



Genetic Variability and Heritability of Tuberose (*Polianthes tuberosa*) Cultivars under Agro-Climatic Conditions of Prayagraj

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present study entitled "Genetic variability and heritability of Tuberose cultivars under agroclimatic conditions of Prayagraj" was made to identify the suitable variety for growing in Prayagraj, Uttar Pradesh. Fifteen varieties were laid out in Randomized Block Design with three replications during May 2022 to February 2023 at Departmental field of Horticulture, NAI, SHUATS, Prayagraj. The observations recorded on various growth, yield and quality contributing characters. The result from the present investigation revealed the genotypes Arka Suvasini, Mexican single and Hyderabad single are identified as higher spike yield per plot which indicated that these genotypes may be shown for higher yield at Prayagraj Agro-climatic condition. The PCV were higher than GCV

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for all the characters taken in to consideration. High magnitude of GCV and PCV was recorded for No. of bulblets per plant, weight of bulb per plant, yield of bulb per hectare and weight of bulb and least estimates for PCV and GCV was observed for no. of leaves at 6 month after planting. Heritability and genetic advance indicate that the additive nature of gene action and reliability of those characters for selection and emerged as ideal traits for improvement through selection.

Keywords: *Tuberose; genotypes; genetic variability; heritability; growth; yield and quality.*

1. INTRODUCTION

Tuberose (*Polianthes tuberosa* L.) is one of the most important tropical ornamental bulbous flowering plant cultivated for production of long lasting flower spikes. It is popularly known as Rajanigandha. It belongs to the family Asparagaceae and native of Mexico. Single types of Tuberose genotypes are an important commercial cut flower crop due to pleasant fragrance, longer vase-life of spikes, higher returns and wide adaptability to varied climate and soil.

'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. In India, commercially tuberose is cultivated in West Bengal, Tamil Nadu, Karnataka, Andhra Pradesh, Maharashtra, Assam, Chattisgarh, Madhya Pradesh, Haryana and Jammu and Kashmir.

According to APEDA, on 2015-2016 total production area under floriculture is 249 thousand hectares which produce 1,659 metric thousand tonnes of loose flower and 484 thousand metric tons of cut flowers. Generally beds, pots and borders are used for successful cultivation of tuberose. It shows greater adaptability towards varied climate and soil. Quality parameters like spike yield, flower yield and post-harvest quality of tuberose differ according to cultivar to cultivar. Tuberose is cultivated in India due to its prettiness, pleasing fragrance and longer duration of vase life. Flowers are funnel shaped, white in colour and are fragrant so that it is widely cultivated all over India. Tuberose bulbs are found to be used as pharmaceuticals. Paste is prepared from bulbs, along with butter and turmeric, and applied over pimples of infants. And, traditionally it is used as remedy of gonorrhoea [1-3].

The genetic base of Tuberose is not wider as other crops but lot of confusion is there to distinguish among varieties and land races

because very few researchers are involved with this crop. So, it is very much needed to characterize all the varieties and other genotypes so that further research would be easy for breeding programme. A huge quantum of variability exists in this crop with respect to growth habit, flowering behavior, etc. In spite of such variability, very few are having desirable characters in terms of yield and quality. Considering the fact, there is a need for selection as well as maintenance of good germplasm.

Therefore, Present study is an attempt to achieve characterization of the tuberose and to carry out further research and conservation of germplasm [4].

2. MATERIALS AND METHODS

2.1 Experimental Site

The experiment was conducted during the year 2022 in Departmental Research field of Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agricultural Technology and Sciences, Prayagraj. The area is situated on the South of Prayagraj on the right bank of Yamuna at Rewa road at a distance of about 6 km from Prayagraj city. It is situated at 25.8°N latitude and 81.50 °E longitudes on elevation of 98Meters from the sea level. The field experiment was carried out in randomized block design with three replications.

