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Mohit Chaudhary
Department of Horticulture, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, India

Sunil Malik
Department of Horticulture, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, India

Mukesh Kumar
Department of Horticulture, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, India

Rajendra Singh
Department of Entomology, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, India

Vivek Ujjwal
Department of Horticulture, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, India

Anil Panwar
Department of Horticulture, G. B. Pant University of Agriculture & Technology, Pantnagar, Rudrapur, Uttarakhand, India

Correspondence
Mohit Chaudhary
Department of Horticulture, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, India

Study the performance of tuberose genotypes for twenty-two characters on tuberose germplasm

Mohit Chaudhary, Sunil Malik, Mukesh Kumar, Rajendra Singh, Vivek Ujjwal and Anil Panwar

Abstract
The present investigation on "Study the performance of tuberose genotypes for twenty-two characters on tuberose germplasm materials twenty-two diverse genotypes of tuberose at the Horticultural Research Centre at Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, during 2015-2016. Experimental were evaluated at Material was grown in randomized block design with row to row and plant to plant spacing of 30 cm and 20 cm, respectively. The observations on five randomly selected plants from each genotype in each replication were recorded for the characters viz., days taken to sprouting, plant height, number of leaves per plant, length of longest leaf , width of longest leaf, number of sprouts per bulbs, days required for visibility of first spike, days taken to opening of first flower, number of florets per spike, diameter of flower, number of spike per bulb, diameter of spike, length of spike, length of rachis, longevity of spike, vase life, number of bulbs per plant, number of bulblets per plant, yield of bulb per plant, diameter of bulb, yield of bulb and bulblets per plant and yield of bulb. All cultivars indicated wide range of variation with respect to yield of bulb per plant, the maximum number yield of bulb were found in cultivar Phulerajani (403.92) gm followed by ArkaNirantra (394.65) gm bulbs and the minimum number of yield of bulbs per plant were found in cultivar Pragyaculum (178.61). The grand mean value of this character was (296.74) gm bulbs per plant.

Keywords: Tuberose genotypes, for twenty-two characters on tuberose germplasm

Introduction
India is bequeathed with numerous agro-climatic zones favorable for production of delicate and gentle floriculture harvests. Now a day's floriculture is fast emerging sector as a major venture on the world scenario. Consequently, flower cultivation is recognized as most remunerative living with a much higher potential for return per unit area than other field crops.
The tuberose *Polianthes tuberosa* (Linn.), is a night-blooming perennial plant, belongs to the family Asparagaceae and thought to be native to Mexico along with every other species of *Polianthes* (Benschop, 1993) [4]. The common name of *Polianthes tuberosa* derives from the Latin *tuberosa*, meaning swollen or tuberous in reference to its root system and *Polianthes* means "many flowers" in Greek language. It consists of about 12species.
Tuberose is having elongated spikes up to 45 cm long that produce clusters of fragrant waxy white flowers that bloom from the bottom towards the top of the spike. It has long, bright green leaves clustered at the base of the plant and smaller, clasping leaves along the stem. Plant height 60-120 cm long and propagated through bulb like tuberous root stock, covered with broadened bases of fleshy leaves forming arosette, 6-9 in number, 3-4.5 cm long and about 1.5 cm wide. It occupies a prime place among the bulbous ornamentals because of its elegant, highly fragrant flowers, which can be used in various ways. (Sheela, 2008) [11].
The area under floriculture production in India was 255.00 thousand hectares with a production of 1,754 thousand metric tons loose flowers and 543 thousand metric tons cut flowers during 2013-14 (Anonymous, 2015). Floriculture is now commercially cultivated in several states with West Bengal (32%), Karnataka (12%) Maharashtra (10%), having gone ahead of other producing states like Madhya Pradesh, Gujarat, Punjab, Haryana, Andhra Pradesh, Orissa, Jharkhand, Uttar Pradesh and Chhattisgarh. India's total export of floriculture was Rs. 455.90 crores in 2013-14. The major importing countries were United States, Netherlands, Germany, United Kingdom, United Arab Emirates, Japan and Canada.
The flowers of tuberose produce one of the rarest and most valuable aromas with sweet and pleasant fragrance. In the last two decades or so a few new tuberose cultivars have been identified and recommended for commercial cultivation in different regions of our country. Several cultivars had been assessed and evaluated for their performance under different regions of the country taking single petalled and double petalled cultivars together by Bankar and Mukhopadhyay (1980) [3], Bhattacharjee *et al.*, (1981) [5], Pratap and Manohar Rao (2003) and Singh

