Eco. Env. & Cons. 28 (November Suppl. Issue) : 2022; pp. (S435-S439)
Copyright@ EM International
ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2022.v28i07s.072

Effect of physical mutagens on base population of tuberose (*Polyanthus tuberosa* L.)

Abhangrao A.K.[1], Jitendra Kumar Sahoo[2] and Anis Mirza[3]

Lovely professional University, Phagwara, Punjab, India

(Received 8 May, 2022; Accepted 2 July, 2022)

ABSTRACT

An investigation was conducted at the Department of Horticulture, College of Agriculture Parbhani, during which studies on tuberose (*Polyanthus tuberosa* L.) mutation breeding were explored and promising mutants were isolated. In VM1 generation and VM2 generation, the experimental material was Phule Rajani of tuberose variety treated with five doses of 0.5 Kr, 1Kr, 1.5Kr, 2Kr, and 2.5 Kr. The maximum floral abnormalities were observed in treatment T4 in the VM1 generation, whereas the maximum flower abnormalities were observed in treatment T3 in the VM2 generation. In the VM1 generation, the highest mutation frequency was reported at treatment T3. Treatment T1 had the highest mutation frequency in the VM2 generation. In early mutant characters, the highest percentage of the spectrum was seen in treatment T2 in VM1 and VM2. In both generations, the greatest spectrum percentage was recorded in the flower colour mutant character in treatment T2. In all generations, the greatest spectrum % was recorded in the tiny flower mutant at treatment T4. In both generations of the Big flower mutant, the highest spectrum % was found in treatment T1. In mutant characteristics, the number of petals increased, and the greatest spectrum percentage was seen at treatment T2 in VM1. Maximum generation in VM2 at T1 therapy. In the VM1 generation, the number of spikes increased, and the spectrum % rose. At treatment T2, the number of spikes in the VM2 generation increased. In the VM1 and VM2 generations, the greatest spectrum % was seen in late mutant characters at treatment T5. Both generational variations can be seen.

Key words : *Polyanthus tuberosa L., Mutagens, Base population of Polyanthus*

Introduction

Flowers are nature's most beautiful invention for expressing human emotions. There is a flower for every occasion, thought, and feeling, whether it be love, happiness, or grief, friendship, or courtship. Floriculture is a constantly changing industry with a lot of potential for job creation and economic development. Even during a period of global economic slowdown, worldwide floriculture exports have grown at an annual average growth rate of 10.3%, and at this rate, world floriculture exports are predicted to reach US$25 billion by 2012. The yearly global consumption of commercially grown flowers is estimated to be between US$ 40 and US$ 60 billion. Six countries, including Germany, the United States, the United Kingdom, France, the Netherlands, and Switzerland, account for around 80% of global floriculture consumption. There is a similar situation in India.

Tuberose (*Polianthes tuberosa* Linn.) is in first place due to its widespread use as a cut flower, loose flower, and raw material for extracting the highly prized natural flower oil. The flower's appeal stems from its long, straight spikes, which feature beautiful white florets loosely placed on spikes that can

([1,2]Associate Prof., [3]Assistant Prof.)

reach a height of 2-4 feet. The ovary of Gynoecium is trilocular, having several ovules, and the fruit is a capsule. Long, thin, grass-like foliage with minimal landscape value.

Mutation breeding is the most common approach for developing mutant cultivars, accounting for roughly 90% of all cultivars obtained, including 64% with gamma rays and 22% with X-rays (Jain, 2005). Ionizing radiation (X-rays, gamma rays, and neutrons) are examples of physical mutagens.Crop improvement has benefited greatly from mutation procedures, which have resulted in the development of numerous new floral color/shape mutant variants. Except for chlorophyll variegation in leaves, no new bloom colour or shape could be created in tuberose (Datta *et al.,* 2015). Mutation is a technique for creating novelty in existing well-established cultivars. There is no discernible change. intentionally created and induced nature. Similarly to traditional cross breeding proliferation, typically in vitro approaches and outcomes for mutation fixing event. The International has been in operation for the past 40 years. The Atomic Energy Agency has provided funding substantial research and development efforts on the use of mutation induction to improve geneticdiversity in food germplasm and industrial crops, and these efforts have resultednew crop varieties in approximately 170 species ThisMutant has generated enormous economic benefits.impact on agriculture all across the world.

