Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 8 [4] March 2019 : 105-109

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD
Global Impact Factor 0.876
Universal Impact Factor 0.9804
NAAS Rating 4.95

ORIGINAL ARTICLE **OPEN ACCESS**

Standardization of Lethal Dose of Gamma Radiation and Its Effect On Flowering And Postharvest Quality Of Tuberose

Ch. Sai Ratna Sharavani*[1], Swarajya Lakshmi Kode[2], B. Tanuja Priya[2], T. Usha Bharathi[3], M. Reddi Sekhar[4], Ch. Ruth[5] and M. Ramakrishna[2]

[1]Department of Floriculture and Landscape Architecture, Dr Y.S.R. Horticultural University, Anantharajupeta-516105
[2] Department of Horticulture, Dr Y.S.R. Horticultural University, Anantharajupeta
[3] Department of Floriculture and Medicinal Crops, IIHR, Bengaluru-560065
[4] Department of Genetics and Plant Breeding, S.V Agricultural College, ANGRAU, Tirupati
[5]Department of Plant Pathology, Dr Y.S.R. Horticultural University, Anantharajupeta
*Corresponding author's E-mail: chnani11@gmail.com

ABSTRACT

Mutation breeding appears to be well standardized, efficient and cost-effective breeding techniques that can be exploited for the creation of novel ornamental cultivars. Tuberose (Polianthes tuberosa Linn.) is one of the most important bulbous perennial flowering plant of tropical and sub-tropical areas. In India, it occupies second position after gladiolus in area and production. To avoid excessive loss of actual experimental materials, radio-sensitivity tests were conducted to determine LD $_{50}$ doses before massive irradiation of similar material. Bulbs of Tuberose variety 'Hyderabad Single' were exposed to six doses of gamma irradiation (5, 10, 15, 20, 25 and 30 Gy) at BARC, Mumbai and 0 as control was maintained. Significant reduction in floral characters was observed with increased dose of gamma irradiation. Bulbs treated with doses 5, 10, 15, 20 Gy and control plants has shown flowering. Control plants recorded maximum values for all floral attributes followed by T_1 (5 Gy). The probit analysis based on sprouting percentage and mortality of treated bulbs exhibited that LD_{50} value of gamma irradiation for Tuberose var. Hyderabad Single was 20 Gy.

Keywords: Lethal dose, Tuberose, gamma Radiation

Received 12.12.2018 Revised 29.12.2018 Accepted 24.01.2019

INTRODUCTION

Tuberose (*Polianthes tuberose* L.) is one of the most important tropical ornamental bulbous flowering plants cultivated for production of long lasting flower spikes. It is one of the major bulbous crops which is cultivated commercially for both cut as well as loose flowers. It has pleasant fragrance, longer vase-life of spike and wide adaptability to varied climate and soil. The essential oil of Tuberose is one of the most expensive perfumes [13]. In India, it occupies second position after gladiolus with the total area of 14.92 thousand hectare and production of 106.49 thousand MT loose flowers and 89.83 lakh cut flowers [1].

Flowers of Tuberose are bisexual, funnel shaped with waxy white and fragrant perianth tube. Perianth tube consists of six acute tepals. Stamens are six in number with the anthers dorsifixed in the middle of the tube. Gynoecium has a trilocular ovary with numerous ovules and the fruit is a capsule. Foliage is long, slender and grass-like with little landscape value.

There is constant demand for novelty in existing crops in floriculture industry. So, development of new cultivars through conventional or modern breeding techniques has been a prime objective in commercial floriculture. In spite of its ever rising demand, there is a big constraint associated with it is that in all its the existing varieties, flower colour is limited to white only, although some varieties show pinkish tinge at bud stage. Since self-incompatibility exists in tuberose [15]. So, there is limitation of convention breeding methods involving hybridization in it.

