

Genetic variability and heritability of Tuberose (*Polianthes tuberosa*) cultivars under agro-climatic conditions of Prayagraj

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 2022 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 for all the characters taken in 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~~ months 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:

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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, long 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 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. Tuberose is cultivated in India due to its prettiness, pleasing fragrance and long duration of vase life. Flowers are funnel shaped, white in colour and are

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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 a remedy of gonorrhoea.

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.

genotypes viz. Single, Phulera jani

2. MATERIAL 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 Rewaroad at a distance of about 6 km from Prayagraj city. It is situated at 25.8°N latitude and 81.50°E longitude and an elevation of 98.4 meters from sea level (fig. 1).

The experiment was carried out by 15 Tuberose

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Comment [Pa3]: Fig. 1. Localization of study area

, Arka sugandhi, Calcutta double, Sikkimselection, Arkanirantara, Hyderabadingle, Hyderabad double, GKTC-4, Mexicansingle, Arka prajwal, Arka suvasini, Arkavaibhav, Swarnarekha, Arkashringar.

2.2. Climate and weather

The area of Prayagraj district comes under subtropical belt in the South East of Uttar Pradesh, which experience extremely hot summer and fairly cold winter. The maximum temperature of the location reaches upto 46°C - 48°C and seldom falls as low as 4°C - 5°C. The relative humidity ranges between 20 to 94 percent. The average rainfall in this area are around 1013.4 mm annually.

3. RESULT 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 (Table 1 and 2). Among the 15 genotypes Arka suvasini attained maximum plant height (6MAP) (64.87 cm) which was followed by Mexicansingle (64.27 cm) and Arkashringar (63.30 cm). Sikkimselection recorded lowest plant height (52.20 cm). Sikkimselection recorded maximum number of leaves (6MAP) (70.67) which was followed by Arkanirantara (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 Arkashringar (41.52 cm) whereas Arka sugandhi attained only (29.93 cm). For number of florets per plant among different types of tuberose genotypes, Arkavaibhav attained highest

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mean value (61.93) followed by Calcuttadouble (57.20) and Hyderabaddouble (57.20) whereas Sikkim selection attained lowest mean (38.13).

Arkasugandhi 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 Arkaprajwal 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 Arkaprajwal 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 Hyderabaddouble (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. Phulrajani recorded highest (21.27) for no. of bulbs per plant among 15 tuberose genotypes and Arkanirantar 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 represented in Table 3.

Among 15 tuberose genotypes, for all the traits studied shown higher phenotypic variance than genotypic variance.

The maximum PCV and GCV 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 (21.69768%, 20.77678%) that indicates the presence of considerable variability in these traits and scope of selection and improvement (Ranchana *et al.*, 2013).

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 higher heritability associated with moderate and low genetic advance, indicating the presence of non-additive gene action. Similar genetic behavior has been reported by (Chaudhary *et al.*, 2018). In this context,

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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 be positive due to the action of additive genes. The characters without such combination appear generally because of the non-additive gene action. The selection of traits with these gene actions will be useful for crop improvement.

