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**Urfi Fatmi**  
Department of Horticulture  
Sam Higginbottom University of  
Agriculture, Technology and  
Sciences, Prayagraj, Uttar  
Pradesh, India

**Devi Singh**  
Department of Horticulture  
Sam Higginbottom University of  
Agriculture, Technology and  
Sciences, Prayagraj, Uttar  
Pradesh, India

## Flower quality, yield and bulb production of different varieties of tuberose as affected by different planting time and geometry under Prayagraj agro-climatic conditions

Urfi Fatmi and Devi Singh

### Abstract

A field trial sponsored by UPCST, Lucknow, with nineteen (19) varieties of tuberose and three (3) spacings were conducted in the Deptt. of Horticulture, SHUATS, Prayagraj, during 2018-2019 to find out the most suitable time of planting and plant geometry for flower quality, yield and bulb production. The experiment was conducted in Factorial Randomized Block Design with three replications. Among March and April planting time, March planting resulted in significantly higher no. of bulbs produced per plant as well as higher bulb yield (quintal) per hectare. Among the different plant geometry (20 x 30 cm<sup>2</sup>, 25 x 25 cm<sup>2</sup>, 30 x 30 cm<sup>2</sup>), spacing of 30cm x 30cm resulted in significant earliness in bud emergence, spike length, no. of florets per spike, floret diameter, floret length, duration of flowering, vase life and no. of bulbs produced per plant. However, spacing of 25cm x 25cm resulted in significantly higher bulb yield per hectare.

**Keywords:** Tuberose, planting geometry, planting time, bulb production

### Introduction

*Polianthes tuberosa* commonly called tuberose, popularly known as "Rajnigandha" in Hindi, belongs to the family Amaryllidaceae. It is commercially grown both as cut flower and loose flower crop and is propagated by bulbs. But on large scale it is grown for its loose flower and is mostly used for oil extraction, making garlands and floral ornaments. Tuberose is of four types viz. Single (corolla segment has only one row), Semi-double (corolla segments bears double to triple rows), Double (corolla segments bears more than three rows) and Variegated (with golden striped leaf). Single flowers are mostly used as loose flower and are highly fragrant whereas double flowers are used as cut flower purpose. Climatic factors like temperature, humidity and rainfall play a major role in successful tuberose production. Thus, staggered planting dates ensure a continuous supply of cut flowers over an extended period of harvest. Staggered planting time provides continuous flower and bulb propagation, regular income to growers, employment and increased flower duration. Plant geometry is an important factor in planting of tuberose. Optimum spacing provides good amount of sunlight, moisture and nutrient availability for successful crop production and quality, high plant growth and yield. Planting at a wider spacing records higher plant height, maximum number of leaves and spikes per clump per plant and longer flowering duration (Kumar and Singh, 1998) [2].

### Materials and Methods

A field trial under the project entitled "Refinement of planting material (corms & bulbs) production technology of gladiolus and tuberose and its demonstration at farmers' field", funded by UPCST, Lucknow, was carried out during 2018-2019 in the Deptt. of Horticulture, Sam Higginbottom

University of Agriculture Technology and Sciences, Prayagraj (Uttar Pradesh), India. Design of the experiment was Factorial Randomised Block Design having two factors. Factor 1 consisted of 19 varieties viz. Arka Prajjawal, Kalyan Single, Hyderabad Single, Arka Nirantara, GKTC 4, Sikkim Selection, Kolkata Double, Arka Sringer, Pearl Double, Phule Rajani, Arka Vaibhav, Mexican Single, Hyderabad Double, Single, Arka Suvasini, STR 505, Double, Swarna Rekha, Arka Sugandhi, and factor 2 comprised of three planting geometry viz., 25cm x 25cm, 30cm x 20cm and 30cm x 30cm. Bulbs were planted during March and April, 2018 in each plot with different planting geometries at a depth of 5cm. The observations on flowering and bulb parameters were recorded and analysed statistically.

