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Field performance of tuberose cultivars for growth, floral and economic characters under sub-humid southern plains and Aravalli hills of Rajasthan

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ABSTRACT

The present investigation was carried out at AICRP on Floriculture, Horticulture Farm, RCA Campus, MPUAT, Udaipur to find out field performance 13 tuberose cultivars with respect to growth, floral and economic parameters. The maximum values for plant height (91.67 cm), leaves plant^{-1}(43.50), bulbs plant^{-1} (50.0), bulb weight plant^{-1} (727.50 g), spike length (74.90 cm), peak flowering duration (21.83 days), vase-life in plain water (7.83 days), spikes plant^{-1} (3.02), florets spike^{-1} (53.17), florets remaining open at a time (6.17), floret size (4.73 cm), spike weight (118.30 g), net returns (Rs. 5,60,514/-) / ha and benefit : cost ratio (Rs. 2.69) were recorded in cv. Prajwal followed by Phule Rajani in single type cultivars. However, in double type tuberose cultivars tallest plant (85.67 cm), leaves plant^{-1} (42.33), bulbs plant^{-1} (48.67), bulb weight plant^{-1} (739.50 g), spike length (75.62 cm), peak flowering duration (32.92 days), vase life in plain water (7.57 days), spikes plant^{-1} (2.90), florets spike^{-1} (49.83), florets remaining open at a time (6.83), floret size (4.58 cm), spike weight (109.33 g), net returns (Rs. 5,21,292/-) / ha and benefit : cost ratio (2.52) were obtained in cv. Suvasini followed by Vaibhav. On the basis of observations recorded for growth, floral and economics parameters cv. Prajwal in single and Suvasini in double type of tuberose recommended for cut flowers and exhibition purposes under Udaipur conditions.

Key words: Bulb, cut spike, floret, spike length, tuberose.

INTRODUCTION

Tuberose commonly known as 'Rajanigandha' (*Polianthes tuberosa* L.) belongs to family Amaryllidaceae and native to Mexico. *Polianthes* genus contains three types of flowers one of them is single flower type having basic chromosome number n = x = 30 and 2n = 60, which is female fertile used in perfumery industry and breeding programme as female parent, semi-double and double type of flower 2n = 50 and generally used for cut flower (Biswas *et al*., 4). Its blooms are mainly used for making garlands, bouquets, floral ornaments for bridal make-up and other floral arrangement. At present scanty research works available on recommendations of the suitable tuberose cultivars for growth, floral and economic parameters under sub-humid southern plains and Aravalli hills of Rajasthan. To find out the suitable tuberose cultivars in single and double types the present study was undertaken.

MATERIALS AND METHODS

The present study was carried out during 2006-07 and 2007-08 from the month of April to February at Research Farm, Department of Horticulture, MPU AT., Udaipur, which is situated at an elevation of 559.65 m above mean sea level at latitude of 24°N and longitude of 75°E. The region falls under agro-climatic zone IV A- sub-humid southern plain and Aravalli hills of Rajasthan. The experiment was conducted on clay loam soil have 8.4 pH and 0.54 dS / m EC under irrigated conditions. The seven genotypes belonging to single type, *viz*., Calcutta Single, Hyderabad Single, Phule Rajani, Prajwal, Pune Local Single, Shringar, Sikkim Selection-6 and six belonging to double types, *viz*., Calcutta Double, Hyderabad Double, Pune Local Double, Suvasini, Swarna Rekha and Vaibhav were selected for the study. Uniform cultural practice was adopted for all the cultivar. The bulbs of 2 cm diameter spindle shape were planted at the spacing of 30 cm in row to row and 30 cm from plant to plant in April, 2006 on bed size of 1.2 m x 1.2 m on drip irrigation system with three replications in randomized block design. The observations were recorded for two years on vegetative growth, floral and economic parameters. The data were statistically analyzed as per the method suggested by Gomez and Gomez (6).

RESULTS AND DISCUSSION

Out of the 13 cultivars evaluated for their vegetative (Table 1a & b) characteristics, the maximum plant height, leaves and bulbs per plant were recorded in cv. Prajwal (91.67 cm, 43.50 and 50.0), whereas,

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Table 1a. Plant growth, floral characteristics and vase-life in single-type tuberose cultivars.

