Advances in Crop Science and Technology

Ranchana et al., Adv Crop Sci Tech 2013, 1:3
http://dx.doi.org/10.4172/2329-8863.1000109

Research Article Open Access

Genetic and Correlation Studies in Double Genotypes of Tuberose (*Polianthes tuberosa*) for Assessing the Genetic Variability

Ranchana P*, Kannan M and Jawaharlal M

Department of Floriculture and Landscaping, HC& RI, TNAU, Coimbatore-3, India

Abstract

Five genotypes of tuberose (double) were evaluated for twelve different parameters to ascertain the genetic variability and association among the characters during the year 2011-12 at Tamil Nadu Agricultural University, Coimbatore. The results of the experiment revealed that 'Suvasini' showed its superiority for certain parameters *viz.,* plant height, number of leaves per plant, number of florets/ spike, length of the floret, weight of florets per spike, number of spikes/m^2 and yield of florets/ plot (2*2 m). The phenotypic coefficient of variation (PCV) was higher than genotypic coefficient of variation (GCV) for all twelve characters studied. The higher PCV and GCV estimates were found for number of florets/spike. High heritability with high genetic advance was observed for number of florets per spike, number of spikes/m^2, rachis length and yield of florets per plot (2×2 m). The correlation studies revealed that plant height exhibited positive correlation with spike length, yield of florets/plot (2×2 m), number of florets per spike, flowering duration, number of leaves per plant, weight of florets per spike, number of spikes/m^2, rachis length and length of the floret. There exists a positive relationship of number of leaves per plant with weight of florets per spike, yield of florets/plot (2×2 m), spike length, flowering duration, and number of florets per spike, length of the floret, number of spikes/m^2 and rachis length. Spike length exhibited positive and significant association with yield of florets/ plot (2×2 m), number of florets per spike, weight of florets per spike, number of spikes per m^2, length of the floret and rachis length.

Keywords: Tuberose; Double types; Heritability; Genetic advance; Correlation

Introduction

The top cut flowers like rose, carnation, gladiolus, tuberose, chrysanthemum, etc., are commonly and frequently demanded in both local as well as international market. Among them, tuberose (*Polianthes tuberosa)* is one of the most important flowers used for both cut and loose flower purpose. There are only two types of tuberose (Single and Double) cultivated in the world. Among these two types, double flowered types are highly preferred for cut flower purpose. As of commercial importance, the genotypes *viz.* Calcutta Double, Hyderabad Double, Pearl Double, Suvasini and Vaibhav are cultivated throughout India. It is an ornamental bulbous plant, native of Mexico and belongs to family *Amaryllidaceae*. 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 [1,2], and are in great demand for making floral arrangement and bouquets in major cities of India. A huge quantum of variability exists in this crop with respect to growth habit, flowering behavior, etc. Inspite 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. The study of interrelationship of various characters in the form of correlation is an important aspect in crop breeding. Knowledge of correlation studies helps the plant breeder to ascertain the real components of yield and provide an effective basis of selection. The characters contributing significantly to desirable traits can be significantly identified, and can be used as alternate selection criteria in crop improvement programme. Very little work on this aspect has been reported so far, hence the present study to find out the association among important quantitative characters in tuberose.

Materials and Methods

The study was carried out at Botanical gardens, Tamil Nadu Agricultural University, Coimbatore, during the year 2011-2012. It is situated at 11°02" N latitude, 76°57" E longitude and 426.76 m above mean sea level. Experimental material consists of five 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 m width and convenient length were formed and the medium sized bulbs (3.0-3.5 cm diameter) of about 25 grams were planted, with a spacing of 45×20 m which accommodates 11 plants per m^2. Uniform cultural practices were followed throughout the experimentation. The data were recorded on five plants from each genotype in each replication for 12 characters *viz.,* days taken for sprouting of bulb (days), plant height (cm), number of leaves per clump, days to spike emergence, flowering duration, spike length (cm), rachis length (cm), number of florets/spike, length of the floret, weight of the florets/spike, number of spikes/m^2, yield of florets/plot. Data were analysed and presented in tabular form. Data were put to statistical analysis as per [3] Genetic parameters like genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were estimated according to Burton and Vane [4], and heritability as suggested by Weber and Moorthy [5] Correlation analysis was carried out as per the formulae suggested by Fisher [6]. The significance of phenotypic and genotypic correlation coefficients