and Misra (2005) [10] and have revealed that a market demand has increased manifold for want of diverse forms and intense fragrance found in them.

The study of correlation between yield and its components is of prime importance in formulating the selection criteria. Selection is generally based on the phenotypic values of a character which partly determined by genotypes which is heritable, and partly by environment which is non-heritable. The characters that are largely influenced by environment are said to have low heritability while those which are less susceptible to environment variation shows high heritability. Paroda and Joshi (1970) [8] referred the idea about heritability.

Materials and Methods

Germplasm

Table 1: The twenty-two genotypes tuberose following.

S. No.	Genotypes	S. No.	Genotypes
1	Sardar Local	2	Srinagar
3	Pearl Double	4	Vaibhav
5	Prajwal	6	Suvasini
7	Mexican White Double	8	Sikkim Selection
9	Hyderabad Double	10	Mexican Single
11	GKTC-4	12	Swarn Rekha
13	Phule Rajani	14	Arka Nirantra
15	Hyderabad Single	16	Nirantra Extension
17	Pragya Culum	18	Arka Sugandhi
19.	Rajat Rekha	20	Bidhan Rajani-1
21	Bidhan Rajani-2	22	Bidhan Rajani-2

Field preparation

1. The land of experimental field was prepared by ploughing before planting of bulbs. At last ploughing well-rotten FYM @400q/ha was applied. Besides of FYM, a recommended dose of N: P: K @ 120:150:150 kg /ha were also added into the experiment, out of which 60 kg N and entire dose of P_2O_5 and K_2O are applied as basal dose.

Planting

Tuberose bulbs were planted on at 30x20 cm spacing and 4.0 cm depth.

Observations

Following observations for morphological characters based on five randomly selected plants in each treatment/genotype of all replications were recorded at thirty-day interval, respectively.

1. Days taken to sprouting

Days taken for sprouting the bulb were counted from the day of sowing till germination of plant.

2. Plant height (cm)

The total plant height of randomly selected plants was measured from base to top portion of plant, when it attained maximum height by using meter scale and average was calculated.

3. Number of leaves per plant

The number of leaves was counted from selected plants in thirty days interval respectively and average was calculated.

4. Length of longest leaf (cm)

The total length of longest leaves from base to top was measured of each randomly selected plant by using scale and average was calculated.

5. Width of longest leaf (cm)

The width leaf from randomly selected plants was calculated every thirty days intervals by meter scale and average was calculated.

6. Number of sprouts per bulb

The number of sprouts per bulb were counted at the duration of crop from selected five randomly plants and average was calculated.

7. Length of spike (cm)

The length of tuberose spike was recorded from five randomly selected plants by meter scale and average of same was recorded.

8. Length of rachis (cm)

The length of rachis was measured from the emerging points of spike to the first basal flower from selected plants and average length of rachis was recorded in centimeter.

9. Number of spikes per bulb

Flowering spike per bulb of the selected plants was counted during the entire experimental period. The number of flowering spikes produced by selected plant and average was calculated.

10. Diameter of spike (mm)

The diameter of the spike was recorded at full bloom stage with the help of Vernier caliper. The mean diameters of spike were calculated and expressed in centimetre.

11. Number of florets per spike

The number of florets per spike was calculated by counting and recorded treatments wise.

