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Influence of Gamma Dose on Growth, Flower and Bulb Parameters in Tuberose Varieties

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A B S T R A C T

Present experiment was carried out to see the influence of gamma dose *i.e*. 2 kR and 4 kR along with untreated (control) in different varieties of tuberose at Horticulture Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during 2016-2017. Experiment was laid down in Randomized Block Design with three replications. 4 kR dose of gamma ray does not sprout due to lethal effect. Maximum sprouting percentage was recorded with control followed by 2 kR doses of gamma irradiation. Untreated plants resulted longest leaf. Maximum leaf area was recorded with cultivar Prajwal. Maximum plant spread was registered with control followed by 2 kR. Early flowering was noticed due to gamma irradiation dose at 2 kR which was significantly earlier than control. Control plants produced more rachis length in comparison to 2 kR doses of gamma irradiation. Maximum internodal length was registered with control which was significantly more than 2 kR. Maximum length of florets was registered with control. Maximum duration of flowering was noticed in control which was significantly more than 2 kR. Maximum number of spikes per plant was recorded in Sikkim Selection. Maximum number of bulbs per hill was recorded in Sikkim Selection. Maximum weight of bulbs per hill was registered with control which was significantly more than 2 kR. Maximum diameter of bulb was noticed in control in comparison to 2 kR.

Introduction

Tuberose (*Polianthes tuberosa* L.) is one of the most important tropical ornamental bulbous flowering plants cultivated for production of long lasting flower spikes. Tuberose is an important commercial cut as well as loose flower crop due to pleasant fragrance, longer vase-life of spikes, higher returns and wide adaptability to varied climate and soil. They are valued much by the aesthetic world for their beauty and fragrance. The flowers are attractive and elegant in appearance with sweet fragrance. It has long been cherished for the aromatic oils extracted from its fragrant white flowers.

The flower is very popular for its strong fragrance and its essential oil is important component of high-grade perfumes. 'Single' varieties are more fragrant than 'Double' type and contain 0.08 to 0.14 percent concrete which is used in high grade perfumes. There is high demand for tuberose concrete and absolute in international markets which fetch a very good price. Flowers of the Single type (single row of perianth) are commonly used for extraction of essential oil, loose flowers, making garland etc., while that of Double varieties (more than two rows of perianth) are used as cut flowers, garden display and

interior decoration. Fragrance of flowers is very sweet, floral and honey-like and can help give emotional strength. The flower spike of tuberose remains fresh for long time and finds a distinct place in the flower markets. Due to its immense export potential, cultivation of tuberose is gaining momentum day by day in our country. Tuberose is vegetatively propagated through bulbs and bulblets. After identification of a superior genotype it can be further multiplied by bulbs and bulblets. Mutation is an important pathway for the production of new genotypes in vegetatively propagated species (Broertjes, 1972) and to enhance natural genetic resource (Jain, 2006). Induction of mutation in vegetatively propagated crops has attracted considerable attention because the selection of mutations of directly prescribed characteristics like colour, form or size, is generally not difficult. Another reason is that cultivars are heterozygous and show a comparatively high mutation frequency, spontaneous as well as induced.

Materials and Methods

The present investigation was carried out at the Horticulture Research Farm, Department of Horticulture, Banaras Hindu University, Varanasi, Uttar Pradesh during 2016-2017. The experimental site lies approximately in the centre of North-Gangetic alluvial plain, on the left bank of river Ganga which is homogeneously fertile with uniform texture. Varanasi city is situated at 250 10' North latitude and 830 03' East longitudes. The site is at an altitude of 123.23 meter above the mean sea level. The climate of Varanasi is humid subtropical with large variation between summer and winter temperatures. Tuberose bulb of 14 varieties *viz.,* Shringar, Calcutta Double, Vaibhav, Pune Local Single, Arka Nirantra, Sikkim Selection, Prajwal, Hyderabad Single, Phule Rajani Single, Mexican Single, ACC No.7, GKTC-4 and ACC No.9 were exposed to gamma doses at 2 kR at National Botanical Research Institute, Lucknow. The bulbs were planted with a spacing of 25×25 cm. The experiment was laid out in randomized block design with 3 replications. Various parameters were observed on growth, flowering and bulb of tuberose.