Induction of mutations has proven to be sustainable, highly-efficient, environmentally acceptable, flexible, unregulated, nonhazardous and a low-cost technology to enhance crop improvement 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. Among various mutagens, the gamma irradiations at 1 K rads to 7.5 K rads proved best according to crop response in vegetatively propagated crops [11].
During mutation breeding, to avoid excessive loss of actual experimental materials, radio-sensitivity tests were conducted to determine LD_{50} doses before massive irradiation of similar material. By keeping this in view, the present experiment was conducted to standardize the LD_{50} value for gamma rays and to study the effect of various doses of gamma rays on flowering of Tuberose var 'Hyderabad Single'.

MATERIAL AND METHODS

The present investigation on Standardization of lethal dose of gamma radiation and its effect on flowering of Tuberose variety 'Hyderabad Single' was conducted at College of Horticulture, Anantharajupeta, Dr. Y.S.R. Horticultural University, Andhra Pradesh during year 2017. Bulbs of Tuberose var 'Hyderabad Single was procured from AICRIP on Flower crops, Rajendranagar, Hyderabad. These were irradiated at Babha Atomic Research Centre, Mumbai using physical mutagen, gamma rays at doses 5 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) as control. 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 was observed for mortality percentage, based on probit curve LD_{50} value was calculated. Various floral attributes *viz.,* Days to spike emergence, days taken for first floret opening, Spike length, rachis length, diameter of spike, Number of florets, Weight of individual floret, flower colour, flower stalk colour, number of stamens, vase life and DUS characters were recorded.The data were subjected to Completely Randomized Block Design (CRD) [10].

RESULTS AND DISCUSSION

Percentage Mortality

Data on percentage mortality was presented in Table 1. Maximum mortality was recorded for T_6 treatment (72.91%) followed by T_5 (47.91%). Minimum mortality was recorded for T_2 (4.16%). Whereas, no mortality was recorded for control and T_1. As dosage of gamma rays increases, Mortality percentage also increases. Mortality per cent is directly related to gamma ray dose.
The results are similar with findings of Kaintura *et al.* [7] while working on on Tuberose and Patil and Dadhuk [11] on Gladiolus. Sensitivity of the plant material to gamma rays depends on the genetic constitution, amount of DNA, dose used, stage of development and genotype [3].
Based on mortality percentage, LD_{50} was calculated using probit curve (Fig 1) as 20Gy. This was similar with findings of Kayalvizhi *et al.* [8] on Tuberose variety 'Prajwal'.

Floral attributes

Data pertaining to floral characters were presented in Table 2 and 3. Maximum days for spike emergence was taken by T_4 (192 days) whereas, minimum number of days for spike emergence was taken for control, T_7 plants (96.67) followed by T_1 (108.33). There was an increase in number of days for emergence of spike as radiation dose increases upto 20 Gy. Similar results were obtained by Dilta *et al*. [4] in chrysanthemum, Kole and Meher [9] in zinnia and Patil and Dhaduk [11] in gladiolus. Delay in spike emergence might be due to disturbance in biochemical pathway which assists in flower induction pathway (2).
Maximum number of days taken for first floret opening was recorded for T_4 (26) followed by T_3 (24), T_2 (22.33), T_1 (19.67) respectively. Whereas, minimum number of days for first floret opening was recorded for control (20.33) T_7 plants. There was an increasing trend observed for number of days taken for first floret opening as the dosage of gamma rays increases up to 20 Gy. Above 20Gy no flower development was noticed.
Significantly highest spike length was recorded for control T_7 plants (73.33 cm) followed by T_1 (65.67 cm) (Plate 1). Whereas, lowest spike length was recorded for T_4 (30 cm). Maximum rachis length was recorded for control T_7 plants (24.83 cm) followed by T_1 (22 cm). Whereas, minimum rachis length was recorded for T_4 (9.67 cm). In general there was decrease in spike and rachis length with increased dose of gamma irradiation as compared to control. The results are in conformity with the findings Patil and Dhaduk [14] in gladiolus. Decrease in spike and rachis length due to increased dosage of gamma rays may be due to inhibition of mitotic activities and chromosome damage associated with secondary physiological damage.
Maximum spike diameter was recorded for control T_7 plants (10.43 mm) followed by T_1 (9.59 mm). Whereas, minimum spike diameter was recorded for T_4 (3.47 mm). There was a decreasing trend observed in spike diameter as dosage of gamma rays increases. Flower stalk colour based on RHS colour charts was presented in Table 2. Both T_7 and T_1 has shown green group 137A, while T_2 and T_3 showed green group 138 A, T_4 showed green group 143A.

