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Assessment of Growth and Bulb Attributing Characters Influenced by Different Doses of EMS in Tuberose

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ABSTRACT

The present investigation entitled assessment of growth and bulb attributing characters influenced by different doses of EMS in tuberose was conducted at Horticulture Research Farm, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during 2022- 2023.The experiment was laid out in Randomized Block Design with three replications. Bulbs of twenty tuberose varieties were treated with 600 ppm and 1200 ppm of EMS concentration along with untreated bulbs (control). The data on growth parameters indicated that early sprouting was found in treatment of EMS @ 600 ppm than control and higher concentration of chemical mutagen. Plant height and number of leaves/plants were decreased with the higher concentration of EMS and maximum plant height and number of leaves were recorded in control. In general, there was significant rise in weight of bulb and bulbils in all varieties treated with higher dose of EMS as compared to untreated bulbs (control). The chemical mutagen EMS @ 600 ppm was found effective for weight of bulbils/hill and resulted in maximum number of bulbils. The number of bulbils/hill and diameter of bulb were adversely affected due to higher concentration. Maximum number of bulbils/hill and diameter of bulb were recorded with untreated bulbs (control). However, weight of bulb/hill was positively influenced by higher dose of EMS. Varieties Arka Nirantara, Prajwal and Bidhan Snigdha were resulted in positively growth in all yield attributes whereas, among the varieties Vaibhav found more sensitive to EMS treatment and resulted in very poor performance in all growth and bulb attributes.

Keywords Growth attributes, Bulb attributes, Tuberose, Spike, Florets, EMS.

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INTRODUCTION

The social fabric of human life has always included flowers in significant quantities. In the past, man has expressed or displayed his deepest sentiments to god and other deities, given flowers to his loved ones, complimented people and expressed every imaginable emotion. Since ancient times, flowers have been essential to all facets of life and no occasion would

be complete without them (Singh and Sisodia 2017). Tuberose (*Polianthes tuberosa* L.) is one of the most important tropical ornamental bulbous plants cultivated for the production of long-lasting flower spikes which are used for both cut as well as loose flower purpose (Sah *et al.* 2017). It belongs to the family Amaryllidaceae and native to Mexico (Singh and Sisodia 2017). It is extensively cultivated in many subtropical and tropical parts of the world including India. It is a bulbous perennial plant producing long spikes, bearing waxy white fragrant flowers, which impregnate the atmosphere with their sweet fragrance. Due to the long keeping quality of spikes, they are in great demand for making floral arrangement and bouquets in major cities of India. Despite having a significant importance in floriculture, tuberose does not exhibit a lot of natural variation in terms of bloom color or type. The tuberose blossom lacks the appealing color diversity found in many other flowers. Spontaneous and induced mutations by physical and chemical mutagens have played an important role in origin of new variety. A few scientists tried to induce mutations using EMS and ionizing radiation with some degree of success. As the varieties selected for the present experiment are strictly vegetatively propagated, any mutant recovered will have the advantage of perpetual propagation without any alteration of character commonly associated with seed propagation (Singh *et al*. 2017).

MATERIALS AND METHODS

A field experiment was carried out to study the performance of twenty varieties of tuberose treated with EMS at the Horticulture Research Farm, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during the year 2022-2023. Experiment was laid out in Randomized Block Design with three replications and bulbs were treated with EMS @ 600 ppm and 1200 ppm concentration for 24 hrs (Acc No. 05, Acc No. 07, Arka Nirantara, Bidhan Snigdha, Bidhan Ujjwal, Calcutta Double, Double, GKTC-4, Hyderabad Double, Hyderabad Single, Kalyani Single, Mexican Single, Pearl Double, Phule Rajani, Pune Local Single, Shringar, Single, Suvasini, Vaibhav) along with untreated bulbs (control). The field was properly ploughed and harrowed in order to achieve a fine tilth. The plot was left unattended to allow soil solarization to kill soil-borne pathogens. After proper levelling the field and crushing of soil clods, plots were then prepared in accordance with the layout plan. Field preparation was followed by the incorporation of well-rotten farm yard manure (FYM) @ 5 tones/ha. The EMS treated healthy, disease-free and uniform sized spindle shaped bulbs were planted at a spacing of 15×15 cm. Various growth and yield attributing characters were recorded timely and analyzed statistically.

RESULTS AND DISCUSSION

Growth parameters

Effect of different concentration of EMS mutagen on biological parameters such as bulb sprouting, number of leaves/plant and plant height in M_1 generation were studied in twenty varieties of tuberose. Data show in Table 1 revealed that early sprouting was noticed in treatment EMS @ 600 ppm (15.09 days), whereas control resulted in late sprouting. The finding is in line with the previous finding of Patel *et al.* (2015), reported similar result in gladiolus. Days to sprouting were significant due to different varieties and early sprouting was recorded in variety Bidhan Snigdha whereas, variety Single resulted in late sprouting. The reason of sprouting stimulated at lower mutagenic treatment doses is could be that at low mutagenic doses, chemicals like enzymes are released by low radiation, stimulating growth. These results are consistent with the findings of Kainthura and Srivastav (2015) and Kayalvizhi *et al.* (2016) in tuberose and Singh and Sisodia (2015) in gladiolus.