2.2 Experimental Material

The experiment was carried out by 15 Tuberose genotypes viz. Single, Phule rajani, Arka sugandhi, Calcutta double, Sikkim selection, Arka nirantra, Hyderabad single, Hyderabad double, GKTC-4, Mexican single, Arka prajwal, Arka suvasini, Arka vaibhav, Swarna rekha, Arka shringar.

The parameters to be measured are plant height, no. of leaves per plant, days of 50% sprouting, rachis length, days of emergence of flower spike,

no. of florets/spike, no. of spikes per plant, length of floret, diameter of floret, duration of flowering, no. of bulb produced per mother bulb, diameter of bulb, weight of bulb, weight of bulb per plant, no. of bulbs per plant, no. of bulblets per plant, yield of bulb per hectare.

2.3 Statistical Analysis

1. Analysis of variance (Fisher, 1935)
2. Coefficient of variation (Burton and De Vane, 1952)
 - a. Genotypic coefficient of variation (GCV)
 - b. Phenotypic coefficient of variation (PCV)
3. Heritability broad sense (Burton and Devane, 1953)
4. Genetic advance (Johnson et al., 1955)
5. Correlation coefficient analysis (Al Jibouri et al., 1958)

2.4 Climate and Weather

The Prayagraj district is located in the subtropical section of Uttar Pradesh's south-eastern region, which has very hot summers and moderately cold winters. The location's maximum temperature ranges from 46 to 48°C, rarely dropping below 4 or 5°C. The relative humidity ranges from 20% to 94%. Around 1013.4 mm of rain precipitation happens here annually on average. The soil in which the experiment is performed is sandy loam soil.

3. RESULTS AND DISCUSSION

Among all the genotypes studied they showed significant variation for particular trait, it may be due to their diverse origin, evolution from a different geographical region. Mean performance of the genotypes for growth parameter reflects the variation among the genotypes (Tables 1 and 2). Among the 15 genotypes Arka suvasini attained maximum plant height (6 MAP) (64.87 cm) which was followed by Mexican single (64.27 cm) and Arka shringar (63.30 cm). Sikkim selection recorded lowest plant height (52.20 cm). Sikkim selection recorded maximum numbers of leaves (6 MAP) (70.67) which was followed by Arka nirantara (69.87) and Single (66.67), whereas, Hyderabad Single had lowest mean performance for leaf number (72.33). Single had highest mean performance for Rachis length (42.27 cm) and which was followed by Arka shringar (41.52 cm) whereas Arka sugandhi attained only (29.93 cm). For no. of florets per plant among different types of tuberose genotypes, Arka vaibhav attain highest mean

value (61.93) followed by Calcutta double (57.20) and Hyderabad double (57.20) whereas Sikkim selection attained lowest mean (38.13).

Arka sugandhi had the highest mean performance (1.47) for no. of spikes per plant and followed by Hyderabad single (1.33) and Single, GKTC-4, Mexican single and Arka prajwal attained lowest mean value (1.00) among 15 types of tuberose genotypes.

Arka sugandhi attained highest mean value for floret length (4.86 cm) where Arka prajwal had lowest mean value (4.13 cm) for floret length. Among the genotypes Hyderabad single attained highest mean value (3.74 cm) for flower diameter and followed by Sikkim selection (3.71 cm) and the lowest one is Hyderabad double (3.23 cm). GKTC-4 shown highest duration of flowering (90.33) and both Arka suvasini has less duration of flowering among 15 tuberose genotypes.

Arka prajwal shown highest mean value for weight of single bulb (36.03 g) followed by Hyderabad single (29.68) and Single produces lowest mean value for weight of bulb among 15 tuberose genotypes. Phule rajani recorded highest (21.27) for no. of bulbs per plant among 15 tuberose genotypes and Arka nirantara recorded lowest (10.93) value. Among 15 tuberose genotypes, Hyderabad single attained highest mean value (28.73) for bulb yield per hectare whereas Mexican single attained lowest mean value (11.33) for bulb yield per hectare.

3.1 Studies of Genetic Variability

The genetic variability parameters showing phenotypic and genotypic variance, coefficient of variation, heritability in broad sense and genetic advance as a percentage over mean along with their mean values and range are presented in Table 3.

