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Growth and yield of tuberose as influenced by different levels of manures and fertilizers

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Abstract
The study was conducted at the Horticultural Farm of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during the period from May 2014 to February, 2015. The experiment consisted five levels nutrient sources: F_0 - Control, F_1 - Cowdung 10 t + 250 kg Urea + 190 kg TSP + 190 kg MP/ha, F_2 - Poultry litter 5 t + 250 kg Urea + 190 kg TSP + 190 kg MP/ha, F_3 - Cowdung: 15 t/ha and F_4 - Poultry litter: 10 t/ha. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Application of fertilizer showed significant variations on most of the parameters. The highest yield of spike (3,57,650 / ha) was recorded from F_1 and the lowest (2,88,940 / ha) from F_0. The highest yield of bulb per hectare (26.64 ton) was recorded from F_1 and the lowest yield (18.38 ton) was recorded from F_0. The highest yield of bulblet per hectare (23.63 ton) was found from F_1 and the lowest yield (16.66 ton) was recorded from F_0. So, application of cowdung 10 t + 250 kg Urea + 190 kg TSP + 190 kg MP per hectare was found suitable for growth and yield of tuberose.

Keywords: Tuberose, nutrient sources, growth and yield

1. Introduction

Tuberose (*Polianthes tuberosa* L.) is one of the most popular bulbous ornamental plants of tropical and sub-tropical areas in the family Amaryllidaceae, produces attractive, elegant and fragrant white flowers. The flowers having excellent keeping quality and are widely used as cut flowers. The flowers remain fresh for quite a long time and stand long distance transportation and fill a useful place in the flower market (Patel *et al*, 2006). It is used as vase decoration, bouquets, making veni, garland, button-holes or crown and frequently used during marriage or religious ceremonies (Randhawa and Mukhopadhyay,1986). The long flower spikes of tuberose are excellent as cut flowers for table decoration when arranged in bowls and vases. The flowers emit a delightful fragrance and are the source of tuberose oil. The natural flower oil of tuberose remains today as one of the most expensive of the perfumes raw materials.

Tuberose is a native of Mexico from where it spreads to the different parts of the world during 16 century. How and when the tuberose found its entrance to India, Ceylon and elsewhere in the orient is probably an unanswerable question (Yadav *et al*., 1982). Now a days, it is cultivated on large scale in France, Italy, South Africa, USA, and in many tropical and subtropical areas, including India and Bangladesh. In Bangladesh, for the last few years, tuberose has become a popular cutflower for its attractive fragrance and beautiful display in the vase. Now, it is one of the most important commercial cutflowers. Tuberose has high demand in the market and its production is highly profitable. In Bangladesh, its commercial cultivation was introduced during 1980 by some pioneer and innovative farmers at Panishara union of Jhikorgacha thana under Jessore district near the Benapol border. Although tuberose is now grown in the country, very little is known about production technology in Bangladesh condition.

Tuberose is a half-hardy bulbus perennial multiplying itself through the bulblets. Roots are mainly adventitious and shallow, the leaves are long, narrow, linear grass like, green and arise in rosette, the flowers have a funnel shaped perianth, waxy white in color and borne in a spike. There are three types of tuberose: single with one row of corolla segments, semi- double bearing flowers with two to three rows of corolla segments and double having more than three rows of corolla segments.

Plant growth and economic cultivation of tuberose are affected by many factors among them fertilizer is important one. Tuberose is a gross feeder and requires a large quantity of NPK,

both in the form of organic and inorganic fertilizers (Singh *et al*, 1976). Fertilizers have great influence on growth, flower and bulb production in tuberose (Mitra *et al*, 1979; Yadav *et al*, 1985). Effect of NPK on tuberose production has been reported by several authors of different geographical region (Cirrito, 1975; Singh *el al*, 1976; Mitra *et al*, 1979; Mukhopadhyay and Banker, 1986; Yadav *et al*, 1985). Nitrogen has significant effect on bulb production of tuberose. It also increases plant height, number of leaves, spike per hill, earlier flowering and higher number of flowers per spike (Mukhopahyay and Banker, 1986; Roy, 1992). Phosphorus has a significant effect on spike production and floret quality (Jana et al, 1974; Banker and Mukhopadhyay, 1985). Potash appears to help increasing the number of spike, flower per spike and number of flowers per hill (Cirrito, 1975; Singh *et al*., 1976).