More number of florets per spike was recorded for control T_7 plants (46.67) followed by T_1 (41.33). Whereas, number of flowers per spike was reduced (10) significantly for bulbs treated with T_4 (20Gy). Maximum weight of individual floret was recorded for control T_7 plants (1.02 g) followed by T_1 (0.91 g). Whereas, minimum weight of individual floret was recorded for T_4 (0.54 g). The decrease in number of florets per spike with higher doses is mainly due to decrease in plant growth [5].

There was a significant increase in average length of floret for control T_7 (6.07 cm) plants followed by T_1 (5.6 cm). Significant reduction in average length of floret was recorded for T_4 (3.77 cm). There was a decrease in average length of floret as exposure to gamma ray dose increases.

Maximum floret neck diameter was recorded for control T_7 plants (7.11 mm) followed by T_1 (6.34 mm). Whereas, minimum floret neck diameter was recorded for T_4 (3.14 mm). Significant increase in vase life was recorded for control T_7 plants (8 days) which was on par with T_1 (7.67days).Whereas, minimum vase life was recorded for T_4 (3.67 days). DUS characters were recorded which are presented in Table 4.

There was significant reduction in all floral attributes as dosage of gamma rays increased was due to reduction in vegetative growth due to destruction of enzyme system or inhibition of auxin synthesis due to irradiation [6].

Table 1: Effect of gamma irradiation on mortality per cent

Treatment	Mortality percent
T1 (5 Gy)	0 (0.0)
T2	4.16 (8.42)
T3	4.16 (8.42)
T4	37.5 (31.07)
T5	47.91 (33.11)
T6	72.91 (53.83)
T7	0 (0.00)
SE m	3.60
CD	10.78

Table 2: Effect of different doses of gamma irradiation on inflorescence of Tuberose

Treatments	Days to spike emergence (days)	Days taken for first floret opening	Spike length (cm)	Rachis length (cm)	Diameter of spike (mm)	Flower stalk colour
T_1 (5 Gy)	108.33	19.67	65.67	22	9.59	137B
T_2 (10 Gy)	136.00	22.33	60.67	21.5	8.22	138 A
T_3 (15 Gy)	157.67	24.00	68.67	17.67	7.69	138A
T_4 (20 Gy)	192.00	26.00	30.00	9.67	3.74	143A
T_5 (25 Gy)	0.00	0.00	0.00	0	0.00	-
T_6 (30 Gy)	0.00	0.00	0.00	0	0.00	-
T_7 (0 Gy)	96.67	20.33	73.33	24.83	10.43	137 B
S Em ±	1.29	0.57	0.83	0.41	0.47	
C D at 5%	3.95	1.77	2.53	1.25	0.155	

Table 3: Effect of gamma irradiation on floret quality and vase life of Tuberose

Treatments	Number of florets per spike	Weight of individual floret (g)	Average length of the floret (cm)	Floret neck Diameter (mm)	Vase life	Flower colour
T_1 (5 Gy)	41.33	0.91	5.6	6.34	7.67	N155A
T_2 (10 Gy)	36.67	0.83	5.17	5.94	7.00	N155A
T_3 (15 Gy)	27.33	0.73	4.93	5.24	6.33	N155A
T_4 (20 Gy)	10.00	0.54	3.77	3.14	3.67	N155A
T_5 (25 Gy)	0.00	0.00	0	0	0.00	N155A
T_6 (30 Gy)	0.00	0.00	0	0	0.00	N155A
T_7 (0 Gy)	46.67	1.02	6.07	7.11	8.00	N155A
S Em ±	2.04	0.02	0.099	0.084	0.31	
C D at 5%	0.67	0.06	0.3	0.258	0.94	