***Corresponding author:** Ranchana P, Department of Floriculture and Landscaping, HC& RI, TNAU, Coimbatore-3, India, E-mail: ranchanahorti@gmail.com

Received August 09, 2013; **Accepted** August 27, 2013; **Published** August 29, 2013

Citation: Ranchana P, Kannan M, Jawaharlal M (2013) Genetic and Correlation Studies in Double Genotypes of Tuberose (*Polianthes tuberosa*) for Assessing the Genetic Variability. Adv Crop Sci Tech 1: 109. doi:10.4172/2329-8863.1000109

was tested against 'r' value given in Fisher and Yates table [7] at (n-2) degrees of freedom.

Results and Discussion

A significant variation in growth was observed among the genotypes with regard to days taken for sprouting of bulb, number of leaves per plant and plant height under tropical condition (Table 1 and 2). The variations among the growth parameters may be due to their diversified origin, and also evolution of the particular genotype as a morphotype in their specific geographical location. This offers scope for selecting genotypes with better performance under tropical condition.

Mean performance of the cultivars for growth parameters reflected the variation among the cultivars. Among the genotypes, significantly less number of days taken for sprouting of bulbs (12.32) was recorded in 'Suvasini', followed by 'Vaibhav' (12.67), and more number of days was taken by 'Hyderabad Double' (16.15 days). Maximum plant height (86.25 cm) was noticed in 'Suvasini'. This is in accordance with the results of Gudi [8]. 'Suvasini' also produced maximum number of leaves/ plant (270) followed by 'Vaibhav' (250), while minimum number of leaves was recorded in 'Hyderabad Double' (235). The differences among the varieties for vegetative characters are attributed to their variation in their genetic makeup [9]. The number of days taken for spike emergence was less (84 days) in 'Suvasini', followed by 'Vaibhav' (85 days), while it was more in 'Hyderabad Double' (89 days). Similarly, the duration of flowering was also significantly more in Suvasini (12.40 days), followed by Vaibhav (11.43 days). This is in line with the findings of Patil et al. [10].

Suvasini produced spike with maximum length of 71.25 cm followed by 'Vaibhav' 66.38 cm, and it was minimum in 'Hyderabad Double' (53.87 cm). The rachis length was significantly higher in 'Vaibhav' (54.00 cm), followed by 'Suvasini' (44.00 cm), and it was minimum in 'Hyderabad Double' (33.95 cm). The variation in spike length and rachis length in different genotypes might be due to variation in their intrinsic factor. 'Suvasini' showed its superiority for number of florets/ spike (54.00), followed by 'Vaibhav' (44), and it was minimum in 'Pearl Double' (30). The increased floret length was noticed in 'Suvasini' (7.50), and it was lowest in 'Hyderabad Double' (6.70). This finding is in consonance with the findings of Patil et al. [10]. Weight of florets/spike was maximum in 'Suvasini' (146.88 g), followed by 'Vaibhav' (119.24 g). This might be due to the increased number of florets/spike. The increased number of spikes/m^2 and yield of florets/plot (4*1 m) were noticed in Suvasini (34.10 and 3.42 kg). The maximum yield may be accorded due to its capacity to produce more number of florets per spike, increased floret length and weight of florets/spike.

The phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) (Table 3) was the highest for number of florets/spike (24.59, 24.38), suggesting that this character is under genetic control. Hence, these characters can be relied upon selection for further improvement. The phenotypic coefficient of variation (PCV) was higher than genotypic coefficient of variation (GCV) for all the characters under study, indicating the role of environment in expression of genotype. Similar results were also reported by Misra et al. (1987) in dahlia and Sheela et al. [11] in *heliconia*. Minimum values of phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were recorded for days to spike emergence (3.58, 1.49), length of the floret (5.04, 3.93) and number of leaves per plant (6.14, 5.25). This type of findings indicated that very minimum variation existed among the genotypes with respect to these characters.

High heritability, coupled with high genetic advance, was observed for number of florets per spike (98.35, 69.81), number of spikes/m^2 (96.93, 65.78), rachis length (96.91, 45.18) and yield of florets per plot (95.78, 40.20). This indicates the lesser influence of environment in expression of these characters and prevalence of additive gene action in their inheritance. Hence, these traits are found suitable for selection. High heritability with moderate genetic advance was recorded for weight of florets per spike (94.67, 46.64), spike length (93.79, 44.46), flowering duration (92.83, 32.39), days taken for sprouting of bulb (91.91, 22.26) and plant height (90.52, 19.17), suggesting the presence of both additive and non-additive gene actions, and simple selection offers best possibility of improvement of this trait. The estimate of heritability was high with low genetic advance as percentage of mean for length of the floret (60.68, 6.30), days taken for spike emergence (77.38,

S.NO	Genotypes	Days taken for sprouting of bulb (days)	Plant height (cm)	No. of leaves per plant (Nos.)	Days to spike emergence	Flowering duration (days)
1.	Calcutta Double	13.25	73.92	246.00	88.00	10.48
2.	Hyderabad Double	16.15	68.87	235.00	89.00	9.12
3.	Pearl Double	14.62	69.70	238.00	86.00	10.39
4.	Suvasini	12.32	86.25	270.00	84.00	12.40
5.	Vaibhav	12.67	81.38	250.00	85.00	11.43
SE(D)		0.38	1.96	6.45	0.62	0.28
CD (0.5)		0.87	4.53	14.88	1.26	0.64

Table 1: Performance of tuberose genotypes for growth parameters (2011- 2012).

S.No.	Genotypes	Spike length (cm)	Rachis length (cm)	Number of florets/ spike (Nos.)	Length of the floret (cm)	Weight of florets per spike (g)	Number of spikes/m^2 (Nos.)	Yield of florets/ plot (2*2 m) (kg)
1.	Calcutta Double	58.92	38.75	35.00	7.10	112.36	32.00	2.57
2.	Hyderabad Double	53.87	33.95	34.00	6.70	108.56	21.01	2.48
3.	Pearl Double	54.70	42.67	30.00	7.40	109.32	31.50	2.42
4.	Suvasini	71.25	44.00	54.00	7.50	146.88	34.10	3.42
5.	Vaibhav	66.38	54.00	44.00	7.20	119.24	33.75	3.26
SE(D)		1.57	5.08	6.02	0.08	6.07	0.25	0.07
CD (0.5)		3.62	11.12	12.34	0.19	14.08	1.52	0.16

Table 2: Performance of tuberose genotypes for spike and yield parameters (2011- 2012).

1.28) and number of leaves per plant (73.06, 9.25), which indicated that high heritability were due to non-additive gene effects and influence of environment. Hence, there is a limited scope for selection. These results are in accordance with the findings of Sheikh and John [12] in Iris.

