Original Research Article

Bulb Sizes Effects on Flowering and Bulb Production of Tuberose (*Polianthes tuberosa* L.) cv. Single

ABSTRACT

A field experiment was executed under sub-tropical conditions during the period from April 2020 to March 2021 to observe the effects of bulb sizes on the flower and bulb yield of tuberose *cv.* single. The experiment consisted of three bulb sizes namely, a small-sized bulb (1.0-1.5 cm in diameter); a medium-sized bulb (1.6-2.5 cm in diameter), and large sized bulb (2.6-3.0 cm in diameter). Results disclosed that plant height, the number of leaves plant-1, leaf length and breadth, the number of lateral shoots plant-1, production of bulbs plant-1, bulb length and diameter, bulb yield both plant-1 and hectare-1, length of rachis, spike length and diameter, the number of florets spike-1 and flower yield both spike-1 and hectare-1 were increased with the increment of bulb sizes. The longest plant, highest leaf production, larger leaf, bulb production plant-1, bulb size and bulb yield both plant-1 and hectare-1, rachis length, spike length and diameter, number of flowers spike-1, flower yield both spike-1 and hectare-1 were recorded in large sized mother bulb. In contrast, the lowest above the studied parameters were obtained in small-sized mother bulbs. So, large-sized bulbs can be used for commercial production of flowers and bulb of single cv. of Tuberose.

Keywords: Tuberose, bulb size, flower longevity, flower yield

INTRODUCTION

Tuberose (*Polianthes tuberose* L.) which poaches the position in ornamental horticulture is one of the commercially cherished flower crops. It produces elegant, attractive, and fragrant white flowers. It takes a very special position to flower-loving people because of its elegance, prettiness, and adorable pleasant fragrance. It has good economic importance for the cut flower business and in the essential oil industry [7]. The flower remains vernal for quite a long time and stands for distance movement and fills a key position in the flower market [8]. For vase decoration and bouquet preparation, long spikes of tuberose are used and the florets are used for making ornaments, and artistic garlands. The flowers throw an attractive fragrance and are also a good source of floral oil [2]. Natural tuberose oil is one of the most costly perfumer's raw materials.

Many factors can influence the plant growth and commercial production of tuberose. Bulb size is one of the prime factors among cultural factors which influence the growth, bulbing, as well as production of a flower. For commercial production and better yield, the sizes of bulbs are so exigent to be determined. In the case of the small-sized bulb, there is a loss of labor, land, and verve. When large-sized bulbs are used, enhance growth, long spikes, a good number of florets spike-1, late senescence, and achieve the highest bulb and flower yield. The developmental pathway also depends on bulb sizes. Alternately bulbs having a small size produce shorter spikes, rachis, and fewer florets spike-1, giving lower bulb and flower yields [11]. Sometimes flowering occurs early before the completion of the vegetative stage, and even starts earlier senescence from small-sized bulbs [6]. But for tuberose, the number of flowers spike-1 and bulb production plant-1 increases from large-sized bulbs [3]. However, much evidence that the maximum bulb production can be obtained from large-sized bulbs [1].

In Bangladesh, very few works have been performed in respect of bulb size and for the cultivation of tuberose. So, there are demands for research on the production techniques of tuberose. Considering those facts, such kind of research work is enormously important for scientists and tuberose growers. The present experiment was performed to find out the optimum bulb size of tuberose for obtaining the highest growth, bulb, and flower yield under sub-tropical conditions.

MATERIALS AND METHODS

Experimental site

The experiment was conducted at farmer's field of Sutiakhali, Sadar, Mymensingh, located in between 24.68° North latitudes and 90.45° East longitudes during the period from April, 2020 to March, 2021. The soil of the experimental plots contain 1.11% organic matter, 18.4 ppm available phosphorus, 0.28 meq% exchangeable potassium, 17 ppm sulfur and a total nitrogen 0.062% along with 6.8 pH having silty loam texture. The experimental field was under subtropical climate distinguished by heavy rainfall during May to September and nominal rainfall during October to April.

Treatments and experimental design

The experiment was designed to study the effects of bulb sizes on growth, bulb production, and flower yield of tuberose. The experiment consisted of three bulb sizes of tuberose namely a small-sized bulb (size 1.0-1.5 cm), a medium-sized bulb (size 1.6-2.5 cm), and large sized bulb (size 2.6-3.0 cm). The experiment was a single factor and laid out in a Randomized Complete Block Design (RCBD) with three replications.