Cultivar	Plant ht. (cm)	Leaves/ plant	No. of bulbs/ plant	Bulb wt. per plant (g)	Days to first flowering (days)	Spike length (cm)	Peak flowering duration (days)	Vase-life (days)	No. of spikes/ plant
Calcutta Single	76.67	41.00	31.17	447.50	110.17	67.53	19.00	6.70	2.15
Hyderabad Single	72.67	38.33	34.50	672.50	120.33	61.07	17.17	6.93	1.98
Phule Rajani	80.50	42.67	45.00	692.50	128.08	70.68	19.00	7.40	2.58
Prajwal	91.67	43.50	50.00	727.50	139.00	74.90	21.83	7.83	3.02
Pune Local Single	71.00	34.00	40.00	571.50	119.33	62.28	15.83	5.93	2.10
Shringar	66.33	35.33	21.00	663.17	119.00	53.13	17.83	7.30	2.35
Sikkim Sel. 6	70.67	38.00	44.00	555.50	127.33	57.90	18.17	6.47	1.83
CD at 5%	4.927**	2.232**	3.247**	29.03**	3.243**	5.186**	2.676**	0.286**	0.308**

Table 1b. Plant growth, floral characteristics and vase-life in double-type tuberose cultivars.

Cultivar	Plant ht. (cm)	Leaves/ plant	No. of bulbs/ plant	Bulb wt./ plant (g)	Days to first flowering (days)	Spike length (cm)	Peak flowering duration (days)	Vase-life (days)	No. of spikes/ plant
Calcutta Double	76.00	38.33	33.00	597.17	108.00	69.32	18.50	7.10	2.15
Hyderabad Double	77.00	41.00	39.00	685.83	131.50	69.00	16.17	6.00	2.15
Pune Local Double	79.25	39.33	43.17	582.50	137.00	66.77	15.17	6.93	2.18
Swarnarekha	51.33	24.33	22.00	447.50	121.83	61.38	15.50	5.90	2.03
Suvasini	85.67	42.33	48.67	739.50	139.33	75.62	32.92	7.57	2.90
Vaibhav	84.73	39.50	47.00	706.50	129.33	72.90	20.83	7.33	2.62
CD at 5%	4.927**	2.232**	3.247**	29.03**	3.243**	5.186**	2.676**	0.286**	0.308**

minimum in cv. Shringar in single flower type except leaves per plant. However, the tallest plant, leaves plant^{-1} and bulbs plant^{-1} were obtained in cv. Suvasini, while minimum in Swarna Rekha in double flower type. The highly significant variation in plant height, leaves plant^{-1} and bulbs plant^{-1} among various cultivars may be due to the hereditary traits, which is further modified by prevailing environmental condition. Present findings were in conformity with the findings reported by Bhaskar and Reddy (1), Bhaskar *et al*. (2), Mahawer *et al.* (8) in tuberose; Kumar *et al.* (5) in dahlia and Kumar (7) in gladiolus.

The maximum bulb weight plant^{-1} were recorded in cultivar Prajwal (727.50 g), whereas, minimum in cv. Calcutta Single in single flower type of tuberose. In case of double flower type cultivar highest bulbs weight plant^{-1} was recorded in cultivar Suvasini (739.50 g), while, lowest in cv. Swarna Rekha. The variation in bulbs weight plant^{-1} among different cultivars at bulb harvesting stage might be due to the distinguished varietal genetic make-up of the cultivar with more leaves improve photosynthetic activity, source sink relationship accumulate more carbohydrates and improve bulbs weight plant^{-1} under prevailing conditions. The significant variation for bulbs weight were also recorded by Mahawer *et al.* (8), and Ramachandrudu and Thangam (10) recorded bulb weight ranging from 7.96 (Shringar) to 11.98 g (Mexican Single) in tuberose and Kumar (7) obtained highest corm weight in gladiolus cv. Creamy White.

