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Research Paper

Effect of Varieties and Planting Materials on Growth, Flowering and Bulb Production in Tuberose

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Abstract

An experiment was conducted at the Floriculture Research Field of Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute, Gazipur, Bangladesh during April, 2015 to February, 2017 to find out the suitable planting materials for specific tuberose genotype for growth, flowering and bulb production of tuberose. Individually both genotypes showed better performances for some specific parameters and large bulb showed best results among different planting materials. The genotype TR-001, single variety produced the longer plant and spike (49.37 and 85.04 cm, respectively) and also the heavier stick (72.14 g). Alternatively, TR-004 which is semi-double variety obtained the longer rachis (32.12 cm) and the maximum florets/spike (44.38). In case of bulb and bulblet production, TR-001 produced the heaviest and the largest bulb (19.9 g and 2.89 cm, respectively) while TR-004 produced the maximum bulblets/plant and also the highest bulblet weight/plant (18.39 and 33.88 g, respectively). Considering the nature and size of tuberose bulb, the large bulb demonstrated the longest rachis (33.34 cm), the maximum florets/spike (45.54), the heaviest flower sticks (76.25 g), the maximum number of bulbs/plant (6.70), the heaviest and the largest bulb (22.55 g and 3.12 cm, respectively) and also the maximum number and weight of bulblets/plant (22.55 g and 38.53 g, respectively). There were no significant variations among the various combination of tuberose varieties and planting materials on growth, flowering, bulb and bulblet production of tuberose. Besides, mother/old and medium sized bulb showed also statistically similar performances in respect of rachis length, florets/spike, bulbs/plant, weight and diameter of bulb and bulblets/plant. So, mother/old bulb of any tuberose variety can also be used for the commercial production with the large and medium sized bulbs.

Keywords: Bulb production, Flowering, Planting materials, Tuberose, Variety.

INTRODUCTION

Tuberose (*Polianthes tuberosa* Linn.) is one of the most important commercial cut flowers and is widely cultivated in many tropical and sub-tropical regions of the world including Bangladesh. This flower is native to Mexico belongs to family Agavaceae (formerly known as Amaryllidaceae). It is considered as one of the most important fragrant truncated (cut branch) flowers which are in worthy consideration in the perfume Industry (Jokar and Salehi, 2006). Tuberose blooms throughout the year and its clustered spikes are rich in fragrance; florets are star shaped, waxy and loosely arranged on spike that can reach up to 30 to 45 cm in length. This flower is very much popular in international market for its distinct floral pattern, sweet fragrance and essential oils and also has a huge economic prospect for cut flower business in Bangladesh. In addition to national consumption, there is a great scope to export this flower to many other countries. Expanded interest in tuberose cut flower needs improved cultural management for boosting yield and quality of tuberose.

The successful cultivation of tuberose depends on selection of suitable varieties and propagating materials. Two cultivars of tuberose viz. 'Single' and 'Double' are commonly available in Bangladesh. Recently, some good cultivars of single, semi-double and double tuberose have been introduced through different sources. Flowers of those Single type (single row of perianth) are recommended both for loose and cut flowers while that of Semi-double and Double varieties (more than one and two rows of perianth) are used as cut flowers, garden display and interior decoration.

Selection of suitable bulbs is very much important for successful commercial cultivation in tuberose. In general, spindle -shaped bulbs free from diseases having diameter between 1.5 and 3.0 cm are suitable for planting (Safeena *et al*., 2015). The size and nature of propagating material is an important factor for changing the growth, flowering and also the production of propagating materials of the respective plants. For commercial tuberose production about 3-4 ratoon crops can be taken from a single planting (Safeena *et al*., 2015). But for quality flower production more than two years of ratooning is not suggested (Khan and Dadlani, 2014). After two years of cultivation a large number of bulbs including mother bulbs may be obtained. Mother bulbs may be used as planting materials for tuberose flower production though it is not normally encouraged by the farmers for quality flower production. Moreover, size of bulb also influences vegetative growth, flowering and also bulb yield of tuberose. The number, size and quality of harvested bulbs considerably affected by preliminary bulb size. Tuberose plants grown from large bulbs took minimum days to emerge and produced more number of floret/spike, maximum bulb and bulblets volume per plant (Khan *et al*., 2016). Large sized bulb induced healthy growth with better flower quality and resulted in a greater number of bulblets production in tuberose (Ahmad *et al*., 2009). Similar performances were also observed in gladiolus where large sized corms (3 to 3.5 cm) showed maximum sprouting (96.67 %), longest spike (47.55 cm), maximum number of florets/spike (8.31) in the variety of Red majesty compared to medium and small corms (Kareem *et al*., 2013).

