Madras Agric. J., 102 (4-6): 182-184, June 2015
https://doi.org/10.29321/MAJ.10.001095

Genetic Divergence Analysis in Tuberose

P. Ranchana*, M. Kannan and M. Jawaharlal
Department of Floriculture and Landscaping, Horticultural College and Research Institute,
Tamil Nadu Agricultural University, Coimbatore - 641003

An experiment on genetic divergence analysis in tuberose was carried out at Department of Floriculture and Landscaping, Tamil Nadu Agricultural University, Coimbatore during 2012. Genetic divergence of the double type tuberose genotypes based on yield and component characters were estimated using D^2 statistic. Divergence analysis grouped the genotypes into three clusters, respectively. The cluster means revealed the best cluster for various growth and flowering traits depending upon the aim of the breeding, hence the best genotype can be selected from different clusters as parents in a hybridization programme. Cluster I had high mean values for flowering duration (22.08) and rachis length (20.36) and low mean values for plant height (32.63), number of leaves per plant (15.00), spike length (22.46), number of florets per spike (27.00) and floret length (4.01). The cluster II possessed high mean values for plant height (43.69), number of leaves per plant (24.73), spike length (126.15), number of florets per spike (35.48), floret length (6.32), weight of florets per spike (0.86), number of spikes per m^2 (1.81), yield of florets per plot (2 * 2 m) (35.28) Yield of florets per plot (2 * 2 m) contributed maximum (35.67 %) towards genetic divergence, followed by weight of florets per spike (24.54 %). Genotypes were much in use having the above mentioned characters in cluster II would offer a good scope for the improvement of this crop through hybridization and rational selection.

Key words: Tuberose, D^2 analysis, Selection criteria

Tuberose (*Polianthes tuberosa)* is one of the most important cut flower. It is an ornamental bulbous plant, native of Mexico and belongs to the family Amaryllidaceae (Benschop, 1993). There are only two types of tuberose (Single and Double) cultivated in the world. Ornamental plants have prime importance in maintaining ecological balance and checking pollution in surroundings. About 45% of world trade in floriculture products goes to cut flower. In India, it occupies a prime position in the floriculture industry. Tuberose is an important commercially grown flower crop much adored for its colour, elegance and fragrance. It occupies a prime position, because of its popularity as a cut flower, loose flower, as well as for its potential in perfume industry. Waxy white flowering spikes of single as well as double flower tuberose impregnate the atmosphere with their sweet fragrance and longer keeping quality of flower spikes (Sadhu and Bose, 1973) and are in great demand for making floral arrangement and bouquets in major cities of India. Single types of tuberose are cultivated on a large scale in Tamil Nadu, Karnataka, West Bengal and Maharastra. To a lesser extent it is also grown in Andhra Pradesh, Haryana, Delhi, Uttar Pradesh and Punjab. The flowers are also used for the extraction of natural aromatic oil much needed for the high cost perfume industry. The essential oil is exported at an attractive price to France, Italy and other countries (Sadhu and Bose, 1973). There are only a few varieties and hybrids of tuberose under cultivation *viz.,* Calcutta single, Calcutta double, Hyderabad single, Hyderabad double, Kahikuchi single, Mexican single, Navsari local, Pearl double, Phule rajani, Prajwal, Pune single, Shringar, Suvasini, Vaibhav and Variegated single. In plant breeding, genetic diversity plays an important role because hybrids between genetically diverse parents manifest greater heterosis than those between closely related parents (Ramanujam *et al.,* 1974; Singh and Sharma, 1989 and Ivy *et al.,* 2007).

The D^2 technique based on multivariate analysis developed by Mahalanobis (1936) is the most effective method for quantifying the degree of genetic diversity among genotypes, which helps in selecting the parents for hybridization and the magnitude of genetic diveristy among all the possible pairs of population at genotypic level before effecting actual crosses in modeling the genotypes in a desired genetic architecture. The scope for improvement in a crop is dependent on the genetic diversity present in available germplasm. Keeping this in view the genetic divergence study was undertaken in tuberose.