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

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	Genotypes	PH3MAP	PH6MAP	PH9MAP	NL3MAP	NL6MAP	NL9MAP	DS50%	RL	NDEFS	NFS
1	Single	37.00	60.40	41.33	29.33	66.67	28.73	41.33	42.67	75.47	45.33
2	Phulerajani	38.07	61.87	44.07	29.73	65.80	29.20	44.07	40.18	72.73	43.47
3	Arkasugandhi	34.13	57.33	41.00	31.67	64.80	34.53	49.20	29.93	75.40	45.47
4	Calcuttadouble	37.93	61.00	42.27	27.60	65.80	28.67	44.87	38.26	77.20	57.20
5	Sikkimselection	33.80	52.20	39.20	33.67	70.67	35.80	49.40	40.30	81.60	38.13
6	Arkanirantara	37.27	60.20	39.27	29.20	69.87	32.67	43.60	36.32	73.60	43.47
7	Hyderabadsingle	36.53	58.80	38.87	34.33	62.33	27.73	41.67	32.70	79.73	41.73
8	HyderabadDouble	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	Mexicansingle	38.33	64.27	37.40	32.33	66.60	29.93	40.73	40.39	77.20	51.53
11	Arkaprajwal	35.73	58.40	39.07	36.13	66.13	33.27	41.53	38.07	78.33	41.33
12	Arkasuvasini	35.13	64.87	38.20	29.33	66.07	31.87	39.20	40.15	77.00	43.27
13	Arkavaibhav	34.40	63.07	40.07	29.53	64.13	35.27	46.07	40.32	81.67	61.93
14	Swarnarekha	35.33	59.13	38.40	36.20	64.00	31.00	45.27	40.84	74.80	53.60
15	Arkashringar	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
	CDat5%	2.52	5.33	3.33	4.60	3.63	4.76	5.73	4.50	5.42	8.11
	CDat1%	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

TABLE:2.-Mean performance of 15 genotypes for growth, flowering and bulbs yield characters of Tuberose (*Polianthes tuberosa* L.)

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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	Phulerajani	1.07	4.85	3.45	72.33	6.27	2.80	27.29	21.27	21.07	296.60	26.69
3	Arkasugandhi	1.47	4.86	3.69	80.67	5.40	3.11	17.55	15.00	10.80	239.20	21.52
4	Calcuttadouble	1.07	4.24	3.47	80.00	5.87	2.61	21.26	14.73	15.07	199.80	17.98
5	Sikkimselection	1.20	4.77	3.71	72.00	6.60	2.65	27.42	16.33	20.53	267.27	24.05
6	ArkaNirantara	1.13	4.62	3.33	81.67	6.33	2.96	20.15	10.93	14.13	257.80	23.20
7	Hyderabadsingle	1.33	4.35	3.74	78.33	7.20	2.64	29.68	19.53	21.67	319.20	28.73
8	HyderabadDouble	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	MexicanSingle	1.00	4.79	3.39	81.67	6.87	3.31	23.57	12.53	14.60	125.87	11.33
11	ArkaPrajwal	1.00	4.13	3.25	90.33	6.13	3.23	36.03	15.80	11.27	160.33	14.43
12	ArkaSuvasini	1.13	4.65	3.41	71.33	5.33	2.54	21.91	13.93	14.40	234.00	21.06
13	ArkaVaibhav	1.07	4.54	3.37	71.67	5.93	2.81	27.03	13.80	11.67	228.87	20.60
14	Swarnarekha	1.20	4.28	3.28	90.33	5.27	2.85	27.39	16.20	13.20	302.33	27.21
15	ArkaShringar	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
CDat5%	0.19	0.40	0.30	8.26	0.65	0.29	3.00	2.03	2.59	40.92	2.46
CDat1%	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

TABLE:3.- Estimation of component of variance and genetic parameters for 21 character growth, flowering and bulb yield of 15genotypesin Tuberose

Sl.No.	Characters	ECV	GCV	PCV	h2	GA5%	GA5% M
1	Plantheight(3MAP)	4.15	3.20	5.24	37.30	1.46	4.03
2	Plantheight(6MAP)	5.26	4.32	6.81	40.24	3.42	5.64
3	Plantheight(9MAP)	5.02	3.87	6.34	37.30	1.93	4.87
4	Numberofleaves (3MAP)	8.75	7.16	11.31	40.06	2.94	9.33
5	Numberofleaves (6MAP)	3.29	2.53	4.15	37.30	2.10	3.19
6	Numberofleaves (9MAP)	9.04	7.15	11.52	38.49	2.87	9.14
7	Daysto 50%sprouting	7.68	5.94	9.71	37.45	3.34	7.49
8	Rachislength(cm)	7.00	8.51	11.02	59.61	5.20	13.54
9	Numberofdaysforemergenceofflowerspike	4.20	3.31	5.35	38.23	3.25	4.21
10	Numberofflorets perplant	10.20	13.90	17.24	64.98	10.97	23.08