12. Diameter of flower (cm)

Diameter of the flower was measured in centimeter with help of meter-scale on the selected plant during the season.

13. Days required for visibility of first spike (days)

Days required for the first spike emergence were recorded from selected plant from date of planting of the bulbs in each treatment and average was calculated.

14. Days taken to opening of first flower (days)

Days taken from the opening of the first flower on the spike were recorded from the date of visibility of first spike in each treatment and average was calculated.

15. Longevity of spike (days)

It was recorded from the selected plant by observing the date of opening of the first floret and the fading of the last floret and average was calculated.

16. Vase life of flower (days)

Vase lives of flowers are checked by dipping spike completely in demonized water till the florets get faded.

17. Diameter of bulb (mm)

The diameter of the bulb from each treatment was measured with the help of Vernier calipers and average expressed in millimeters.

18. Yield of bulb per plant

Each bulb is weighted (gm) from selected plants with the help of an electrical balance in each treatment and average was counted.

19. Number of bulb lets per bulb

After harvesting, the total number of bulblets was counted from each bulb separately in selected plant and average numbers of bulblets were counted.

20. Number of bulbs per plants

The total number of bulbs was counted per plant from selected treatments after harvesting, with suitable methods and carefully average was counted accordingly.

21. Yield of bulb and bulb lets per plant (q/ha)
Bulbs and bulb lets were weighted (gm) separately from each selected plants with the help of an electric balance and average was counted.

22. Yield of bulb (q/ha)
Bulb should be weighted (gm) from selected plants with the help of electrical balance and the weight unit is converted from grams to quintals per hectare.

Statistical analysis
The mean values of genotypes in each replication were used for statistical analysis. The data were analyzed for a randomized block design to test the significance of differences between the genotypes for various characters. The analysis of the data was as described by Panse and Sukhatme (1969) [7].

Heritability and Genetic advance
1. Heritability
Heritability in broad sense h² (b) was computed as a ratio of genotypic variance to phenotypic variance (Allard, 1960) [2].

$$h^2(b) = \frac{\sigma^2 g}{\sigma^2 p} \times 100$$

Where,
h² (b) = Heritability in broad sense
σ²g = Genotypic variance
σ²p = Phenotypic variance

Result
1. Analysis of variance
The mean values of twenty-two tuberose genotypes observed for different characters studied along with their range and critical differences are presented in table 2. Analysis of variance for the randomized block design with respect to twenty-two genotypes of tuberose revealed significant differences among the material used in the investigation for all the twenty-two characters studied viz. days taken to sprouting, plant height, number of leaves per plant, length of longest leaf, width of longest leaf, number of sprouts per bulbs, days required for visibility of first spike, days taken to opening of first flower, number of florets per spike, diameter of flower, number of spike per bulb, diameter of spike, length of spike, length of rachis, longevity of spike, vase life, number of bulbs per plant, number of bulblets per plant, yield of bulb per plant, diameter of bulb, yield of bulb and bulblets per plant, yield of bulb, indicating wide spectrum of variation among the genotypes.

2. Mean performance of genotypes
The mean performance of twenty-two genotypes of tuberose for twenty-two characters revealed a wide range of variation a brief account of the silent observation is given below and data is presented in table-3.

1. Days taken to sprouting
It is revealed from the table 1 that all the genotypes differed from each other terms of days taken to sprouting. Hyderabad single taken maximum days to sprouting (13.93) days, followed by Prajwal (13.83) days. On the other hand, cv. Pragyaculum and Sikkim selection took minimum days to sprouting (12.57 and 12.60) days, respectively. The grand mean value of this character was (13.47) days.

2.2. Plant height (cm)
The data given in the table-3, showed that all the cultivars different from each other in terms of plant height. Prajwal had maximum plant height (55.30 cm), followed by Arka Nirantra (54.06 cm). On the other hand, cv. Sardar Local and Suvasini had minimum plant height (35.90 and 37.92 cm), respectively. The grand mean value of this character was (44.20 cm).

