

The Assessment of Genetic Parameters: Yield, Quality Traits and Performance of Single Genotypes, of Tuberose (*Polianthes Tuberosa*)

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Abstract

An experiment was laid out in a Randomized Block Design (RBD) with three replications to determine genetic parameters and performance of single tuberose cultivars such as "Calcutta Single, Hyderabad Single, Kahikuchi Single, Mexican Single, Navs.ari Local, Phule Rajani, Prajwal, Pune Single, Shringar and Variegated Single" under Coimbatore, India, conditions during 2011-2012. The results of the experiment revealed that 'Prajwal' performed best in certain parameters including days to bulb sprouting, weight of bulb, weight of bulblets per clump, number of leaves per plant, days to spike emergence, flowering duration, spike length, rachis length, number of florets per spike, length of the floret, weight of florets per spike, number of spikes/m² and yield of florets per plot (2 * 2 m). The parameters including flowering duration, weight of florets per spike and number of florets per spike showed high phenotypic and genotypic coefficients of variation. Further, a high heritability coupled with high genetic advance as per cent of mean were observed for flowering duration, weight of florets per spike, number of florets per spike and rachis length.

Keywords: Tuberose; Single types; Variability; Heritability; Genetic advance

Introduction

Tuberose (*Polianthes tuberosa*) is one of the most important cut flowers in India. It is an ornamental bulbous plant, native to Mexico and belongs to the family Amaryllidaceae. 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 the surrounding environments. About 45% of the world's trade in floriculture products is contributed by cut flower. In India, it occupies a prime position in the floriculture industry. The waxy white flowering spikes of single as well as double types of tuberose impregnate the atmosphere with their sweet fragrance and because of the longer keeping quality of flower spikes of the double types [1,2] tuberose is in great demand for making floral arrangement and bouquets in the major cities of India. It is widely grown as a specimen for exhibition and for cut flower. Single types of tuberose are cultivated on a large scale in Tamil Nadu, Karnataka, West Bengal and Maharashtra. To a lesser extent it is also grown in Andhra Pradesh, Haryana, Delhi, Uttar Pradesh and Punjab. Valuable natural aromatic oil is extracted from the flowers for the high cost perfume industry. Its essential oil is exported at an attractive price to France, Italy and other countries [1], as long as there is no synthetic flavour to replace its fragrance. 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, Navs.ari Local, Pearl Double, Phule Rajani, Prajwal, Pune Single, Shringar, Suvasini, Vaibhav and Variegated Single". As the commercial cultivation of tuberose is gaining importance, introduction and identification of high yielding varieties is necessary. Varieties which perform well in one region may not do well in other regions of varying climatic conditions [3]. Hence, it is important to study morphological variation and performance of genotypes in a new location to enhance the efficiency of a breeding programme. For a sound breeding programme, critical assessments of the nature and extent of genetic variability in the germplasm and assessment of the heritability and genetic advance of the important yield contributing characters in a crop are essential [4]. Hence, the present investigation was undertaken to understand the relative performance of ten genotypes of single tuberose and the

variability present within them.

Materials and Methods

The present study was carried out at the Botanical gardens, Tamil Nadu Agricultural University, Coimbatore, India, during the year 2011-2012. The location is situated at 11° 02' N latitude, 76° 57' E longitude and 426.76 m above mean sea level. The experimental material consists of ten genotypes of tuberose including "Calcutta Single, Hyderabad Single, Kahikuchi Single, Mexican Single, Navs.ari Local, Phule Rajani, Prajwal, Pune Single, Shringar and Variegated Single". The experiment was laid out in a randomized block design (RBD) with three replications. Before initiating the experiment, the soil was brought to a fine tilt with four deep ploughings. Weeds, stubbles, roots etc., were removed. At the time of the last ploughing, Farm yard manure was applied at the rate of 25 t ha⁻¹. After levelling, raised beds of 1 m width and 1 m length were formed and medium sized bulbs (3.0-3.5 cm diameter) of about 25 grams were planted at a spacing of 45 m x 20 m which accommodates 11 plants per m². Standard cultural practices were followed throughout the experimentation. The data were recorded on ten plants from each genotype collected at random in each replication for 15 characters viz., days to sprouting (days), bulb weight (g), number of bulblets/ clump, weight of bulblets/ clump (g), 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/m², yield of florets/ plot (2 m*2 m) and the phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were calculated as suggested by Burton

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Received August 7, 2013; Accepted September 11, 2013; Published September 13, 2013

Citation: Ranchana P, Kannan M, Jawaharlal M (2013) The Assessment of Genetic Parameters: Yield, Quality Traits and Performance of Single Genotypes, of Tuberose (*Polianthes Tuberosa*). Adv Crop Sci Tech 1: 111. doi:10.4172/2329-8863.1000111

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[5]. The heritability (h^2) in broad sense was calculated according to Lush [6] and expressed as percent and the genetic advance as percent mean were calculated as suggested by Johnson et al. [7].

