

## The Effect of Bulb Size and Plant Spacing on the Growth and Flowering of Tuberose

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**Abstract:** This study was conducted in Agriculture Research Farm, the University of Swabi, Khyber Pakhtunkhwa, Pakistan, during 2014. There were two types of bulbs i.e. bulbs, bulbils and two plant spacing of 6 and 10 inches were used which were replicated thrice. Bulbs were sown at equal depth. Experiment was laid out according to randomized complete block design having four treatments replicated thrice. The results showed that bulb sizes and plant spacing had a significant effect on all growth parameters, except days to bolting. The minimum days to emergence (131.00), days to flowering (21.667), days to 50% fading (12.667), days to full fading (18.000), while the maximum stalk length (111.00 cm), canopy (9.8333 cm), leaves plant<sup>-1</sup> (39.667) was recorded in plants grown from bulbs at distance of 6 inches.

**Key words:** Tuberose • Plant spacing • Bulb size • Plant canopy • Stalk length

### INTRODUCTION

Tuberose (*Polianthes tuberosa* L.) is a member of family Amaryllidaceae, was originated in Mexico and is grown on large scale in Asia. The etymology of *polianthes* is *poly*, meaning several and *anthes*, meaning flowers – “bearing or contains several flowers.” Tuberose is half-hardy, perennial, bulbous plant. Bulbs are made of scales and leaf bases and stem remains concealed within scales. Roots are mainly adventitious and shallow. Flowers have a funnel shaped perianth and are fragrant, waxy white, about 25 mm long. Stamens are six in number, ovary 3 locular, ovules numerous and fruits are capsule.

Morocco, France, Hawaii, South Africa, India and China are the major producers of tuberose. There are two main flowering cultivars of tuberose viz. Mexican single having six petals and the Pearl having 12 petals. Tuberose blooms in summer/autumn and its clustered spikes are rich in fragrance; florets are star shaped, waxy and loosely arranged on spikes that can reach upto 30 to 45 cm in length.

It is an important cut flower crop from aesthetic as well as commercial point of view. Tuberose has unique place among the flowering plants and is easy to cultivate.

The flower is very popular for its strong fragrance and its essential oil is important component of high-grade perfumes in southern France. Raja and Palanisamy [1] reported that in bulbous flowers, variable bulb sizes had variable effects on the production and quality of the flowers. The flowers remain fresh for quite a long time and stand distance transportation and occupy a useful place in the flower market [2]. The long spikes of tuberose are used for vase decoration and bouquet preparation and the florets for making artistic garlands, ornaments and buttonhole use. In Bangladesh, for the last few years, tuberose has become a popular cut flower for its attractive fragrance and beautiful display qualities. Now, it is one of the most important commercial cut flowers. Tuberose has high demand in the market and its production is highly profitable.

Fertilizers have great influence on growth, flowering and bulb production in tuberose [3, 4]. Optimum plant density is another important factor for high plant growth and yield. In tuberose, the spacing has a great importance for manipulating flower quality and quantity characteristics. Therefore, inter and intra row spacing and balanced supply of nutrient such as nitrogen are important for obtaining higher tuberose flower quality and

quantity. But, the information on the effects of integrated use of nitrogen and plant spacing on yield and quality of flower in tuberose is very limited. It has been reported that the highest plant height, panicle length and number of flowers per panicle were obtained at 350 kg ha<sup>-1</sup> [5]. In an experiment, it was evaluated the effects of nitrogen doses and plant densities on growth and yield of tuberose. Growth and yield increased with increasing nitrogen doses and plant densities. Highest flower stem height, yield, number of stems and flower clusters was related to 200 kg ha<sup>-1</sup> N and three number bulbs in each hole [6]. Yadav *et al.* [3] investigated nitrogen and phosphorus levels on the growth and yield of tuberose. The production and consumption of cut flowers has also increased over the last decade and growth is expected to continue given the number of indefinite factors in Pakistan.

Keeping the above mentioned importance of tuberose, the present studies was designed to find out the suitable bulb's size and plant spacing for the growth of tuberose.

#### MATERIALS AND METHODS

The experiment was conducted in Agriculture Research Farm, The University of Swabi, during year 2014 to investigate the effect of different bulb sizes and plant spacing on the different aspects of growth, yield and bulbils production of tuberose. There were two different sizes of bulbs i.e. bulbs, bulbils and plant spacing D1= 6 inches and D2 = 10 inches, bulbs were sown at equal depth. Experiment was laid out according to randomized complete block design having four treatments replicated thrice. Planting was carried out on 23<sup>rd</sup> December, 2013 first irrigation was applied immediately after sowing. All other cultural practices like fertilization, irrigation, hoeing, IPM etc., were same for all treatments during the entire period of study. Data was recorded on the following growth characteristics.

