 14x16 inch containing potting media of 2:1:1 ratio of soil, FYM and cocopeat. The experiment containing seven treatments and four replications were arranged in Completely Randomized Design. Plants developed from treated bulbs and control were observed for various attributes viz., Sprouting percentage, Plant height, number of leaves, Leaf length, leaf width, Leaf area, number of tillers, chlorophyll, leaf colour and variegation, number of bulbs per clump, average bulb diameter and bulb weight per clump.

Statistical analysis

The data were subjected to Completely Randomized Block Design (CRD) [6].

RESULTS AND DISCUSSION

Mutagenic treatments showed significant effects on percentage sprouting. Maximum sprouting percentage (100%) was recorded for bulbs treated with 0 and 5 Gy gamma rays (Table 1). Whereas, percentage sprouting was reduced as dosage of gamma rays increased. Bulbs treated with10 and 15 Gy gamma rays showed equal sprouting percentage (95.8%). These are followed by 20 Gy (72.4%), 25 Gy (53.1%) and 30 Gy (35.4%), respectively.

As mutagenic dose increases, percentage sprouting decreases. The results are similar with findings of Kainthura *et al.* (2016) while working on both physical and chemical mutagens on Tuberose and Patil and Dadhuk (2009) on Gladiolus. Sprouting percentage or survival rate is directly proportional the concentration of mutagen. Whereas, sensitivity of the plant material to gamma rays depends on the genetic constitution, amount of DNA, dose used, stage of development and genotype [3].

Plant height was significantly effected by various doses of gamma rays (Table 2, Plate 1). Maximum plant height (44.8 cm) was recorded for bulbs treated with 5 Gy gamma rays followed by control (44.75 cm). Whereas, minimum plant height was recorded in plants exposed to T_6 (30 Gy) treatment. There was an increase in plant height at 5 Gy treatment, and as exposure dose increases, reduction in plant height was observed. This was due to stimulatory effects of low doses of radiation which had lead to early modifications in axillary bud development and changes in initial rate of floral differentiation [4].

Significantly more number of leaves (55.25) (Table 2) were recorded for T_1 (5 Gy) treatement followed by control T_7 (45). There was a decreasing trend observed with increase in dosage from 10 to 30 Gy. Minimum number of leaves were recorded in T_6 (11.44). Minimum leaf width was recorded for T_6 (0.77 cm) where as maximum leaf width (2.02 cm)was recorded for control T_7 followed by T_1 (1.92 cm). Similar trend of decrease in leaf width was observed by increase in doses of gamma rays. Minimum leaf width was recorded for T_6 (0.77 cm).

Minimum leaf area (Table 2) was recorded for T_6 (4.91 cm^2). Where as leaf area of control T_7 plants has increased significantly (49.51 cm^2) followed by T_1 (47.57 cm^2). There was a significant reduction in leaf area with an increase in dosage of gamma rays. Similarly, minimum number of tillers was recorded in T_6 (1.625), where as Significant increase in number of tillers were recorded for bulbs exposed to T_1 (14) followed by control T_7 (12).

Reduction in vegetative growth is due to changes in auxin level or due to inactivation of auxin (2**)** or due to destruction of enzyme system or inhibition of auxin synthesis due to irradiation could result in decrease in vegetative growth. Inhibition of mitotic activities and chromosome damage associated with secondary physiological damage was could also be the cause for reduction in vegetative growth [11].
Maxmimum SPAD chlorophyll meter reading (Table 2) was recorded for control (56.5 µg cm-2) which was on par with T_1 treatment. Minimum chlorophyll content was recorded in T_6(35 .5 µg cm-2)treatment. Significant variation in the chlorophyll content due to mutagenic treatment was also reported by Kainthura *et al*. (2016) in Tuberose. Variation in chlorophyll development seems to be controlled by many genes located on several chromosomes which could be adjacent to centromere and proximal segment of chromosome [13].
Leaf variegation were recorded for T_3, T_4 and T_5treatment (Plate 2) giving two chlorophyll mutants in first generation.
Maximum number of bulbs per clump (17.11), average bulb diameter (3.59 cm) and weight of bulbs per clump (310.22 g) were recorded for control T_7(Table3) followed by T_1. Minimum number of bulbs per clump (4.33), average bulb diameter (1.32) and weight of bulbs per clump (20.12 g) were recorded for T_6. There was a decreasing trend was observed with all bulb parameters with an increase in gamma rays.