Results and Discussion

Growth parameters

Maximum sprouting percentage was recorded with control which was significantly higher than 2kR. Sprouting percentage was significant due to different varieties and maximum sprouting percentage was observed in germplasm Sikkim Selection. Germplasm ACC No.7 resulted in minimum sprouting percentage. Sprouting percentage was also greatly varied due to gamma doses and it was observed that decrease doses of gamma rays resulted in decreased sprouting percentage in tuberose. Similar results were found by Sisodia and Singh (2015) in gladiolus. Maximum length of longest leaf was noticed with control plants followed by 2 kR. Length of longest leaf was significant due to different varieties and maximum length of longest leaf was recorded in germplasm Prajwal (Table 1).

Length of leaf reduced as the doses of gamma irradiation increased. Similar results were reported earlier by Banerji *et al.,* (1994) in gladiolus. This may be caused by the reduced amount of endogenous growth regulators, especially the cytokinin, because of breakdown or lack of synthesis due to irradiation. Maximum leaf area was found in control as compare to 2 kR treatment of gamma doses. Different varieties show significant results on leaf area. Maximum leaf area was observed in germplasm Prajwal. Leaf area decreased at 2 kR treatment of gamma dose. Similar results on leaf area and leaf area index have been reported by Singh and Sisodia (2015).

Table.1 Effect of gamma irradiation on growth parameters in tuberose varieties

Treatment / Variety	Sprouting%			Length of longest leaf (cm)			Leaf area (cm^2)			Plant spread (cm)		
	Control	2 kR	Mean	Control	2 kR	Mean	Control	2 kR	Mean	Control	2 kR	Mean
Shringar	100.00	33.33	66.66	34.98	9.58	22.28	52.55	6.55	29.55	63.08	16.66	39.87
Calcutta Double	100.00	66.66	83.33	55.50	32.41	43.95	68.20	42.65	55.42	90.08	50.16	70.12
Vaibhav	100.00	50.00	75.00	51.03	47.46	49.25	67.27	59.77	63.52	94.51	80.74	87.62
Pune Local Single	83.33	-	41.66	36.15	-	18.07	63.48	-	31.74	57.67	-	28.83
Arka Nirantra	100.00	-	50.00	54.50	-	27.25	67.21	-	33.60	85.33	-	42.66
Sikkim Selection	100.00	100.00	100.00	46.58	36.25	41.41	65.39	28.24	46.82	65.39	58.82	62.11
Prajwal	100.00	16.66	58.33	69.60	34.00	51.80	114.14	16.57	65.35	78.58	15.62	47.10
Hyderabad Single	100.00	50.00	75.00	60.66	23.73	42.20	76.56	26.06	51.31	65.82	28.46	47.14
Phule Rajani Single	83.33	16.66	50.00	49.21	7.05	28.13	67.30	3.52	35.41	71.39	10.22	40.80
Calcutta Single	100.00	-	50.00	40.75	-	20.37	49.93	-	24.96	71.29	-	35.64
Mexican Single	100.00	-	50.00	44.86	-	22.43	55.32	-	27.66	62.86	-	31.43
ACC No.7	66.66	-	33.33	31.66	-	15.83	29.99	-	14.99	40.85	-	20.42
GKTC-4	100.00	83.33	91.66	43.16	35.58	39.37	54.68	44.70	49.69	68.34	54.87	61.61
ACC No.9	66.66	100.00	83.33	24.25	26.26	25.25	23.98	21.73	22.86	34.56	37.32	35.94
Mean	92.85	36.90		45.92	18.02		61.14	17.84		67.84	25.20	
C.D. (0.05)												
Treatment	11.04			6.12			7.56			7.10		
Variety	29.22			16.21			20.00			18.79		
Treatment × Variety	41.32			22.93			28.29			26.58		

Table.2 Effect of gamma irradiation on flowering characters in tuberose varieties

