Original Research Article

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

ABSTRACT

A field experiment was conducted under sub-tropical conditions ($24^0$75´ N and $90^0$50´ E) during the period from April 2013 to March 2014 to investigate the effect of bulb size on the growth, bulb, and flower yield of tuberose *cv*. single. The experiment consisted of three bulbs size viz., small size bulb (1.0-1.5 cm in diameter); medium size bulb (1.6-2.5 cm in diameter), and large size bulb (2.6-3.0 cm in diameter). Results revealed that plant height, leaf number plant-1, leaf length and breadth and number of side shoots plant-1, bulb production plant-1, bulb length, bulb diameter, and bulb yield both per plant and per hectare, rachis length, spike length and diameter, the number of florets spike-1 and flower yield both per spike and per hectare increased with increasing bulb size. The longest plant, maximum leaf production, larger leaf, and bulb production plant-1, bulb size and bulb yield both per plant and per hectare, rachis length, spike length and diameter, number of flowers spike-1, and flower yield both per spike and per hectare was recorded in large size mother bulb. In contrast, the lowest above studied parameters was recorded in small size mother bulb.

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

INTRODUCTION

Tuberose (*Polianthes tuberose* L.) which occupies the place in ornamental horticulture is one of the commercially exploited flower crops. It produces attractive, elegant, and fragrant white flowers. It occupies a very selective and special position to flower-loving people because of its prettiness, elegance, and sweet pleasant fragrance. It has a great economic potential for the cut flower trade and essential oil industry [8]. The flowers remain fresh for quite a long time and stand for distance transportation and fill a useful place in the flower market [9]. The long spikes of tuberose are used for vase decoration and bouquet preparation and the florets for making artistic garlands, ornaments, and buttonhole use. The

flowers emit a delightful fragrance and are the source of tuberose oil [2]. The natural flower oil of tuberose is one of the most expensive perfumer's raw materials.

Many factors can affect the plant growth and economic cultivation of tuberose. Bulb size is one of the prime major important factors among all the cultural factors which greatly influence growth, bulbing, and flower production. For economic production and good yield, bulb size is so important to be determined. In the case of very small size of bulb, there is an actual loss of land, labor, and energy. When plants are grown by large size bulbs, enhances vigorous growth, long spikes, and a large number of florets per spike delays senescence and achieves the maximum bulb and yield. The developmental process also depends on the size of the bulb. Small-sized bulbs produce the shortest spike and rachis, minimum florets per spike, contribute lower yield of bulbs and flowers [12]. Sometimes from small size bulbs, flowering may be early before the completion of full vegetative growth, often senescence starts earlier [7]. In the case of tuberose, the number of flowers per spike and bulb production per plant increases with large-sized bulbs [4]. However, there are reports that the maximum production of bulbs can be achieved from the large-sized bulb [1].

In Bangladesh, little work has been done in respect of bulb size and the use of manures for tuberose cultivation. So, research work is so lacking on the production technique of tuberose. Considering the facts, such research is very important for the greater interest of the scientist as well as the growers of our country. The present investigation was undertaken to find out the optimum size of the bulb of tuberose for achieving the maximum growth, flower, and bulb yield under sub-tropical conditions.

MATERIALS AND METHODS

Experimental site

The experiment was carried out at the farmer's field of Sutiakhali, Mymensingh Sadar Upazilla, Mymensingh, during the period from April, 2013 to March, 2014. The soil of the experimental plot is silty loam having a total nitrogen 0.062%, organic matter 1.11%, available phosphorus 18.4 ppm, exchangeable potassium 0.28 meq%, sulphur 17 ppm and pH 6.8. The experimental field is under subtropical climate characterized by heavy rainfall during the month of May to September and scanty rainfall during October to April.

Comment [H1]: The experiment was conducted around 9 years back.

Treatments and experimental design

The experiment was designed to study the effect of bulb size on growth, flower and bulb yield of tuberose. The experiment consisted of three bulb size such as small bulb (size 1.0-1.5 cm), medium bulb (size 1.6-2.5 cm) and large bulb (size 2.6-3.0 cm). The widely cultivated variety, Tuberose Single was used as planting material. The experiment was laid out in a Randomized Complete Block Design with three replications.

Comment [H2]: Whether, the statistical design was single factor or two factors.

Management practices

The size of the unit plot was 2 m × 3 m. Urea, Triple Super Phosphate (TSP), Muriate of Potash (MP), and gypsum were used as a source of nitrogen, phosphorus, potassium, and sulfur, respectively. Cow-dung was also applied. The cow dung (10 t/ha), TSP (300 kg/ha), and gypsum (100 kg/ha) were incorporated during the final land preparation. The total dose of urea (400 kg/ha) and MP (300 kg/ha) was applied in three equal installments. The first installment was applied 30 days after planting. The second and third installments were applied at 65 and 100 days, respectively after planting.