2.3. Number of leaves per plant
The pertaining data given in table-**3**, clearly inoculates that all genotypes showed wide range of variation with respect to number of leaves per plant. The maximum number leaves per plant (40.97) were found in cv. Srinagar followed by, Bidhan Rajani-2 and Bidhan Rajani-3 (37.33) and minimum number of leaves per plant (21.90) produced by cv. Arka Nirantra. The grand mean value of leaves per plant was recorded (33.26).

2.4. Length of longest leaf (cm)
The data given in table-3, significantly showed variation with respect to length of leaf any the genotypes. The maximum leaf length given by the cultivar Prajwal (54.21 cm) followed by, Arka Nirantra (53.02 cm). The minimum leaf length was found in cultivar Sardar Local (34.89 cm). The grand mean value was (43.29 cm) for leaf length.

2.5. Width of longest leaf (cm)
It is exhibited in table-3,that the maximum leaf width (1.98 cm) was recorded in cv. Hyderabad Single followed by, Suvasini (1.75 cm), whereas, lowest leaf width (1.44 cm) was found in cv. Sardar Local. The grand mean was (1.59cm).

2.6. Number of sprouts per bulb
The data given in table-3, indicates that all the cultivars differed from each other in terms of number of sprouts per bulb. The maximum number of sprouts per bulb (7.37), were found in cv. Prajwal, followed by, Mexican White Double (6.62) and the minimum sprouts (2.80), were recorded in the cv. Arka Nirantra. The mean value of this character was (4.76) sprouts per bulb.

2.7. Days required for visibility of first spike
The data presented in table-3, clearly indicated that the visibility of first spike in all cultivar differed from each other. The maximum visibility of spike (80.24 days) was recorded in the cultivar Arka Nirantra followed by GKTC- 4 (68.00 days) and the minimum days for visibility first spike (61.97 days) were recorded in the cv. Sardar Local followed by Hyderabad Single (62.14 days). The grand mean value of this character was (65.80 days).

2.8. Days taken to opening of first flower
The presented data in table-3, showed wide variation with respect to longevity of spike in days among the genotypes. The maximum opening of first flower in days was recorded in the cultivars (88.89 days) in the cv. Arka Nirantra followed by Prajwal (78.02 days) and the minimum days for opening of first flower days (71.94 days) were also recorded in the cv. Swarn Rekha. The grand mean value of this character was (75.41 days).

2.9. Number of florets per spike
The data presented in table-3, indicated that all genotypes showed wide variation with respected to number of florets per spike. The maximum number of florets per spike were found in the cultivar of Hyderabad Single (46.80) followed by Arka Nirantra (44.67) florets and the minimum number of florets per spike (32.42) was recorded in the cv. Hyderabad Double followed by Mexican Single (32.77). The grand mean value of this character was (37.99).

2.10. Diameter of flower (cm)
It is exhibited from table-3, that all genotypes showed significant variation in flower diameter. The maximum flower diameter was recorded in the cultivar Vaibhav (3.99) cm followed by Prajwal (3.92 cm) and the minimum diameter of flower (2.75 cm) was

recorded in the cv. Phule Rajani. The grand mean value of this character was (3.57 cm).

2.11. Number of spikes per plant
The data given in the table-3, showed significant variation among the genotypes and varied from (14.03-31.57). Cultivar Phule Rajani (31.57) produced maximum no. of spikes per plant followed by Hyderabad Single (25.87) respectively. The minimum spikes per plant was obtained from cv. Pragyaculum (14.03) followed by Sardar Local (14.03). The grand mean value of this characters was (21.52) spikes per plant.