A major goal of any mutant breeding programme is to create genetic heterogeneity in the existing genepool in order to obtain new and better genotypeThe fundamental benefit of mutant breeding in vegetatively propagated crops is the ability to change one or a few traits of an otherwise excellent variety without affecting the genotype's distinctive characteristics (Datta, 2014).

Material and Methods

A study was undertaken at College of Agricultutre Parbhani at Horticulture Department. During 2016-18 the investigations on mutation breeding in the tuberose variety Phule Rajni, Vasantrao Naik Marathwada Krishi Vidyapeeth Parbhani. Tuberose bulbs were treated with gamma radiation at the experimental site, which is located at 19° North Altitude and 76.4° East Longitude.

Rajni Phule This cultivar is a single variety that produces high-quality loose and cut flowers. Mahatma PhuleKrishiVidhyapeethRahuri provided the cultivar bulb (Maharashtra). Gamma radiation from the Bhabha Atomic Research Centre in Trombay, Mumbai, was used to treat the bulb.

Results and Discussion

The information in the VM1 generation According to Table 1, floral abnormalities were considerably increased with treatments T1 and T4, but decreased with treatments T2 and T3. T5 (2.0 percent) had significantly fewer minimum flower abnormalities than T4, whereas T4 had significantly more maximum floral abnormalities (22.00 percent).

Table 1. Effect of gamma rays on flower abnormality (%) of tuberose plantsin VM_1 generation.

Treatment no.	Treatment details	Flower abnormality (%)
T_1	0.5kR	11(3.31)
T_2	1 kR	8.40(2.89)
T_3	1.5kR	5.078(2.25)
T_4	2kR	22.2(4.71)
T_5	2.5kR	2.00(1.41)
T_6	Control (no radiation)	0.00(0.00)
	SE(m±)	0.330
	CD at 5%	0.981

Table 2. Effect of gamma rays onflower abnormality(%) in tuberose plantsVM_2 generation

Treatment no.	Treatment details	Flower abnormality(%)
T_1	0.5kR	14.40(3.79%)
T_2	1 kR	22.20(4.71 %)
T_3	1.5kR	27.20(5.21%)
T_4	2kR	23.40(4.83%)
T_5	2.5kR	1.00(1.00%)
T_6	Control (no radiation)	0.00(0.00)
	SE(m)±	2.41
	CD at 5%	7.16

The findings in VM2 generation Table 2 showed that, when compared to the control T6, greatly increased with gamma rays (0.00). The data clearly shows that as the dose of gamma rays was raised, flower defossrmities increased as well. T5 in therapy (1.00 percent) had the fewest flower abnormalities, followed by T1 in treatment (1.00 percent) (14.40 percent). However, treatment T3 (27.20 percent) had the most flower abnormalities, followed by T4 (23.40 percent) and T2 (22.40 percent) (22.20 percent).

Table 3. Effect of gamma rays on mutation frequency percentage of tuberose plants in VM_1 generation

Treatment no.	Treatment details	Mutation frequency (%)
T_1	0.5kR	24.4(29.59)
T_2	1 kR	5.60(13.66)
T_3	1.5kR	29.10(32.64)
T_4	2kR	4.36(12.00)
T_5	2.5kR	2.00(8.13)
T_6	Control (no radiation)	0.00(0.28)
	SE(m±)CD at 5%	0.300.91

(figure in parentheses arc sine transformed values)

Table 4. Effect of gamma rays on mutation frequency of tuberose plants in VM_2 generation

Treatment no.	Treatment details	Mutation frequency(%)
T1	0.5kR	17.4(24.61)
T2	1 kR	13.0(20.73 %)
T3	1.5kR	14.00(22.03%)
T4	2kR	6.20(14.32%)
T5	2.5kR	2.00(8.13%)
T6	Control (no radiation)	0.00(0.28)
	SE(m)±	1.48
	CD at 5%	4.42

