Influenced of Yield and Yield Contributing Characters of Tuberose by the Application of Bulb and Fertilizers

Mohammad Shahjahan[1*], Abul Hasnat Muhammad Solaiman[2], Khairul Kabir[3], Md. Abdullah Al Mahmud[4], Shakil Arvin Zomo[5]

[1,2,3]Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh
[4,5]Department of Agricultural Extension, Dhaka, Bangladesh.
Corresponding author**: shahjahansau@gmail.com**

Abstract— *The experiment was conducted at the Horticultural farm of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh to investigate the influenced of yield and yield contributing characters of tuberose by the application of bulb and fertilizers. The experiment consisted of three bulb size viz., B_1- small (1.0-1.5 cm); B_2- medium (1.6-2.5 cm) and B_3- large (2.6-3.0 cm) in diameter and different sources of fertilizers viz.,F_0= control (no fertilizers), F_1- chemical fertilizers 330, 150 and 200 kg ha^{-1} of urea, TSP and MoP, respectively; F_2- vermicompost 5 t ha^{-1}; F_3- poultry litter 10 t ha^{-1} and F_4- cowdung 20 t ha^{-1}. The experiment was laid out in a two factor Randomized Complete Block Design with three replications. The growth parameters as well as yield characters were greatly influenced by the application of poultry manure. In case of bulb size, the highest flower (12.45 t ha^{-1}) and bulb (23.93 t ha^{-1}) yield was recorded from B_3 and the lowest flower (8.83 t ha^{-1}) and bulb (12.94 t ha^{-1}) yield was recorded from B_1. In case of fertilizers, the highest flower (12.09 t ha^{-1}) and bulb (21.36 t ha^{-1}) yield was recorded from F_3 and the lowest flower (7.95 t ha^{-1}) and bulb (14.44 t ha^{-1}) from F_0. The maximum flower (14.19 t ha^{-1}) and bulb (27.19 t ha^{-1}) was found from the treatment combination of B_3F_3 and the minimum flower (6.16 t ha^{-1}) and bulb (10.15 t ha^{-1}) yield from B_1F_0. So, it may be concluded that large bulb size and 10 t ha^{-1} poultry litter is best for growth, bulb and flower production of tuberose.*

Keywords— Bulb size, flower yield, organic farming, poultry manure, tuberose.

I. INTRODUCTION

Tuberose (*Polianthus tuberose* L.) which occupies important place in ornamental horticulture is one of the commercially exploited flower crops belonging to the family Amaryllidaceae. It has a great economic potential for cut flower trade and essential oil industry (Alan *et al*., 2007). 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 natural flower oil of tuberose is one of the most expensive perfumer's raw materials. The impact of increased fertilizer use on crop production has been large and important (Shankar *et al.*, 2010). Cowdung, farm yard manure, poultry manure, vermicompost and also green manure are excellent sources of organic matter as well as primary plant nutrients (Pieters, 2005). In recent years, there has been serious concern about long-term adverse effect of continuous and indiscriminate use of inorganic fertilizers on deterioration of soil structure, soil health and environmental pollution (Singh, 2000). In contrast to organic fertilizers can improve soil structure, improve nutrient exchange and maintain soil health and that is why interests have been raising in organic farming (Mitra, 2010). Fertilizers have great influence on growth, building and flower production in tuberose (Polara *et al*., 2004). Effect of chemical and manures on tuberose production has been reported by several authors for different geographical region (Nanjan *et al*, 1980; Yadav *et al*, 1985; Singh *et al*., 2005; Shankar *et al.*, 2010). Nitrogen, phosphorus and potassium have a significant effect on spike production and floret quality (Singh *et al*., 2004). Poultry manure is an excellent organic fertilizer, as it contains high nitrogen, phosphorus, potassium and other essential nutrients (Garg and Bahla, 2008). Vermicompost has been shown to have high levels of total and available nitrogen, phosphorus, potassium, micronutrients, microbial and enzyme activities and growth regulators (Chaoui *et al*., 2003). When plants are grown by large size bulb, enhance to vigorous growth, long spikes, large number of florets per spike, delay senescence and to achieve the maximum bulb and yield. Small sized bulbs produce the shortest spike and rachis, minimum florets per spike, contribute lower yield of bulb and flowers (Khayrunnessa, 2008**)**. Sometimes from small size bulb, flowering may early before the completion of full vegetative growth, often senescence starts earlier (Vandor Valk & Timmer, 1974). In case of tuberose, number of flower per spikes and bulb production per plant increases with large sized bulbs (Mukhopdahyay *et al.*, 1986). Considering the facts, such research is very important for the greater interest of the scientist as well as the growers of our country. The objectives were- to find out

the optimum size of bulb of tuberose for achieving the maximum growth, flower and bulb yield of tuberose; to investigate the effect of different fertilizers on growth and yield of tuberose and to identify the suitable combination of bulb size and fertilizers for ensuring the higher flower and bulb yield of tuberose.