As far as variety and planting materials of tuberose are concerned, very little work has been done in Bangladesh. Keeping in view the present experiment was taken to explore the nature and size of bulbs which can produce healthy plants with good quality flowers and give maximum number of bulbs and bulblets to be utilized in future. Therefore, the experiment was carried out to find out the suitable planting materials for specific tuberose genotype for growth, flowering and bulb production of tuberose.

MATERIALS AND METHODS

The experiment was carried out at Floriculture Research Farm of Horticulture Research Center, Bangladesh Agricultural Research Institute, Gazipur during April, 2015 to February, 2017. Two tuberose genotypes TR-001 (Single) and TR-004 (Semi-double) were considered as one factor.

And the other factor was nature and size of bulb with four levels viz. mother/old (4.0-4.5 cm in diameter), large (3.0-3.5 cm in diameter), medium (2.4-2.9 cm in diameter) and small (1.5-2.0 cm in diameter) bulb (Fig. 1). The experiment was laid out in RCB factorial design and the treatments were replicated thrice. The unit plot size was 1.5 m x 1.8 m and spacing was maintained at 30 cm × 30 cm with 9 cm depth.

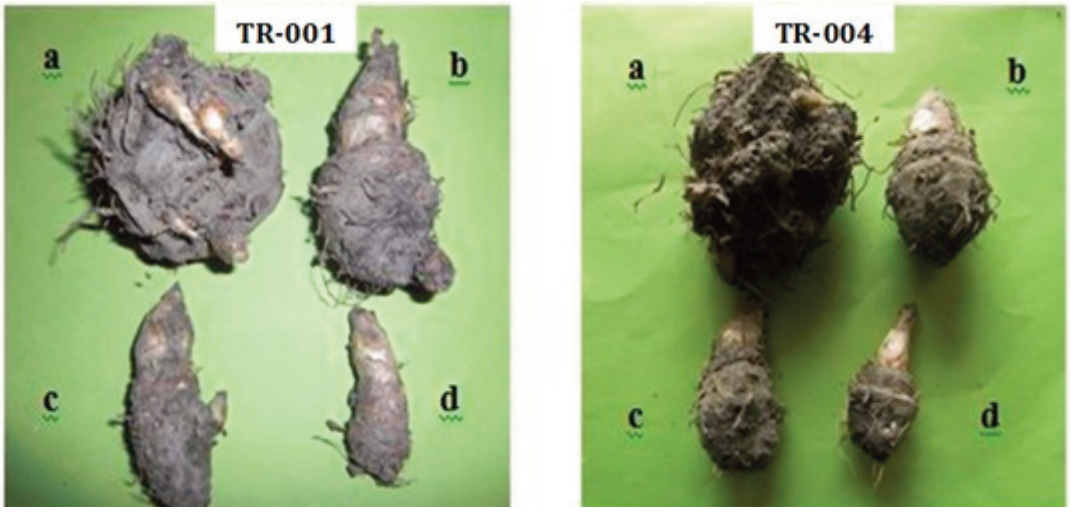

Fig. 1. Bulbs of two species of tuberose a: Mother/old bulb; b: Large bulb, c: Medium bulb, d: Small bulb.

The experiment field was well prepared by adding 10 t cowdung and fertilized with 435 kg urea, 400 kgTSP, 300 kg MoP, 12 kg boric acid and 8 kg $ZnSO_4$/ha (Khan and Dadlani, 2014). Cowdung, TSP, MoP, boric acid and $ZnSO_4$ were applied as basal and urea was top-dressed in two equal splits at 21 days after planting and spike initiation stage. The data on growth, flowering and bulb characters were recorded from ten randomly selected plants from each unit plot during the study period which are as follows.

Germination (%): Germination was counted 45 days after sowing and germination percent was calculated using following formula:

$$\text{Germination (\%)} = \frac{\text{Number of plants germinated/plot}}{\text{Total number of bulbs planted/plot}} \times 100$$

Plant height (cm): Plant height refers to the length of the 10 selected plants from ground level to tip of erect leaf measured by a meter scale during optimum stage of flower harvesting and then mean was calculated.