Management practices

The dimension of each unit plot was 6m2 (2m × 3m). For nitrogen, potassium, phosphorus, and sulfur sources Urea, Muriate of Potash (MoP), Triple Super Phosphate (TSP), and Gypsum were used respectively. Cow dung was also applied as an organic matter source. The cow dung (10 t ha-1), TSP (300 kg ha-1), and Gypsum (100 kg ha-1) were applied during the final land preparation. The total dose of Urea (400 kg ha-1) and MoP (300 kg ha-1) was applied in three equal splits. The first split was applied 30 days after planting. The second and third splits were applied at 65 and 100 days, respectively after planting.

Three different sizes of bulbs according to the treatments (1.0 to 3.0 cm in diameter) of tuberose cv. single was selected for planting separately. The bulbs were planted at about a 6 cm depth in each unit plot on April 20, 2020. Distance between row to row and plant to plant was maintained at 25 cm. Frequent weeding and mulching were done just after irrigation by breaking down the crust to conserve soil moisture and for easy aeration. During the cropping, season plots were irrigated when required. Insect attacks namely field cricket, mole cricket, and cutworm were a problem during the seedling stage for tuberose cultivation. Preventive measures were taken against the insect pest namely Dursban 20 EC was applied @ 0.2% at 15 days intervals three times starting from 20 days after the emergence of the bulb, and Dithane M-45 @ 0.2% was sprayed to control the fungal infection. The spikes were harvested when the first floret in the rachis was opened. Harvesting was completed from 22 August 2020 to 14 January 2021; bulbs and bulblets were harvested on 16 March 2021.

Parameters measured

Data on various plant characters like morphological, bulb and floral characters were recoded from 10 randomly selected plants from each plot. Bulb and flower yields of each plot was recorded and then converted into tha^{-1}.

Statistical analysis

The recorded data were analyzed statistically following the technique analysis of variance (ANOVA) and the mean differences among treatments were compared by Duncan's Multiple Range Test (DMRT) using the statistical computer package program, MSTAT-C [10].

RESULTS AND DISCUSSION

Morphological characters

The effects of bulb sizes on morphology such as plant height, number of leaves plant $^{-1}$, leaf length, leaf breadth and number of side shoots plant^{-1} were significant at different days after planting (Fig. 1. a, b, c, d). Results exposed that plant height, leaf production, leaf length, leaf breadth and number of side shoot plant^{-1} increased with increasing bulb sizes at all growth stages. The highest plant height, leaf length and breadth, leaf number and side shoot number was recorded in large sized mother bulb at all growth stages followed by medium size mother bulb. In contrast, the lowest above studied parameters were recorded in small sized mother bulb. These results indicate that bulb size of 2.6-3.0 cm may be the optimum size for maximizing the flower production of tuberose. [4] It was observed that plant height, leaf length and leaf number were increased with increasing bulb sizes that justify the present experimented result.