Data shown in Table 1 indicated that maximum plant height was recorded in control (34.52 cm) which was significantly higher than 600 ppm and 1200 ppm dose of EMS. This result is consistent with the findings of Tirkey and Singh (2019), Sisodia *et al.* (2015a), Sisodia and Singh (2015b,c) in gladiolus. At low concentration of EMS chemical plant height was increased but with higher concentration its negatively affected the height of plant. Generally, it was found that higher doses of chemical mutagen adversely affected the growth parameters of plants due to lethal effect. Auxin levels can fluctuate,

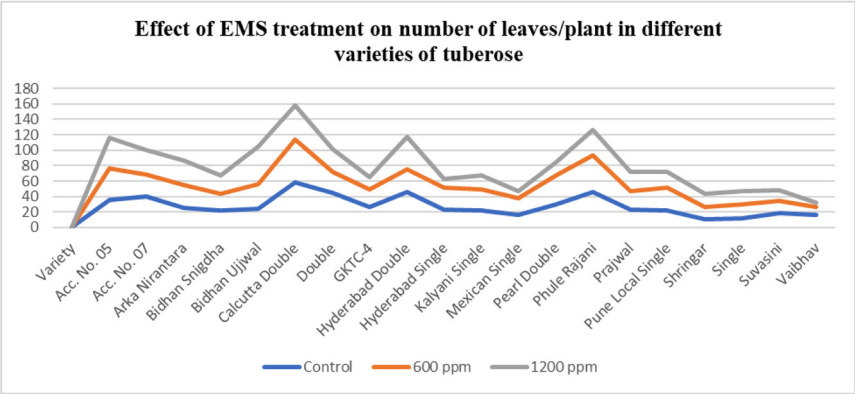

Fig. 1. Effect of EMS treatment and different varieties on number of leaves/plant in different varieties of tuberose.

or auxin can be inactivated, destroyed by an enzyme system, prevented from synthesizing auxin or prevented from performing mitotic functions, which can all result in a decrease in vegetative growth. Patel *et al.* (2015) and Abhangrao *et al.* (2019) also found same result in tuberose and Pal *et al.* (2023b) in balsam. Plant height was significant due to different varieties and maximum plant height was recorded in variety Calcutta Double whereas, minimum height of plant was observed in variety Shringar.

It is evident from Fig. 1 that higher dose of EMS chemically adversely affected the number of leaves/plant. Maximum number of leaves/plant were

Table 1. Effect of EMS doses and different varieties on days to sprouting and plant height (cm) in tuberose.

Treatment	Days to sprouting				Plant height			
Variety	Control	600 ppm	1200 ppm	Mean	Control	600 ppm	1200 ppm	Mean
Acc. no. 05	12.25	13.58	9.77	11.87	42.05	24.74	38.23	35.01
Acc. no. 07	14.27	12.40	11.83	12.83	24.91	23.03	26.53	24.82
Arka nirantara	11.83	12.50	09.50	11.27	30.24	32.38	34.15	32.26
Bidhan snigdha	9.50	10.91	12.58	11.00	37.40	35.94	34.96	36.10
Bidhan ujjwal	20.88	18.91	12.41	17.40	34.02	35.13	34.27	34.47
Calcutta double	20.30	11.0	17.33	16.21	38.39	44.03	43.04	41.82
Double	22.08	19.41	21.91	21.13	43.59	33.00	37.29	37.96
GKTC-4	09.66	14.89	17.16	13.90	43.97	34.24	30.97	36.40
Hyderabad double	12.83	10.41	13.38	12.21	39.75	37.95	44.13	40.61
Hyderabad single	17.77	15.25	13.58	15.53	33.54	38.37	30.30	34.07
Kalyani single	11.16	13.19	19.11	14.49	36.71	35.86	33.45	35.34
Mexican single	24.58	18.52	21.33	21.48	29.18	28.45	20.47	26.03
Pearl double	32.50	12.50	18.66	21.22	34.07	38.92	29.30	34.10
Phule rajani	14.55	10.75	19.74	15.01	29.09	34.66	34.33	32.70
Prajwal	20.16	17.16	17.58	18.30	43.05	37.42	35.83	38.77
Pune local single	9.75	14.58	10.50	11.61	47.15	39.50	29.35	38.67
Shringar	25.00	12.19	21.91	19.70	14.94	21.81	20.04	18.93
Single	21.88	30.97	18.72	23.85	22.99	21.88	23.46	22.78
Suvasini	23.22	18.72	23.33	21.75	34.09	32.07	28.98	31.71
Vaibhav	17.50	13.94	7.33	12.92	31.27	31.97	20.67	27.97
Mean	17.58	15.09	15.88	17.58	34.52	33.07	31.49	
CD (5%)								
Treatment	0.882				3.06			
Variety	0.342				1.19			
Treatment × Variety	1.528				5.30			