Materials and Methods

The experiment was carried out at Botanical gardens, Tamil Nadu Agricultural University,

*Corresponding author email :ranchanahorti@gmail.com

Coimbatore during 2012. It is situated at 11^0 02" N latitude, 76^0 57" E longitude and 426.76 m above mean sea level. Experimental materials consisted of five double genotypes of tuberose *viz.,* Calcutta double, Hyderabad double, Pearl double, Suvasini and Vaibhav. The experiment was laid out in randomized block design (RBD) with three replications. The soil was brought to a fine tilth by giving four deep ploughings. Weeds, stubbles, roots *etc*., were removed. At the time of last ploughing, FYM was applied at the rate of 25 t ha^{-1}. After levelling, raised beds of 1.5 x 1.5 m were formed and the medium sized bulbs of 3.0 - 3.5 cm diameter weighing about 25 g each were planted at a spacing of 45 x 30 m, which accommodated 7 plants per m^2. Uniform cultural practices were followed throughout the experimentation. Observations were recorded from 10 randomly selected plants in each genotype for days taken for sprouting, plant height, number of leaves per clump, days to spike emergence, flowering duration, spike length, rachis length, number of florets /spike, length of the floret, weight of the florets/spike, number of spikes/m^2, yield of florets/ plot (2 * 2 m). Genetic diversity was studied following Mahalanobis's (1936) generalized distance (D^2) extended by Rao (1952). Clustering of genotypes was done according to Tocher's method (Rao, 1952).

Results and Discussion

The D^2 technique based on multivariate analysis developed by Mahalanobis (1936) is the most effective method for quantifying the degree of genetic diversity among genotypes, which helps in selecting the parents for hybridization. In plant breeding, genetic diversity plays an important role because hybrids between genetically diverse parents manifest greater heterosis than those between closely related parents (Ramanujam *et al.*, 1974 and Singh and Sharma, 1989).

Table 1. Composition of D^2 cluster and their geographical origin in tuberose (Double types)

Cluster	Total no.of types	Name of types	Origin
I	3	Suvasini	IIHR, Bangalore
		Calcutta Double	Calcutta
		Hyderabad Double	Hyderabad
II	1	Vaibhav	MPKV, Rahuri, Maharastra
III	1	Pearl Double	Mexico

Table 2. Intra and Inter cluster distance variation for different characters in tuberose (Double types)

Clusters	I	II	III
I	12.62	15.36	1.76
II		0.00	35.23
III			11.23

Table 3. Cluster means for different characters in tuberose (Double types)

Clusters	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12
I	14.76	**32.63**	**15.00**	20.97	**22.08**	**22.46**	**20.36**	**27.00**	**4.01**	0.81	1.53	32.78
II	**10.34**	**43.69**	**24.73**	**2.91**	18.76	**126.15**	18.12	**35.48**	**6.32**	**0.86**	**1.81**	**35.28**
III	**15.32**	36.43	20.53	**41.28**	**12.98**	123.45	**13.46**	32.23	4.07	**0.72**	**1.08**	**19.62**

X1. Days taken for sprouting of bulb
X2. Plant height
X3. No. of leaves per plant
X4. Days to spike emergence
X5. Flowering duration
X6. Spike length
X7. Rachis length
X8. Number of florets/ spike
X9. Length of the floret
X10. Weight of florets per spike
X11. Number of spikes/m^2
X12. Yield of florets/ plot (4 * 1 m)

The genotypes were significantly different from each other. D^2 values also varied to a larger extent. The five double genotypes of tuberose were grouped into three clusters indicating wide genetic diversity in the present material (Table 1 and 2). Among the three clusters, cluster I had three genotypes; while cluster II and III had only one genotype from the same geographical area and hence, they were not grouped into different clusters. In the present study, all clusters had genotypes from different geographical origin indicated that factors other than geographical diversity might be responsible for such grouping. Moll *et al.*, (1962) regarded eco-geographical diversity as a reasonable index of genetic divergence. But eco-geographical diversity might be an inferential criterion, which obviously could not always be used for the discrimination among the populations inhibiting the similar agroclimatic regions. Moreover, geographic distribution and genetic diversity as estimated by D^2 statistics need not be directly related (Murthy and Arunachalam, 1966).

The intra and inter cluster distance indicates that the crossing of genotypes between these three clusters in double types with high genetic divergence might result in a high degree of heterosis as indicated by Moll *et al.,* (1962). A considerable divergence among Calcutta, Andhra Pradesh and Karnataka types distributed into different clusters showed varying degree of inter cluster genetic divergence, which might be desirable for heterosis breeding.

Table 4. Contribution of each character to divergence in tuberose (Double types)

Characters	No. of first rank	Percentage of contribution
Days taken for sprouting of bulb	0	0.00
Plant height	9	2.27
Number of leaves per plant	1	0.24
Days to spike emergence	1	0.23
Flowering duration	3	0.72
Spike length	8	7.22
Rachis length	1	0.25
Number of florets per spike	5	0.51
Floret length	4	9.57
Weight of florets per spike	6	24.54
Number of spikes per m^2	7	1.85
Yield of florets per plot (4 * 1 m)	2	35.67

Cluter mean for twelve characters (Table 3, Fig.