II. MATERIAL AND METHOD

The experiment was conducted at Horticulture farm of Sher-e-Bangla Agricultural University (SAU), Dhaka Bangladesh. The location of the site is at 23.774^0 N latitude and 90.335^0 E longitude with an elevation of 8.2 m from sea level. The experiment consisted of two factors as - Factor A: Bulb size, B_1 - small bulb size (1.0-1.5 cm in diameter) ,B_2 - medium bulb size (1.6-2.5 cm in diameter), B_3 - large bulb size (2.6-3.0 cm in diameter) and Factor B: Fertilizers F_0 - control (No fertilizers) , F_1 - 330, 150 and 200 , Kgha^{-1} of urea, TSP and MP, respectively, F_2 - 5 t ha^{-1} vermicompost, F_3 - 10 t ha^{-1} poultry litter and F_4 - 20 t ha^{-1}Cowdung. The two factors experiment was laid out in Randomized Complete Black Design (RCBD) with 3 replications. The bulbs of tuberose cv. Double were collected from Horticulture Farm (SAU). Urea, Triple Super Phosphate (TSP) and Muriate of Potash (MoP) were used as source of nitrogen, phosphorus and potassium respectively. Full dose of cow dung (15 t ha^{-1}), vermicompost (5 t ha^{-1}), poultry litter (10 t ha^{-1}) and TSP (as per treatment) were incorporated during final land preparation. The planting distance was 25 cm x 25 cm between row to row and plant to plant. Data were collected on following parameters- plant height, number of leaves/plant, maximum length of leaves, breadth of leaves, number of side shoot, length of spike, length of rachis, diameter of a single spike, diameter of a single spike, weight of a single spike, spike yield per plot, flower yield, length of bulb, diameter of bulb, yield of bulb, number of side bulb per plant and fresh weight of bulb per hill. The collected data were analyzed statistically following the analysis of variance (ANOVA) technique and the mean differences were adjusted by Duncan's Multiple Range Test (DMRT) using the statistical computer package program, MSTAT (Russell, 1986).

III. RESULT AND DISCUSSION

3.1 Plant height

The plant height was recorded at different stages of growth i.e. 30, 60, 90 days after planting (DAP) and at harvest. The plant height varied significantly due to planting of different size of bulbs. During the period of plant growth stage, the longest plant was observed in large size of bulb (B_3) and the smallest size of bulb (B_1) (Fig. 1). Results revealed that plant height was greater in different fertilizers applied plots than no fertilizer applied plots (Fig. 2).The tallest plant at all growth stages was recorded in poultry litter applied plots. In contrast, the shortest plant was recorded in no fertilizer applied plots. This result indicates that poultry litter had tremendous effect on growth and development in tuberose. The highest plant height was recorded in the treatment combination of larger bulb with poultry litter and the shortest plant height was recorded in the treatment combination of small bulb size with no fertilizer (Table 1).

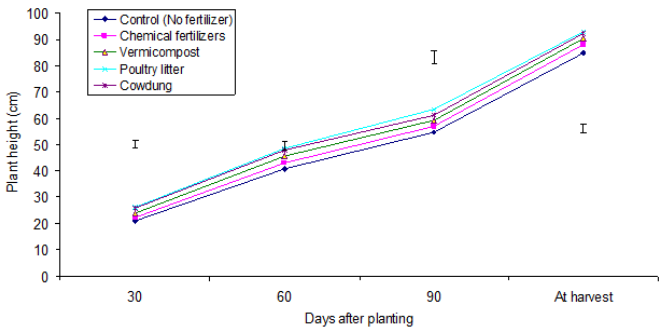

FIG.1. EFFECT OF BULB SIZE ON PLANT HEIGHT AT DIFFERENT DAYS AFTER PLANTING OF TUBEROSE. VERTICAL BARS REPRESENT LSD (0.05)

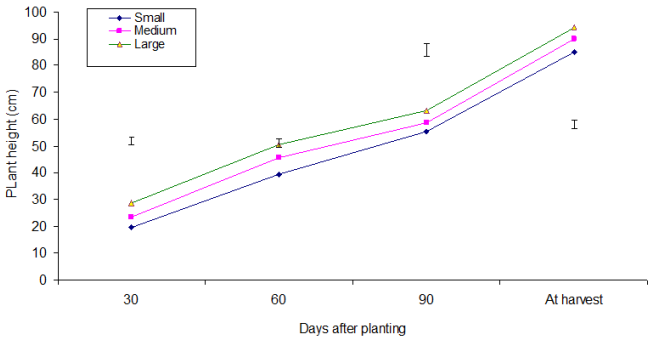

FIG.2. EFFECT OF DIFFERENT FERTILIZERS ON PLANT HEIGHT AT DIFFERENT DAYS AFTER PLANTING OF TUBEROSE. VERTICAL BARS REPRESENT LSD (0.05)