2.12. Diameter of spike (mm)
The data given in table-4, clearly indicates significant variation among the genotypes in diameter of spikes. The maximum diameter of spike (5.88 mm) was recorded in the cultivars Prajwal followed by cv. Suvasini (5.84 mm) and the minimum of diameter spike (5.20 mm) was recorded in the cv. Vaibhav. The grand mean value was obtained for was 5.56 mm.

2.13. Length of spike (cm)
The revealed data in table-4, indicates that the cultivar Prajwal exhibited maximum length of spike (87.86 cm) was followed by Mexican White Double (68.07 cm) and the minimum spike length (62.22 cm) was recorded in GKTC- 4. The grand mean value of this character was (66.50 cm).

2.14. Length of rachis (cm)
The maximum length of rachis was also showed in the table-4, significant variation among the genotypes. The genotype Prajwal (32.79 cm) followed by Pearl Double (28.54 cm) and the minimum length of rachis was recorded in Nirantra Extension (20.36 cm). The grand mean obtained for thus this character was (26.02 cm).

2.15. Longevity of spike
The presented data in table-4, showed wide variation with respect to longevity of spike in days among the genotypes. The maximum longevity of spike (16.00 days) was recorded in to cv. Hyderabad Single followed by Bidhan Rajani-1 (15.93 days) while the minimum longevity of spike (14.37 days) was observed in the cv. Pearl Double. The mean value of this character was (15.45 days).

2.16. Vase life
The data pertained in table-4, clearly indicated that all the genotypes significantly differed from each other in terms of vase life. The maximum vase life was recorded in cultivar GKTC-4 (7.17 days) and minimum vase life was observed with cultivar Sardar Local (6.10 days). The grand mean of this character was (6.54 days).

2.17. Number of bulbs per plant
The revaluated given in table table-4, significant showed bulb per plant wide range of variation with respect to number of bulbs per plant. Among the genotype maximum number of bulbs (57.70) was found in cultivar Phule Rajani followed by Hyderabad single (44.74) and lowest number bulbs per plant were found in cultivar Pragyaculum (22.33) respectively. The grand mean of this character was (32.90) bulbs per plant.

2.18. Number of bulblets per plant
All cultivars indicated wide range of variation as given in table-4 with respect to number of bulblets per plant, the maximum number of bulblets (9.81), were found with cultivar Phule Rajani followed by Hyderabad Single (8.54) bulblets and the minimum number of bulblets per plant were found in cultivar Pragyaculum (3.96). The grand mean value of this character was (6.04) bulblets per plant.

2.19. Yield of bulb per plant (gm)
All cultivars indicated wide range of variation as given in table 4, with respect to yield of bulb per plant, the maximum number yield of bulb were found in cultivar Phulerajani (403.92) gm followed by Arka Nirantra (394.65) gm bulbs and the minimum number of yield of bulbs per plant were found in cultivar Pragyaculum (178.61). The grand mean value of this character was (296.74) gm bulbs per plant.

2.20. Diameter of bulb (mm)
Among the genotypes significant showed wide variation in terms of diameter of bulb as given in table 4, the highest bulb diameter (1.79 mm) was recorded in cultivars Arka Nirantra followed by Nirantra Extension (1.63 mm), while lowest bulb diameter (1.06 mm) was found in cv. Sardar Local. The grand mean of this character was (1.51 mm).

2.21. Yield of bulb and bulblets per plant (q/ha)
All genotypes indicated wide range of variation as given in table-4, with respect to yield of bulb and bulblets per plant, the maximum number yield of bulb and bulblets were found in cultivar Phule Rajani (737.28) followed by Arka Nirantra (701.12) and the minimum number of yield of bulb and bulblets per plant were found in cultivar Pragyaculum (327.70). The grand mean value of this character was (538.84) q/ha bulb and bulblets per plant.