Spike length (cm): It was measured from the end where from it was cut off at the base to the tip of the spike by measuring scale from 10 randomly selected spikes during optimum stage of flower harvesting and then mean was calculated.

Rachis length (cm): The florets bearing length of 10 randomly selected spikes were measured during optimum stage of flower harvesting and then mean was calculated.

Florets/spike: It was recorded by counting number of florets from 10 randomly selected spikes when all the florets of the spike were fully opened and then mean was calculated.

Flower stick weight (g): 10 randomly selected flower sticks were weighted during optimum stage of flower harvesting and the mean was then calculated.

Bulbs/plant: Bulbs of 10 randomly selected plants were counted during bulb lifting and their average/plant was computed.

Bulb weight (g): Weight of harvested bulbs from 10 randomly selected plants was divided by respective number of bulbs during bulb lifting.

Bulblets/plant: Bulblets of 10 randomly selected plants were counted and divided by respective number of plants during bulb lifting.

Bulblet weight/plant (g): During bulb lifting, weight of harvested bulblets from 10 randomly selected plants was recorded and divided by respective number of plants.

Diameter of bulb (cm): Diameter of harvested bulbs was measured by using slide calipers from 10 randomly selected plants after lifting of bulbs and was divided by respective number of bulbs.

All the data were analyzed statistically and the mean differences were adjudged by LSD.

RESULTS AND DISCUSSION

Main effect of varieties and planting materials on growth and flowering parameters of tuberose

The tuberose genotypes showed significant differences in all the growth and floral attributes except germination (%) (Table 1 and Fig. 1). The genotype TR-001, 'Single' variety produced the longer plant and spike (49.37 and 85.04 cm, respectively) and also the heavier stick (72.14 g). Alternatively, TR-004 which is 'Semi-double' variety obtained the longer rachis (32.12 cm) and the maximum florets/spike (44.38) (Table 1 and Fig. 2). These variations among different genotypes could be attributed to their differences in genetic makeup.

Table 1. Main effect of varieties and planting materials on growth and flowering of tuberose.

Treatments	Germination (%)	Plant height (cm)	Spike length (cm)	Rachis length (cm)	Florets/spike
Varieties					
A_1	97.92(9.88)	49.37	85.04	27.78	38.45
A_2	98.33(9.91)	39.41	70.75	32.12	44.38
Level of significance	ns	**	**	**	**
Planting materials					
B_1	98.34(9.91)	45.80	75.95	28.81b	40.17bc
B_2	99.17(9.95)	45.78	79.85	33.34a	45.54a
B_3	99.17(9.95)	43.92	79.20	29.84b	42.10ab
B_4	95.84(9.78)	42.06	76.57	27.82b	37.84c
Level of significance	ns	ns	ns	*	**
CV(%)	1.94	7.49	5.19	9.02	5.51

*, ** and ns: Significant at $P<0.05$, $P<0.01$ and no significant respectively.A_1=TR-001 (Single), A_2=TR-004 (Semi double), B_1= Mother bulb, B_2= Large bulb, B_3= Medium bulb, B_4= Small bulb.

Fig. 2. Rachis length and number of florets/spike influenced by the tuberose varieties, TR-001 (left) and TR-004 (right).

Planting materials (nature and size of the bulb) showed significant variations on rachis length, florets/spike and stick weight on tuberose production (Table1 and Fig. 3). The large bulb demonstrated the longest rachis (33.34 cm), the maximum florets/spike (45.54) and the heaviest flower sticks (76.25 g). This result indicates the gradual improvements of different attributes with the increase of bulb size which might be due to the presence of higher reserved food in the large bulb of tuberose. These results also confirmed by Kariuki and Kako (1999) and Singh (2000). Though germination (%) did not show significant variation among the treatments, the large and medium sized bulb showed the highest germination percentage (99.17 %). The results are supported by the findings of Ahmad *et al.* (2009) in tuberose. Kareem *et al*. (2013) also reported that the maximum germination (96.67 %) were obtained by large sized corm in gladiolus.