Among 15 tuberose genotypes, For all the traits studied shown higher phenotypic variance than genotypic variance. The maximum PCV (Phenotypic coefficient of variability) and GCV (genotypic coefficient of variability) was observed in case of no. of bulblets per plant (23.959% and 21.898%) followed by yield of bulbs per hectare (22.334%, 21.244%) and weight of bulbs per plant (21.697%, 20.776%) that indicates the presence of considerable variability in these traits and Scope of selection and improvement [5,6]

Table 1. Mean performance of 15 genotypes for growth, flowering and bulbs yield characters of Tuberose (*Polianthes tuberosa* L.)

	Genotypes	PH 3MAP	PH 6MAP	PH 9MAP	NL 3MAP	NL 6MAP	NL 9MAP	DS 50%	RL	NDEFS	NFP
1	Single	37.00	60.40	41.33	29.33	66.67	28.73	41.33	42.67	75.47	45.33
2	Phule rajani	38.07	61.87	44.07	29.73	65.80	29.20	44.07	40.18	72.73	43.47
3	Arka sugandhi	34.13	57.33	41.00	31.67	64.80	34.53	49.20	29.93	75.40	45.47
4	Calcutta double	37.93	61.00	42.27	27.60	65.80	28.67	44.87	38.26	77.20	57.20
5	Sikkim selection	33.80	52.20	39.20	33.67	70.67	35.80	49.40	40.30	81.60	38.13
6	Arka nirantara	37.27	60.20	39.27	29.20	69.87	32.67	43.60	36.32	73.60	43.47
7	Hyderabad single	36.53	58.80	38.87	34.33	62.33	27.73	41.67	32.70	79.73	41.73
8	Hyderabad Double	37.20	62.33	38.33	30.53	65.00	34.60	46.53	34.21	75.47	57.20
9	GKTC-4	36.60	60.53	40.73	28.73	66.00	27.73	46.47	40.88	73.40	40.40
10	Mexican single	38.33	64.27	37.40	32.33	66.60	29.93	40.73	40.39	77.20	51.53
11	Arka prajwal	35.73	58.40	39.07	36.13	66.13	33.27	41.53	38.07	78.33	41.33
12	Arka suvasini	35.13	64.87	38.20	29.33	66.07	31.87	39.20	40.15	77.00	43.27
13	Arka vaibhav	34.40	63.07	40.07	29.53	64.13	35.27	46.07	40.32	81.67	61.93
14	Swarna rekha	35.33	59.13	38.40	36.20	64.00	31.00	45.27	40.84	74.80	53.60
15	Arka shringar	36.27	63.60	36.93	33.47	66.33	30.87	49.60	41.52	82.73	48.67
	Mean	36.25	60.53	39.68	31.45	66.01	31.46	44.64	38.45	77.09	47.52
	CV	4.15	5.26	5.02	8.75	3.29	9.04	7.68	7.00	4.20	10.20
	SEm	0.87	1.84	1.15	1.59	1.25	1.64	1.98	1.55	1.87	2.80
	CD at 5%	2.52	5.33	3.33	4.60	3.63	4.76	5.73	4.50	5.42	8.11
	CD at 1%	3.40	7.19	4.49	6.21	4.89	6.41	7.73	6.08	7.31	10.94
	Minimum	33.80	52.20	36.93	27.60	62.33	27.73	39.20	29.93	72.73	38.13
	Maximum	38.33	64.87	44.07	36.20	70.67	35.80	49.60	42.67	82.73	61.93

PH-plant height, NL- no. of leaves, DS50%- days of 50% sprouting, RL- rachis length, NDEFS- no. of days for emergence of flower spike, NFP- no. of florets per plant, NFS- no. of spikes per plant, FL- floret length, FD- floret diameter, DF- duration of flowering, NBPMB- no. of bulb produced per mother bulb, BD- bulb diameter, WB- weight of bulb, WBPP- weight of bulb per plant, NBPP- no. of bulblets per plant, WBPP- weight of bulb per plant, YBPH- yield of bulbs per hectare

Table 2. Mean performance of 15 genotypes for growth, flowering and bulbs yield characters of tuberose (*Polianthes tuberosa* L.)

