J. Environ. Sci. & Natural Resources, 4(2): 55-59 , 2011 ISSN 1999-7361

Response of Tuberose to Integrated Nutrient Management

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Abstract

A field experiment was conducted at the farmer's field of Sutiakhali, Mymensingh Sadar Upazilla, Mymensingh, during the period from April, 2009 to March, 2010 to investigate the effect of organic fertilizers along with half chemical fertilizers on the growth, bulb and flower yield of tuberose *cv.* single. The experiment consisted of four different sources of fertilizers *viz.*, (i) recommended chemical fertilizers @ 400, 300, 300 and 100 kg ha^{-1} of urea, TSP, MP and gypsum, respectively; (ii) vermicompost @ 5 t ha^{-1} along with half of chemical fertilizers; (iii) poultry litter @ 20 t ha^{-1} along with half of chemical fertilizers and (iv) cowdung @ 20 t ha^{-1} along with half of chemical fertilizers. The experiment was laid out in a randomized complete block design with three replications. 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, number of florets $spike^{-1}$ and flower yield both per spike and per hectare were greater in organic fertilizers along with half chemical fertilizers than absolute use of chemical fertilizers. The highest bulb and flower yield both per plant and per hectare were recorded in poultry manures followed by cowdung. The bulb and flower yields were higher in poultry manures might be due to increased side shoots number, bulb size and flowers $plant^{-1}$. In contrast, the lowest bulb and flower yields were recorded in chemical fertilizers due to production of fewer side bulb and flowers $plant^{-1}$.

Key words: Inorganic fertilizer, organic fertilizer, flower yield, tuberose

Introduction

Tuberose (*Polianthus tuberosa* L.) which occupies 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 cut flower trade and essential oil industry (Alan *et al.*, 2007). The flowers remain fresh for quite a long time and stand distance transportation and fill a useful place in the flower market (Patil *et al.*, 1999). 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. The natural flower oil of tuberose is one of the most expensive perfumer's raw materials.

After the industrial revolution widespread introduction of inorganic fertilizers, led to a decline in the use of organic material in the cropping systems (Hasanuzzaman *et al.*, 2010). The impact of increased fertilizer use on crop production has been large and important (Shankar *et al.*, 2010). More recently, attention is focused on the global environmental problems. The world elite society is giving emphasize on utilization of organic wastes, farm yard manures, compost, vermicompost and poultry manures as the most effective measure to save the environment to some extent. Organic materials are the safer sources of plant nutrients which have no detrimental effect to crops and soil. 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 have 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 inorganic fertilizer the use of green manures and other organic matter can improve soil structure, improve nutrient exchange and maintain soil health and that is why interests have been raising in organic farming (Mitra, 2010).

The growing period of tuberose in normally one year or more. Therefore, a high amount of organic and inorganic fertilizers are needed to maintain sustainable growth and flowering over a long period. There are many factors which affect plant growth and economic cultivation of tuberose. Tuberose is a gross feeder and requires a large quantity of NPK, both in the form of organic and inorganic fertilizers (Amarjeet and Godara, 1998). 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). Duration of flower in the field was improved through using chemical fertilizer. 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). Continuous and adequate use of organic fertilizers with proper management can increase soil organic carbon, soil water retention and improvement of physical properties of soil.

In Bangladesh, a little work has been done in respect of use of organic manures for tuberose cultivation. So, research work is so lack about 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. Therefore, the present investigations were undertaken to study the effect of different organic manures on growth and yield of tuberose.

Materials and Methods

The experiment was carried out at the farmer's field of Sutiakhali, Mymensingh Sadar Upazilla, Mymensingh, during the period from April, 2009 to March, 2010. 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 experiment comprised four different sources of fertilizers *viz.*, (i) recommended chemical fertilizers @ 400, 300, 300 and 100 kg ha^{-1} of urea, TSP, MP and gypsum, respectively; (ii) vermicompost @ 5 t ha^{-1} along with half of chemical fertilizers; (iii) poultry litter @ 20 t ha^{-1} along with half of chemical fertilizers and (iv) cowdung @ 20 t ha^{-1} along with half of chemical fertilizers. 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. 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 source of nitrogen, phosphorus, potassium and sulphur, respectively. Full dose of cow dung (20 t/ha), vermicompost (5 t/ha), poultry litter (20 t/ha), TSP (300 kg/ha; 150 kg/ha, as per treatment) and gypsum (100 kg/ha; 50 kg/ha, as per treatment) were incorporated during final land preparation. The total dose of urea (400 kg/ha; 200 kg/ha, as per treatment) and MP (300 kg/ha; 150 kg/ha as per treatment) were applied in three equal installments. The first installment was applied at 30 days after planting. The second and third installments were applied at 65 and 100 days, respectively after planting.

