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Genetic and correlation studies in tuberose for assessing the genetic variability

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ABSTRACT

Ten genotypes of tuberose were evaluated for eighteen different parameters to ascertain the genetic variability and association among the characters during the year 2014-15 in the Horticulture Section, College of Agriculture, Nagpur. The experiment was conducted in three replications with a spacing of 20 x 20 cm. The results of the experiment revealed that Prajwal was superior in desirable direction for all the parameters studied. The phenotypic coefficient of variation (PCV) was higher than genotypic coefficient of variation (GCV) for all the thirteen characters studied. The higher GCV and PCV estimates were found for leaf area at 50 per cent flowering, weight of ten florets, spike yield plot^{-1} and moderate for height of plant, days to first harvesting, length of spike and vase life. High heritability and high genetic advance was observed for diameter of spike, length of rachis, weight of ten florets, number of florets spike^{-1} and spike yield plot^{-1}. The correlation studies revealed that genotypic correlation coefficient was higher than the phenotypic correlation coefficient for all the characters studied. Number of leaves clump^{-1}, leaf area at 50% flowering, diameter of spike, length of rachis, weight of ten florets, diameter of floret and number of florets spike^{-1} exhibited positive significant correlation with spike yield plot^{-1}. Genotype Prajwal was identified to be the best genotype which was followed by Arka Nirantara, and Hyderabad Single.

***Keywords*:** Correlation, genetic advance, heritability, tuberose, variability

Tuberose (*Polianthes tuberose*) is one of the most important commercial bulbous ornamentals due to its potentiality for cut flower, trade, long vase life and essential oil industry, attractive long spikes, high cut flower yield and flowers are available round the year in tropical and subtropical climates (Vanlalruati *et al.* 2013). There is a tremendous scope for improvement especially with spike related traits through inter and intra specific hybridization programmes. A study on such traits will be essential for a successful breeding programme. In tuberose, like any other plant species, the phenotypic expression of a character is mainly governed by the genetic make-up of the plant, the environment in which it is grown and the interaction between the genotypes and the environment. Further, the genotype of a plant is controlled by additive gene effect (heritable), non-additive gene effect or dominance (non heritable) and epistasis (non-allelic interaction). Partitioning of phenotypic variability into its heritable and its non-heritabie components with suitable genetic parameters such as genotypic and phenotypic coefficient of variation, heritability and genetic advance is necessary (Radhakrishna *et al*., 2004; Vijaylaxmi *et al*., 2012 and Valalruati *et al*., 2013).

A large 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. The study of interrelationship of various characters in the form of correlation is also 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. Considering the above aspects, the present study was undertaken to estimate the genetic variability and to find out the association among important quantitative characters in tuberose.

MATERIALS AND METHODS

This study was carried out at, Horticulture Section, College of Agriculture, Nagpur during the year 2014-15. Experimental material consisted of ten genotypes of tuberose *viz.*, Prajwal, Shringar, Hyderabad single, NT-1, NT-2, Arka Nirantara, NT-3, NT-4, NT-5 and NT-6. The experiment was laid out in Randomized Block Design (RBD) with three replications. For planting of tuberose plot was prepared at the dimension of 0.8 x 1.6 m. Before planting, the bulbs were treated with copper oxychloride (0.1%) and the individual bulbs weighing 20-30 gm were selected for planting. The treated bulbs were planted at 5 cm depth at a spacing of 20 x 20 cm between the plant and row as per the standard recommendation on 21th July, 2014. Uniform cultural

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practices were followed throughout the experimentation. The data were recorded on five plants from each genotype in each replication for thirteen characters which includes vegetative parameters like plant height, number of leaves clump^{-1}, leaf area at 50 per cent flowering, reproductive parameters like days to first harvesting, flower quality parameters like length of spike, diameter of spike, length of rachis, weight of ten florets, length of floret, diameter of floret, vase life and yield parameters like number of florets spike^{-1} and spike yield plot^{-1}. Data were subjected to statistical analysis as per method given by Panse and Sukhatme (1957). Genetic parameters like genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were estimated according to Singh and Chaudhary (1979) and heritability in broad sense as suggested by Falconer, 1981 and genetic advance was calculated using the formula given by Johnson *et al*., (1955). Correlation analysis was carried out as per the formulae suggested by Fisher (1954). The significance of phenotypic and genotypic correlation coefficients was tested against ‘r’ value given in Fisher and Yates table (1963) at n-2 degrees of freedom.