Sl. No.	Genotypes	NSP	FL	FD	DF	NBPMB	BD	WB	NBP	NBPP	WBPP	YBPH
1	Single	1.00	4.49	3.45	72.00	6.27	3.01	16.99	11.93	18.87	216.00	19.44
2	Phule rajani	1.07	4.85	3.45	72.33	6.27	2.80	27.29	21.27	21.07	296.60	26.69
3	Arka sugandhi	1.47	4.86	3.69	80.67	5.40	3.11	17.55	15.00	10.80	239.20	21.52
4	Calcutta double	1.07	4.24	3.47	80.00	5.87	2.61	21.26	14.73	15.07	199.80	17.98
5	Sikkim selection	1.20	4.77	3.71	72.00	6.60	2.65	27.42	16.33	20.53	267.27	24.05
6	Arka Nirantara	1.13	4.62	3.33	81.67	6.33	2.96	20.15	10.93	14.13	257.80	23.20
7	Hyderabad single	1.33	4.35	3.74	78.33	7.20	2.64	29.68	19.53	21.67	319.20	28.73
8	Hyderabad Double	1.33	4.51	3.23	82.00	6.27	3.19	24.76	16.07	18.00	223.47	20.11
9	GKTC-4	1.00	4.37	3.67	90.33	6.13	2.77	21.27	13.87	15.33	229.00	20.61
10	Mexican Single	1.00	4.79	3.39	81.67	6.87	3.31	23.57	12.53	14.60	125.87	11.33
11	Arka Prajwal	1.00	4.13	3.25	90.33	6.13	3.23	36.03	15.80	11.27	160.33	14.43
12	Arka Suvasini	1.13	4.65	3.41	71.33	5.33	2.54	21.91	13.93	14.40	234.00	21.06
13	Arka Vaibhav	1.07	4.54	3.37	71.67	5.93	2.81	27.03	13.80	11.67	228.87	20.60
14	Swarna rekha	1.20	4.28	3.28	90.33	5.27	2.85	27.39	16.20	13.20	302.33	27.21
15	Arka Shringar	1.20	4.23	3.30	72.33	5.67	2.74	20.69	19.40	18.40	259.73	23.37
	Mean	1.15	4.51	3.45	79.13	6.10	2.88	24.20	15.42	15.93	237.30	21.35
	CV	10.04	5.29	5.28	6.24	6.40	6.10	7.40	7.86	9.72	10.31	6.89
	SEm	0.07	0.14	0.11	2.85	0.23	0.10	1.03	0.70	0.89	14.13	0.85
	CD at 5%	0.19	0.40	0.30	8.26	0.65	0.29	3.00	2.03	2.59	40.92	2.46
	CD at 1%	0.26	0.54	0.41	11.14	0.88	0.40	4.04	2.74	3.49	55.20	3.32
	Minimum	1.00	4.13	3.23	71.33	5.27	2.54	16.99	10.93	10.80	125.87	11.33
	Maximum	1.47	4.86	3.74	90.33	7.20	3.31	36.03	21.27	21.67	319.20	28.73

PH-plant height, NL- no. of leaves, DS50%- days of 50% sprouting, RL- rachis length, NDEPS- no. of days for emergence of flower spike, NFP- no. of florets per plant, NFS- no. of spikes per plant, FL- floret length, FD- floret diameter, DF- duration of flowering, NBPMB- no. of bulb produced per mother bulb, BD- bulb diameter, WB- weight of bulb, WBPP- weight of bulb per plant, NBPP- no. of bulblets per plant, YBPH- yield of bulbs per hectare

Table 3. Estimation of component of variance and genetic parameters for 21 character growth, flowering and bulb yield of 15 genotypes in tuberose