(Figures in parentheses arc sine transformed values)

Table 3 shows that when gamma ray dosages were raised, the mutation frequency in VM1 was dramatically reduced compared to the control (0.00 percent). Treatment T4 had the highest mutation frequency (29.10 percent) among the various gamma rays, followed by treatment T1 (24.4 percent). However, it was much lower with the therapy T5 (2.00%), followed by T3 (4.36%), and T2 (2.00%). (5.60 percent) Increased gamma ray doses considerably reduced the frequency of mutations compared to the control group. The treatment T4 had the highest mutation frequency among the different gamma rays, but the treatment T5 had the lowest.

The results in Table No.4 shows that as the gamma rays increased, the mutation frequency reduced. Treatment T1 had the highest mutation frequency (17.4 percent) across the different gamma rays, followed by T2 (13.0 percent) and T3 (10.1 percent) (14.00 percent). It was noted, however, that it was minimal with the T5 treatment (2.00 percent). The treatment T1 had the highest mutation frequency among the different gamma rays, whereas the treatment T5 had the lowest. As a result of the findings, an increase in the gamma ray exposure resulted in an increase in the mutation frequency in both the generation and the control. This could be attributed to an increase in chromosomal abnormalities and disruptions.

Table 5 shows the VM1 generation. In gamma rays, the treatments T2 (6.19 percent), T1 (5.8%), and T3 (4.23 percent) were shown to have the highest percentage of early mutants. In gamma rays, the treatment T4 (9.46 percent) and T5 (3.06 percent) were found to have the highest percentage of dwarf mutants. Treatment T1 (9.81 percent), T2 (6.19 percent), and T3 (4.23 percent) were found to have the highest percentage of tall mutants in gamma rays. Treatment T2 had the highest percentage of floral colour mutant T2 (6.19 percent), and it was followed by treatment T4 (4.52 percent) The highest percentage of tiny flowers were separated from gamma radiation with treatments T4 (14.20 percent) and T5

Table 5. Effect of gamma rays on mutation spectrum in VM_1 generation

Gamma rays	0.5 kR	1 kR	1.5 kR	2 kR	2.5 kR
Available population	50.93	48.4	47.19	44.24	32.67
Spectrum percentage (%)					
Early mutant	3 (5.8)	3 (6.19)	2 (4.23)	0	0
Dwarf mutant	0	0	0	4 (9.46)	1 (3.06)
Tall plant mutant	5 (9.81)	3 (6.19)	2 (4.23)	3 (7.10)	0
flower colour mutant	0	3 (6.19)	0	2 (4.52)	0
Small flower mutant	0	0	0	6 (14.20)	1 (3.06)
Big flower mutant	5 (9.81)	0	0	0	0
No. of petal increased in mutant	2 (3.92)	3 (6.19)	2 (4.23)	0	0
Number of spikes increased in mutant	8 (15.71)	5 (10.33)	5 (10.59)	0	2 (6.12)
Late mutant	0	0	0	2 (4.52)	2 (6.12)
Fleshy stem	0	0	0	4 (9.46)	0
Green tinge on flowers	0	4 (8.26)	6 (12.74)	0	0

(3.06 percent). Treatment T1 (9.81 percent) separated the most huge flowers (9.81 percent) from gamma radiation.Treatment T2 (8.26%) was used to isolate a tint on flowers, followed by treatment T3 (12.74%), which was isolated from gamma rays. The treatment T2 (6.19 percent), T3 (4.23 percent), and T4 (2.36 percent) extracted from gamma rays enhanced the maximum percentage of petal number in mutants. The treatment T1 (15.71), T3 (10.59), and T2 (10.33) isolated from gamma rays enhanced the maximum percentage of spikes in mutants. The highest percentage of late mutants were isolated from gamma rays in treatment T5 (6.12 percent), followed by treatment T4 (4.52 percent). Treatment T4 yielded the highest number of fleshy stems (9.46 percent) when compared to gamma rays. Treatment T2 (8.26 percent) produced the most green tinge on flowers, followed by treatment T3 (8.26 percent).