The genotypic and phenotypic correlation coefficients were computed in all possible combinations for twelve characters, and are presented in Table 4 and 5. Correlation coefficient analysis measures the mutual relationship between various plant characters, and determines the component characters on which selection is based for genetic improvement for a particular character [13]. A positive correlation between desirable characters is favorable to the plant breeder, because it helps in simultaneous improvement of both the characters. In the present study, genotypic correlation coefficients were found to be higher than phenotypic correlation coefficients for most of the characters, indicating a strong inherent association between various characters, and were masked by environmental component with regard to phenotypic expression

Correlation coefficient analysis measures the mutual relationship between various plant characters and determines the component characters on which selection is based for genetic improvement for a particular character [13]. A positive correlation between desirable characters is favorable to the plant breeder because it helps in simultaneous improvement of both the characters. In the present study, genotypic correlation coefficients were found to be higher than phenotypic correlation coefficients for most of the characters, indicating a strong inherent association between various characters, and were masked by environmental component with regard to phenotypic expression. Similar results were obtained by Singh [14] in antirrhinum. The study showed a highly significant and positive correlation between days taken for sprouting of bulb with days to spike emergence (0.671). This trait however, showed negative correlation with flowering duration (-0.978), number of leaves per plant (-0.954), number of spikes per m^2 (-0.952), plant height (-0.939), spike length (-0.927), weight of florets per spike (-0.874), yield of florets per plot (2*2 m) (-0.803), rachis length (-0.802), length of the floret (-0.761) and number of florets per spike (-0.736).

Highly significant and positive correlations for plant height was observed with spike length (1.001), yield of florets per plot (2*2 m) (0.975), number of florets per spike (0.971), number of leaves per plant (0.958), flowering duration (0.944), weight of florets per spike (0.904), number of spikes per m^2 (0.695), rachis length (0.652) and length of the floret (0.623). The trait however, showed negative correlation with

S.NO.	Characters	GCV	PCV	HERT	GA (%) of mean
1	Days taken for sprouting of bulb	11.27	11.76	91.91	22.26
2	Plant height	9.78	10.28	90.52	19.17
3	Number of leaves per plant	5.25	6.14	73.06	9.25
4	Days to spike emergence	1.49	3.58	77.38	1.28
5	Flowering duration	11.28	11.71	92.83	32.39
6	Spike length	12.26	12.66	93.79	44.46
7	Rachis length	17.35	17.62	96.91	45.18
8	Number of florets/ spike	24.38	24.59	98.35	69.81
9	Length of the floret	3.93	5.04	60.68	6.30
10	Weight of florets per spike	13.29	13.66	94.67	46.64
11	Number of spikes/ m^2	17.64	17.92	96.93	65.78
12	Yield of florets/ plot	14.98	15.31	95.78	40.20

Table 3: Estimates of variability and genetic parameters for flower yield and its components.

S.NO	1	2	3	4	5	6	7	8	9	10	11	12
1.	1.000	-0.772	-0.637	1.036*	-0.830	-0.792	-0.646	-0.690	-0.477	-0.623	-0.852	-0.698
2.		1.000	0.939**	-0.347	0.940**	0.999**	0.639**	0.955**	0.581**	0.900**	0.685**	0.971**
3.			1.000	-0.157	0.914**	0.928**	0.413**	0.897**	0.608**	0.946**	0.649**	0.931**
4.				1.000	-0.445**	-0.389**	-0.411**	-0.416**	-0.125**	-0.364**	-0.427**	-0.401**
5.					1.000	0.940*	0.683*	0.854*	0.806*	0.868*	0.859*	0.896*
6.						1.000	0.639**	0.961**	0.595**	0.899**	0.685**	0.974**
7.							1.000	0.470*	0.544*	0.320*	0.734*	0.500*
8.								1.000	0.456**	0.946**	0.490**	0.993**
9.									1.000	0.621**	0.812**	0.554**
10.										1.000	0.516*	0.963*
11.											1.000	0.550*
12.												1.000

1. Days taken for sprouting of bulb
2. Plant height
3. No. of leaves per plant
4. Days to spike emergence
5. Flowering duration
6. Spike length
7. Rachis length
8. Number of florets/ spike
9. Length of the floret
10. Weight of florets per spike
11. Number of spikes/m^2
12. Yield of florets/ plot (2 * 2 m)

Note:

*Significant at 5% level
**Significant at 1% level

Table 4: Phenotypic correlation coefficient among different characters in tuberose (double).