There is a scope of increasing flower yield, quality of flower and bulb production of tuberose using fertilizer. Considering the present situations and above facts the present investigation was undertaken with the following objective to determine the effect of nutrient sources on growth, flowering and yield of tuberose.

2. Materials and Methods

The experiment was conducted at the Horticultural Farm of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka, Bangladesh. The location of the study site is situated in 23°74′N latitude and 90°35′E longitude. The experimental soil belongs to the Modhupur Tract under AEZ No. 28 (UNDP, 1988). The selected experimental plot was medium high land and the soil series was Tejgaon (FAO, 1988). The climate of experimental site was under the subtropical , characterized by three distinct seasons, the monsoon or the winter season from November to February and the pre-monsoon period or hot season from March to April and the monsoon period from May to October (Edris *et al*., 1979). Bulbs of tuberose were used as planting materials and they were collected from Horticultural Farm of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka- 1207, Bangladesh. The experiment consisted five levels nutrient sources: F_0 - Control, F_1 - Cowdung 10 t + 250 kg Urea + 190 kg TSP + 190 kg MP/ha, F_2 - Poultry litter 5 t + 250 kg Urea + 190 kg TSP + 190 kg MP/ha, F_3 - Cowdung: 15 t/ha and F_4 - Poultry litter: 10 t/ha. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. There were 15 unit plots, the size of each was 2.0 m x 1.0 m. The experimental plot was opened in the first week of May 2014, with a power tiller and left exposed to the sun for a week.

The sources of N, P_2O_5, K_2O as urea, TSP and MP were applied, respectively as per treatment (Mollah *et al*., 2002). The entire amounts of TSP and MP were applied during the final land preparation. Urea was applied in three equal installments at 30, 55 and 85 days after planting bulb of tuberose. Well-rotten cowdung and poultry litter also applied during final land preparation as per treatment. The bulbs were planted on 20 May, 2014 with a distance on 20 cm x 20 cm and the number of bulb/plot was 50.

Data of plant height, number of leaves per plant, days required for emergence of spike, percentage of flowering plant, length of flower stalk at harvest, length of rachis at harvest, number of spikelet per spike, number of spike per hectare, individual bulb thickness, individual bulb weight, individual bulb diameter, number of bulblet per plant, weight of bulblet, diameter of bulblets, bulb yield per plot and hectare, bulblet yield per plot and hectare were recorded from the sample plants during the course of experiment. Ten plants were randomly selected from each unit plot for collection of data.

The experimental data obtained for different parameters were statistically analyzed.The mean values of all the recorded characters were calculated and analysis of variance was performed by 'F' (variance ratio) test. The significance of the difference among the individual and treatment combinations means was estimated by the Duncan's Multiple Range Test (DMRT) at 5% level of probability (Gomez and Gomez, 1984).

3. Results and Discussion

3.1 Days required to emergence of spike

Significant difference was recorded on days required to emergence of spike of tuberose due to the application of different nutrient sources (Table 1). The minimum days required to emergence of spike (59.24) was found from F_3 and the maximum days (65.47) was observed from F_0.

3.2 Flowering plant

Flowering plant of tuberose varied significantly for the application of different nutrient sources (Table 1). The highest flowering plant (93.61 %) was observed in F_1 and the lowest flowering plant (80.09 %) was obtained from F_0. Nutrient sources have great influence flower production in tuberose (Mitra *et al*, 1979; Yadav *el al*, 1985).