**Days to Emergence:** Days to emergence was recorded by counting the days from sowing to emergence.

**Days to Bolting:** Days to bolting was recorded by counting the days from emergence to bolting.

**Days to Flowering:** Days to flowering was recorded by counting the days from bolting to flowering.

**Days to 50% Fading:** Days to 5% fading was recorded by counting the days from flowering to 5% fading on three randomly selected plants.

**Days to 100% Fading:** Days to 100 % fading was recorded by counting the days from 50% fading to 100% fading. Data was recorded on three randomly selected plants.

**Stalk Length:** Stalk length was measured by measuring tape from ground level to top of stalk on three randomly selected plants. Measurement was recorded in centimeters.

**Number of Leaves per Plant:** Total number of leaves per plant was counted on three randomly selected plants after the completion of vegetative growth of the plant.

**Plant Canopy:** Plant canopy was recorded by taking the measurement from either sides and divided by two. Data was recorded on three randomly selected plants. The measurement was taken through measuring tape in centimeters.

**Data Analysis:** Data analysis was done by using Randomized Complete Block Design (RCBD) and significant results were further compared by using LSD test with a help of Statistics 8.1 software [7].

#### RESULTS AND DISCUSSION

**Days to Emergence:** It is clear from Table 1 that days to emergence was significantly affected by bulb's type and planting space. The maximum number of days to emergence (147.33) was observed in bulblets with 6 inches plant spacing, while the lowest days to emergence (131.00) was observed in bulbs with plant spacing of 10 inches. The least days to emergence was taken by plants grown from bulbs as compared to bulblets because bulb have more food reserves, hence results in earlier emergence [8].

**Days to Bolting:** Data regarding days to bolting presented in mean Table 2 shows that bulb sizes and their interaction had non-significant effect while, plant spacing had a non significant effect on days to flowering. The maximum number of days to bolting (45.33) was observed in bulblets with 6 inches plant spacing, while the lowest days to bolting (38.00) was observed in bulbs with plant spacing of 10 inches. The results regarding bulb size are in agreement with those obtained by Ahmad *et al.* [9], who illustrated that plants grown from large bulbs required minimum days to bolting.

Table 1: Influence of bulb size and plant spacing on days to emergence of tuberose

	Spacing (inches)		Mean
	6	10	
Bulb	140.67 b	131.00 c	135.83 b
Bulblet	147.33 a	141.67 b	144.50 a
Mean	144.00 a	136.33 b	

LSD value at 5% for bulb size = 1.2680  
 LSD value at 5% for distance = 1.2680  
 LSD value at 5% for bulb size × distance = 1.7932

Table 2: Influence of bulb size and plant spacing on days to bolting of tuberose

	Spacing (inches)		Mean
	6	10	
Bulb size	6	10	
Bulb	38.000 b	44.00 a	41.00 a
Bulblet	41.67 ab	45.33 a	43.50 a
Mean	39.83 b	44.67 a	

LSD value at 5% for bulb size = 2.9029  
 LSD value at 5% for distance = 2.9029  
 LSD value at 5% for bulb size × distance = 4.1053

Table 3: Influence of bulb size and plant spacing on days to flowering of tuberose

	Spacing (inches)		Mean
	6	10	
Bulb size	6	10	
Bulb	23.00 bc	21.67 c	22.33 b
Bulblet	24.67 a	24.00 ab	24.33 a
Mean	23.83 a	22.83 a	

LSD value at 5% for bulb size = 1.0263  
 LSD value at 5% for distance = 1.0263  
 LSD value at 5% for bulb size × distance = 1.4514

Table 4: Influence of bulb size and plant spacing on days to 50% fading of tuberose

	Spacing (inches)		Mean
	6	10	
Bulb size	6	10	
Bulb	14.33 b	16.00 a	15.17 a
Bulblet	12.67 c	13.33 bc	13.00 b
Mean	13.50 b	14.67 a	

LSD value at 5% for bulb size = 0.7538  
 LSD value at 5% for distance = 0.7538  
 LSD value at 5% for bulb size × distance = 1.0661

Table 5: Influence of bulb size and plant spacing on days to full fading of tuberose

	Spacing (inches)		Mean
	6	10	
Bulb size	6	10	
Bulb	21.33 b	23.67 a	22.50 a
Bulblet	18.00 c	20.00 b	19.00 b
Mean	19.67 b	21.83 a	

LSD value at 5% for bulb size = 1.3319  
 LSD value at 5% for distance = 1.3319  
 LSD value at 5% for bulb size × distance = 1.8836