TABLE 1

INTERACTION EFFECT OF BULB SIZE AND FERTILIZERS ON PLANT HEIGHT AT DIFFERENT DAYS AFTER PLANTING OF TUBEROSE

Interaction	Plant height (cm)			Number of leaves/plant			Leaf length (cm)			Leaf breadth (cm)			Number of side shoots		
	30 DAP	60 DAP	90 DAP	30DAP	60DAP	90 DAP	30 DAP	60 DAP	90 DAP	30DAP	60DAP	90DAP	30DAP	60DAP	90DAP
B_1F_0	17.28 i	34.29 k	50.62 i	3.85 h	6.32 i	7.35 k	15.55 h	27.69 i	33.46 h	0.89 g	1.84 l	1.91 j	0.08 j	1.30 m	2.01 h
B_1F_1	18.45 hi	37.00 j	53.42 h	4.00 h	6.67 i	7.92 j	16.58 g	30.79 h	34.50 gh	0.98 fg	1.97 k	1.97 i	0.08 j	1.42 m	2.13 h
B_1F_2	19.25 h	40.25 i	56.06 fg	4.25 gh	7.25 h	8.25 ij	17.16 g	35.67 g	35.50 g	1.07 f	2.06 j	2.06 h	0.25 i	2.08 l	2.46 g
B_1F_3	20.96 fg	42.33 gh	58.08def	4.50 g	7.67 gh	8.58 hi	18.50 f	37.50 fg	37.25 f	1.20 e	2.09 ij	2.09gh	0.41h	2.25 k	2.63 g
B_1F_4	21.71 fg	43.58 g	58.75 de	5.25 f	7.83 g	9.00 gh	20.08 e	37.92 efg	37.85 ef	1.22 e	2.12 i	2.12 g	0.56g	2.48 j	3.05 f
B_2F_0	20.75 g	41.26 hi	54.77 gh	5.10 f	7.76 g	8.68 hi	19.90 e	37.41 fg	37.29 f	1.25 e	2.18 h	2.20 f	1.05 f	2.63 i	3.15 f
B_2F_1	22.41 f	43.75 g	56.92efg	5.38 f	8.07 fg	9.00 gh	20.24 e	38.20 ef	39.20 e	1.28de	2.23 gh	2.23 f	1.08 f	2.81 h	3.21 f
B_2F_2	24.00 e	45.67 f	59.17 de	5.91 e	8.33 ef	9.25 fg	21.58 d	39.42 def	41.25 d	1.29de	2.25 fg	2.25 ef	1.42 e	3.00 g	3.50 e
B_2F_3	25.62 cd	49.00 d	62.75 c	6.75 c	8.75 de	9.83 de	23.38 c	41.17 cd	42.25 cd	1.40bc	2.32 de	2.32 d	1.75 c	3.56 d	4.41 c
B_2F_4	24.83 de	47.75 de	59.71 d	6.33 d	8.58 de	9.33 efg	23.16 c	40.25 cde	42.25 cd	1.36cd	2.30 ef	2.30de	1.60d	3.36 ef	4.18 d
B_3F_0	25.1cde	46.39 ef	58.36def	6.96 bc	8.72 de	9.69 def	21.50 d	40.25 cde	43.70 bc	1.39bc	2.37 cd	2.35 d	1.60d	3.26 f	4.13 d
B_3F_1	26.46 c	48.42 d	60.33 d	7.08 bc	9.00 cd	10.06 cd	23.91 c	42.42 bc	44.00 b	1.42bc	2.42 c	2.42 c	1.71 c	3.46 de	4.43 c
B_3F_2	28.58 b	50.58 c	62.85 c	7.23 b	9.30 c	10.50 c	26.58 b	44.58 ab	45.25 b	1.45bc	2.49 b	2.49 b	2.21b	4.18 c	4.85 b
B_3F_3	31.91 a	54.17 a	69.75 a	7.83 a	10.67 a	12.33 a	28.49 a	46.18 a	49.50 a	1.52 a	2.56 a	2.56 a	2.80 a	4.46 b	5.23 a
B_3F_4	31.16 a	52.48 b	65.42 b	7.66 a	9.92 b	11.28 b	28.66 a	45.85 a	49.00 a	1.48ab	2.54 ab	2.54ab	2.78 a	4.71 a	5.04ab
$LSD_{0.05}$	1.39	1.37	2.30	0.413	0.429	0.501	1.03	2.18	1.48	0.091	0.052	0.052	0.052	0.129	0.218
F-test	*	*	*	**	**	**	**	**	*	**	*	**	**	**	**
CV (%)	3.49	1.82	2.33	4.20	3.08	3.20	2.85	3.34	2.17	4.27	1.66	1.17	1.99	2.52	3.62

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

3.2 Leaf production

The highest number of leaves/plant was recorded in large bulb and the lowest number of leaves production was observed in smaller size bulb at all growth stages (Fig. 3). Khayrunnessa (2008) observed that leaf production increased with increasing bulb size from 1.0 cm to 3.0 cm bulb size which is supported the present experimental result. Poultry litter applied plant produced the maximum leaves and the fewest leaves were recorded in control treatment (fig. 4). This result is consistent with Marban *et al.* (2008) who reported that leaf production was higher in organic manure plant than control plants. The maximum leaf production was recorded in the treatment combination of large bulb with poultry litter (Table 1) and the fewest leaf was recorded in the treatment combination of small bulb with no fertilizers treatment.