Table 4: Effect of different doses of gamma irradiation on DUS flower characters of tuberose

DUS characters	T1 (5Gy)	T2 (10Gy)	T3 (15Gy)	T4 (20Gy)	T4 (20Gy)	T6 (30Gy)	T7 (0Gy)
Flower tube shape	Straight	Straight	Straight	Bent	-	-	Straight
Flower shape	Wide	Narrow	Narrow	Tubular	-	-	Wide
Inflorescence	Straight	Straight	Straight	Straight	-	-	Straight
Tepal tip	Acute	Acute	Acute	Acute	-	-	Acute
Flower type	Single	Single	Single	Single	-	-	Single
Stigma type	Thrum	Thrum	Thrum	Thrum	-	-	Thrum
Anthers	Normal	Normal	Normal	Normal	-	-	Normal
No.oftepals	6	6	6	5	-	-	6
Flower opening	Wide	Wide	Wide	Shallow	-	-	Wide

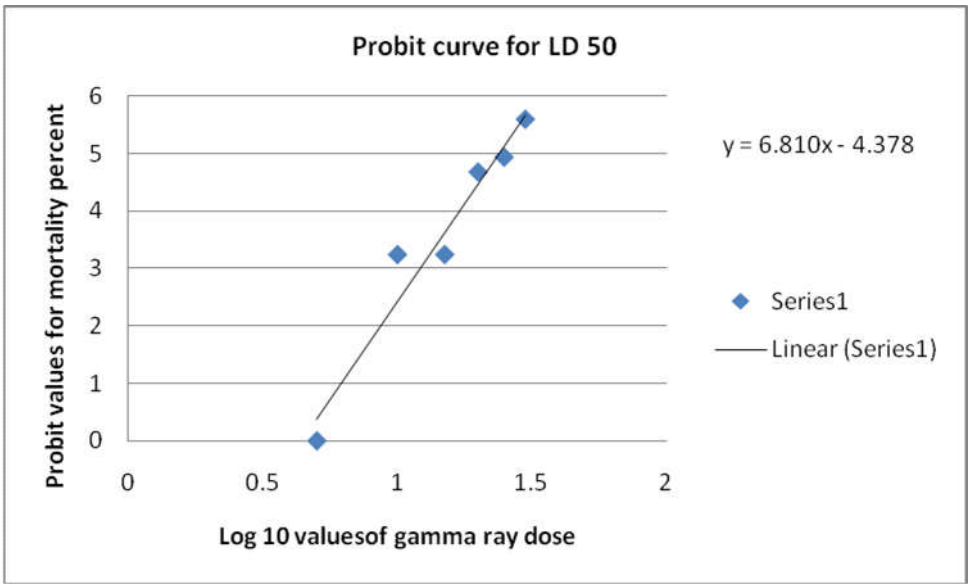

Fig 1: Probit curve for LD $_{50}$

Plate 1: Effect of different doses gamma irradiation on Flower quality of Tuberose

CONCLUSION

Based on probit curve and mortality percentage of the treated bulbs, LD_{50} was calculated as 20 Gy for variety 'Hyderabad Single'. There was significant reduction in all floral attributes, observed in treated plants compared to control. Control plants recorded maximum growth and flower quality. As dosage of gamma rays increases, there was significant reduction in flowering was noticed up to 20 Gy. Beyond 20 Gy, no flowering was recorded during the period of study. Hence gamma rays at minimal doses are beneficial compared to higher doses for creation of variability in Tuberose.