Three different sizes of bulbs according to the treatment (1.0 to 3.0 cm in diameter) of tuberose cv. single was selected for planting separately. The bulbs were planted in each unit plot at about a depth of 6 cm on April 20, 2013. The planting distance was 25 cm 25 cm between row to row and plant to plant. The plots were kept weed free by regular weeding. The soil was mulched frequently after irrigation by breaking the crust for easy aeration and to conserve soil moisture. The experimental plots were irrigated as and when necessary during the crop period. Mole cricket, field cricket, and cutworm attacks were a problem during the seedling stage for tuberose cultivation. As a preventive measure against the insect pest, Dursban 20 EC was applied @ 0.2% at 15 days intervals three times starting from 20 days after the emergence of the bulb. Dithane M-45 @ 0.2% was sprayed to check the fungal infection. The spikes of tuberose were harvested when the first floret in the rachis opened. Harvesting was done from 22 August 2013 to 14 January 2014 and bulbs and bulblets were harvested on 16 March 2014. The spikes of tuberose were harvested when the first floret in the rachis opened.

Parameters measured

Data on various plant characters like morphological, bulb and floral characters were taken from 10 randomly selected plants from each plot. Bulb and flower yields of each plot was recorded and then converted into tons/ha.

Statistical analysis

The collected data were analyzed statistically following the analysis of variance (ANOVA) technique and the mean differences among treatments were compared by Duncan's Multiple Range Test (DMRT) using the statistical computer package program, MSTAT-C [11].

Comment [H3]: Here, the design is same as mentioned earlier or different.

RESULTS AND DISCUSSION

Morphological characters

The effect of bulb size on morphological characters such as plant height, number of leaves plant $^{-1}$, leaf length, leaf breadth and number of side shoots plant^{-1} was significant at different days after planting (Fig. 1 a, b, c, d). Results revealed that plant height, leaf production, leaf length, leaf breadth and number of side shoot plant^{-1} increased with increasing bulb size at all growth stages. The highest plant height, leaf number, leaf length and breadth and side shoot number was recorded in large size mother bulb at all growth stages followed by medium size mother bulb. In contrast, the lowest above studied plant parameters was recorded in small size mother bulb. These results indicate that bulb size of 2.6-3.0 cm

may be optimum size for maximizing flower production of tuberose. [5] Observed that plant height, leaf number and leaf length increased with increasing bulb size that supported the present experimental result.

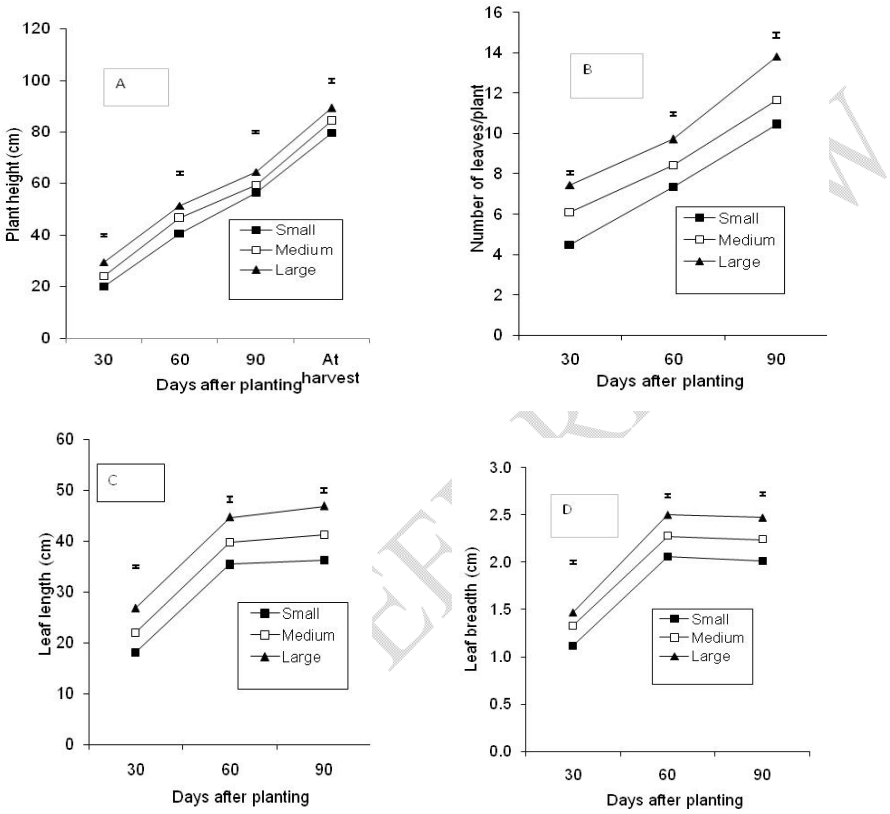

Fig. 1. Effect of bulb size on (A) plant height, (B) leaf number, (C) leaf length and (D) leaf breadth at different plant age of tuberose. Vertical bars represents LSD (0.05)