1) indicated that in Cluster I had high mean values for flowering duration (22.08) and rachis length (20.36) and low mean values for plant height (32.63), number of leaves per plant (15.00), spike length (22.46), number of florets per spike (27.00) and floret

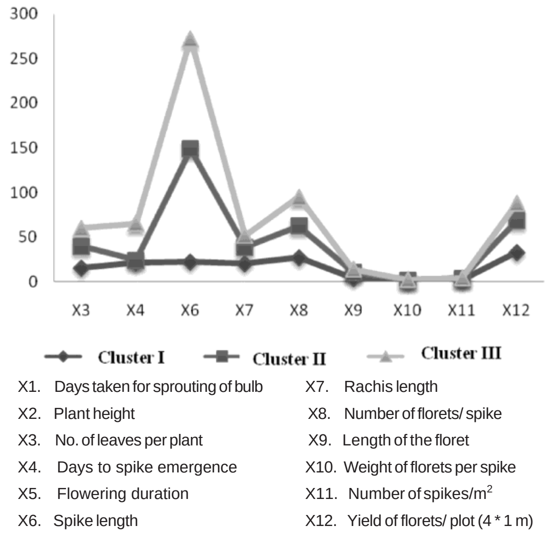

Fig. 1. Cluster mean for yield per plant in double types of tuberose

length (4.01). The cluster II possessed high mean values for plant height (43.69), number of leaves per plant (24.73), spike length (126.15), number of florets per spike (35.48), floret length (6.32), weight of florets per spike (0.86), number of spikes per m^2 (1.81),

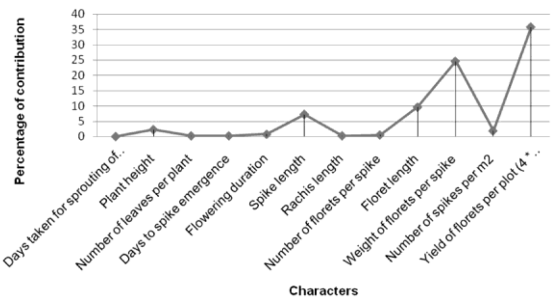

Fig. 2. Contribution of each character to divergence in tuberose (Double types)

yield of florets per plot (2 * 2 m) (35.28) while it was low for days taken for sprouting of bulb (10.34) and days to spike emergence (2.91). Cluster III showed the high mean values for days taken for sprouting of bulb (15.32), days to spike emergence (41.28) and low mean values for flowering duration (12.98), rachis length (13.46), weight of florets per spike (0.72), number of spikes per m^2 (1.08) and yield of florets per plot (2 * 2 m) (19.62).

In double types yield of florets per plot (2 * 2 m) contributed maximum (35.67 %) towards genetic divergence, followed by weight of florets per spike (24.54 %) (Table 4, Fig. 2). This is in consonanace with the findings of Vairavan *et al.* (1973). Further, yield of flowers per plot showed high heritability. Based on the mean performance and genetic divergence, the genotype Suvasini (Double) has been identified for commercial cultivation.

References

Benschop, M. 1993. Polianthes. In: De Hertogh, A., Le Nard, M. (Eds.), The physiology of flower bulbs. *Elsevier*, Amsterdam, The Netherlands, pp**:** 589 - 601.

Ivy, N.A., Uddin, M.S., Sultana, R., Masud, M.M. 2007. Genetic divergence in maize (*Zea mays L.*). *Bangladesh J. Breed. Genet*., **20 (1):** 53 - 56.

Mahalonobis, P.C. 1936. On the generalized distance in statistics. *Proc. Natn. Inst. Sci.* India*,* **2:** 49 - 55.

Moll, R.H., Salhuana, W.S. and Robinson, H.F. 1962. Heterosis and genetic diversity in varietal crosses of maize. *Crop. Sci***., 2:** 197-198.

Murthy, B.R., Arunachalam, V. 1966. The nature of divergence in relation to breeding system in some crop plants. *Indian J. Genet*., **26:** 188-198.

Ramanujam, S., Tiwari, A.S. and Mehra, R.B. 1974. Genetic divergence and hybrid performance in mung bean. *Theoret. Appl. Genetics*, **25:** 211 – 214.

Rao, C.R. 1952. Advanced Statistical Methods in Biometrical Research*. John Wiley and Sons, publications*. New York, **34:** 213-215.

Sadhu, M.R., Bose, T.K. 1973. Tuberose for most artistic garlands. *Indian Hort.,* **18(3):** 17 -20.

Singh, S.P., Sharma, J.R. 1989. *Theort. Appl. Genetics*, **79:** 841 – 846.

Vairavan, S., Siddia, V.A., Arunachalam, V., Swaminathan, M.S. 1973. A study on the nature of genetic divergence. *Appl. Gent*., **43:** 213-221.

Received after revision: January 21, 2015; Accepted: April 4, 2015