S.NO	1	2	3	4	5	6	7	8	9	10	11	12
1.	-0.588	-0.939	-0.954	0.671**	-0.978	-0.927	-0.803	-0.736	-0.761	-0.874	-0.952	-0.803
2.		1.000	0.958**	-1.574	0.944**	1.001**	0.652**	0.971**	0.623**	0.904**	0.695**	0.975**
3.			1.000	-1.759	0.941**	0.965**	0.438**	0.981**	0.730**	0.994**	0.665**	0.987**
4.				1.000	-1.706	-1.518	-1.384	-1.276	-2.136	-1.406	-1.418	-1.430
5.					1.000	0.944*	0.695*	0.859*	0.851*	0.875*	0.862*	0.899*
6.						1.000	0.653**	0.967**	0.604**	0.905**	0.696**	0.974**
7.							1.000	0.481*	0.566*	0.347*	0.742*	0.517*
8.								1.000	0.489**	0.950**	0.500**	0.996**
9.									1.000	0.630**	0.918**	0.561**
10.										1.000	0.534*	0.965*
11.											1.000	0.565*
12.												1.000

1. Days taken for sprouting of bulb
2. Plant height
3. No. of leaves per plant
4. Days to spike emergence
5. Flowering duration
6. Spike length
7. Rachis length
8. Number of florets/ spike
9. Length of the floret
10. Weight of florets per spike
11. Number of spikes/m^2
12. Yield of florets/ plot (2 * 2 m)

Note:
*Significant at 5% level
** Significant at 1% level

Table 5: Genotypic correlation coefficient among different characters in tuberose (double).

days to spike emergence (-1.574). Prabhat et al. [15] did similar studies and reported significant and positive association of plant height with spike length in gladiolus. Further, the number of leaves per plant had highly significant relationship with weight of the florets per spike (0.994), yield of florets per plot (2*2 m) (0.987), number of florets per spike (0.981), spike length (0.965), flowering duration (0.941), length of the floret (0.730), number of spikes per m^2 (0.665) and rachis length (0.438). The trait however, showed negative correlation with days to spike emergence (-1.759). Similar findings were also reported by Vetrivel [16] and Prabhat et al. [15] in gladiolus.

Days to spike emergence showed highly significant, but negative correlation with flowering duration (-1.706), spike length (-1.518), yield of florets per plot (2*2 m) (-1.430), number of spikes per m^2 (-1.418), weight of florets per spike (-1.406), rachis length (-1.384), length of the floret (-2.136) and number of florets per spike (-1.276). This is line with the findings of Prabhat et al. [15] in gladiolus for spike length and weight of florets per spike.

Positive and significant association for flowering duration was observed for spike length (0.944), yield of florets per plot (2*2 m) (0.899), weight of florets per spike (0.875), number of spikes per m^2 (0.862), number of florets per spike (0.859), length of the floret (0.851) and rachis length (0.695). This is in line with the findings of Rakesh et al. [17] in snapdragon. The spike length showed highly significant and positive correlation with yield of florets per plot (2*2 m) (0.974), number of florets per spike (0.967), weight of florets per spike (0.905), number of spikes per m^2 (0.696), rachis length (0.653) and length of the floret (0.604). This is in consonance with the findings of Rakesh et al. [17] in snapdragon. There exists a positive and highly significant relationship of rachis length with number of spikes per m^2 (0.742), length of the floret (0.566), yield of florets per plot (2s*2 m), number of florets per spike (0.481) and weight of florets per spike (0.347). Similar such findings were reported by Rakesh et al. [17] in snapdragon. Positive and significant association was observed for number of florets/ spike with yield of florets per plot (2*2 m) (0.996), weight of florets per spike (0.950), number of spikes per m^2 (0.500) and length of the floret (0.489). These results are in conformity with the findings of Prabhat et al. [15] in gladiolus. Length of the floret exhibited positive and significant association with number of spikes per m^2 (0.918), weight of florets per spike (0.630) and yield of florets per plot (2*2 m) (0.561). In genotypic and phenotypic levels, weight of florets per spike exhibited positive relationship with yield of florets per plot (2*2 m) (0.965) and number of spikes per m^2 (0.534). Positive and significant association was also observed for number of spikes/ m^2 with yield of florets per plot (2*2 m) (0.565). This is in consonance with the findings of Prabhat et al. [15] in gladiolus for number of spikes/ m^2.