RESULTS AND DISCUSSION

A significant variation for all the thirteen parameters were observed among the genotypes table 1. The variations among the genotypes 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 Vidarbha region. Mean performance of genotypes for growth, reproductive, quality and yield parameters reflected the variation among the genotypes (Table 2). The range for plant height was recorded from 54.54 cm (NT-3) to 69.71 cm (Prajwal), for number of leaves clump^{-1} from 26.43 (NT-2) to 32.10 (Prajwal), for leaf area at 50% flowering from 66.56 (NT-5) to 159.67 (Prajwal), for days to first harvesting from 122.67 days (Prajwal) to 95.00 days (NT5), for length of spike from 73.00 cm (Shringar) to 94.33 cm (Prajwal), for diameter of spike from 0.73 cm (NT-3) to 1.37 cm (Prajwal), for length of rachis from 19.00 cm (Shirngar to 34.03 cm (Arka Nirantara), for weight of ten florets from 6.07 g (NT-5) to 12.94 g (Prajwal), for length of floret from 5.70 cm (Hyderabad Single) to 6.83 cm (NT-3), for diameter of floret from 3.23 cm (NT-3, NT-5) to 3.85 cm (Prajwal), for vase life from 7.40 days (NT-4) to 10.33 days (Prajwal), for number of florets spike^{-1} from 24.57 (Shringar) to 43.80 (Prajwal) and for spike yield plot^{-1} from 16.67 (Arka Nirantara) to 34.33 (Prajwal). As per the mean performance of the ten genotypes, genotype Prajwal ranked first and was significantly superior for all the characters in the desirable direction except length of rachis and length of floret.

Table 1: Performance of tuberose genotypes for thirteen different traits

Genotypes	Plant height (cm)	No. of leaves clump^{-1}	Leaf area at 50% flowering (cm^2)	Days to first harvesting (days)	Length of spike (cm)	Diameter of spike (cm)
Prajwal	69.71	32.10	159.67	95.00	94.33	1.37
Shringar	61.63	30.73	98.29	103.67	73.00	1.00
Hyderabad single	57.97	31.15	122.72	111.30	78.33	0.77
NT-1	56.15	29.08	79.20	113.33	81.33	1.03
NT-2	55.39	26.43	70.03	116.00	81.37	0.93
Arka Nirantara	62.61	30.18	125.90	113.67	93.67	1.00
NT-3	54.54	28.60	81.51	118.67	81.07	0.73
NT-4	57.13	26.93	85.00	120.00	86.00	0.93
NT-5	55.35	28.33	66.56	122.67	91.67	0.93
NT-6	56.20	29.03	128.42	118.17	78.33	0.90
Mean	**58.66**	**29.25**	**101.72**	**113.24**	**83.91**	**0.96**
SEd	**2.42**	**1.23**	**4.44**	**4.67**	**3.47**	**0.07**
LSD(0.05)	**5.0**	**2.60**	**9.34**	**9.81**	**7.30**	**015**
CV (%)	**5.06**	**5.18**	**5.35**	**5.05**	**5.07**	**9.46**

Table 1: Continued

Genotypes	Length of rachis (cm)	Weight of ten florets (g)	Length of floret (cm)	Diameter of floret (cm)	Vase life (days)	No. of floret spike^{-1}	Spike yield plot^{-1}
Prajwal	32.70	12.94	6.80	3.85	10.33	43.80	34.33
Shringar	19.00	10.07	6.00	3.24	9.73	24.57	24.00
Hyderabad single	24.50	10.07	5.70	3.32	8.80	32.67	33.93
NT-1	30.33	6.08	6.51	3.43	8.67	38.50	32.40
NT-2	25.03	8.01	6.60	3.37	8.73	33.97	22.80
Arka Nirantara	34.03	10.09	6.70	3.67	8.00	40.27	16.67
NT-3	20.50	8.16	6.83	3.23	7.80	28.10	22.63
NT-4	25.50	8.07	6.70	3.35	7.40	35.67	20.77
NT-5	27.50	6.07	6.65	3.23	7.60	37.63	19.55
NT-6	24.47	10.07	5.89	3.37	8.97	30.23	17.17
Mean	**26.35**	**8.96**	**6.43**	**3.40**	**8.60**	**34.54**	**24.42**
SEd	**1.07**	**0.43**	**0.32**	**0.18**	**0.41**	**1.41**	**1.05**
LSD(0.05)	**2.26**	**0.92**	**0.67**	**0.38**	**0.87**	**2.97**	**2.21**
CV (%)	**5.00**	**5.98**	**6.14**	**6.50**	**5.94**	**5.02**	**5.28**

High heritability (%) coupled with high genetic advance (as percentage) of mean were observed for leaf area at 50 per cent flowering (96.93, 61.12), diameter of spike (76.62, 30.90), length of rachis (93.03, 36.32), weight of ten florets (93.75, 46.28), number of florets spike^{-1} (91.69, 32.93), spike yield plot^{-1} (96.40, 55.42). This indicated the lesser influence of environment in the 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 as percentage of mean were recorded for height of plant (68.62, 12.78), days to first harvesting (64.07, 11.13), length of spike (71.86, 14.15) and vase life (75.16, 18.48), suggesting the presence of both additive and non-additive gene actions, and simple selection offers best possibility of improvement of these traits. The estimate of heritability was high with low genetic advance as percentage of mean for number of leaves clump^{-1} (52.06, 8.03) and moderate heritability with low genetic advance for length of floret (43.16, 7.25) and diameter of floret (32.87, 5.38), which indicated that high or moderate heritability were due to non-additive gene effect and influence of environment. Hence there is a limited scope for improvement by selection using these traits. These results were in accordance with the findings of Sheikh and John (2005) in Iris, Vikas *et al*. (2011) in Dahlia and Ranchana *et al*., (2013) and Vanlalruati *et al*. (2013) in tuberose. They also reported the prevalence of additive gene action in the inheritance of number of characters like number of floret spike^{-1}, rachis length, spike yield plot^{-1}, spike length etc., based on heritability and genetic advance indicating the suitability of these traits for selection.

The genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) was high for leaf area at 50 per cent flowering (30.12, 30.60), weight of ten florets (23.20, 23.96 and spike yield plot^{-1} (27.40, 27.90), as observed from Table 2, suggesting that these characters are under genetic control. Hence, these characters can be relied upon for further selection and 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 the expression of the genotypes. In accordance to this result, Ranchana *et al*. (2013) and Vanlalrauti *et al*. (2013) also reported higher value of PCV than GCV for different characters in Tuberose indicating high degree of environmental influence. Moderate GCV and PCV were observed for diameter of spike (17.13, 19.58), length of rachis (18.28, 18.95), vase life (10.35, 11.94) and number of florets spike^{-1} (16.69, 17.43) indicating the importance of these characters also for selection. Low values of GCV and PCV were recorded for height of plant (7.49, 9.04), number of leaves clump^{-1} (5.40, 7.49), days to first harvesting (6.75, 8.43), length of spike (8.10, 9.56), length of floret (5.35, 8.15) and diameter of floret (4.55, 7.94). These type of findings indicated that very minimum variation existed among the genotypes with respect to these characters.

The phenotypic and genotypic correlation coefficients were computed in all possible combinations for 13 characters and the association of different independent variable on dependent variable are presented in table 2. In the present study, the genotypic correlation co-efficient were observed to be higher than the phenotypic correlation coefficient for all the characters studied. This indicated that these differences might be due to mostly genetic make up of the varieties and not due to environmental variation. This revealed a

Table 2: Estimates of variability, genetic parameters and correlations

Characters	GCV (%)	PCV (%)	Heritability (%)	GA (%) of mean	Spike yield plot^{-1} rg	Spike yield plot^{-1} rp
Height of plant	7.49	9.04	68.62	12.78	0.392	0.392
No. of leaves clump^{-1}	5.40	7.49	52.06	8.03	0.641*	0.641*
Leaf area at 50% flowering	30.12	30.60	96.93	61.12	0.685*	0.685*
Days to first harvesting	6.75	8.43	64.07	11.13	-0.705**	-0.705**
Length of spike	8.10	9.56	71.86	14.15	-0.114	-0.114
Diameter of spike	17.13	19.58	76.62	30.90	0.653*	0.653*
Length of rachis	18.28	18.95	93.03	36.32	0.640*	0.640*
Weight of ten florets	23.20	23.96	93.75	46.28	0.736**	0.736**
Length of floret	5.35	8.15	43.16	7.25	-0.162	-0.162
Diameter of floret	4.55	7.94	32.87	5.38	0.678*	0.678*
Vase life	10.35	11.94	75.16	18.48	0.580	0.580
Number of florets spike^{-1}	16.69	17.43	91.69	32.93	0.767**	0.767**
Spike yield plot^{-1}	27.40	27.90	96.40	55.42		

*Note: *, ** Significant at 5 per cent and 1 per cent level, rg : genotypic correlation coefficient, rp : phenotypic correlation coefficient*

strong inherent association between various characters and was masked by environmental component with regard to phenotypic expression. Similar to this result Vanlalruati *et al*., (2013) and Ranchana *et al*., (2013) also reported high value of genotypic correlation coefficient than phenotypic correlation coefficient in tuberose. Correlation coefficient analysis measures the mutual relationship between various plant characters and determines various plant characters and component characters on which selection can be based for genetic improvement for a particular character. A positive correlation between desirable characters is favourable to the plant breeder, because it helps in simultaneous improvement of both the characters. Genotypic and phenotypic correlation of different independent variable when worked out with the dependent variable spike yield plot^{-1} , it was observed that number of leaves clump^{-1}, leaf area at 50% flowering, diameter of spike, length of rachis, weight of floret, diameter of floret and number of floret spike^{-1} exhibited positive significant correlation with spike yield plot^{-1}. Hence improvement in spike yield plot^{-1} can be done indirectly by selecting for number of leaves clump^{-1}, leaf area at 50% flowering, diameter of spike, length of rachis, weight of ten floret, diameter of floret and number of florets spike^{-1}. Out of the seven characters mentioned above except for number of leaves clump^{-1} and diameter of floret, all other five characters namely leaf area at 50% flowering, diameter of spike, length of rachis, weight of ten florets, and number of florets spike^{-1} also exhibited high heritability and genetic advance. Therefore, based on these five traits genotype Prajwal was identified to be best genotype. This was followed by Arka Nirantara, and Hyderabad single.

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