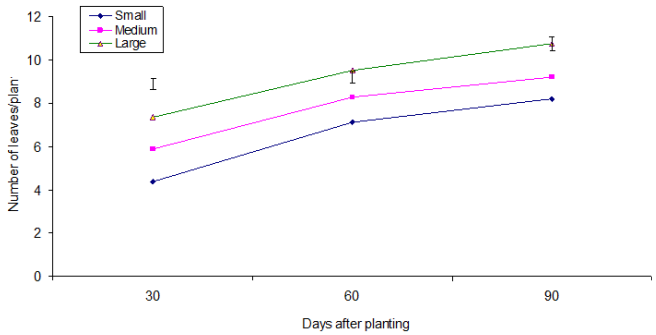

FIG.3. EFFECT OF DIFFERENT BULB SIZE ON LEAF PRODUCTION IN TUBEROSE AT DIFFERENT DAYS AFTER PLANTING. VERTICAL BARS REPRESENT LSD (0.05)

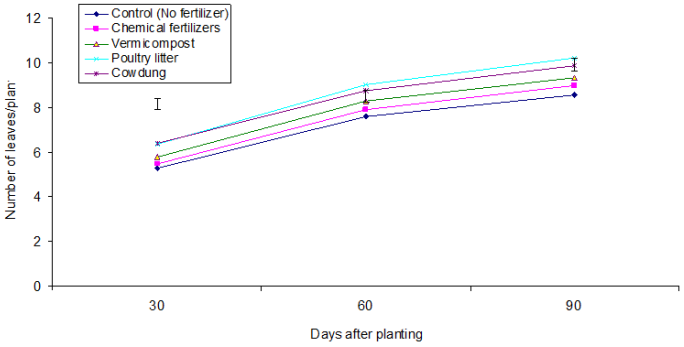

FIG.4. EFFECT OF DIFFERENT FERTILIZERS ON LEAF PRODUCTION IN TUBEROSE AT DIFFERENT DAYS AFTER PLANTING. VERTICAL BARS REPRESENT LSD (0.05)

3.3 Leaf length

Results revealed that leaf length increased with increasing bulb size (Fig. 5). The maximum leaf length (46.94 cm) was recorded in large size bulb and the minimum leaf length (36.28 cm) was recorded in small size bulb. Dhua et al. (1987) observed that leaf length increased with increasing bulb size. The highest leaf length was recorded in poultry litter (Fig. 6). Marban et al. (2008) who reported that leaf length was higher in organic manures than no fertilizers in tuberose that supported the present experimental results. The highest leaf length was recorded in the treatment combination of large bulb with chicken manure and the lowest leaf length in the treatment combination of small bulb size with no fertilizer.

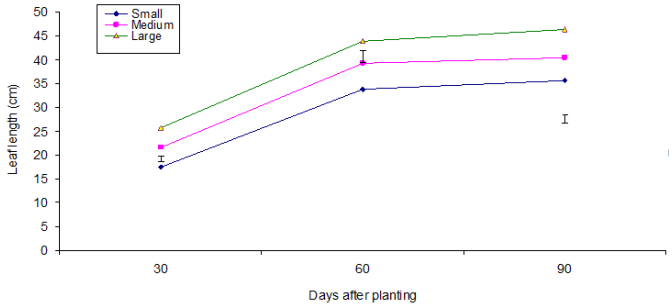

FIG.5. SHOWING LEAF LENGTH INFLUENCED BY DIFFERENT BULB SIZE OF TUBEROSE AT DIFFERENT DAYS AFTER PLANTING. VERTICAL BARS REPRESENT LSD (0.05)

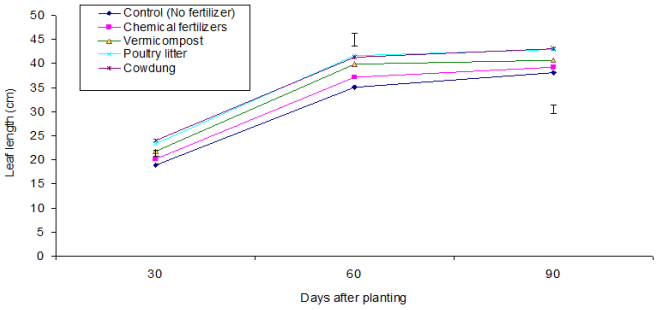

FIG.6.SHOWING LEAF LENGTH INFLUENCED BY DIFFERENT FERTILIZERS AT DIFFERENT DAYS AFTER PLANTING OF TUBEROSE. VERTICAL BARS REPRESENT LSD (0.05)

3.4 Leaf breadth

The leaf breadth increased rapidly till 60 DAP followed by slowly increased (Fig. 7). The widest leaf was recorded in large size bulb (2.47 cm at 90 DAP) at all growth stages and the narrowest leaves was recorded in small size bulb (2.01 cm at 90 DAP) at all growth stages. This result is in agreement with that of Misra *et al.* (2000) who reported that leaf breadth increased with increasing bulb size till 3.0 cm diameter. The widest leaf was recorded in poultry litter (Fig. 8). This result is consistent

with Padaganur *et al.* (2010) who reported that leaf breadth in tuberose was greater in organic fertilizer applied plant than control plants. The highest leaf breadth was recorded in the treatment combination B_3F_3 (Table 1) and the lowest B_0F_0.