There was a significant different in side shoot production due to use of different size bulb in tuberose (Fig. 2). Result showed that side shoot production increased rapidly till 60 DAP followed by increased slowly up to 90 DAP. Result further showed that side shoot number increased with increasing bulb size. The highest number of side shoots plant^{-1} was recorded in large bulb followed by medium size bulb at all growth stages. In contrast, the lowest number of side bulb was recorded in small size bulb at all growth stages. This result is in full agreement with that of [6] who stated that the number of side shoots plant^{-1} increased with increasing bulb size in tube rose.

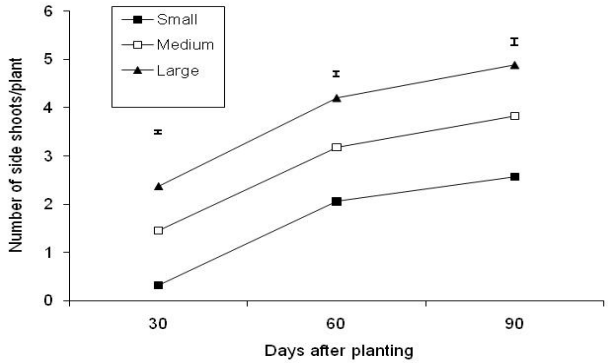

Fig. 2. Side shoot production as influenced by bulb size in tuberose at different plant age. Vertical bars represent LSD (0.05).

Phenological parameters

The effect of bulb size on days required for germination and flowering, germination percentage, and flower longevity was significant (Table 1). Results showed that days required for germination, germination percentage, and flower longevity increased with increasing bulb size while the reverse trend was observed in days required for a flowering start. The longest days to germination and flowering start, and flower duration was recorded in large bulb followed by medium size 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 indicates that bulb size has a tremendous effect 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 reported that spike length increased with increasing bulb size in tuberose.

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

Bulb size	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	**	**	**	**

Comment [H4]: Is not there any C. D. value in F test

CV (%)	2.41	9.50	6.66	3.87

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

Bulb characters

Bulb characters such as bulb production plant-1, bulb length, bulb diameter, and bulb yield both per plant and per hectare were significantly influenced by bulb size (Table 3). Results showed that bulb production, bulb length, bulb diameter, and bulb yield both per plant and per hectare were increased with increasing bulb size to 2.6-3.0 cm in diameter. These results indicate that a large mother bulb size of 2.6-3.0 cm in diameter may be the optimum bulb size for maximizing tuber 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 bulb length and diameter was higher in large size bulb than in smaller size bulb which supported the present experimental result. (10 &13).

TABLE 2. Effect of bulb size on bulb characters and bulb yield of tuberose

Bulb size	Bulbils/ plant (no.)	Bulb length (cm)	Bulb diameter (cm)	Bulb weight/ plant (g)	Bulb yield (t/ha)
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 (%)	6.51	3.54	7.29	3.98	8.41

In a column, figure (s) bearing same letter 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 such as number of spike plant-1, rachis length, spike length and diameter, number of flowers spike-1, and flower yield both per spike and per hectare due to the use of different size bulbs. Results revealed that the number of spike plant-1, rachis length, spike length, and diameter, the number of flowers spike-1, and flower yield increased with increasing bulb size. The highest flower yield was recorded in large size mother bulbs due to increased flower spike-1 and flower size. In contrast, the lowest flower yield was recorded in small size mother bulbs due to fewer flowers spike-1 as well as small size flowers. This result is consistent with [7] who reported that rachis length increased with increasing bulb size up to 3.5 cm in tuberose.

TABLE 3. Effect of bulb size on yield attributes and flower yield of tuberose cv. Single

Bulb size	Spikes /plant (no.)	Rachis length (cm)	Spike length (cm)	Spike diameter (cm)	Florets/ spike (no.)	Flower weight/ spike (g)	Flower yield (t/ha)
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, figure (s) bearing same letter do not differ significantly at P ≤ 0.05 by DMRT; ** indicates significant at 1% level of probability

CONCLUSION

Growth, bulb, and flower yield of tuberose were affected by different sizes of the bulb. A large size mother bulb (diameter: 2.6-3.0 cm) appeared to be the best-suited bulb size for optimizing bulb and flower yield of tuberose under sub-tropical conditions.

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Comment [H5]: Reference is not seen in the text.

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