3.3 Length of flower stalk at harvest

Statistically significant difference was recorded on length of flower stalk at harvest due to the application of different nutrient sources (Table 1). The highest length of flower stalk at harvest (68.03 cm) was observed from F_1 and the lowest length of flower stalk at harvest (59.93 cm) was found from F_0.

3.4 Length of rachis at harvest

Statistically significant difference was found on length of rachis at harvest for the application of different nutrient sources (Table 1). The highest length of rachis at harvest (36.15 cm) was recorded from F_1 and the lowest length of rachis at harvest (29.31 cm) was recorded from F_0. Yadav (2007) reported that length of rachis was remarkably increased with N and P application, alone and in combination.

3.5 Number of spikelets per spike

Significant difference was recorded on number of spikelets per spike due to the application of different nutrient sources (Table 1). The highest number of spikelets per spike (14.69) was performed by F_1 and the lowest number of spikelets per spike (11.21) was found from F_0. Yadav (2007) reported that number of spike per plot was remarkably increased with N and P application, alone and in combination.

Table 1: Effect of nutrient sources on growth parameter of tuberose

Treatment	Days required to emergence of spike	Flowering plant (%)	Length of flower stalk at harvest (cm)	Length of rachis at harvest (cm)	Number of spikelets per spike
F_0	65.47a	80.09 c	59.93c	29.31c	11.21b
F_1	60.58 b	93.56 a	68.03 a	36.15 a	14.69 a

F_2	60.69 b	90.33 b	66.33 ab	35.86ab	13.99 a
F_3	59.24 c	88.72 b	65.65 b	34.47 b	13.65 a
F_4	61.02 b	88.92 b	65.56 b	33.95 b	13.64 a
$LSD_{(0.05)}$	0.903	2.783	2.196	1.502	1.036
CV (%)	6.59	7.34	9.62	6.78	8.65

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s)
Significantly as per 0.05 level of probability

3.6 Weight of individual bulb
Weight of individual bulb showed statistically significant differed due to the application of different nutrient sources (Table 2). The highest weight of individual bulb (29.95 g) was observed in F_1 and the lowest weight of individual bulb (25.36 g) was found from F_0.

3.7 Diameter of individual bulb
Statistically significant difference was found on diameter of individual bulb for the application of different nutrient sources (Table 2). The highest diameter of individual bulb (2.11 cm) was found from F_1 and the lowest diameter of individual bulb (1.85 cm) was observed from F_0.

3.8 Number of bulblet per plant
Application of different nutrient sources showed statistically significant difference on number of bulblet per plant (Table 2). The highest number of bulblet per plant (23.76) was found from F_1 and the lowest number of bulblet per plant (21.01) was recorded from F_0. Patil *et al*. (1999) reported that application of 250:200:200 kg NPK/ha on 3 tuberose tubers per hill resulted in the highest flower and spike yields (7.86 t/ha, 3.33 spikes/ha, respectively).

3.9 Weight of bulblet per plant
Significant variation was observed for weight of bulblet per plant for the application of different nutrient sources (Table 2). The highest weight of bulblet per plant (15.85 g) was recorded from F_1 and the lowest weight of bulblet per plant (12.14 g) was recorded from F_0.

3.10 Diameter of bulblet
Diameter of bulblet varied significantly due to the application of different nutrient sources (Table 2). The highest diameter of bulblet (1.42 cm) was found from F_1 which was statistically similar (1.36 cm) by F_3 and closely followed (1.33 and 1.31) by F_2 and F_4 , while the lowest diameter of bulblet (1.11 cm) was found from F_0.