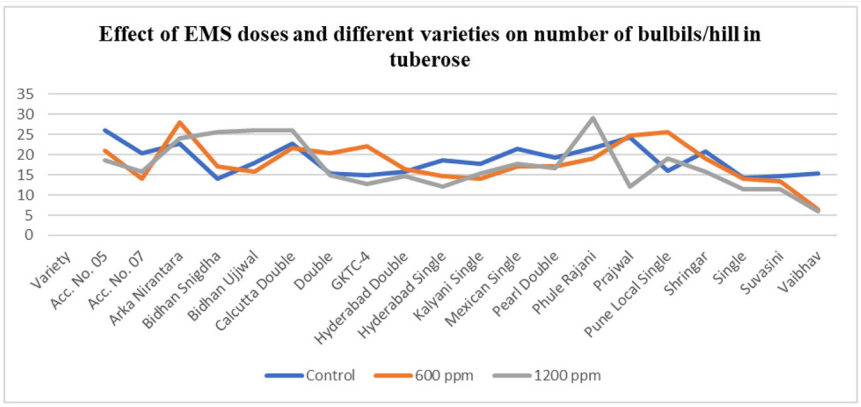

Fig. 2. Effect of EMS treatment and different varieties on number of bulbils/hill in different varieties of tuberose.

recorded in control (28.17) whereas, bulbs treated with EMS @ 1200 ppm resulted in minimum number of leaves/plant. It is may be due to the lethal effect of chemical mutagen. A similar finding was also observed in previous study (Sah *et al.* 2017) in tuberose and Sisodia and Singh (2015b) in gladiolus. Variety Calcutta Double resulted in maximum number of leaves/plant whereas, variety Vaibhav resulted in minimum number of leaves/plant. Sisodia *et al.* (2015a) reported that deterioration may be related to the fact that at greater doses, treatments harm the physiology of plant, affecting respiration and photosynthesis and causing incorrect development and a compromized root system.

Table 2. Effect of EMS doses and different varieties on Diameter of bulbs (cm^2) and weight of bulb (g) in tuberose.

Treatment	Diameter of bulb (g)				Weight of bulb (g)			
Variety	Control	600 ppm	1200 ppm	Mean	Control	600 ppm	1200 ppm	Mean
Acc. no. 05	24.50	33.10	23.00	26.87	5.19	3.83	3.17	4.06
Acc. no. 07	27.50	35.50	24.90	29.30	3.30	4.38	2.88	3.52
Arka nirantara	50.33	43.50	54.50	49.44	4.31	4.00	5.29	4.53
Bidhan snigdha	51.17	60.83	64.50	58.83	4.77	5.13	4.55	4.82
Bidhan ujjwal	33.67	27.00	39.33	33.33	3.86	3.02	3.97	3.62
Calcutta double	29.67	49.00	63.67	47.44	3.92	5.10	4.79	4.60
Double	24.67	36.83	22.17	27.89	3.69	3.58	3.77	3.68
GKTC-4	33.33	25.17	33.00	30.50	4.22	3.81	4.30	4.11
Hyderabad double	35.83	31.83	39.83	35.83	4.68	4.34	4.50	4.51
Hyderabad single	56.10	36.83	34.33	42.42	4.21	4.75	3.89	4.28
Kalyani single	25.17	25.83	39.33	30.11	3.64	2.90	4.03	3.52
Mexican single	23.33	14.50	13.83	17.22	3.21	3.04	2.81	3.02
Pearl double	28.17	26.67	32.60	29.14	3.69	3.84	4.06	3.86
Phule rajani	32.00	30.67	25.33	29.33	4.00	3.76	3.70	3.82
Prajwal	32.17	40.67	39.00	37.28	3.75	4.33	4.19	4.09
Pune local single	24.00	34.67	18.33	25.67	3.72	4.41	3.24	3.79
Shringar	23.67	18.00	24.00	21.89	3.14	3.07	3.25	3.15
Single	17.67	13.83	13.17	14.89	3.23	2.88	2.71	2.94
Suvasini	39.50	19.00	19.83	26.11	4.08	3.44	3.77	3.76
Vaibhav	18.83	6.07	9.00	11.30	3.29	2.00	2.95	2.75
Mean	31.56	30.48	31.68		3.90	3.78	3.79	
CD (5%)								
Treatment	1.391				0.198			
Variety	0.539				0.077			
Treatment × Variety	2.41				0.343			