Results and Discussion

Vegetative characteristics

The mean performance of the cultivars for vegetative growth (Table 1) reflected the variation among the cultivars. Significantly less number of days to bulb sprouting (12.00) was recorded in 'Prajwal', followed by 'Variegated Single' (13.23) while longer days were observed in 'Hyderabad Single' (16.48). Plant height was highest (117.50cm) in 'Variegated Single followed by Prajwal' (113.05 cm). This is in accordance with the results of Gudi [8] and Vijayalaxmi et

variation in spike length in different cultivars might be due to variation in their genetic factor. 'Prajwal' also showed the highest number of florets/ spike (43.00) followed by Shringar (42), while the lowest was observed in "Mexican Single" (17). The largest growth in floret length was also observed in Prajwal (6.40 cm) while the lowest was observed in Pune Single (6.10 cm). This finding is in consonance with Vijayalaxmi et al. [9] in tuberose. The weight of florets/ spike was also largest in Prajwal (74.80 g) followed by Shringar (51.48 g). This might be due to the increased number of florets/ spike. Among single genotypes of tuberose, Prajwal showed the highest in yield of florets/ plot (2* 2 m) (4.40 tonnes, respectively). The highest yield registered by Prajwal might be due to its capacity to produce more number of florets per spike, floret length and weight of florets / spike.

S.NO	Genotypes	Days taken for sprouting of bulb	Bulb weight at planting (g)	Number of bulblets/clump	Weight of bulblets/ clump	Plant height	No. of leaves per plant
1.	Calcutta Single	14.380	345.230	19.29	72.29	78.89	243.00
2.	Hyderabad Single	16.483	350.290	30.28	116.07	80.96	220.00
3.	Kahikuchi Single	13.670	318.460	20.76	73.12	77.30	252.00
4.	Mexican Single	15.780	400.183	13.54	70.37	91.77	238.00
5.	Navs.ari Local	14.590	328.450	24.43	89.32	92.85	242.00
6.	Phule Rajani	13.793	380.160	34.16	121.08	72.50	251.00
7.	Prajwal	12.120	456.200	22.31	144.92	113.05	260.00
8.	Pune Single	15.970	392.650	25.29	110.23	110.07	232.00
9.	Shringar	14.260	332.497	27.80	122.82	91.75	245.00
10.	Variegated Single	13.230	398.250	26.78	115.23	117.50	253.00
	SE(D)	0.42	10.26	1.52	4.72	2.57	6.74
	CD (0.5)	0.88	21.55	3.22	9.84	5.39	14.15

Table 1: Performance of tuberose genotypes (single) for vegetative growth and bulb production (2010- 2011).

al. [9] Prajwal produced the highest number of leaves/ plant (260) in first year after planting followed by Variegated Single (253), while the lowest number of leaves was recorded in Hyderabad Single (220). The differences among the varieties for vegetative characters are attributed to the variation in their genetic makeup [10]. The weight of bulb was the highest in Prajwal (456.20 g) followed by Mexican Single (400.18 g).

The increased weight of bulb might be due to balanced partitioning of dry matter between floral parts and the storage organs. The cultivars differed significantly with respect to number and weight of bulblets produced per plant. 'Phule Rajani' had the highest number of bulblets (34.16) followed by Hyderabad Single (30.28) while Mexican Single had the least number (13.54). The variation in the number of bulblets produced per plant might be due to its genetic character and the results are in consonance with the findings of Ramachandrudu and Thangam and Vijayalaxmi et al. [9,11]. The weight of bulblets was larger in Prajwal (144.92) followed by Shringar (122.82) while the smallest was recorded in 'Mexican Single' (70.37). The higher relative growth potential of Prajwal may be the probable reason for the large weight of bulblets.

Floral characteristics

The mean performance of the cultivars in floral characteristics (Table 2) reflected the variation among the cultivars. The least number of days to spike emergence was observed in Prajwal (78) while the longest was observed in Calcutta Single (94). The duration of flowering was high in Prajwal (17 days) followed by Shringar (15 days). This is in line with the findings of Patil et al. [12] 'Variegated Single' produced spikes with the highest length of 102.50 cm followed by Prajwal (98.05 cm) while the shortest was found in Kahikuchi Single (52.50 cm). The

Variability, heritability and genetic advance

Variability in a population is a prerequisite especially for characters under genetic improvement. The success of plant breeding programmes largely depends on the amount of genetic variability present in a given crop for the character under improvement [13]. Generally, phenotypic coefficient of variation (PCV) was higher than the corresponding genotypic coefficient of variation (GCV) for all the attributes under study, indicating that traits interacted with environment (Table 3). Similar results were reported by Gurav et al. and Vijayalaxmi et al. [9,14] in tuberose. The PCV and GCV were the highest for flowering duration (35.79 vs. 35.62) followed by the weight of florets per spike (32.43 vs. 32.27) and number of florets per spike (32.01 vs. 31.80) suggesting that these characters are under genetic control. Hence, these characters can be relied upon through phenotypic selection for further improvement. The PCV was higher than the GCV for all the characters under study, indicating the role of environment in the expression of genotype. Similar results were reported by Mishra et al. [15] in dahlia and Sheela et al. [16] in *heliconia*. The low values of PCV and GCV were recorded for characters including the length of florets (3.11 vs. 1.45) number of leaves per plant (5.50 vs. 4.34) and days to spike emergence (6.60 vs. 5.60) and days to bulb sprouting (9.74 vs. 9.08). These findings indicate that minimal variation exist among the genotypes for o these characters.