Out of the 13 tuberose cultivars evaluated for their floral (Table 1a,b) parameters among the single flower type days to first flowering was earlier in Calcutta Single (110.17 days), while flowering was late in cv. Prajwal. In case of double flower type cultivar earliest flowering was recorded in cv. Calcutta Double (108.0 days), whereas it was very late in Suvasini (139.33 days). The variation in days to first flowering was primarily due to the different genetic make-up of the cultivars under study and prevailing environmental conditions.

The data for days to first flowering varied significantly and in conformity with the findings of Biswas *et al*. (3), Mahawer *et al*. (8), and Bhaskar *et al*. (2) obtained earliest flowering in tuberose cv. Hyderabad Single, and Ramachandrudu and Thangam (10) recorded in cv. Mexican Single.

The highest spike length, peak flowering duration and vase-life in plain water were showed significant variation in cv. Prajwal (74.90 cm, 21.83, 7.83 days), whereas, lowest in cv. Shringar for spike length and rest characters in Pune Local Single respectively among single flower type. Further, in double flower type cultivars higher trends for spike length, peak flowering duration and vase-life in tap water were recorded in Suvasini (75.62 cm, 32.92 and 7.57 days), however, lower trends for spike length and vase-life were recorded in Swarna Rekha except for peak flowering duration, which exist in Pune Local Double respectively. This variation in spike length among single and double type of various tuberose cultivars may be due to different genetic make-up and prevailing environmental conditions. Present findings are in accordance with the findings of Patil *et al*. (12), and Mahawer *et al*. (8) also obtained highest spike length and vase-life in cv. Prajwal. Ramachandradu and Thangam (10) reported long spike length in cvs. Suvasini (91.4 cm) and Prajwal (97.78 cm). Sateesha *et al.* (11) reported good vase-life in tuberose cvs. Vaibhav (9.33 days) and Prajwal (9.67 days). The highly significant variation for cut spike vase-life in plain water among single and double flower type tuberose cultivars may be due to different genetic make-up with prevailing environmental conditions, which finally affects physiological processes like cell turgidity, water uptake through xylem tissue, water loss through transpiration, respiration and breakdown of the reserved food and senescence responsible enzyme which reduces vase-life under lab conditions. Flower bud abscission was also recorded in double flower type tuberose cultivars and failed to open in plain water under labortory conditions due to starvation.

Whereas, highest spikes plant^{-1} was recorded in cvs. Prajwal (3.02), Suvasini (2.90), lowest trends were seen in Sikkim Selection-6 (1.83), Swarna Rekha (2.03) in single and double flower types respectively. The results indicated that highly significant difference among different cultivars with respect to spikes produced per plant. Being genetically controlled factor variation occurred due to the hereditary traits of different cultivars under prevailing environment. The significant variation in spikes plant^{-1} are in accordance with Martolia and Srivastava (9), Sateesha *et al*. (11) in cv. Prajwal (1.9) at Dharwad, Ramachandrudu and Thangam (10) in cvs. Suvasini (2.43) to Mexican Single (5.73) at Goa conditions for tuberose.

The two year pooled data revealed (Table 2 a,b) that maximum trend for number of florets, floret remains opened spike^{-1} and floret size were recorded in cultivars Prajwal, Suvasini, while minimum trend were in Sikkim Selection-6, and Swarna Rekha, except floret size which exist in Calcutta Double among single and double flower types, respectively. The variation in florets per spike, floret remained open and floret size may be due to genetic variability among the different cultivars of tuberose and prevailing environmental condition during field trial. Present findings are in conformity with the findings of Patil *et al*. (12) who noted significant variation in cv. Prajwal, Mahawer *et al.* (8), and Ramachandrudu and Thangam (10) noted in cvs. Suvasini (57.46, 4.12 cm), Prajwal (51.39, 3.59 cm) for florets per spike, floret size in tuberose. Kumar (7) and Kumar and Yadav (6) also noted significant variation for same parameters in gladiolus.

Further, the highest spike weight was recorded in cultivars Prajwal (118.30 g), and Suvasini (109.33 g), while lowest were in cvs. Pune Local Single, and Swarna Rekha in single / double flower types, respectively. Variation in spike weight might be due to different genetic make-up of the different cultivars and prevailing environment conditions. Present findings are in accordance with the findings of Kumar and Yadav (6) in gladiolus, and Mahawer *et al.* (8) in tuberose.