Table 1: Effect of gamma irradiation on sprouting of Tuberose bulbs

Treatments	Sprouting percentage (%)
T_1 (5 Gy)	100 (90.00)
T_2 (10 Gy)	95.8 (83.96)
T_3 (15 Gy)	95.8 (81.56)
T_4 (20 Gy)	72.9 (58.9)
T_5 (25 Gy)	53.1 (56.85)
T_6 (30 Gy)	35.4 (36.27)
T_7 (0 Gy)	100 (90)
S Em ±	3.68
C D at 5%	10.9

Table 2. Effect of Gamma irradiation on Vegetative growth of Tuberose Var 'Hyderabad Single'

Treatments	Plant height (cm)	Number of leaves	Leaf width (cm)	Leaf area (cm²)	Number of tillers	Chlorophyll (SPAD µg cm-2)	Leaf colour (RHS colour)
T_1	44.8	55.25	1.92	47.57	14	53	137A
T_2	37.3	41.85	1.81	37.58	7.05	49	137C
T_3	32	35.65	1.6	27.58	4.95	47.5	137C
T_4	27.35	25.7	1.48	23.89	5.2	47	138B
T_5	15.54	17.76	1.09	9.89	3.65	42	138B
T_6	8.28	11.44	0.77	4.91	1.625	35.5	143A
T_7	44.75	45	2.02	49.51	12	56.4	137A
S Em ±	4.25	2.67	0.052	0.23	0.344	1.45	-
C D at 5%	1.43	2.67	0.155	0.72	1.02	4.55	-

Table 3: Effect of Gamma irradiation on various Bulb attributes of Tuberose var 'Hyderabad Single'

Treatments	Weight of bulbs per clump (g)	No of bulbs per clump	Average bulb diameter (cm)
T_1 (5 Gy)	278.3	14.47	3.07
T_2 (10 Gy)	185.2	13.44	2.53
T_3 (15 Gy)	140.33	11.00	1.27
T_4 (20 Gy)	55.3	8.40	1.79
T_5 (25 Gy)	32.1	6.31	1.50
T_6 (30 Gy)	20.12	4.33	1.32
T_7 (0 Gy)	310.22	17.11	3.59
S Em ±	1.33	0.38	0.07
C D at 5%	4.52	1.17	0.21

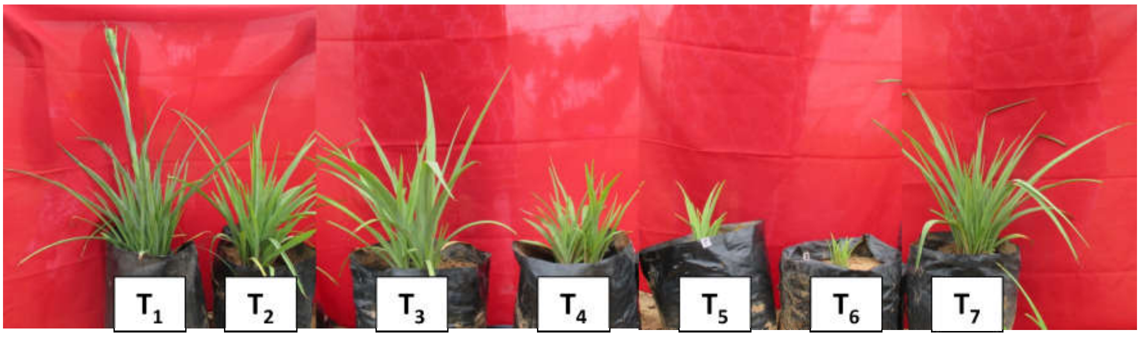

Plate 1: Effect of gamma irradiation on Growth of tuberose var 'Hyderabad Single'

15 Gy (T_3) 20 Gy (T_4)

25 Gy (T_5)

Plate 2: Effect of gamma irradiation on Leaf variation of tuberose var 'Hyderabad Single'

CONCLUSION

There was a decreasing trend of most of the vegetative and bulb attributes recorded on increasing dosage of gamma rays. Among various treatments T_1 recorded maximum plant height, number of leaves, leaf width, number of tillers. Whereas, control recorded maximum leaf area, chlorophyll content, weight of bulbs per clump, number of bulbs and average bulb diameter. Higher dose treatment (T_6) recorded significant reduction in growth. Chlorophyll mutants were observed in T_3, T_4, T_5 treatment i.e., 15, 20, 25 Gy.

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