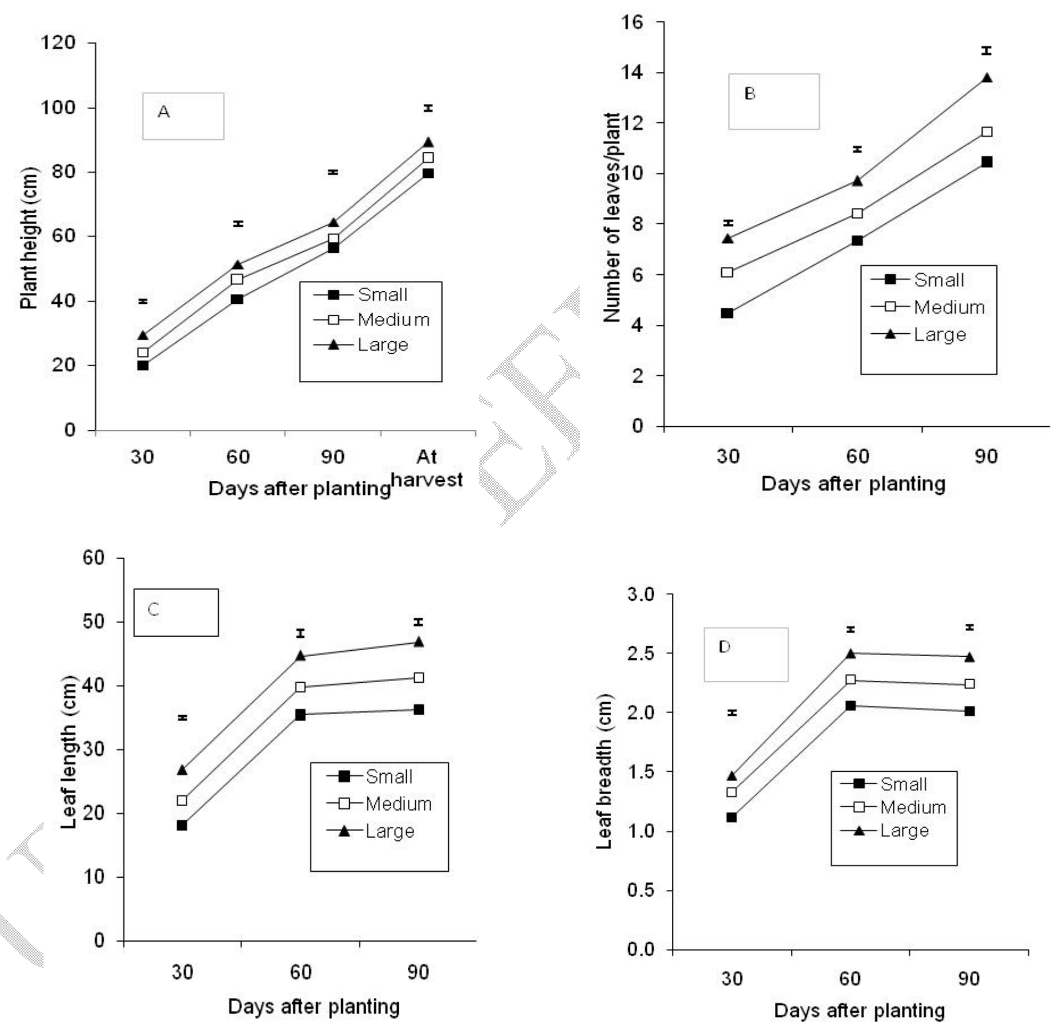

Fig. 1. Effects of bulb sizes on (A) plant height, (B) leaf number, (C) leaf length and (D) leaf breadth at different plant age of tuberose. Vertical bars represent LSD (0.05)

There was a significant difference in lateral shoot production for using different sizes of bulbs in tuberose (Fig. 2). Result revealed that lateral shoot production increased rapidly till 60 DAP followed by increased slowly up to 90 DAP. Results also showed that lateral shoot number increased with the increment of bulb size. The maximum number of lateral shoots plant^{-1} were found in large bulb followed by medium sized bulb at all growth stages. In contrast, the minimum number of lateral shoots were recorded in small sized bulb. This results are in full agreement with that of [5] who declared that the number of lateral shoots plant^{-1} increased with the increment of bulb sizes in tube rose.

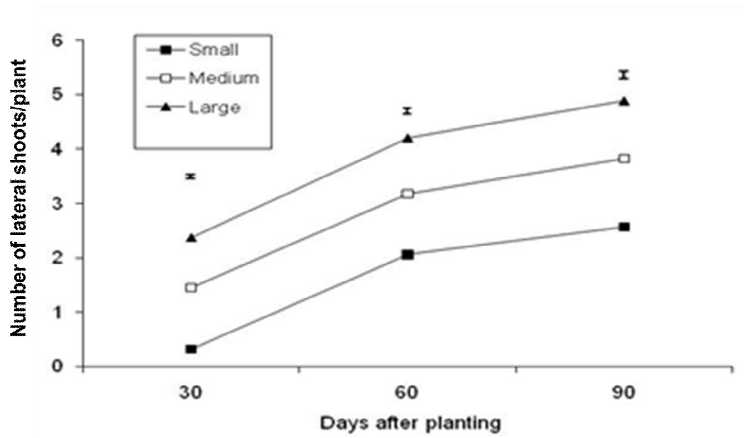

Fig. 2. Lateral shoot production in tuberose as influenced by bulb sizes at different plant age. Vertical bars represent LSD (0.05).

Phenological parameters

The effects of bulb sizes on days required for germination and flowering, germination percentage, and flower longevity were significant (Table 1). Results revealed that days required for germination, germination percentage, and flower longevity increased with the increment of bulb sizes while the opposite trend was found in days required for a flowering start. The longest days to germination, initiation of flowering, and flower duration were found in large-sized bulbs followed by the medium-sized bulb. In contrast, the shortest days to germination and flowering start, and flower duration was recorded in small size bulb (22.35 cm). This result suggests that bulb sizes have tremendous effects on phenological characters. Reduced days required for a flowering start in large-size bulbs might be due to available assimilation supply by the bulb to the young plant and resulted in insufficiency of enough assimilates to rapid growth and development as compared to small-size bulbs ones. This result is in agreement with that of [1] who found that spike length increased with the increment of bulb sizes in tuberose.