**Corresponding Author:**  
**Urfi Fatmi**  
Department of Horticulture  
Sam Higginbottom University of  
Agriculture, Technology and  
Sciences, Prayagraj, Uttar  
Pradesh, India

**Table 1:** Flower quality of different tuberose varieties as affected by different planting time and geometry

MARCH												
Varieties	Days to bud emergence				Number of florets per spike				Spike yield per ha			
	30 x 30 cm <sup>2</sup>	25 x 25 cm <sup>2</sup>	20 x 30 cm <sup>2</sup>	Mean (S)	30 x 30 cm <sup>2</sup>	25 x 25 cm <sup>2</sup>	20 x 30 cm <sup>2</sup>	Mean	30 x 30 cm <sup>2</sup>	25 x 25 cm <sup>2</sup>	20 x 30 cm <sup>2</sup>	Mean
Arka Prajjawal	140.397	143.357	145.240	142.998	56.334	43.083	41.037	46.818	407,407.000	586,666.700	611,108.700	535,060.800
Kalyan Single	141.990	150.243	159.753	150.662	41.380	39.556	39.148	40.028	407,407.000	586,666.700	611,108.700	535,060.800
H'bad Single	147.493	149.920	156.027	151.147	41.046	39.485	38.258	39.596	370,370.000	533,333.300	555,553.300	486,418.900
Arka Nirantara	142.617	154.117	159.680	152.138	51.196	50.222	45.861	49.093	481,481.000	693,333.300	722,219.300	632,344.600
GKTC 4	139.653	144.437	147.700	143.930	36.222	33.055	30.447	33.241	518,518.000	746,666.700	777,774.700	680,986.400
Sikkim Selection	134.867	142.513	158.787	145.389	27.591	25.149	24.000	25.580	370,370.000	533,333.300	555,553.300	486,418.900
Kolkata Double	139.380	166.167	167.343	157.630	41.458	39.556	39.130	40.048	222,222.000	320,000.000	333,332.000	291,851.300
Arka Sringer	147.047	149.193	153.607	149.949	42.996	40.148	40.158	41.101	296,296.000	426,666.700	444,442.700	389,135.100
Pearl Double	145.953	155.183	167.517	156.218	46.408	45.588	45.625	45.874	296,296.000	426,666.700	444,442.700	389,135.100
Phule Rajani	138.620	149.233	157.530	148.461	31.411	30.152	29.000	30.188	296,296.000	426,666.700	444,442.700	389,135.100
Arka Vaibhav	143.847	146.287	149.600	146.578	54.927	50.927	49.076	51.643	444,444.000	640,000.000	666,664.000	583,702.700
Mexican Single	143.833	149.223	154.593	149.217	33.000	29.666	28.406	30.357	333,333.000	480,000.000	499,998.000	437,777.000
H'bad Double	155.167	157.167	159.773	157.369	45.296	43.293	41.259	43.283	222,222.000	320,000.000	333,332.000	291,851.300
Single	155.540	161.473	162.700	159.904	46.333	45.297	44.777	45.469	333,333.000	480,000.000	499,998.000	437,777.000
Arka Suvasini	143.610	151.347	163.353	152.770	54.488	49.190	45.994	49.891	333,333.000	480,000.000	499,998.000	437,777.000
STR 505	163.383	167.737	153.800	161.640	33.778	31.596	31.407	32.260	333,333.000	480,000.000	499,998.000	437,777.000
Double	142.417	145.700	158.867	148.994	34.119	30.922	29.023	31.355	333,333.000	480,000.000	499,998.000	437,777.000
Swarna Rekha	143.433	153.953	163.147	153.511	44.057	41.114	39.951	41.707	148,148.000	213,333.300	222,221.300	194,567.600
Arka Sugandhi	143.317	153.200	157.767	151.428	46.676	44.150	42.555	44.460	37,037.000	53,333.330	55,555.330	48,641.890
Mean (V)	144.872	152.129	157.725		42.564	39.587	38.164		325,535.800	468,771.900	488,302.100	
CD <sub>0.05%</sub>												
Variety	1.134				1.257				99,534.659			
Spacing	0.450				0.499				39,551.063			
Variety x Spacing	1.963				2.176				N/A			