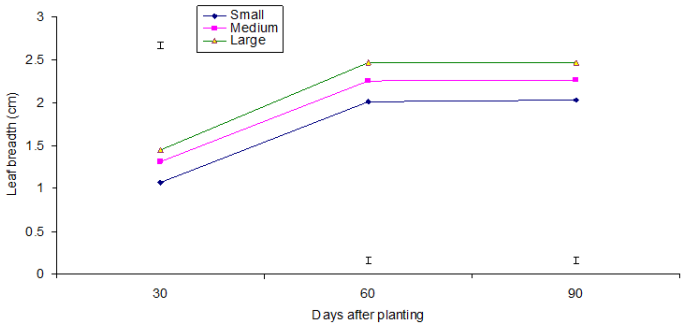

FIG.7. SHOWING LEAF BREADTH AS INFLUENCED BY DIFFERENT BULB SIZE AT DIFFERENT DAYS AFTER PLANTING OF TUBEROSE. VERTICAL BARS REPRESENT LSD (0.05)

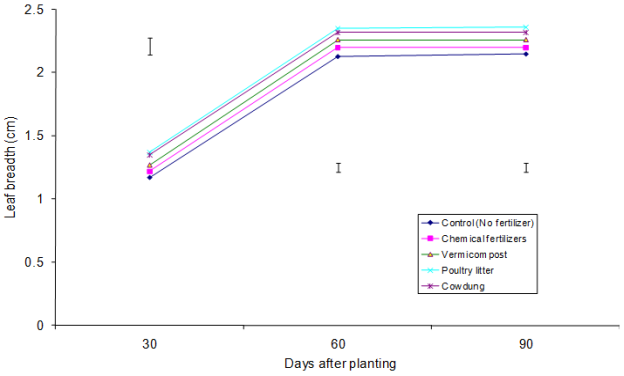

FIG.8. SHOWING LEAF BREADTH INFLUENCED BY DIFFERENT FERTILIZERS AT DIFFERENT DAYS AFTER PLANTING OF TUBEROSE. VERTICAL BARS REPRESENT LSD (0.05)

3.5 Number of side shoots plant^{-1}

The highest number of side shoots plant^{-1} was recorded in B_3 and the lowest number of side bulb was recorded in B_0. This result is in full agreement with Pathak *et al.* (1980), who stated that the number of side shoots plant^{-1} increased with increasing bulb size in tube rose. The highest number of side shoots plant^{-1} was recorded in poultry litter (Fig. 10) and the lowest side shoots plant^{-1} was recorded in no fertilizer. Variation in shoots plant^{-1} due to different fertilizers was observed by Rahim (2009). The highest number of shoots plant^{-1} was recorded in the treatment combination of large bulb with poultry litter (Table 1) and the lowest number of side shoots plant^{-1} was recorded in the treatment combination of small bulb with no fertilizers.

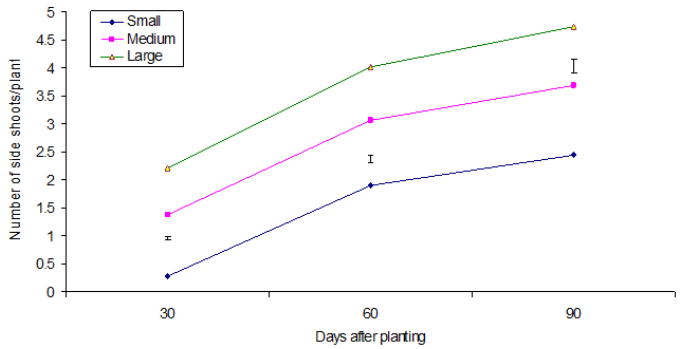

FIG.9. SIDE SHOOTS PRODUCTION AS INFLUENCED BY BULB SIZE IN TUBEROSE AT DIFFERENT DAYS AFTER PLANTING. VERTICAL BARS REPRESENT LSD (0.05)

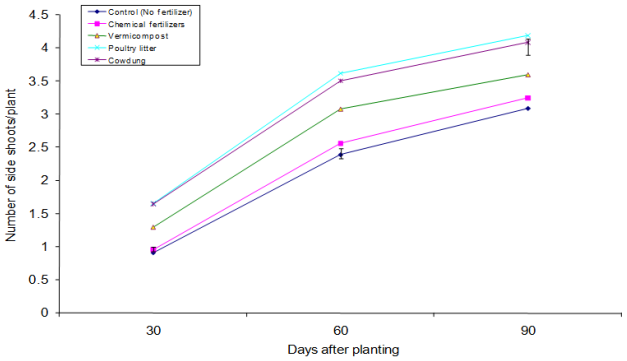

FIG.10. EFFECT OF DIFFERENT FERTILIZERS ON SIDE SHOOT AT DIFFERENT DAYS AFTER PLANTING. VERTICAL BARS REPRESENT LSD (0.05)

3.6 Spike length

Small size bulb produced the shortest spike whereas the longest spike from large sized bulb plants. This result is in agreement with that of Kale and Bhujbal (1972).The longest spike was observed in poultry litter (29.22 cm) and the shortest spike was recorded in no fertilizers (22.00 cm). Marban et al. (2008) reported that spike length was higher chicken manure than Cowdung. The longest spike was recorded in the treatment combination of B_3F_3 while, the shortest spike was recorded from B_1F_0.

3.7 Rachis length

Large size bulb gave the longest rachis while the shortest was in small size bulb. This result is consistent with Misra et al. (2000), rachis length increased with increasing bulb size up to 3.5 cm in tuberose. The highest rachis length was recorded in

poultry litter (9.23 cm) and the lowest rachis length found from control (7.07 cm). Rachis length was higher in organic fertilizer applied plants than chemical fertilizer applied plants (Mitra, 2010). The highest rachis length was recorded in the treatment combination of B_3F_3 and the lowest was recorded from B_1F_0.