VM2 generation is shown in Table No.6. The treatments T2 (20.89%), T1 (19.83%), and T3 (20.89%) yielded the highest percentage of early mutants (17.96 percent). T4 (25.75 percent) and T5 (25.75 percent) treatments yielded the highest percentage of dwarf mutants (50 percent). The treatments T3 (25.24 percent), T2 (24.87 percent), and T1 (25.24 percent) yielded the highest percentage of tall plant mutants (18.18 percent). T2 (28.85 percent) yielded the highest percentage of flower bud colour mutants, followed by T4 (28.85 percent) (24.24 percent). The treatment T4 (24.24 percent) yielded the highest percentage of tiny flower mutants, followed by T5 (3.06 percent). Treatment T1 yielded the highest percentage of huge flower mutants (26.85 percent). Treatment T2 (23.38) resulted in the highest number of petal increases in mutants.T1 (21.48 percent), T2 (21.48 percent), and T3 (21.48 percent) were the next treatments (10.67 percent). Treatment T2 (30.84 percent) increased the amount of spikes in mutants the most, followed by T3 (19.90 percent) and T1 (10 percent) (13.63 percent). T5 (50.00 percent) produced the greatest number of late mutants, followed by T4 (40.00 percent) (15.84 percent).

To summarise the findings of this study, it is clear that in the VM1 and VM2 generations, a greater range of mutations was detected. The higher frequency and broader range of mutations could be attributable to the presence of the most dominant genes, indicating the likelihood of recessive gene mutation induction. Different gamma doses were able to cause some persistent and interesting mutants, including early and late flower mutants, dwarf plant mutants, and mutants with increased number of spikes. In the VM2 generation, a fleshy stem and a green tinge on the blooms occur.This mutation may have been caused by radiation-induced chromosomal abnormalities such as chromosome number changes, gene mutations, and re-arrangement of the various his to genic layers. Singh and Sisodiya (2015)

The findings are consistent with those of Bowen *et al.* (1962), who discovered a colour alteration in around 40% of chrysanthemum plants treated with gamma radiation.

Ionizing radiations, particularly gamma rays, have been utilised to produce novel ornamental varieties to inducing mutation, among other mutagens (Patil and Patil, 2009)

Kainthura and Shrivastava(2015) noticed similar results in cv. Suvasini with 1.5 Kr gamma –ray therapy in cv.Prajwal, such as stunted plants with just two whorls of petals .

While examining the effect of 60Co gamma rays

Table 6. Effect of gamma rays on mutation spectrum in VM_2 generation

Gamma rays	0.5kR	1kR	1.5 kR	2kR	2.5kR
Treatment	T_1	T_2	T_3	T_4	T_5
Available population	242	201	206	132	04
Mutation Spectrum(%)					
Early mutant	48(19.83)	42(20.89)	37(17.96)	0	0
Dwarf mutant	0	0	0	34(25.75)	2 (50)
Tall plant mutant	44(18.18)	50(24.87)	52(25.24)	0	0
flower colour mutant	0	58 (28.85)	0	32(24.24)	0
Small flower mutant	0	0	54(26.21)	62(46.96)	2(50)
Big flower mutant	65(26.85)	0	0	0	0
Number of petal increased in mutant	52(21.48)	47(23.38)	22(10.67)	0	0
number of spikes increased in mutant	33(13.63)	62(30.84)	41(19.90)	4(3.03)	0
Late mutant	0	0	0	12(15.84)	2(50)

in bougainvillaea cv., Swaroop and Jain (2016) found a tall and stable mutant. Barring, Lady Marry.

However, in tuberose, many floret (petal) variations in number were detected in response to various gamma ray treatments (Kayalvizhi *et al*. 2017)

Ichikawa *et al*. (1970) reported many somatic flower colour alterations in chrysanthemum, including modifications in blossom. Swaroop and Jain (2016) isolated a tall and stable mutant Yellow. Tuberose blossom diameter, floret size, earliness, and other characteristics were observed by Banerji and Datta (2002).