2.22. Yield of bulb (q/ha)
All genotypes indicated wide range of variation as given in table-4, with respect to yield of bulb. The maximum number yield of bulb was found in cultivar Phule Rajani (673.11) and the minimum number of yield of bulb were found in cultivar Pragyaculum (297.45). The grand mean value of this character was (494.30) q/ha bulb**.** The success of plant improvement lies in careful management of variability and techniques to be employed in each case will depend upon clear understanding of the extent and nature of variability. According to Fisher (1918), the continuous variation exhibited by quantitative traits with which most of the plant breeder have to deal with, includes the heritable and non-heritable components. A through screening material study under present investigation exhibited sufficient variability for all twenty two characters namely, Days taken to sprouting, plant height, number of leaves per plant, length of longest leaf, width of longest leaf, number of sprouts per bulbs, days required for visibility of first spike, days taken to opening of first flower, number of florets per spike, diameter of flower, number of spike per bulb, diameter of spike, length of spike, length of rachis, longevity of spike, vase life, number of bulbs per plant, number of bulblets per plant, yield of bulb per plant, diameter of bulb, yield of bulb and bulblets per plant and yield of bulb. The range of variation was 0.05 (width of longest leaf) to 26518.96 (yield of bulbs and bulblets per plant). High amount of genetic variability for many of these traits has also been reported earlier by Ranchana *et al.* 2013 [9].

Table 2(1): Analysis of variance (ANOVA) for twenty-two characters of tuberose.

Source	D.F	Days taken to sprouting	Plant height (cm)	No. of leaves per plant	Length of longest leaf (cm)	Width of longest leaf (cm)	No. of sprouts per bulb	Days required for visibility of first spike	Days taken to opening of first flower	No. of florets per spike	Diameter of flower (cm)	No. of spikes per bulb
Replication	2	0.16	1.10	15.02	1.65	0.00	5.29	0.10	6.18	11.04	0.01	0.14
Treatment	21	0.40**	58.95**	70.18**	58.37**	0.05**	5.42**	37.42**	34.12**	44.30**	0.17**	45.26**
Error	42	0.17	1.17	7.78	1.20	0.01	1.00	0.62	2.58	2.48	0.01	1.71

Table 2(2): Analysis of variance (ANOVA) for twenty-two characters of tuberose.

Source	d.f	Diameter of spike (mm)	Length of spike (cm)	Length of rachis (cm)	Longevity of spike	Vase life	No. of bulbs per plant	No. of bulblets per plant	Yield of bulb per plant(gm)	Diameter of bulb(mm)	Yield of bulb and bulblets per plant (q/ha)	Yield of bulb (q/ha)
Replication	2	0.03	0.00	0.51	0.06	0.01	3.13	0.23	581.63	0.00	1793.14	1628.31
Treatment	21	0.08**	73.68**	24.03**	0.60**	0.19**	149.10*	4.42**	8359.91**	0.06**	26518.96**	23229.93**
Error	42	0.02	0.72	1.46	0.10	0.05	1.89	0.11	335.55	0.02	1035.04	935.74

*,** significant at 5% and 1% level, respectively.