References

1. Sadhu MR, Bose TK (1973) Tuberose for most artistic garlands. Indian Hort 18: 17-20.
2. Benschop M (1993) Polianthes. In: De Hertogh A, Le Nard M (Ed.), The physiology of flower bulbs, Elsevier, Amsterdam, the Netherlands 589-601.
3. Panse VG, Sukhutme PV (1967) Statistical methods for agricultural workers. (2nd Edn.), Indian Council of Agricultural Research, New Delhi, India 381.
4. Burton GW, Vane D (1953) Estimating heritability in late fescue from replicated clonal material. Agronomy Journal 45: 478-479.
5. Weber CR, Moorthy BR (1952) Heritable and nonheritable relationship and variability of soil content and agronomic characters in F2 generation of soybean crosses. Agronomy Journal 44: 202-209.
6. Fisher RA (1954) Statistical methods for research workers. Din Oliver and Boyd Ltd, London, United Kingdom.
7. Fisher RA, Yates F (1963) Statistical table for biological, agricultural and medical research. Oliver and Boyd Ltd, Edinburgh, Scotland 146.
8. Gudi G (2006) Evaluation of tuberose varieties. Thesis submitted to University of Agricultural Sciences, Dharwad, Karnataka, India.
9. Swaroop K (2010) Morphological variation and evaluation of gladiolus germplasm. Ind J Agric Sci 80: 742-745.
10. Patil VS, Munikrishnappa PM, Tirakannanavar S (2009) Performance of growth and yield of different genotypes of tuberose under transitional tract of north Karnataka. J Ecobiol 24: 327-333.
11. Sheela VL, Rakhi R, Jayachandran Nair CS, Sabina George T (2005) Genetic variability in heliconia. J Ornamental Hort 8: 284-286.
12. Sheikh MQ, John AQ (2005) Genetic variability in Iris (Iris japonica Thumb). J Ornamental Hort 8: 75-76.

13. Robinson HF, Comstock RE, Harvey PH (1949) Estimates of heritability and degree of dominance in corn. Agronomy Journal 41: 353-359

14. Singh AK (2011) Assessment of snapdragon germplasm for various traits. Indian Journal of Ornamental Horticulture 76.

15. Prabhat K, Kumar MR, Binayak C, Rakesh M, Mishra DS (2011) Genetic variability and correlation studies in Gladiolus hybrida L. under tarai condition of Uttarakhand. Progressive Horticulture 43: 323- 327.

16. Vetrivel T (2010) Evaluation of gladiolus (Gladiolus spp l.) varieties suitable for shevaroys conditions. M.Sc. (Hort.) Thesis, Tamil Nadu Agricultural University, Coimbatore, India.

17. Rakesh Kumar, Santosh Kumar, Awani Kumar Singh (2012) Genetic variability and diversity studies in snapdragon (Antirrhinum majus) under tarai conditions of Uttarakhand. Indian Journal of Ornamental Horticulture 82.

Citation: Ranchana P, Kannan M, Jawaharlal M (2013) Genetic and Correlation Studies in Double Genotypes of Tuberose (*Polianthes tuberosa*) for Assessing the Genetic Variability. Adv Crop Sci Tech 1: 109. doi:10.4172/2329-8863.1000109