The bulbs were planted in each unit plot at about depth of 6 cm on April 20, 2009. 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. As a preventive measure against the insect pest, Dursban 20 EC was applied @ 0.2% at 15 days interval for three times starting from 20 days after emergence of 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 during 22 August 2009 to 14 January, 2010 and bulb and bulblet were harvested on 16 March, 2010. The spikes of tuberose were harvested when the first floret in the rachis opened.

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. The collected data were then analyzed statistically using the statistical computer package program, MSTAT-C.

Results and Discussion

The effects of different fertilizer combinations on morphological characters such as plant height, number of leaves and side shoots $plant^{-1}$ and leaf length were significant (Table 1). Results revealed that the above parameters were greater in organic fertilizers applied plants than only chemical fertilizers applied. These results indicate that application of organic fertilizers had tremendous effects on plant growth and development in tuberose. But the effect was more pronounce in poultry litter followed by cowdung and vermicompost. The tallest plant with highest number of leaves and side shoots $plant^{-1}$ and leaf length was recorded in F_3 treatment (Half chemical fertilizers + 20 t ha^{-1} poultry litter) followed by the treatment of F_4 (Half chemical fertilizers + 20 t ha^{-1} cowdung). In contrast, the shortest plant, lowest number of leaves and side shoots $plant^{-1}$ and leaf length were recorded in F_1 treatment (Recommended chemical fertilizers only). These results have conformity with the result of Padaganur *et al.* (2010)

who reported that application of organic fertilizers along with chemical fertilizers enhanced plant growth and development in tuberose.

Table 1. Effect of organic fertilizers on morphological characters in tuberose cv. single

Treatments	Plant height (cm)	Leaves plant^{-1} (no.)	Leaf length (cm)	Side shoots plant^{-1} (no.)
F_1	87.1 d	9.53 c	41.6 c	3.82 d
F_2	91.01 c	9.88 bc	43.2 b	4.18 c
F_3	95.6 a	11.1 a	45.9 a	4.82 a
F_4	93.1 b	10.3 b	45.3 a	4.61 a
F-test	**	**	**	**
CV (%)	3.43	4.86	3.78	4.44

In a column, figure (s) bearing same letter do not differ significantly at $P \leq 0.05$ by DMRT; ** indicates significant at 1% levels of probability.

F_1: Application of urea, TSP and MP @ 400, 300 and 300 kg/ha, respectively (recommended dose); F_2 : Half of chemical fertilizers + 5 ton/ha vermicompost; F_3: Half of chemical fertilizers + 20 t/ha poultry litter; F_4 : Half of chemical fertilizers + 20 t/ha cowdung.

Application of organic fertilizers had significant effect on bulb characters such as number of side bulbs plant^{-1}, bulb length and diameter and bulb yield both per plant and per hectare (Table 2). The highest bulb yield both per plant and per hectare was recorded in F_3 treatment due to increased production of side bulb with larger bulb size. The second highest bulb was recorded in F_4 treatment. In contrast, the lowest bulb yield both per plant and per hectare was recorded in F_1 treatment where only chemical fertilizers were applied. These results are consistent with the result of Marban *et al.* (2008) who reported that application of organic fertilizers with chemical fertilizers increased bulb yield. The higher bulb yield in organic fertilizers applied plants than chemical fertilizers might be produced more assimilate by greater number of leaves (Table1)

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Table 2. Effect of organic fertilizers on bulb characters in tuberose cv. single