TABLE 1. Variation in phenological parameters due to different sizes of bulb

Bulb sizes	Germination time (days after planting)	Germination %	Days required to flowering start	Flower longevity (days)
Small	38.2 c	65.6 c	112.1 a	14.5 c
Medium	44.9 b	84.5 b	110.4 a	16.6 b
Large	49.2 a	92.4 a	105.5 b	19.7 a
F-test	**	**	**	**
CV (%)	2.41	9.50	6.66	3.87

In a column, values with same letter (s) do not differ significantly at P ≤ 0.05 by DMRT; ** indicate significant at 1% level of probability

Bulb characters

Bulb characteristics such as bulb length (cm), bulb diameter (cm), and bulb yield both plant-1 and hectare-1 were significantly influenced by bulb size (Table 3). Results showed that bulb length, bulb diameter, and bulb yield both plant-1 and hectare-1 were increased with increasing bulb size to 2.6-3.0 cm in diameter. These results agree that a large mother bulb size of 2.6-3.0 cm in diameter may be the optimum bulb size for maximizing bulb yield. On the other hand, the lowest bulb production, bulb size, and bulb yield were recorded in the small size of the mother bulb. Many researchers reported that the length and diameter of bulbs were higher in large-sized bulbs compared to the smaller sized bulb which supported the present experimental results. [9 &12].

TABLE 2. Effects of bulb sizes on bulb characters and bulb yield of tuberose

Bulb sizes	Bulbils plant^{-1} (no.)	Bulb length (cm)	Bulb diameter (cm)	Bulb weight plant^{-1} (g)	Bulb yield (tha^{-1})
Small	10.0 c	5.16 c	2.10 c	100.1 c	13.83 c
Medium	12.7 b	6.04 b	2.49 b	124.7 b	17.81 b
Large	15.9 a	6.59 a	2.78 a	176.7 a	25.90 a
F-test	**	**	**	**	**
CV (%)	5.51	2.54	6.29	4.38	7.28

In a column, values with same letter (s) do not differ significantly at P ≤ 0.05 by DMRT; ** indicates significant at 1% level of probability

Floral characters

There were significant differences in floral characters namely number of spike plant^{-1}, rachis length (cm), spike length (cm), diameter (cm), number of flowers spike^{-1} and flower yield both spike^{-1} and hectare^{-1} due to the use of different size bulbs. Results showed that the number of spike plant^{-1}, spike length, rachis length, number of flowers spike^{-1}, diameter and flower yield increased with the increment of bulb sizes. The highest flower yield was found in large sized mother bulbs due to increased flower spike^{-1} and flower size. In contrast, the lowest flower yield was observed in small sized mother bulbs due to fewer flowers spike^{-1} as well as small size flowers. This result is consistent with [6] who reported that rachis length increased with the increment of bulb sizes up to 3.5 cm in tuberose.

TABLE 3. Effects of bulb sizes on yield attributes and flower yield of tuberose

Bulb size	Spikes plant^{-1} (no.)	Rachis length (cm)	Spike length (cm)	Spike diameter (cm)	Florets spike^{-1} (no.)	Flower weight spike^{-1} (g)	Flower yield (t ha^{-1})
Small	1.63 c	11.6 c	23.8 c	0.77 c	7.88 c	36.17 c	9.55 c
Medium	2.19 b	12.9 b	29.6 b	0.89 b	9.39 b	41.65 b	11.77 b
Large	2.80 a	14.1 a	33.9 a	0.99 a	10.4 a	50.35 a	14.44 a
F-test	**	**	**	**	**	**	**
CV (%)	10.22	3.32	6.08	2.85	7.19	8.90	6.42

In a column, values with same letter (s) do not differ significantly at P ≤ 0.05 by DMRT; ** indicates significant at 1% level of probability

CONCLUSION

This study was mainly performed to determine the optimum bulb size of tuberose cv. single for better flower and bulb yield. From the results, it can be concluded that large sized mother bulb (diameter: 2.6-3.0 cm) appeared to be the best-suited bulb size for optimizing flower and bulb yield of tuberose under sub-tropical conditions and farmers will be benefitted by using large-sized bulbs for commercial cultivation.

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