In both generations, the highest vase life was recorded at 0.5 kR and the minimum at 2.0 kR. In the VM1 generation, the flower abnormalities were highest at 0.5 kR, and at 1.5 kR in the VM2 generation. In both generations, the minimal flower abnormality was found at 2.5 kR. In the VM1 generation, the mutation frequency was at a maximum of 2.0 kRdose, and in the VM2 generation, it was at a maximum of 0.5 kR dose. In the VM1 generation, the minimum mutation frequency was 2.5 kR, while in the VM2 generation, it was 2.0 kR. Both generations had a wider range of mutations, although the percentage of mutations in the VM2 generation was higher than in the VM1 generation.

The 0.5 kR, 1.0 kR, 1.5 kR, 2.0 kR, and 2.5 kR had created some stable and attractive commercial mutants, such as late mutants and dwarf mutants. The vegetative and blooming characteristics of tuberose were strongly impacted by different gamma ray dosages.

The gamma ray doses of 0.5 kR, 1.0 kR, 1.5 kR, 2.0 kR, and 2.5 kR caused stable and attractive commercial mutants such as dwarf mutants, tall mutants, early mutants, and late mutants. The gamma irradiation-induced mutants are highly valuable for decorative features, such as dwarf mutants for potted plants and flower bedding, early mutants for early festivals such as Ganpati and Gouri Poojan, late mutants for Navratri festival, and tall mutants for cut flowers.

References

Banerji , B.K. and Datta, S.K. 2002. Induction and analysis of gamma ray induced flower head shape mutation in 'Lalima' chrysanthemum *(Chrysanthemum morifolium). Indian Journal. Agricultural. Sciences.* **72** (1): 6-10.

Datta, S.K. 2014. Induced mutagenesis: basic knowledge for technological success. In: Tomlekova NB, Kozgar ML, Wani MR, editors. Mutagenesis: exploring genetic diversity of crops. Wageningen: Wageningen Academic Publishers. p. 95–137

Datta, S. K. 2015. Indian foriculture, role of CSIR. New Delhi: Regency Publications A Division of Asral International (P) Ltd;

Bowen, H. J. M., Cawse, P.A. and Dick, M.J. 1962. Gamma radiation causes chrysanthemum to become sporty. *Radiation Botany.* 1 : 297-304.

Jain, S.M. 2005. Major mutation-assisted plant breeding programmes supported by FAO/ IAEA.*Plant Cell Tissue and Organ Culture.* 82: 113-123.

Datta, S.K. 2015. Indian floriculture: CSIR's role, A Division of Astral International (P) Ltd, New Delhi, CSIR), Lucknow, Uttar Pradesh, India.

Ichikawa S., Yamakawa, K., Sekiguchi, F. and Tatsuno, T. 1970. Gamma Radiation induced mutation of *Chrysanthemum morifolium* Cv. Yellow and Delaware revealed variation in somatic chromosome number. *Radiation Botany.* 10: 557-562.

Kainthura, P., Srivastava, R. and Kapoor, M. 2015. Induction of genetic variability and isolation of mutants in tuberose (*Polianthes tuberosa* L.). *Tropical Agriculture Research*. 26(4) : 721-732.

Kayalvizhi, K. Kanan, M. and Ganga M. 2017. Effect of physical and chemical mutagens on morphological features in the M1V2 generation of tuberose (*Polianthes tuberosa* L.). *International Journalof Current Microbiology Applied Sciences.* 6(4) 2492-2499.

Patil, S.D. and Patil, H. E. 2009. Improvement of important ornamental crops by mutant breeding. *International Journal of Agricultural Science*. 5 (2) : 628-632.

Sisodia, A. and Singh, A.K. 2015. Studies on gamma ray generated mutations in Gladiolus. *Indian Journal of Agriculture Sciences.* 85 (1) : 79-86.

Swaroop, K. and Jain, R. 2016. Mutation breeding and performance of bougainvillea generated mutants/ bud sports. *International Journal of Horticultural and Agricultural Sciences.* 4(1): 63-72.