APRIL												
Varieties	Days to bud emergence				Number of florets per spike				Spike yield per ha			
	30 x 30 cm <sup>2</sup>	25 x 25 cm <sup>2</sup>	20 x 30 cm <sup>2</sup>	Mean (S)	30 x 30 cm <sup>2</sup>	25 x 25 cm <sup>2</sup>	20 x 30 cm <sup>2</sup>	Mean	30 x 30 cm <sup>2</sup>	25 x 25 cm <sup>2</sup>	20 x 30 cm <sup>2</sup>	Mean
Arka Prajjawal	130.000	135.307	141.300	135.536	57.667	42.667	41.333	47.222	518,518.000	746,666.700	777,774.700	680,986.400
Kalyan Single	131.700	143.070	149.203	141.324	42.500	41.500	43.500	42.500	518,518.000	746,666.700	777,774.700	680,986.400
H'bad Single	140.517	147.037	150.453	146.002	37.000	40.500	42.667	40.056	481,481.000	693,333.300	722,219.300	632,344.600
Arka Nirantara	133.987	140.333	147.770	140.697	52.000	54.667	44.333	50.333	592,592.000	853,333.300	888,885.300	778,270.300
GKTC 4	134.483	140.337	143.323	139.381	37.933	29.833	33.333	33.700	629,629.000	906,666.700	944,440.700	826,912.100
Sikkim Selection	128.670	137.253	150.620	138.848	24.500	29.000	28.167	27.222	481,481.000	693,333.300	722,219.300	632,344.600
Kolkata Double	131.073	149.907	156.403	145.794	40.343	39.667	43.333	41.114	333,333.000	480,000.000	499,998.000	437,777.000
Arka Sringer	140.187	144.263	147.570	144.007	51.333	51.000	44.333	48.889	259,259.000	426,666.700	444,442.700	376,789.400
Pearl Double	138.950	149.463	157.103	148.506	47.500	47.443	48.917	47.953	444,444.000	586,666.700	611,108.700	547,406.400
Phule Rajani	129.780	106.357	153.883	130.007	28.667	33.283	29.667	30.539	407,407.000	586,666.700	611,108.700	535,060.800
Arka Vaibhav	136.500	139.743	141.850	139.364	57.667	48.667	50.000	52.111	407,407.000	640,000.000	722,219.300	589,875.400
Mexican Single	135.837	140.740	144.317	140.298	28.333	29.800	35.333	31.156	444,444.000	640,000.000	666,664.000	583,702.700
H'bad Double	144.180	149.757	154.490	149.476	45.500	46.417	42.050	44.656	333,333.000	480,000.000	499,998.000	437,777.000
Single	148.047	153.990	159.747	153.928	47.333	48.167	46.167	47.222	444,444.000	640,000.000	666,664.000	583,702.700
Arka Suvasini	135.733	141.460	153.553	143.582	56.000	35.000	48.000	46.333	444,444.000	640,000.000	666,664.000	583,702.700
STR 505	145.823	154.893	160.880	153.866	34.167	33.333	35.333	34.278	444,444.000	640,000.000	666,664.000	583,702.700
Double	131.857	142.423	148.423	140.901	34.833	34.833	32.333	34.000	444,444.000	640,000.000	666,664.000	583,702.700
Swarna Rekha	135.540	143.370	154.807	144.572	45.417	46.900	43.483	45.267	185,185.000	266,666.700	333,332.000	261,727.900
Arka Sugandhi	134.587	149.220	150.223	144.677	47.850	48.000	40.433	45.428	111,111.000	160,000.000	166,666.000	145,925.700
Mean (V)	136.182	142.575	150.838		42.976	41.088	40.669		417,153.500	603,508.800	634,500.400	
CD <sub>0.05%</sub>												
Variety	9.608				4.626				73,013.715			
Spacing	3.818				1.838				29,012.709			
Variety x Spacing	N/A				8.012				N/A			

**Table 2:** Flowering duration and bulb production of different tuberose varieties as affected by different planting time and geometry

MARCH												
Varieties	Duration of flowering (days)				No. of bulbs per plant				Bulb yield per ha (quintal)			
	30 x 30 cm <sup>2</sup>	25 x 25 cm <sup>2</sup>	20 x 30 cm <sup>2</sup>	Mean (S)	30 x 30 cm <sup>2</sup>	25 x 25 cm <sup>2</sup>	20 x 30 cm <sup>2</sup>	Mean	30 x 30 cm <sup>2</sup>	25 x 25 cm <sup>2</sup>	20 x 30 cm <sup>2</sup>	Mean
Arka Prajjawal	163.197	161.730	154.293	159.740	24.000	20.000	17.333	20.444	200.370	238.400	165.055	201.275
Kalyan Single	247.117	238.777	232.130	239.341	16.667	12.000	10.667	13.111	117.222	149.867	85.000	117.363
H'bad Single	265.567	261.427	256.070	261.021	21.000	17.000	14.667	17.556	123.896	146.187	104.944	125.009
Arka Nirantara	194.263	186.010	184.253	188.176	18.000	16.000	12.667	15.556	166.296	218.667	184.999	189.987
GKTC 4	277.667	271.487	267.517	272.223	21.000	19.000	13.333	17.778	163.333	213.333	176.110	184.259
Sikkim Selection	275.333	268.950	265.633	269.972	23.333	15.667	12.667	17.222	113.704	116.267	73.333	101.101
Kolkata Double	164.830	160.330	157.800	160.987	30.000	25.333	21.333	25.556	129.259	175.413	163.777	156.150
Arka Sringer	166.727	162.897	156.000	161.875	40.333	25.667	22.333	29.444	189.222	258.347	249.999	232.523