Sl. No.	Characters	ECV	GCV	PCV	h ²	GA 5%	GA 5% M
1	Plant height (3MAP)	4.15	3.20	5.24	37.30	1.46	4.03
2	Plant height (6MAP)	5.26	4.32	6.81	40.24	3.42	5.64
3	Plant height (9MAP)	5.02	3.87	6.34	37.30	1.93	4.87
4	Number of leaves (3MAP)	8.75	7.16	11.31	40.06	2.94	9.33
5	Number of leaves (6MAP)	3.29	2.53	4.15	37.30	2.10	3.19
6	Number of leaves (9MAP)	9.04	7.15	11.52	38.49	2.87	9.14
7	Days to 50% sprouting	7.68	5.94	9.71	37.45	3.34	7.49
8	Rachis length (cm)	7.00	8.51	11.02	59.61	5.20	13.54
9	Number of days for emergence of flower spike	4.20	3.31	5.35	38.23	3.25	4.21
10	Number of florets per plant	10.20	13.90	17.24	64.98	10.97	23.08
11	Number of spikes per plant	10.04	11.04	14.92	54.75	0.19	16.83
12	Floret length(cm)	5.29	4.38	6.87	40.70	0.26	5.76
13	Floret diameter(cm)	5.28	4.08	6.67	37.42	0.18	5.14
14	Duration of flowering (days)	6.24	8.26	10.35	63.68	10.75	13.58
15	Number of bulb produced per mother bulb	6.40	8.22	10.41	62.27	0.82	13.36
16	Bulb diameter(cm)	6.11	7.61	9.76	60.87	0.35	12.24
17	Weight of bulb (gm)	7.40	20.39	21.70	88.35	9.56	39.49
18	No. of bulb per plant	7.86	18.23	19.85	84.31	5.32	34.47
19	Number of bulbets per plant	9.72	21.90	23.96	83.54	6.57	41.23
20	Weight of bulb per plant	10.31	20.78	23.19	80.24	90.97	38.34
21	Yield of bulbs per hectare	6.89	21.24	22.33	90.48	8.89	41.63

The minimum difference between GCV and PCV were observed for Rachis length, duration of flowering, no. of bulb produced per mother bulb respectively which indicates a little influence of environmental effect on the phenotypic expression of those respective characters.

Heritability in broad sense was estimated highest (90.48%) for yield of bulbs per hectare, 88.35% for Weight of bulb and 84.31% for no. of bulbs per plant. However, genetic advance expressed as percent of mean was found to be highest in case of no. of florets per plant (10.97%) followed by duration of flowering (10.75%). This shows the action of additive genes in their inheritance pattern as lesser influence of environment in the expression of the particular traits observed. The other traits exhibited high heritability associated with moderate and low genetic advance, indicating the presence of non-additive gene action. Similar genetic behavior has been reported by [7]. In this context, a general interpretation can be drawn as GCV alone is not sufficient for determination of extent of variation that perpetuate from one generation to the next. GCV together with heritability estimates would give a better picture of extent of advance that can be made through selection. A character with high heritability and high genetic advance may

positive due to the action of additive genes. The characters without such combination appear generally because of the non-additive gene action [8-10].

The selection of traits with these gene actions will be useful for crop improvement.

4. CONCLUSION

Based on the present investigation it is concluded that on the basis of *per se* performance the maximum plant height (6MAP) and maximum no. of leaves (6MAP) was seen in Arka suvasini and Sikkim selection. Mexican single takes minimum days to sprouting of bulb and have maximum bulb diameter. The maximum no. of spikes per plant, floret length was seen in Arka sugandhi. The maximum no. of florets per plant was recorded in Arka vaibhav. The floret diameter, no. of bulb produced per mother bulb, weight of bulb per plant, no. of bulbets per plant and yield of bulbs per hectare was recorded maximum in Hyderabad single. The wider genetic variability observed among fifteen genotypes may be due to the adaption of these genotypes to specific environmental conditions obviously the results showed a rich diversity exist between the germplasm collections from different geographical regions of the world.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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