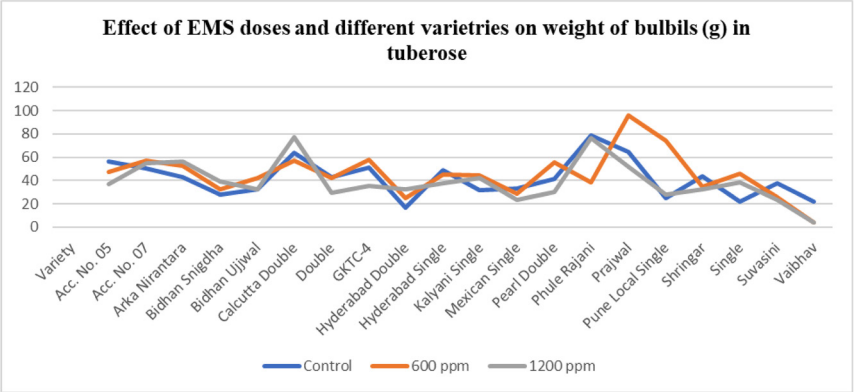

Fig. 3. Effect of EMS doses and different varieties on weight of bulbils (g) in tuberose.

Yield parameters

It is evident from Fig. 2 that maximum number of bulbils/hill were registered with control (18.68) than 600 ppm and 1200 ppm treatment of EMS. Different varieties of tuberose showed significant difference for number of bulbils/hill and maximum number of bulbils/hill were recorded in variety Arka Nirantara whereas, variety Vaibhav resulted in minimum number of bulbils/hill. By introducing random mutations that have a deleterious influence on genes involved to bulbil development, EMS treatment can negatively affect the number of bulbils/hill in tuberose (Sah *et al.* 2017) and in balsam (Pal *et al.* 2023a). Significant differences in number of bulbils/hill were observed due to interaction of EMS doses and varieties. Interaction of variety Phule Rajani with treatment of EMS @ 1200 ppm exhibited maximum number of bulbils/hill whereas, variety Vaibhav with EMS @ 1200 ppm resulted in minimum number of bulbils/hill. This finding is also supported by Sharavani *et al.* (2019) and Yadav *et al.* (2022).

It is apparent from the Table 2 that maximum weight of bulbs/hill were registered with treatment of EMS @ 600 ppm (45.29 g) which was significantly higher than control and 1200 ppm EMS. The finding is in line with previous study of Tirkey and Singh (2019) in gladiolus. It is might be the effect of chemical mutagen on cell division and elongation of bulbils tissue, resulting in heavier bulbs than control. These results are consistent with the findings of Yadav *et al.* (2022). Maximum diameter of bulb was noticed in control (3.90 cm^2) which was significantly higher than 1200 ppm and 600 ppm treatment of EMS (Sah *et al.* 2017). Diameter of bulb was significant due to different varieties and maximum diameter of bulb was recorded in variety Bidhan Snigdha whereas, variety Vaibhav resulted in minimum diameter of bulb. It is may be due to the various effect of chemical mutagen such as inhibition of cell division and expansion, altered nutrient allocation and DNA alteration. These results are in line with findings of Sharavani *et al.* (2019). Different varieties of tuberose showed significant difference on weight of bulbils/hill (Fig. 3) and maximum weight of bulbils/hill were recorded in variety Prajwal whereas, variety Vaibhav resulted in minimum weight of bulbils/hill. Interaction of variety Prajwal with EMS @ 600 ppm exhibited maximum weight of bulbils/hill whereas, variety Vaibhav with 1200 ppm EMS doses resulted in minimum weight of bulbils/hill.

It is evident from Fig. 3 that maximum weight of bulbils/hill was registered with EMS @1200 ppm (31.68 g) than control and 600 ppm dose of EMS. It is may be because mutations can alter the way of nutrients that are allocated within the plant, leading to enhanced bulbs growth and weight. Yadav *et al.* (2022) finding are in lent credence with the present finding. Different varieties of tuberose showed significant difference on weight of bulbs/hill and maximum weight of bulbs/hill was recorded in variety Bidhan Snigdha (58.83 g) whereas, variety Vaibhav resulted in minimum weight of bulbs/hill followed by single and Mexican single.

CONCLUSION

In conclusion, this study demonstrates that EMS mutagen treatment can have significant effects on various biological parameters in tuberose plants. The outcomes vary depending on the concentration of EMS, with lower concentrations often resulting in better outcomes for certain parameters. Varietal differences are also a significant factor in the responses observed. These findings contribute to the understanding of how mutagenic treatments can influence the growth and yield of tuberose plants, which may have implications for breeding and crop improvement programs. However, it is important to note that EMS mutagen treatment can also have adverse effects on plant growth and development, especially at higher concentrations.

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