Table 2: Effect of nutrient sources on bulb and bulblet parameter of tuberose

Treatment	Weight of individual bulb(g)	Diameter of individual bulb(cm)	Number of bulblet/plant	Weight of bulblet/plant (g)	Diameter of bulblet
F_0	25.36 c	1.85 c	21.01c	12.14 d	1.11 c
F_1	29.95 a	2.11 a	23.76 a	15.85 a	1.42 a
F_2	28.38 b	1.98 b	23.02 ab	15.41 ab	1.33 b
F_3	27.99 b	1.96 b	22.80 ab	14.89 bc	1.36 ab
F_4	27.56 b	1.95 b	22.23 b	14.68 c	1.31 b
$LSD_{(0.05)}$	1.086	0.086	0.919	0.608	0.091
CV(%)	6.29	6.74	7.29	6.21	6.16

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ
Significantly as per 0.05 level of probability

3.11 Yield of bulb per plot
Yield of bulb per plot varied significantly for the application of different nutrient sources (Table 3). The highest yield of bulb per plot (0.53 kg) was observed in F_1 and the lowest yield of bulb per plot (0.37 kg) was found from F_0. Singh *et al*., 2001 reported that N, P and K contents in leaves were higher than those in bulbs.

3.12 Yield of bulblet per plot
Application of different nutrient sources varied significantly on yield of bulblet per plot (Table 3). The highest yield of bulblet per plot (0.48 kg) was obtained from F_1 while the lowest yield of bulblet per plot (0.34 kg) was recorded from F_0.

3.13 Yield of bulb per hectare
Yield of bulb per hectare showed statistically significant difference for the application of different nutrient sources (Table 3). The highest yield of bulb per hectare (26.64 ton) was recorded from F_1 and the lowest yield of bulb per hectare (18.38 ton) was recorded from F_0.

3.14 Yield of bulblet per hectare
Significant difference was recorded on yield of bulblet per hectare due to the application of different nutrient sources (Table 3). The highest yield of bulblet per hectare (23.63 ton) was found from F_1 and the lowest yield of bulblet per hectare (16.66 ton) was recorded from.

3.15 Yield of bulblet per hectare
Significant difference was recorded on Number of spike per hectare per hectare due to the application of different nutrient sources (Table 3). The highest Number of spike per hectare 3,57,650 was found from F_1 and the lowest Number of spike per hectare 2,88,940 was recorded from F_0.

Table 3. Effect of nutrient sources yield characteristics of tuberose

Treatment	Yield of bulb (kg/plot)	Yield of bulblet (kg/plot)	Yield of bulb (t/ha)	Yield of bulblet (t/ha)	Number of spike per hectare (000)
F_0	0.37 b	0.34 b	18.38 c	16.66 b	288.94 c
F_1	0.53 a	0.48 a	26.64 a	23.63 a	357.65 a
F_2	0.49 a	0.47 a	24.71 ab	22.48 a	330.86 b
F_3	0.47 a	0.44 a	23.77 b	21.74 a	327.98 b
F_4	0.48 a	0.44 a	24.15 ab	21.62 a	328.45 b
$LSD_{(0.05)}$	0.053	0.043	2.503	2.348	23.06
CV(%)	10.56	11.06	11.85	11.09	10.27

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ Significantly as per 0.05 level of probability

4. Conclusion

The highest yield of spike per hectare (3,57,650) was observed from F_1 and the lowest yield (2,88,940) was found from F_0. The highest diameter of individual bulb (2.11 cm) was found from F_1 and the lowest diameter of individual bulb (1.85 cm) was observed from F_0. The highest diameter of bulblet (1.42 cm) was found from F_1 and the lowest diameter (1.11 cm) was found from F_0. The highest yield of bulb per hectare (26.64 ton) was recorded from F_1 and the lowest yield (18.38 ton) was recorded from F_0. The highest yield of bulblet per hectare (23.63 ton) was found from F_1 and the lowest yield (16.66 ton) was recorded from F_0. So, application of cowdung 10 t + 250 kg Urea + 190 kg TSP + 190 kg MP per hectare was found suitable for growth and yield of tuberose.

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