Treatment / Variety	Days to flowering			Rachis length (cm)			Internodal length (cm)		
	Control	2 kR	Mean	Control	2 kR	Mean	Control	2 kR	Mean
Shringar	188.66	-	94.33	25.93	-	12.96	3.13	-	1.56
Calcutta Double	290.33	94.16	192.25	27.23	27.50	27.36	4.33	1.88	3.10
Vaibhav	253.16	101.16	177.16	33.43	12.86	23.15	3.43	4.03	3.73
Pune Local Single	180.66	-	90.33	23.70	-	11.85	3.95	-	1.97
Arka Nirantra	241.00	-	120.50	48.00	-	24.00	3.76	-	1.88
Sikkim Selection	226.00	225.00	225.50	38.16	28.50	33.33	3.83	5.51	4.67
Prajwal	254.66	57.83	156.25	36.23	3.66	19.95	6.06	1.26	3.66
Hyderabad Single	258.33	-	129.16	34.23	-	17.11	5.00	-	2.50
Phule Rajani Single	212.33	-	106.16	23.33	-	11.66	6.36	-	3.18
Calcutta Single	255.00	-	127.50	29.76	-	14.88	4.36	-	2.18
Mexican Single	207.83	-	103.91	40.00	-	20.00	5.43	-	2.71
ACC No.7	163.00	-	81.50	15.68	-	7.84	3.70	-	1.85
GKTC-4	312.33	272.50	292.41	25.66	16.66	21.16	4.36	5.63	5.00
ACC No.9	125.16	226.16	175.66	23.33	40.66	32.00	4.70	5.76	5.23
Mean	226.32	69.77		30.33	9.27		4.46	1.72	
C.D. (0.05)									
Treatment	26.82			3.61			0.58		
Variety	70.96			9.55			1.55		
Treatment × Variety	100.35			13.51			2.20		

Table.3 Effect of gamma irradiation on flowering characters in tuberose varieties

Treatment / Variety	Length of florets (cm)			Duration of flowering			Number of spikes/plant		
	Control	2 kR	Mean	Control	2 kR	Mean	Control	2 kR	Mean
Shringar	4.06	-	2.03	19.66	-	9.83	1.83	-	0.91
Calcutta Double	4.53	2.63	3.58	17.66	7.66	12.66	1.00	0.83	0.91
Vaibhav	4.56	3.33	3.95	18.00	14.00	16.00	1.83	0.83	1.33
Pune Local Single	5.06	-	2.53	19.00	-	9.50	0.83	-	0.41
Arka Nirantra	4.13	-	2.06	17.33	-	8.66	1.66	-	0.83
Sikkim Selection	4.63	4.00	4.31	17.66	14.66	16.16	5.83	6.00	5.91
Prajwal	3.98	1.26	2.62	18.66	8.00	13.33	1.16	0.16	0.66
Hyderabad Single	4.13	-	2.06	19.00	-	9.50	1.00	-	0.50
Phule Rajani Single	3.96	-	1.98	16.33	-	8.16	1.00	-	0.50
Calcutta Single	3.66	-	1.83	19.00	-	9.50	1.16	-	0.58
Mexican Single	3.86	-	1.93	17.33	-	8.66	2.33	-	1.16
ACC No.7	3.46	-	1.73	16.00	-	8.00	0.83	-	0.41
GKTC-4	3.83	3.93	3.88	19.66	22.33	21.00	1.33	1.00	1.16
ACC No.9	2.90	4.50	3.70	12.66	21.00	16.83	1.16	3.00	2.08
Mean	4.05	1.40		17.71	6.26		1.64	0.84	
C.D. (0.05)									
Treatment	0.44			2.16			0.67		
Variety	1.18			5.73			1.79		
Treatment × Variety	1.68			8.11			N/A		

Table.4 Effect of gamma irradiation on bulb parameters in tuberose varieties

Treatment / Variety	Number of bulbs/hill			Weight of bulbs/hill (g)			Diameter of bulb/hill(cm)		
	Control	2 kR	Mean	Control	2 kR	Mean	Control	2 kR	Mean
Shringar	14.66	1.00	7.83	221.91	18.41	120.16	2.13	0.34	1.23
Calcutta Double	19.66	6.33	13.00	274.91	105.25	190.08	3.00	1.90	2.45
Vaibhav	18.83	10.33	14.58	354.25	297.75	326.00	3.65	3.03	3.34
Pune Local Single	10.83	-	5.41	261.00	-	130.50	2.50	-	1.25
Arka Nirantra	13.33	-	6.66	142.66	-	71.33	3.29	-	1.64
Sikkim Selection	13.83	17.16	15.50	154.16	183.33	168.75	1.74	2.29	2.01
Prajwal	16.83	0.50	8.66	317.50	68.00	192.75	3.13	1.05	2.09
Hyderabad Single	16.66	3.16	9.91	272.83	32.75	152.79	3.43	1.86	2.65
Phule Rajani Single	21.66	2.16	11.91	239.66	32.25	135.95	0.90	0.12	0.51
Calcutta Single	21.66	-	10.83	314.66	-	157.33	3.26	-	1.63
Mexican Single	16.16	-	8.08	233.58	-	116.79	0.54	-	0.27
ACC No.7	9.66	-	4.83	150.75	-	75.37	0.55	-	0.28
GKTC-4	12.33	10.33	11.33	159.91	126.41	143.16	1.33	0.74	1.04
ACC No.9	8.33	6.00	7.16	130.00	78.58	104.29	0.43	0.54	0.49
Mean	15.32	4.07		230.56	67.33		2.13	0.85	
C.D. (0.05)									
Treatment	2.20			33.69			0.35		
Variety	5.82			89.15			0.94		
Treatment × Variety	8.23			126.08			1.33		