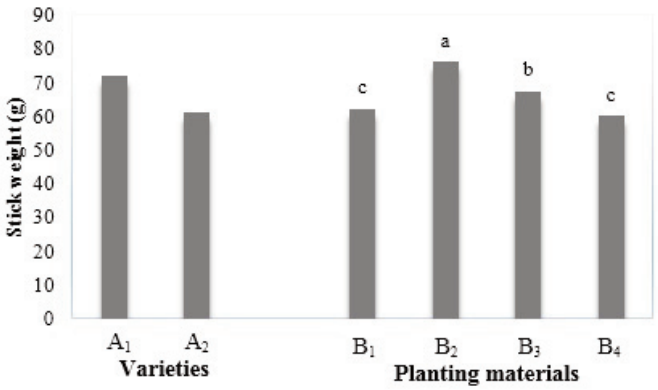

Fig. 3. Flower stick weight (g) influenced by the varieties and planting materials. A1=TR-001 (Single), A2=TR-004 (Semi double), B1= Mother bulb, B2= Large bulb, B3= Medium bulb, B4= Small bulb.

Combined effect of varieties and planting materials on growth and flowering of tuberose

Combination of varieties and planting materials did not show significant variations on growth and flowering of tuberose (Table 2 and Fig. 4). TR-001 with large bulb produced the longest plant and spike (51.19 cm and 87.19 cm, respectively) and the heaviest stick (82.50 g) whereas

the longest rachis (35.46 cm) containing more number of florets / spike (49.0) were produced by the genotype TR-004 couple with large bulbs.

Table 2. Combined effect of varieties and planting materials on growth and flowering of tuberose.

Treatments	Germination (%)	Plant height (cm)	Spike length (cm)	Rachis length (cm)	Florets/spike
A_1B_1	96.67(9.82)	49.60	81.40	25.96	37.13
A_1B_2	100.0(9.99)	51.19	87.19	31.21	42.08
A_1B_3	100.0(9.99)	49.64	86.94	28.15	39.59
A_1B_4	95.0(9.74)	47.06	84.61	25.80	35.0
A_2B_1	100.0(9.99)	42.0	70.50	31.67	43.21
A_2B_2	98.33(9.91)	40.37	72.50	35.46	49.0
A_2B_3	98.33(9.91)	38.19	71.46	31.53	44.62
A_2B_4	96.67(9.82)	37.07	68.53	29.83	40.67
Level of significance	ns	ns	ns	ns	ns
CV (%)	1.94	7.49	5.19	9.02	5.51

ns = Not significant. A1=TR-001 (Single), A2=TR-004 (Semi double), B1= Mother bulb, B2= Large bulb, B3= Medium bulb, B4= Small bulb.

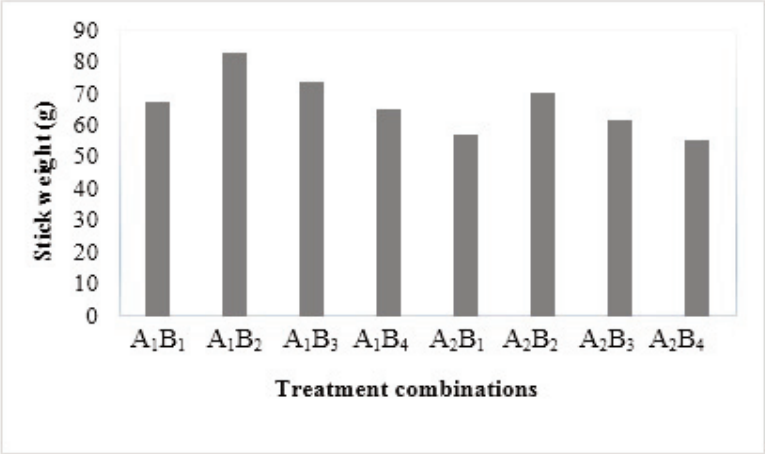

Fig 4. Flower stick weight (g) influenced by the combination of varieties and planting materials. A1=TR-001 (Single), A2=TR-004 (Semi double), B1= Mother bulb, B2= Large bulb, B3= Medium bulb, B4= Small bulb.