Table 3: Performance of tuberose genotypes for twenty-two characters

Genotypes	Days taken to sprouting	Plant height (cm)	No. of leaves per plant	Length of longest leaf (cm)	Width of longest leaf (cm)	No. of sprouts per bulb	Days required for visibility of first spike	Days taken to opening of first flower	No. of florets per spike	Diameter of flower (cm)	No. of spikes per bulb
Sardar local	13.70	35.90	36.27	34.89	1.44	3.00	61.97	72.60	36.00	3.33	14.43
Srinagar	13.77	43.63	40.97	42.65	1.65	5.83	63.57	73.83	36.40	3.47	22.80
Pearl double	13.43	45.14	35.53	45.09	1.68	3.60	64.83	75.05	40.46	3.54	17.77
Vaibhav	13.70	42.88	35.12	42.47	1.46	4.00	64.80	74.56	40.49	3.99	21.43
Prajwal	13.83	55.30	32.50	54.21	1.64	7.37	67.54	78.02	37.37	3.92	24.57
Suvasini	13.53	37.92	32.59	37.03	1.75	4.57	64.65	74.62	38.46	3.73	22.40
Mex. white double	13.63	44.49	36.19	43.59	1.47	6.62	65.52	75.80	36.80	3.63	23.13
Sikkim sel.	12.60	39.39	25.65	38.48	1.46	3.68	64.48	74.33	32.42	3.34	20.17
Hyderabad double	13.80	43.02	31.11	41.78	1.46	4.76	65.73	75.22	33.96	3.55	23.87
Mex. Single	13.23	42.17	33.77	41.36	1.61	5.46	65.52	74.87	32.77	3.51	22.00
GKTC-4	12.97	40.95	26.96	39.93	1.46	3.43	68.00	77.99	39.18	3.70	18.63
Swarn rekha	13.40	42.38	32.90	41.28	1.45	4.04	65.71	71.94	35.03	3.61	21.60
Phule rajani	13.74	44.89	32.04	43.99	1.72	3.90	64.81	73.74	42.35	2.75	31.57
Arka nirantra	13.67	54.06	21.90	53.02	1.57	2.80	80.24	88.89	44.67	3.69	16.57
Hyderabad single	13.93	45.36	39.07	44.35	1.98	6.90	62.14	72.21	46.80	3.70	25.87
Nirantra extension	13.23	49.08	24.15	47.96	1.64	3.20	65.21	75.32	34.15	3.52	18.33
Pragya culum	12.57	44.83	33.47	43.77	1.74	4.43	64.60	74.45	34.89	3.51	14.03
Arka sugandhi	13.63	42.44	35.22	41.48	1.57	4.13	66.64	75.63	37.71	3.75	22.27
Rajat rekha	13.27	42.16	34.25	41.26	1.50	4.90	64.00	73.53	35.65	3.58	23.47
Bidhan rajani1	13.50	45.31	37.34	44.64	1.61	6.17	66.43	75.48	36.48	3.51	23.97
Bidhan rajani2	13.53	45.63	37.33	44.49	1.61	6.40	65.78	76.03	42.40	3.62	22.60
Bidhan rajani3	13.60	45.51	37.33	44.68	1.60	5.63	65.38	74.99	41.39	3.61	22.00
Mean	13.47	44.20	33.26	43.29	1.59	4.76	65.80	75.41	37.99	3.57	21.52
Range	12.57	35.90	21.90	34.89	1.44	2.80	61.97	71.94	32.42	2.75	14.03
	13.93	55.30	40.97	54.21	1.98	7.37	80.24	88.89	46.80	3.99	31.57
SE	0.33	0.88	2.28	0.90	0.08	0.82	0.64	1.31	1.29	0.09	1.07
CD at 5%	0.67	1.77	4.56	1.80	0.15	1.64	1.29	2.63	2.58	0.19	2.14