Different varieties of tuberose showed significant difference on plant spread. Maximum plant spread was recorded in germplasm Vaibhav. Plant spread decreased with 2 kR treatment of gamma dose when compared to control. Reduction in plant spread was also noticed by Singh *et al.*, (2009) in marigold due to irradiation of seeds in African marigold cv. Pusa Narangi Gainda.

Flowering parameters

Early flowering was noticed due to gamma irradiation dose at 2 kR which was significantly earlier than control. Early flowering was recorded in germplasm ACC No.7. Germplasm GKTC-4 resulted in late flowering. Maximum rachis length was registered with control plants. Maximum rachis length was recorded in germplasm Sikkim Selection. Maximum internodal length was registered with control plants as compare to 2 kR treatment. Maximum intermodal length was recorded in germplasm ACC No.9. Maximum length of floret was registered with control which was significantly more than 2 kR. Maximum length of floret was recorded in germplasm Sikkim Selection. Minimum length of floret was recorded in cultivar ACC No.7. Maximum duration of flowering was noticed in control plants followed by 2 kR, whereas maximum duration of flowering was recorded in germplasm GKTC-4. Maximum number of spike per plant was registered with control which was significantly higher than 2 kR. Maximum number of spikes per plant was recorded in germplasm Sikkim Selection. Germplasm Pune Local Single with ACC No.7 resulted in minimum number of spikes per plant. The present findings are also in line on days to flowering in gladiolus cvs. Sylvia and Eurovision reported by Srivastava and Singh (2002). Srivastava *et al.,* (2007) had found increased in days to flowering in cvs. Sylvia and Eurovision at 20 Gy to 60 Gy treatments while there was no flowering was obtained at 80 Gy and above doses of gamma radiations. In the present investigation, reduction in survival of plant to flowering stage at higher doses of gamma irradiation in some varieties might be due to inactivation of auxin, probably decrease in auxin content with increased irradiation doses was responsible for less survival of plants at higher doses. The reason for the reduction in rachis length and floret size might be due to inhibition of growth. Floret length influenced significantly with application of gamma doses and varieties in tuberose (Anu *et al.,* 2003) (Tables 2 and 3).

Bulb parameters

Maximum numbers of bulbs per hill were registered with control which was significantly higher than 2 kR. Maximum number of bulbs per hill was recorded in germplasm Sikkim Selection. Germplasm ACC No.7 resulted in minimum number of bulbs per hill. Maximum weight of bulbs per hill was registered with control plants. Germplasm Arka Nirantra resulted in minimum weight of bulbs per hill. Maximum diameter of bulb was noticed in control which was significantly higher than 2 kR. Maximum diameter of bulb was recorded in germplasm Vaibhav. 2 kR dose of gamma irradiation exhibited less number of bulbs in comparison to control. Similarly weight of bulbs per hill decreased with 2 kR doses of gamma irradiation. Diameter of bulb was not influenced significantly, whereas, with 2 kR dose of gamma irradiation resulted in smaller size of bulb. However, control produces bigger size of bulb than 2kR. The results are in close conformity with the work of Tiwari *et al.,* (2010) and Mishra and Mahesh (1993), who recorded reduction in number of corms per plant in gladiolus due to gamma ray treatment (Table 4). The changes in number of corms per plant may be attributed to the fact that the irradiation treatment damages physiology of the plant at higher doses, which affected photosynthesis and root system

resulting in the improper growth of the plant and hampered root system. Rather and John (2000) carried out a trial on Dutch iris and treated the bulbs with various doses of gamma rays. They found that number of daughter bulbs increased in various doses of gamma irradiation. It further lent support of the earlier observation made by Anu *et al.,* (2003) who conducted an experiment on induced mutation in tuberose by gamma rays and reported that number of bulbs increased at lower dose of gamma irradiation and decreased at higher doses of gamma in comparison to control. They also observed size of bulbs increased at lower doses and drastically decreased at higher doses in tuberose.

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