3.8 Spike diameter

The maximum spike diameter (0.89 cm) was recorded in large bulb whereas minimum (0.78 cm) was in small bulb. Mukhopadhyay *et al.* (1986) observed that spike diameter increased with increasing bulb size up to certain level in tuberose. The highest spike diameter was recorded in poultry manure (0.87 cm) but the lowest spike diameter was control (0.78 cm). Organic fertilizers gave the highest spike diameter compared to other fertilizers (Padaganur *et al.,* 2010). The highest spike diameter was recorded in the treatment combination of B_3F_3 and the lowest spike diameter was recorded in B_1F_0.

3.9 Number of florets spike^{-1}

The highest number of florets spike $^{-1}$ was observed in large size bulb (31.58) whereas the lowest number of florets spike^{-1} in B_1 (26.40). These results are conformity with Pieters (2005) who reported that small size mother bulb produced fewer flowers than larger mother bulb in tuberose. The maximum number of flowers spike^{-1} was recorded in poultry manures (32.22 spike^{-1}) while, the lowest in no fertilizers (24.93 spike^{-1}). This is consistent with Rahim (2009) in tuberose who reported that floret production increased in organic fertilizer applied plants. The highest number of florets spike^{-1} was recorded in B_3F_3 but the lowest number of florets spike^{-1} in B_1F_0.

3.10 Flower yield

Flower yield was higher in large sized mother bulb compared to small size bulb. Flower yield variations in tuberose due to different size mother bulb were also supported by many researchers (Kumar *et al.,* 2003; Khayrunnessa, 2008; Mitra, 2010). The higher flower yield was recorded in poultry manure, on the other hand, the lower flower yield in no fertilizers. Poultry manure increased the flower production (Marban *et al*., 2008; Shankar *et al*., 2010; Mitra, 2010). Therefore, application of poultry manure is more economic than other organic fertilizers for tuberose cultivation. The highest flower yield both per spike and per hectare was recorded in B_3F_3 (Table 2) but lowest flower yield was recorded in B_1F_0.

3.11 Number of side bulbs

The large sized bulb produced the highest number of side bulb per plant (15.20) and the lowest (9.39) was recorded from small sized bulbs. This result is in agreement with that of Patil *et al.* (1987) who reported that side bulb was greater larger bulb than smaller bulb in tuberose. The maximum number of side bulb was found in poultry litter (14.02 plant^{-1}), whereas the minimum number of side bulb was in control treatment (10.54 plant^{-1}). This result is consistent with Rahim (2009) in tuberose who reported that side bulb production increased in organic fertilizer applied plants than no fertilizer applied plants. The highest number of side bulb was recorded in B_3F_3 (Table 2) but the lowest was recorded in B_1F_0.

3.12 Bulb length

The maximum bulb length was recorded in large size bulb and the minimum bulb length was recorded in small size bulb. Raja and Palnisamy (1999) observed that bulb length of tuberose was higher in large bulb than small bulb. The highest bulb length was recorded in poultry litter and the lowest bulb length was recorded in no fertilizers. Shankar *et al.* (2010) reported that bulb length was higher in organic fertilizers than chemical fertilizers. The maximum bulb length was recorded in the treatment combination of large bulb with poultry litter and the lowest bulb length was found in B_1F_0 (Table 2).

3.13 Bulb diameter

The highest bulb diameter was found in large bulb compared to small size bulb. Sadhu and Das (1978) also found the same result. The highest bulb diameter was recorded in poultry litter and the lowest bulb diameter was recorded in no fertilizers. When organic fertilizers were used the bulb diameter becomes maximum (Sohel, 2008). The highest bulb diameter was recorded in the treatment combination of large bulb with poultry litter but the lowest bulb diameter in B_1F_0 (Table 2).

3.14 Bulb yield

Large size bulb gave the highest bulb yield compared to small size bulb. These results are consistent with Raja and Palnisamy (1999) who reported that bulb yield was more in larger size bulb than smaller size bulb. The highest bulb yield was recorded in F_3 (21.36 t ha^{-1}) and the lowest bulb yield was recorded in F_0 (14.44 t ha^{-1}). Most of the researchers (Marban *et al*., 2008; Shankar *et al*., 2010; Mitra, 2010) reported that among the organic fertilizers poultry manure was the best for growth and economic yield of ornamental plants using at the rate of 10 t ha^{-1}. This result indicates that poultry manure is more effective in tuberose growth and development than other organic fertilizers. The highest bulb yield was found in the treatment combination of large bulb with poultry manure (Table 2) but the lowest bulb yield in B_1F_0.