High heritability coupled with high genetic advance was observed for flowering duration (99.07 vs. 73.04), weight of florets per spike (99.02 vs. 66.15), number of florets per spike (98.72 vs. 65.08) and rachis length (98.47 vs. 54.46) (Table 3). This indicates the lesser influence of environment on these characters and the prevalence of additive gene action in their inheritance. Hence, these traits are

S.No.	Genotypes	Days to spike emergence	Flowering duration (days)	Spike length (cm)	Rachis length	Number of florets/spike	Length of the floret	Weight of florets per spike (g)	Number of spikes/m ²	Yield of florets/plot (2* 2 m) (kg)
1.	Calcutta Single	94.00	8.26	63.89	16.75	25.00	6.30	29.25	31.00	2.53
2.	Hyderabad Single	90.00	6.37	65.96	15.30	43.00	6.20	32.76	34.50	2.72
3.	Kahikuchi Single	86.00	10.00	62.30	18.38	38.00	6.30	44.46	33.00	4.01
4.	Mexican Single	88.00	7.00	76.77	21.27	17.00	6.20	28.32	32.20	2.51
5.	Navs.ari Local	92.00	8.98	77.85	27.30	45.00	6.30	33.93	25.75	2.79
6.	Phule Rajani	85.00	8.90	52.50	23.48	40.00	6.30	47.20	35.00	4.06
7.	Prajwal	78.00	17.00	98.05	28.52	47.00	6.40	74.80	47.00	4.40
8.	Pune Single	82.00	9.28	95.07	35.75	37.00	6.10	43.66	39.00	3.90
9.	Shringar	83.00	15.00	76.77	22.32	42.00	6.30	51.48	40.00	4.26
10.	Variegated Single	81.00	7.12	102.50	20.86	28.00	6.20	39.78	33.65	3.78
	SE(D)	1.45	0.28	2.15	3.62	1.12	0.18	1.11	8.11	0.09
	CD (0.5)	2.93	0.58	4.51	7.24	2.36	0.37	2.34	16.24	0.19

Table 2: Performance of tuberose genotypes (single) for floral and yield parameters (2010-2011).

S.NO.	Characters	GCV	PCV	HERT	GA (%) OF MEAN
1	Days to bulb sprouting	9.08	9.74	88.83	17.43
2	Bulb weight	17.16	17.50	96.24	34.69
3	Number of bulblets/clump	4.34	5.50	62.16	17.05
4	Weight of bulblets/clump	5.60	6.60	71.99	19.78
5	Plant height	35.62	35.79	99.07	73.04
6	Number of leaves per plant	21.64	21.91	97.58	44.04
7	Days to spike emergence	26.64	26.85	98.47	54.46
8	Flowering duration	31.80	32.01	98.72	65.08
9	Spike length	1.45	3.11	78.23	15.39
10	Rachis length	32.27	32.43	99.02	66.15
11	Number of florets/spike	16.34	16.68	95.00	42.96
12	Length of the floret	21.71	21.96	98.00	44.22
13	Weight of florets per spike	32.27	39.74	88.83	17.43
14	Number of spikes/m ²	16.34	17.50	96.24	34.69
15	Yield of florets/plot	21.71	5.50	62.16	17.05

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

suitable for selection. High heritability with moderate genetic advance were recorded for yield of florets/ plot (2* 2 m) (98.00 vs. 44.22), spike length (97.58 vs. 44.04), plant height (96.24 vs. 34.69) and number of spikes/m² (95.00 vs. 42.96) indicate the presence of both additive and non-additive gene actions, and simple selection would offer the best possibility for the improvement of these trait. The estimate of heritability was high with low genetic advance as percentage of mean for days to sprouting (88.83 vs. 17.43), length of the floret (78.23 vs. 15.39), days to spike emergence (71.99 vs. 19.78) and number of leaves per plant (62.00 vs. 17.00). The high heritability could be due to non-additive gene effects and a strong influence of the environment. Hence, there is limited scope for selection in these traits Sheikh et al. [17] reported similar results in Iris.

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Citation: Ranchana P, Kannan M, Jawaharlal M (2013) The Assessment of Genetic Parameters: Yield, Quality Traits and Performance of Single Genotypes, of Tuberose (*Pollianthes Tuberosa*). Adv Crop Sci Tech 1: 111. doi:[10.4172/2329-8863.1000111](https://doi.org/10.4172/2329-8863.1000111)

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