REFERENCES

1. Anonymous. National Horticulture Data Base. 2016-17. National Horticulture Board. Ministry of Agriculture, Government of India.
2. Bagnall, D.J., King, R.W., Whitelam, G.C., Boylan, M.T., Wagner, D., and Quail, P.H. (1995). Flowering responses to altered expression of phytochrome in mutants and transgenic lines of *Arabidopsis thaliana* (L.) Heynh. *Plant Physiology*. 108:1495–1503
3. Deshpande, K. N., Mehetre, S. S. and Pingle, S. D. (2010). Effect of different mutagens for induction of mutations in mulberry. *Asian Journal of Experimental Biological Sciences.* 104 – 108.
4. Dilta, B. S., Sharma, Y. D., Gupta, Y. C., Bhalla, R and Sharma, B. P. (2003). Effect of gamma rays on vegetative and flowering parameters of chrysanthemum. *Journal of Ornamental Horticulture.* 6(4):328-334.
5. Dwivedi, A. K. and Banerji, B. K. (2008). Effect of gamma irradiation on dahlia cv. 'Pinki' with particular reference to induction of somatic mutation. *Journal of Ornamental Horticulture*. 11(2): 148-151.
6. Gordon, S. A. and Weber, R. P. (1950). The effects of X-irradiation on IAA and auxin level in plants. *American Journal of Botany*. 37: 678.
7. Kaintura, P., Srivastava, R and Kapoor, M. (2016). Effect of physical and chemical mutagens on different cultivars of tuberose (*Polianthes tuberose* Linn.) with particular reference to induction of genetic variability. *International Journal of Agriculture Sciences.* 8(15):1257-1260
8. Kayalvizhi, K., Kannan, M and Ganga, M. (2016). Effects of gamma irradiation and chemical mutagens in tuberose *Polianthes tuberosa* L. *Res. Environ. Life Sci*. 9(8): 1030-1032
9. Kole, P. C and Meher, S. K. (2005). Effect of gamma rays of some quantitative and qualitative characters in zinnia (*ginnia elegance)* N.J. Jacguin in M1 generation. *Journal of Ornamental Horticulture*. 8(4):303-305.
10. Panse and Sukhatme, P.V. (1985). *Statistical methods for agricultural workers*. Indian Council of Agricultural Research, New Delhi.
11. Patil, S and Dhaduk, B.K. (2009). Effect of gamma radiation on vegetative and floral characters of commercial varieties of gladiolus (*Gladiolus hybrida*). *Journal of Ornamental Horticulture.* 12(4): 232-238.
12. Patil, S.D and Patil, H.E. (2009). Improvement of major ornamental crops through mutation breeding. *International Journal of Agricultural Science.* 5 (2) : 628-632
13. Singh, Krishan, P. Ganesh, B. K. and Jyothi, R. (2010). Production Manual on Tuberose *(Polianthes tuberose* Linn.). *Directorate of Floricultural Research, IARI Campus, Pusa, New Delhi, India.* 1-24.
14. Sparrow, A. H. (1961). Types of ionizing radiations and their cytogenetic effects. *Mutation Plant Breeding NAS-NRC*. 891:55-119.
15. Swaminathan, M.S. (1964). A comparison of mutation induction in diploids and polyploids. *In*: The use of induced mutations in plant breeding. *IAEA Technical Report*, Vienna. 619-641.

CITATION OF THIS ARTICLE

Ch. Sai Ratna Sharavani, Swarajya Lakshmi Kode, B. Tanuja Priya, T. Usha Bharathi, M. Reddi Sekhar, Ch. Ruth and M. Ramakrishna· Standardization of Lethal Dose of Gamma Radiation and Its Effect On Flowering And Postharvest Quality Of Tuberose. Bull. Env. Pharmacol. Life Sci., Vol 8 [4] March 2019 : 105-109