Although, the variation in flower bud stage colour among distinct cultivars used for study showed different colours due to their genetic makeup and colouring pigment present in the cultivars. The single / double-type tuberose cultivars show pinkish colour flower buds due to flavonoids and greenish colour at flower bud may be due to chlorophyll pigment present in these cultivars. The pigment synthesis also controlled by gene and which expressed under prevailing environment. Moreover, eight cultivars showed compact and five cultivars showed loose type of floret arrangement on cut spikes were recorded in single / double type of flowers. Compactness improves appearance of cut spike and suitable for cut flower / exhibition purposes, whereas, loose floret arrangements can be utilized as loose flower.

The single type tuberose cultivars Phule Rajani, Pune Local Single, Shringar and Sikkim Selection-6 recorded seed setting at Udaipur conditions. These single cultivars can be effectively utilized in hybridization programme as female parent and double type cultivars which donot set seeds can be used as male parents for development of hybrids at different location. Generally double type cultivars were developed by petaloidy conditions, *i.e.*, due to fusion of carpel with petals, which resulted into more

Table 2a. Different floral characteristics and seed setting nature in single-flower type tuberose cultivars.

Cultivar	Florets per spike	Florets remain open at a time	Floret size ($cm^{2)}$	Spike wt. (g)	Flower colour at bud stage	Floret arrangement on spike	Seed setting in natural field conditions
Calcutta Single	36.67	4.17	3.60	59.17	Greenish	Loose	No seed setting
Hyderabad Single	45.17	4.17	4.03	78.83	Pinkish	Compact	No seed setting
Phule Rajani	48.17	5.83	4.60	84.08	Greenish	Compact	Seed setting
Prajwal	53.17	6.17	4.73	118.30	Pinkish	Compact	No seed setting
Pune Local Single	36.50	4.17	3.57	46.33	Greenish	Loose	Seed setting
Shringar	45.83	4.83	4.17	78.67	Pinkish	Compact	Seed setting
Sikkim Sel.6	33.17	4.17	3.33	63.17	Pinkish	Loose	Seed setting
CD at 5%	3.181**	0.709**	0.311**	6.092**	-	-	-

Table 2b. Different floral characteristics and seed setting nature in double-flower type tuberose cultivars.

Cultivar	Florets per spike	Florets remain open at a time	Floret size ($cm^{2)}$	Spike wt. (g)	Flower colour at bud stage	Floret arrangement on spike	Seed setting in natural field conditions
Calcutta Double	45.83	5.25	2.87	82.50	Pinkish	Compact	No seed setting
Hyderabad Double	45.83	5.27	3.30	84.08	Pinkish	Compact	No seed setting
Pune Local Double	33.83	4.17	4.03	65.50	Pinkish	Compact	No seed setting
Sawarnrekha	20.83	3.83	3.17	33.50	Pinkish	Loose	No seed setting
Suvasini	49.83	6.83	4.58	109.33	Pinkish	Loose	No seed setting
Vaibhav	47.83	6.17	4.25	96.50	Greenish	Compact	No seed setting
CD at 5%	3.181**	0.709**	0.311**	6.092**	-	-	No seed setting

than one rows of petals, irregularity in cell division at metaphase / anaphase stage and triploid / tetraploid chromosomal level in the cell.

Economic parameters were also calculated for different tuberose cultivars under study (Table 3a & b) revealed that highest trend in marketable cut spikes yield ha^{-1} were recorded in cvs. Prajwal (Rs. 3,35,555) and Suvasini (Rs. 3,22,222) followed by Phule Rajani, Vaibhav, whereas, lowest were in Hyderabad Single, Swarna Rekha for single and double types, respectively. Single type cultivars showed more marketable cut-spike potential per hectare as compared to double type tuberose cultivars under Udaipur conditions. Patil *et al.* (12) also obtained highest cut spike yield ha^{-1} in tuberose cv. Prajwal (5.7 lakhs) at Dharwad.