TABLE.2

INTERACTION EFFECT OF BULB SIZE AND FERTILIZERS ON BULB CHARACTERS AND BULB YIELD OF TUBEROSE

Interaction	Side bulbs/ plant (no.)	Bulb length (cm)	Bulb diameter (cm)	Bulb weight/ plant (g)	Bulb yield (t/ha)	Rachis length (cm)	Spike length (cm)	Spike diameter (cm)	Florets/ spike (no.)	Flower weight/ spike (g)	Flower yield (t/ha)
B_1F_0	7.90 i	4.33 h	1.69 j	72.45 k	10.15 k	5.10 i	17.68 j	0.70 g	22.14 k	37.77 i	6.16 j
B_1F_1	8.25 i	4.67 g	1.84 i	79.67 j	11.25 j	6.77 h	19.58 i	0.76 f	24.61 j	40.83 h	7.8 h
B_1F_2	9.25 h	5.02 f	2.04 h	92.58 i	12.95 i	8.16 fg	21.86 h	0.79 ef	27.62 gh	48.73 f	9.39 g
B_1F_3	10.25 g	5.18 ef	2.14 gh	103.70 h	14.52 h	8.31 fg	23.57 g	0.82 de	28.38 fg	52.88 e	10.44 de
B_1F_4	11.31 f	5.38 e	2.29 fg	113.30 fg	15.85 fg	8.57 ef	24.37 g	0.83 de	29.24 ef	53.10 e	10.32 ef
B_2F_0	10.85 fg	5.20 ef	2.20 fg	106.5 gh	14.39 h	8.15 fg	22.14 h	0.79 ef	25.91 i	45.85 g	7.210 i
B_2F_1	11.50 f	5.73 d	2.35 ef	111.3 g	15.58 g	8.27 fg	24.36 g	0.82 de	28.17 fg	50.50 f	9.750 fg
B_2F_2	12.67 e	6.06 c	2.45 de	119.1 f	16.67 f	8.97 de	28.23 e	0.84 cde	31.06 d	57.30 d	11.06 cd
B_2F_3	13.41 d	6.18 c	2.56 cd	139.5 d	19.53 de	9.200 cd	30.12 cd	0.84 cde	32.86 bc	60.38 c	11.65 c
B_2F_4	13.00 de	6.08 c	2.51 cde	132.5 e	18.55 e	9.060 d	29.50 d	0.85 cde	32.22 c	59.02 cd	11.41 c
B_3F_0	12.86 de	6.02 c	2.51 cde	129.4 e	18.79 e	7.980 g	26.18 f	0.81 def	26.75 hi	56.78 d	10.49 de
B_3F_1	13.50 d	6.11 c	2.62 c	145.6 d	20.38 d	8.530 ef	28.04 e	0.87 cd	29.55 e	60.59 c	11.69 c
B_3F_2	14.83 c	6.34 c	2.77 b	166.0 c	23.24 c	9.540 bc	30.80 c	0.89 bc	32.68 bc	65.82 b	12.70 b
B_3F_3	18.41 a	7.01 a	3.10 a	214.6 a	30.04 a	10.18 a	33.98 a	0.97 a	35.42 a	72.77 a	14.19 a
B_3F_4	16.38 b	6.66 b	2.83 b	194.2 b	27.19 b	9.860 ab	32.18 b	0.93 ab	33.52 b	67.90 b	13.17 b
$LSD_{0.05}$	0.623	0.289	0.149	6.63	0.95	0.436	0.917	0.0528	1.03	2.26	0.630
F-test	**	*	*	**	**	**	**	*	*	*	**
CV (%)	3.04	3.03	3.77	3.10	3.17	3.09	2.10	2.89	2.11	2.44	3.59

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

IV. CONCLUSION

From the result and discussion it is concluded that bulb size of 2.6-3.0 cm was the optimum size for maximizing flower production of tuberose as well as poultry manure @ 10 t ha^{-1} gave the highest flower and bulb yield. The higher flower yield was recorded in poultry litter and cowdung with being the highest in poultry litter (62.01 g $plant^{-1}$ and 12.09 t ha^{-1}) due to increased flowers $spike^{-1}$. These results indicate that large size bulb of 2.6-3.0 cm in diameter with poultry litter @ 10 t ha^{-1} was the optimum combination for maximizing bulb and flower production in tuberose and it will be help to establish different treatment combination for better yield in different growing region in Bangladesh.

REFERENCES

[1] Alan, O., Gunen, Y., Ceylan, S. and Gunen, E. 2007. Effect of nitrogen applications on flower yield, some quality characteristics and leaf mineral content in tuberose (*Polianthes tuberosa* L.). *Aegean Agric. Res. Ins. Direc*. 17(1): 43-57.

[2] Chaoui, I., Zibiliske, M., Ohno, T. 2003. Effect of earthworm and compost on soil microbial activity and plant nutrient availability. *Soil Biol. Biochem.* 35: 295-302.

[3] Dhua, R. S., Ghosh, S. K., Mitra, S. K., Yadav, L. P. and Bose, T. K. 1987. Effect of bulb size, temperature treatment of bulbs and chemicals on growth and flower production in tuberose (*Polianthes tuberosa* L.). *Acta Hort*., 205: 121-128.

[4] Garg, S. and Bahla, G. S. 2008. Phosphorus availability to maize as influenced by organic manures. *Biores. Technol*. 99: 773-777.

[5] Kale, P. N. and Bhujbal, B. G. 1972. Effect of bulb size on flowering and bulb production of tuberose (*Polianthes tuberosa* L.) cv. Single. *Indian J. Orn. Hort.*, 3: 102 -103.