Pearl Double	172.043	166.090	163.237	167.123	37.667	28.333	21.000	29.000	315.185	404.533	383.054	367.591
Phule Rajani	244.177	233.127	229.033	235.446	36.667	31.333	26.000	31.333	197.592	220.800	224.999	214.464
Arka Vaibhav	69.160	66.277	63.453	66.297	30.333	25.333	17.333	24.333	165.555	208.533	204.999	193.029
Mexican Single	241.970	230.857	226.817	233.214	33.667	26.667	23.333	27.889	198.741	242.459	211.888	217.696
H'bad Double	107.713	103.650	101.267	104.210	22.667	18.333	15.000	18.667	249.741	315.360	177.110	247.404
Single	163.917	160.003	157.603	160.508	31.333	28.000	23.000	27.444	136.037	172.107	157.388	155.177
Arka Suvasini	96.173	74.033	66.803	79.003	31.000	22.000	16.000	23.000	164.815	205.333	205.777	191.975
STR 505	187.840	182.140	177.687	182.556	28.333	24.667	17.667	23.556	308.555	351.040	348.165	335.920
Double	224.183	214.707	207.627	215.506	29.000	27.333	24.667	27.000	315.407	405.067	388.776	369.750
Swarna Rekha	104.113	108.103	99.113	103.777	26.667	18.000	17.000	20.556	169.222	213.867	192.555	191.881
Arka Sugandhi	90.613	85.913	81.133	85.887	12.667	10.333	9.000	10.667	92.667	122.133	119.222	111.341
Mean (V)	181.927	175.606	170.920		27.070	21.632	17.632		185.096	230.406	200.903	
<b>CD<sub>0.05%</sub></b>												
Variety	1.406				1.137				5.689			
Spacing	0.559				0.452				2.261			
Variety x Spacing	2.435				1.970				9.854			

<b>APRIL</b>												
Varieties	Duration of flowering (days)				No. of bulbs per plant				Bulb yield per ha (quintal)			
	30 x 30 cm <sup>2</sup>	25 x 25 cm <sup>2</sup>	20 x 30 cm <sup>2</sup>	Mean (S)	30 x 30 cm <sup>2</sup>	25 x 25 cm <sup>2</sup>	20 x 30 cm <sup>2</sup>	Mean	30 x 30 cm <sup>2</sup>	25 x 25 cm <sup>2</sup>	20 x 30 cm <sup>2</sup>	Mean
Arka Prajjawal	173.667	171.000	166.333	170.333	21.000	18.333	15.000	18.111	186.296	218.667	149.999	184.987
Kalyan Single	256.333	254.000	246.333	252.222	14.667	9.667	9.000	11.111	103.704	134.933	72.222	103.620
H'bad Single	281.000	274.333	266.333	273.889	18.667	15.000	12.667	15.444	108.333	131.787	97.333	112.484
Arka Nirantara	168.000	157.667	155.000	160.222	16.000	12.667	10.667	13.111	152.593	198.933	158.888	170.138
GKTC 4	289.000	280.667	278.333	282.667	19.000	17.667	11.333	16.000	149.259	193.600	154.444	165.768
Sikkim Selection	287.333	283.667	272.000	281.000	20.333	13.667	10.667	14.889	99.259	95.467	57.778	84.168
Kolkata Double	181.333	177.000	162.667	173.667	27.667	23.333	19.000	23.333	115.185	152.533	143.888	137.202
Arka Sringar	176.667	171.000	167.000	171.556	37.667	24.667	20.333	27.556	174.815	229.333	223.332	209.160
Pearl Double	183.333	175.333	172.333	177.000	35.667	25.000	19.000	26.556	297.037	384.533	365.276	348.949
Phule Rajani	243.333	238.667	257.333	246.444	34.000	28.667	23.667	28.778	183.333	199.467	206.110	196.303
Arka Vaibhav	73.000	80.000	79.333	77.444	28.000	23.667	15.333	22.333	148.889	197.333	190.555	178.926
Mexican Single	242.667	251.333	242.333	245.444	31.333	24.667	21.333	25.778	185.370	217.333	196.110	199.605
H'bad Double	112.667	113.000	116.333	114.000	20.667	16.000	13.000	16.556	234.815	297.067	157.499	229.794
Single	173.667	169.667	175.000	172.778	29.000	25.333	20.667	25.000	121.852	152.000	142.222	138.691
Arka Suvasini	76.333	106.667	81.333	88.111	28.667	20.000	14.000	20.889	150.741	185.867	183.055	173.221
STR 505	194.333	193.000	196.000	194.444	25.667	22.333	14.333	20.778	294.074	331.467	159.722	261.754
Double	233.667	228.000	235.333	232.333	26.667	24.333	22.000	24.333	301.481	395.733	365.276	354.164
Swarna Rekha	117.333	118.000	114.333	116.556	23.333	16.000	14.000	17.778	148.518	198.400	168.888	171.936
Arka Sugandhi	101.667	98.667	96.667	99.000	10.667	9.333	8.333	9.444	83.148	103.093	93.833	93.358
Mean (V)	187.649	186.404	183.175		24.667	19.491	15.491		170.458	211.450	172.970	
<b>CD<sub>0.05%</sub></b>												
Variety	5.457				1.122				5.554			
Spacing	2.168				0.446				2.207			
Variety x Spacing	9.451				1.943				9.619			