Main effect of varieties and planting materials on bulb and bulblets production of tuberose

Significant influence was noticed by the tuberose varieties on all the parameters of bulb and bulblets production of tuberose except bulbs/plant (Table 3). TR-001 produced the heaviest and the largest bulb (19.9 g and 2.89 cm, respectively). The maximum bulblets/plant (18.39) and also the highest bulblet weight/plant (33.88 g) were produced by the genotype TR-004. While, TR-001 produced less number and minimum weight of bulblet weight/plant (14.15 and 23.63 g, respectively). In another experiment, Bindiya *et al*. (2018) showed the range of bulblet production by the tuberose varieties was 2.30-6.82/plant which was much lower performance compared to

present study. The variations may be attributed to the fact that the performance of a genotype may vary with the climatic conditions prevailing in particular area.

Similarly, all the parameters of bulb and bulblets production of tuberose were significantly influenced by the planting materials (Table 3). The large bulb produced the maximum number of bulbs/plant (6.70), the heaviest and the largest bulb (22.55 g and 3.12 cm, respectively) and also the maximum number and weight of bulblets/plant (22.55 g and 38.53 cm, respectively). These results indicated a positive relation with the bulb size and bulbs/bulblets production of tuberose those were in accordance with the findings of Raja and Palanisamy (1999) in tuberose and Kareem *et al.* (2013) in gladiolus. Mother/old and medium sized bulb showed statistically similar performances in all the parameters except bulblet weight/plant (g) which indicates that mother/old bulb also can be used for the commercial production of tuberose with the large and medium sized bulbs.

Table 3. Main effect of varieties and planting materials on bulb and bulblets production of tuberose.

Treatments	Bulbs/plant	Bulb weight (g)	Diameter of bulb (cm)	Bulblets/plant	Bulblet weight plant (g)
Genotypes					
A_1	4.56	19.9 a	2.89 a	14.15 b	23.63 b
A_2	5.12	17.03 b	2.70 b	18.39 a	33.88 a
Level of significance	ns	**	**	**	**
Planting materials					
B_1	4.42 bc	18.58 b	2.74 bc	14.98 b	24.17 c
B_2	6.70 a	22.55 a	3.12 a	22.55 a	38.53 a
B_3	4.88 b	19.17 ab	2.80 b	17.50 b	30.55 b
B_4	3.35 c	13.57 c	2.51 c	10.05 c	21.75 c
Level of significance	**	**	**	**	**
CV (%)	16.25	11.25	5.47	11.27	9.25

*In each column, means with the similar letters are not significantly different ($P < 0.05$) using the LSD test.
*, ** and ns: Significant at $P<0.05$, $P<0.01$ and no significant respectively. A1=TR-001 (Single), A2=TR-004 (Semi double), B1= Mother bulb, B2= Large bulb, B3= Medium bulb, B4= Small bulb.

Combined effect of varieties and planting materials on bulb and bulblets production of tuberose

Combination of varieties and planting materials did not show significant variations on bulb and bulblets production of tuberose (Table 4). TR-004 with large bulb produced the maximum number of bulbs, bulblets and the highest bulblet weight/plant (7.16, 25.93 and 44.90 g, respectively). On the other hand, TR-001 couple with large bulb produced the heaviest and the largest bulb (24.96 g and 3.20 cm).

CONCLUSION

Individually both genotypes showed better performances for some specific parameters and large bulb showed best results among different planting materials. As there were no significant variations among the various combination of tuberose varieties and planting materials on growth and flowering of tuberose, so all the planting materials specially large and medium sized bulb including mother (old) bulb couple with both genotypes may be used for commercial tuberose flower production.

Table 4. Combined effect of varieties and planting materials on bulb and bulblets production of tuberose.

Treatments	Bulbs/plant	Bulb weight (g)	Bulblets/plant	Bulblet weight/plant (g)	Diameter of bulb (cm)
A_1B_1	4.16	19.83	13.63	19.16	2.86
A_1B_2	6.23	24.96	19.16	32.16	3.20
A_1B_3	4.66	20.33	15.33	26.33	2.90
A_1B_4	3.16	14.46	8.46	16.83	2.56
A_2B_1	4.66	17.33	16.33	29.16	2.61
A_2B_2	7.16	20.12	25.93	44.90	3.03
A_2B_3	5.10	18.00	19.66	34.76	2.69
A_2B_4	3.53	12.66	11.63	26.66	2.46
Level of significance	ns	ns	ns	ns	ns
CV (%)	16.25	11.25	11.27	9.25	5.47

ns=Not significant. A1=TR-001 (Single), A2=TR-004 (Semi double), B1= Mother bulb, B2= Large bulb, B3= Medium bulb, B4= Small bulb.

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