[6] Khayrunnessa, M. 2008. Effect of bulb size and potassium on the growth, bulb and flower yield of tuberose. An M. S Thesis, Dept. Hort., Sher-e-Bangla Agric. Univ., Dhaka. P 15-28

[7] Kumar, R., Gobind, S. and Yadav, D. S. 2003. Growth, flowering and bulb production of tuberose as influenced by different bulb size, spacing and depth of planting. *Hariana J. Hort. Sci.*, 32 (1/2): 66- 99.

[8] Marban, L., Giuffre, L., Riat, M. and Romaniak, R. 2008. Comparison of conventional fertilization and organic manures use for basil cultivation. *J. Applied Hort*. 10: 87-90.

[9] Misra, H., Singh, A. K. and Singh, O. P. 2000. Effect of bulb size and spacing on growth and flowering behaviour of tuberose (*Polianthes tuberose* L.). *Advances in plant Sci*. 13 (2): 563 – 566.

[10] Mitra, M. 2010. Response of tuberose to integrated nutrient management. International conference on biodiversity, livelihood and climate change in the Himalaya. Department of Bot., Tribhuvan Univ., held on 12-14 December, 2010.

[11] Mukhopadhyay, A., Banker, G. J. and Shadu, M. K.1986. Influence of bulb size, spacing and depth of planting on growth, flowering and bulb production in tuberose. *Haryana J. Hort. Sci*., 15 (1/2): 18-24.

[12] Nanjan, K., Nambisan, K.M.P., Veeragavathatham, D. and Krishnan, B.M. 1980. The influence of nitrogen, phosphorus and potash on yield of tuberose (*Polianthes tuberosa* L.). National Seminar on Technology for Commercial Flower Crops. TNAV. pp. 76-78.

[13] Padaganur, V. G., Mokashi, A. N. and Patil, V. S. 2010. Flowering, flower quality and yield of tuberose as influenced by vermicompost and farmyard manure. *Karnataka J. Agric. Sci*. 18: 729-734.

[14] Pathak, S., Choudhuri, M. A. and Chatterjee, S. K. 1980. Effect of bulb size on flower production in tuberose (*Polianthes tuberose* L.) cv. Single. *Indian J. Pl. Physio*.,3(2): 81 -82.

[15] Patil, J. D., Patil, B. A., Chougule, B. B. and Bhat, N. R. 1987. Effect of bulb size and spacing on stalk and flower yield in tuberose (*Polianthes tuberose* L.) cv. Single. *Current Res. Rep. Mahatma phul Agril. Univ.*, 3 (2): 81 – 82.

[16] Pieters, A. J. 2005. Green manuring: principles and practices. Agrobios, Jodhpur, India.pp 48

[17] Polara, N. D., Dhola, S. N., Khimani, R. A., Delvadia, D. V. and Viradia, R. R. 2004. Effect of different levels of inorganic fertilizers on flower quality and nutrient content of tuberose. *J. Current Bio. Sci.*, 2: 194-197.

[18] Rahim, M. A. 2009. Integrated nutrient management of China aster. M. S Thesis, Dept. Hort., Bangladesh Agric. Univ., Mymensingh. pp17-22

[19] Raja, K. and Palnisamy, V. 1999. Effect of bulb size on growth, flowering and bulb yield in tuberose ((*Polianthes tuberose* L.)cv. Single. *South Indian Hort.*, 47 (1-6): 322- 324.

[20] Russell, D. F. 1986. MSTAT-C computer package programme. Crop and Soil Sci. Dept., Michigan State Univ., USA.

[21] Sadhu , M. K. and Das, P. K. 1978. Effect of bulb size on growth and yield of tuberose ((*Polianthes tuberosa* L.) cv. Single. *Indian J. Hort.*, 35: 147 – 150.

[22] Shankar, L., Lakhawat, S. S. and Choudhary, M. K. 2010. Effect of organic manures and bio-fertilizers on growth, flowering and bulb production in tuberose. *Indian J. Hort*. 64: 554-556.

[23] Singh, R. B. 2000. Environment consequence of agricultural development: a case study for the green revolution. *Indian Agric. Ecosystem* 82: 97-103.

[24] Singh, S. R. P., Dhiraj, K., Singh, V. K. and Dwivedi, R. 2005. Effect of NPK fertilizers on growth and flowering of tuberose cv. Single. *Haryana J. de Hort. Sci.*, 34 (1/2): 84.

[25] Singh, S.R.P., Kumar, D. and Singh, V.K. 2004. Effect of NPK combinations on growth and flowering of tuberose (*Polianthes tuberosa* L.) cv. Double. Muzaffamagar, India. *Plant Archives*. 4(2): 515-517.

[26] Sohel, M. 2008. Efferct of organic manures on growth and flower yield of tuberose. An M. S Thesis, Dept. Hort., Bangladesh Agric. Univ., Mymensingh

[27] Vandor Valk, C. C. and Timmer, M. J. G. 1974. Plant density in related to tulip bulb growth. *Scientia Hort*., 2 (1): 69-81.

[28] Yadav, L.P., Bose, T.K. and Maity, R.G. 1985. Response of tuberose (*Polianthes tubersa* L.) to nitrogen and phosphorus fertilization. *Prog. Hort*. 17(2): 83-86.