## Results and Discussion

### Flower quality & yield

The data presented in Table 1 and 2 reveals that there was significant difference in performance of different varieties of tuberose planted during different months at different planting geometry. Earliness in flowering is an important character, which helps farmers to fetch early market. Variety STR-505 during April planting reported earliness (153.866 days) as compared to March planting while planting geometry of 20 cm X 30 cm among the different geometries resulted in flowering earliness (168.640 days). Arka Nirantara among the different varieties during April planting reported significantly more no. of florets per spike (50.333) while planting geometry of 30 cm x 30 cm resulted in more no. of florets per spike (49.093). GKTC-4 in April planting recorded significantly better spike yield per hectare (826912.100) while planting geometry of 20 cm x 30 cm gave maximum spike yield per hectare (680986.400) as compared to other planting geometries. GKTC-4 in April planting resulted in significantly prolonged duration of flowering (283.667 days) while planting geometry of 30 cm x 30 cm resulted in longer duration of flowering (272.223 days). Varietal difference in performance were also observed by Ramachandrudu *et al.*

(2009)<sup>[9]</sup> and Prashanta *et al.* (2016)<sup>[8]</sup> in tuberose. Different varieties performed better for different floral parameters which might be due to the inherent capacity of the particular genotype as well as the prevailing climatic conditions during the growing period. April planting resulted in better performance which might be favored by optimum temperature and longer days providing more sunshine hours during the crop growth period. These findings are in conformity with the findings of Mishra (1999)<sup>[5]</sup>, Singh and Kumar (1998)<sup>[2]</sup>, Trivedi *et al.* (2004)<sup>[13]</sup>, Gurav *et al.* (2005)<sup>[1]</sup>, Nair *et al.* (2004)<sup>[6]</sup>, Padaganur *et al.* (2005)<sup>[7]</sup>, Sharma *et al.* (2007)<sup>[10]</sup> and Kumar *et al.* (2010)<sup>[4]</sup> in *Polianthes tuberosa*. The plants at medium and wide spacing grows more rapidly as there is more uptake of moisture, nutrients and more amount of sunlight as compared to closer spacing resulting in better accumulation of carbohydrates leading to better quality flowers.

### Bulb production

Healthy planting material is requirement for commercial cultivation of any crop. Bulb quality and yield gives additional farm income besides sale of flower spikes. Phule Rajani in April planting reported significantly more no. of

bulbs per plant (28.778 and planting geometry of 30 cm x 30 cm produced maximum no. of bulbs per plant (31.333). Variety Double in April planting resulted in significantly higher bulb yield per hectare (354.164 quintal) as compared to March planting while planting geometry of 25 cm x 25 cm resulted in significantly more bulb yield per hectare (369.750 quintal) as compared to other planting geometry. The bulbs planted in April resulted in maximum no. of bulbs per plant which might be due to the improved photosynthesis which help translocation of carbohydrate through phloem to sink (spike/ bulb). Another probable reason for this variation in numbers of tubers per plant may be governed by gene and effect of environmental conditions prevailing during the period of investigation as reported by (Kumar *et al.*, 2009) in dahlia. Closer spacing resulted in more bulb production as close spacing accommodated more no. of plants unit area thereby, thereby resulting in more bulb yield.

### Conclusion

Based on the above discussion, it is observed that planting time and geometry had varied effect on different varieties. Among the planting times for better flower quality, yield and bulb production in tuberose, April planting was more beneficial while wider spacing of 30 cm x 30 cm improved flower quality, yield and bulb quantity while closer spacing is suitable for increasing productivity.

### Acknowledgement

This field trial was a part of project entitled "Refinement of planting material (corms & bulbs) production technology of gladiolus and tuberose and its demonstration at farmers' field", funded by Council of Science & Technology, Uttar Pradesh (UPCST), Lucknow.

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