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11	Numberofspikes per plant	10.04	11.04	14.92	54.75	0.19	16.83
12	Floretlength(cm)	5.29	4.38	6.87	40.70	0.26	5.76
13	Floretdiameter(cm)	5.28	4.08	6.67	37.42	0.18	5.14
14	Durationofflowering(days)	6.24	8.26	10.35	63.68	10.75	13.58
15	Numberofbulb produced per motherbulb	6.40	8.22	10.41	62.27	0.82	13.36
16	Bulbdiameter(cm)	6.11	7.61	9.76	60.87	0.35	12.24
17	Weightofbulb(gm)	7.40	20.39	21.70	88.35	9.56	39.49
18	No. ofbulb perplant	7.86	18.23	19.85	84.31	5.32	34.47
19	Numberofbulbetsper plant	9.72	21.90	23.96	83.54	6.57	41.23
20	Weightof bulbperplant	10.31	20.78	23.19	80.24	90.97	38.34
21	Yieldof bulbs perhectare	6.89	21.24	22.33	90.48	8.89	41.63

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4. CONCLUSION

Based on the present investigation it is concluded that on the basis of per se performance the maximum plant height (6M AP) and maximum no. of leaves (6MAP) was seen in Arkasuvasini 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 Arkasugandhi. The maximum no. of florets per plant was recorded in Arkavaibhav. The floret diameter, no. of bulb produced per mother

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REFERENCES

Chaudhary, M., Malik, S., Kumar, M., Singh, R., Ujjwal, V., and Panwar, A. (2018). Study the performance of tuberose genotypes for twenty-two characters on tuberose germplasm. *Journal of Pharmacognosy and Phytochemistry*, 7(6): 99-1997.

Dimri, S., Punetha, P., Bohra, M. and Tanuja. (2017). Screening of suitable germplasm of tuberose (*Polianthes tuberosa* L.) for mid hill conditions of Garhwal Himalayas. *International Journal of Agricultural Sciences Research*, 7:499-506.

Prakash, S., Singh, K.P., Singh, M. and Shahi, B.P. (2016) Varietal evaluation of tuberose for better performance in Saharanpur district under western plain zone. *Annals of Horticulture*, 9(1): 101-104.

Ranchana, P., Kannan, M. and Jawaharlal, M. (2013). Genetic and correlation studies in

double genotypes of tuberose (*Polianthes tuberosa*) for assessing the genetic variability. *Advances in Crop Science Technology*, 1:109. doi:10.4172/2329886

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bulb, weight of bulb per plant, no. of bulblets 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 adaptation 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.

assessment of genetic parameters: yield, quality traits and performance of single genotypes of tuberose (*Polygonum tuberosum* L.) *Advances in Crop Science Technology*, 1(3):1-5.

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Sirohi, U., Kumar, M., Chauhan, P., Kumar, R., Chand, P. and Chaudhary, V. (2017).

Morphological variation and genetic diversity in tuberose (*Polygonum tuberosum* L.) Genotypes for growth, yield and essential oil traits. *Chemical Science Review and Letters*, 6(24): 2086-2093.

Tyagi, A., Kumar, V. and Kumar, S. (2008). Performance of tuberose cultivars under Meerut conditions. In: *Book of Abstracts of National Symposium on Recent Advances in Floriculture*, Gujarat Agricultural University, Navsari, Gujarat, pp. 27.

Vijayalakshmi, M., Manohar, R.A., Padmavatyamma, A.S. and Sivasankar. (2010). Evaluation and variability studies in tuberose (*Polygonum tuberosum*) single cultivars. *Journal of Ornamental Horticulture*, 13(4): 251-256

Vijayalaxmi, G.P.
and Lakshmidewa
mma, T.N. (2012). Evaluation of
Tuberose
(*Polianthes tuberosa*) Varieties for Qu
ality Traits. *Advances in Life Science*, 5(
12):370-371.

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