Table 4: Performance of Tuberose genotypes for twenty-two characters

Genotypes	Diameter of spike (mm)	Length of spike (cm)	Length of rachis (cm)	Longevity of spike	Vase life	No. of bulbs per plant	No. of bulblet per plant	Yield of bulb per plant(gm)	Diameter of bulb(mm)	Yield of bulb and bulblets per plant (q/ha)	Yield of bulb (q/ha)
Sardar local	5.49	65.70	24.44	15.47	6.10	28.25	5.78	272.93	1.06	491.55	452.54
Srinagar	5.70	64.28	24.65	15.40	6.53	31.32	6.41	270.79	1.34	487.88	451.31
Pearl double	5.50	65.47	28.54	14.37	6.42	32.60	6.21	271.12	1.51	488.67	451.86
Vaibhav	5.20	66.58	28.00	15.63	6.43	33.15	6.50	253.99	1.44	469.50	423.31
Prajwal	5.88	87.86	32.79	15.83	6.77	34.26	7.00	296.51	1.50	545.55	494.18
Suvasini	5.84	64.73	27.51	15.73	6.60	36.57	5.83	316.50	1.39	573.01	527.49
Mex. White double	5.69	68.07	26.27	14.60	6.71	32.20	5.64	267.43	1.48	488.01	445.21
Sikkim sel.	5.77	66.07	28.30	15.77	6.16	30.45	5.17	254.96	1.49	462.70	424.93
Hyderabad double	5.52	65.81	26.76	15.50	6.20	33.31	5.66	288.53	1.57	528.26	480.81
Mex. Single	5.40	65.53	26.51	15.70	6.68	32.56	5.53	281.83	1.56	513.58	469.69
GKTC-4	5.54	62.22	23.29	14.93	7.17	26.74	5.47	292.24	1.58	532.21	487.06
Swarn rekha	5.41	64.21	25.35	15.57	6.75	35.26	6.00	305.81	1.59	559.63	509.68
Phule rajani	5.48	64.00	25.74	14.60	6.22	57.70	9.81	403.92	1.55	737.28	673.11
Arka nirantra	5.62	66.87	21.02	15.23	6.71	27.86	5.70	394.65	1.79	701.12	657.72
Hyderabad single	5.72	64.74	23.54	16.00	6.59	44.74	8.54	380.24	1.52	701.04	633.70
Nirantra extension	5.50	64.83	20.36	15.53	6.32	25.88	5.30	285.37	1.63	516.66	475.21
Pragya culum	5.50	65.32	24.13	15.70	6.37	22.33	3.96	178.61	1.58	327.70	297.45
Arka sugandhi	5.48	66.37	24.70	15.37	6.56	30.02	5.10	270.21	1.47	488.82	450.34
Rajat rekha	5.62	63.89	24.54	15.40	6.53	31.59	5.37	284.31	1.60	515.21	473.83
Bidhan rajani1	5.35	66.12	28.42	15.93	6.70	33.09	5.63	286.82	1.60	519.44	478.01
Bidhan rajani2	5.59	67.66	29.06	15.63	6.58	32.26	5.48	387.12	1.58	686.41	643.41
Bidhan rajani3	5.55	66.66	28.43	15.90	6.71	31.60	6.83	284.37	1.43	520.21	473.93
Mean	5.56	66.50	26.02	15.45	6.54	32.90	6.04	296.74	1.51	538.84	494.30
Range	5.20	62.22	20.36	14.37	6.10	22.33	3.96	178.61	1.06	327.70	297.45
	5.88	87.86	32.79	16.00	7.17	57.70	9.81	403.92	1.79	737.28	673.11
SE	0.10	0.69	0.99	0.26	0.18	1.12	0.27	14.96	0.11	26.27	21.22
CD at 5%	0.20	1.39	1.97	0.52	0.36	2.25	0.54	29.97	0.22	52.64	42.87

Conclusion

Variability studies suggest that all characters are like days taken to sprouting, plant height, number of leaves per plant, length of longest leaf, width of longest leaf, number of sprouts per bulbs, days required for visibility of first spike, days taken to opening of first flower, number of florets per spike, diameter of flower, number of spike per bulb, diameter of spike, length of spike, length of rachis, longevity of spike, vase life, number of bulbs per plant, number of bulblets per plant, yield of bulb per plant, diameter of bulb, yield of bulb and bulblets per plant, yield of bulb to respond to direct selection is more effective. High heritability coupled with high genetic advance were observed for plant height, length of longest leaf, days required for visibility of first spike, length of spike, number of bulbs per plant and number of bulblets per plant showing the influence of additive gene action on the characters hence, may be useful for effective selection. All genotypes indicated wide range of variation as given in table-2, with respect to yield of bulb. The maximum number yield of bulb was found in cultivar Phule Rajani (673.11) and the minimum number of yield of bulb were found in cultivar Pragyaculum (297.45). The grand mean value of this character was (494.30) q/ha bulb.

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