Table 6: Influence of bulb size and plant spacing on stalk length of tuberose

	Spacing (inches)		Mean
	6	10	
Bulb size	6	10	
Bulb	97.67 c	111.00 a	104.33 a
Bulblet	93.17 d	105.83 b	99.50 b
Mean	95.42 b	108.42 a	

LSD value at 5% for bulb size = 2.2306  
 LSD value at 5% for distance = 2.2306  
 LSD value at 5% for bulb size × distance = 3.1546

Table 7: Influence of bulb size and plant spacing on canopy of tuberose

	Spacing (inches)		Mean
	6	10	
Bulb size	6	10	
Bulb	9.83 a	8.17 c	9.00 a
Bulblet	9.00 a	7.42 d	8.21 b
Mean	9.42 a	7.80 b	

LSD value at 5% for bulb size = 0.5165  
 LSD value at 5% for distance = 0.5165  
 LSD value at 5% for bulb size × distance = 0.7305

Table 8: Influence of bulb size and plant spacing on leaves plant<sup>-1</sup> of tuberose

	Spacing (inches)		Mean
	6	10	
Bulb size	6	10	
Bulb	34.33 b	39.67 a	37.00 a
Bulblet	30.33 c	35.00 b	32.67 b
Mean	32.33 b	37.33 a	

LSD value at 5% for bulb size = 1.2680  
 LSD value at 5% for distance = 1.2680  
 LSD value at 5% for bulb size × distance = 1.7932

**Days to Flowering:** The mean table regarding days to flowering is shown in Table 3 which shows that the effect bulb size and plant spacing on days to emergence was significant. The maximum number of days to flowering (24.67) was observed in bulblets with 6 inches plant spacing, while the lowest days to flowering (21.67) was observed in bulbs with plant spacing of 10 inches. These results are in agreement with those reported by Kalasareddi *et al.* [8], who observed that large sized corms produced flowers earlier in gladiolus as compared to small sized corms.

**Days to 50% Fading:** Days to 50 % fading as shown in Table 4, was significantly affected by bulb size and plant spacing. The maximum number of days to 50% fading (16.00) was observed in bulb with 10 inches plant spacing while the lowest days to 50% fading (12.67) was observed in bulblets with plant spacing of 6 inches [10].

**Days to Full Fading:** The mean table regarding days to full fading is shown in Table 5 that the effect bulb size and plant spacing on days to emergence was significant.

The maximum number of days to full fading (23.67) was observed in bulb with 10 inches plant spacing while the lowest days to full fading (18.00) was observed in bulblets with plant spacing of 6 inches [10].

**Stalk Length:** The mean table pertaining to stalk length as shown in Table 6 shows that the effect bulb size and plant spacing on stalk length was significant. The maximum stalk length (111.00) was observed in bulb with 10 inches plant spacing, while the minimum stalk length (93.17) was observed in bulblets with plant spacing of 6 inches. The increase in plant height might be due to intra plant competition for light, moisture, space, nutrients and aeration. This is resulted in elongation of flower stalk height, may be due to elongation of cells and number of cells due to cell division. Similar observations were also reported by Mane *et al.*, [10] on tuberose.

**Plant Canopy:** The results presented in Table 7 shows that bulb size and plant spacing had a significant effect on stalk length. The maximum plant canopy (9.83) was observed in bulb with 10 inches plant spacing, while the minimum plant canopy (7.42) was observed in bulblets with plant spacing of 6 inches.

**Number of Leaves Plant<sup>-1</sup>:** It is clear from Table 8 that the effect bulb size and plant spacing had significantly affected number of leaves plant<sup>-1</sup>. The maximum leaves plant<sup>-1</sup> (39.67) was observed in bulb with 10 inches plant spacing, while the minimum leaves plant<sup>-1</sup> (30.33) was observed in bulblets with plant spacing of 6 inches. Results indicated that similar trend was observed with increasing in the bulb size, number of leaves. These results coincide with the results of Tehranifar and Akbari [11], who observed the best vegetative growth and leaf number related to plantlets produced from larger bulbs and the weakest of vegetative growth related to small bulbs and the reduced leaves number at closer spacing was also reported by Banker and Mukhopadhyay [12] on tuberose.

## CONCLUSION

It can be concluded that from the present study that the maximum number of days to emergence (147.33), days to bolting (45.333) and days to flowering (24.667) was observed in bulblets with 6 centimeter plant spacing, while the lowest days to emergence (131.00), days to bolting (38.000) and days to flowering (21.667) was observed in bulbs with plant spacing of 10 centimeters.

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