Further, the higher bulb yield ha^{-1} was recorded in cultivars Prajwal (Rs. 5,55,555), Suvasini (Rs. 5,40,777) followed by Phule Rajani, Vaibhav, whereas, lower trends in Shringar, Swarna Rekha among single and double flower types respectively. Single flower type cultivars showed more marketable bulb yield potential per hectare except Shringar as compared to double flower type cultivars. The highest net returns ha^{-1}were obtained in cultivars Prajwal (Rs. 5,60,514/-), Suvasini (Rs. 5,21,292/-), followed by Phule Rajani, Vaibhav, however lowest in Shringar, Swarna Rekha (Rs. 1,38,292/-) among single and double flower types, respectively. Kumar *et al.* (5) noted the highest net returns as Rs. 3,39,427/- per ha from dahlia cv. NT Pompon annually under Udaipur conditions in Rajasthan.

Among various cultivars the higher benefit / cost ratio were recorded in cultivars Prajwal (2.69), Suvasini (2.52), followed by Phule Rajani, Vaibhav, whereas, lower were in Shringar (1.51) and Swarna Rekha (1.41) in single and double flower types, respectively. Present findings were in conformity with the results noted by Kumar *et al.* (5) in dahlia and recorded highest B: C ratio in cv. NT Pompon (2.86). In the light of pooled data it may be concluded that cv. Prajwal (Single type) and Suvasini (Double type), followed by Phule Rajani and Vaibhav, respectively were found to be best for growth, floral and economic parameters respectively, hence recommended for cut spike and bulbs production under sub- humid southern plains and Aravalli hills of Udaipur, Rajasthan.

Table 3a. Economic parameters in cultivation of single-type tuberose cultivars.

Cultivar	First year's cost per ha (Rs.)	Second year's maintenance cost/ ha (Rs.)	Gross cost per ha (Rs.)	Marketable spike/ha	Marketable bulbs/ha	Gross returns (Rs./ha)	Net returns (Rs./ha)	B:C ratio
Calcutta Single	2,23,089	98,618	3,21,707	2,38,889	3,46,333	5,85,222	2,63,515	1.81
Hyderabad Single	2,27,434	98,618	3,26,052	2,20,000	3,83,333	6,03,333	2,77,281	1.85
Phule Rajani	2,29,756	98,618	3,28,374	2,86,666	4,99,999	7,86,665	4,58,291	2.39
Prajwal	2,31,978	98,618	3,30,596	3,35,555	5,55,555	8,91,110	5,60,514	2.69
Pune Local Single	2,23,089	98,618	3,21,707	2,33,333	4,44,444	6,77,777	3,56,070	2.10
Shringar	2,28,645	98,618	3,27,263	2,61,111	2,33,333	4,94,444	1,67,181	1.51
Sikkim Sel. 6	2,25,301	98,618	3,23,919	2,03,333	4,88,888	6,92,221	3,68,302	2.13

Table 3b. Economic parameters in cultivation of double-type tuberose cultivars.

Cultivar	First year's cost per ha (Rs.)	Second year's maintenance cost/ ha (Rs.)	Gross cost/ ha (Rs.)	Marketable spike/ha	Marketable bulbs/ha	Gross returns (Rs./ha)	Net returns (Rs./ha)	B:C ratio
Calcutta Double	2,37,534		3,36,152	2,38,889	3,66,666	6,05,555	2,69,403	1.80
Hyderabad Double	2,38,635	98,618	3,37,253	2,38,889	4,33,332	6,72,221	3,34,968	1.99
Pune Local Double	2,35,311	98,618	3,33,929	2,42,222	4,79,666	7,21,888	3,87,959	2.16
Swarnarekha	2,33,089	98,618	3,31,707	2,25,555	2,44,444	4,69,999	1,38,292	1.41
Suvasini	2,43,089	98,618	3,41,707	3,22,222	5,40,777	8,62,999	5,21,292	2.52
Vaibhav	2,40,867	98,618	3,39,485	2,91,111	5,22,221	8,13,332	4,73,847	2.39

Estimated market selling price Rs. 1.00/- for each cut spike and Rs. 1.00/- planting marketable bulbs at Udaipur conditions.

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