Treatments	Side bulbs plant^{-1} (no.)	Bulb length (cm)	Bulb diameter (cm)	Bulb weight/ plant (g)	Bulb yield (t/ha)
F_1	12.5 c	5.92 c	2.49 b	128.4 d	17.98 d
F_2	13.7 b	6.20 bc	2.61 ab	142.5 c	19.98 c
F_3	15.9 a	6.60 a	2.83 a	177.1 a	24.78 a
F_4	14.7 b	6.37 ab	2.67 ab	163.3 b	22.87 b
F-test	**	*	*	**	**/
CV (%)	6.21	3.50	7.48	4.98	8.41

In a column, figure (s) bearing same letter do not differ significantly at $P \leq 0.05$ by DMRT; *, ** indicates significant at 5% and 1% levels of probability, respectively

F_1: Application of urea, TSP and MP @ 400, 300 and 300 kg/ha, respectively (recommended dose); F_2 : Half of chemical fertilizers + 5 ton/ha vermicompost; F_3: Half of chemical fertilizers + 20 t/ha poultry litter; F_4 : Half of chemical fertilizers + 20 t/ha cowdung.

The floral characters such as spike length and diameter, rachis length, number of florets and flower yield both per plant and per hectare of tuberose were significantly influenced by the application of different organic fertilizers (Table 3). Results revealed that flower yield was greater in organic fertilizers than chemical fertilizers. These results indicate that use of organic fertilizer is important for tuberose production.

However, among the organic fertilizers, poultry litter performed the best in respect of flower characters and flower yield followed by cowdung and vermicompost. The plots those were applied only chemical fertilizers performed the lowest in flower yield due inferiority in flower characters. These results are consistent with Padaganur *et al*. (2005) in tuberose who reported that poultry litter performed better in flower yield than cowdung. On the other hand, Shankar *et al*. (2010) and Mitra (2010) reported that among the organic manures, vermicompost performed best in flower yield of tuberose that is inconsistent with the present findings. The highest spike length and diameter, rachis length and number of florets spike^{-1} were recorded in F_3 treatment which resulted highest flower yield both per plant and per hectare followed by F_4 treatment. The lowest flower yield was recorded in F_1 treatment due to production of fewer florets spike^{-1}.

Table 3. Effect of organic fertilizers on floral characters in tuberose cv. single

Treatments	Spike length (cm)	Spike diameter (cm)	Rachis length (cm)	Florets/ spike (no.)	Flower weight/ spike (g)	Flower yield (t/ha)
F_1	26.2 c	0.84 b	8.40 c	28.9 c	55.5 d	10.02 d
F_2	29.5 b	0.87 ab	9.25 b	31.9 b	60.5 bc	11.18 c
F_3	32.1 a	0.91 a	10.2 a	35.1 a	66.6 a	13.92 a
F_4	30.8 ab	0.89 a	9.33 b	33.9 ab	63.5 b	12.29 b
F-test	**	*	**	**	**	**
CV (%)	6.68	3.65	3.42	6.69	4.85	5.31

In a column, figure (s) bearing same letter do not differ significantly at $P \leq 0.05$ by DMRT; ** indicates significant at 1% levels of probability

F_1: Application of urea, TSP and MP @ 400, 300 and 300 kg/ha, respectively (recommended dose); F_2 : Half of chemical fertilizers + 5 ton/ha vermicompost; F_3: Half of chemical fertilizers + 20 t/ha poultry litter; F_4 : Half of chemical fertilizers + 20 t/ha cowdung.

Many workers reported that flower yield increased due to vermicompost application @ 10 t ha^{-1} in tuberose (Singh, 2000; Padaganur *et al.,* 2005; Marban *et al*., 2008; Shankar *et al*., 2010; Mitra, 2010). In the present experiment, vermicompost was applied @ 5 t ha^{-1} (due to costly than poultry litter and cowdung) that might be much less dose than the requirement. That is why, vermicompost performed inferior to poultry manure and cowdung. However, vermicompost also showed increased flower yield over chemical fertilizers. Again, the price of poultry litter and cowdung are almost similar even some where the price of poultry litter is less than cowdung. Therefore, application of poultry litter @ 20 t ha^{-1} with half chemical fertilizers may be advisable for tuberose cultivation.

Acknowledgement

The authors would like to thank the Ministry of Science and Information & Communication Technology, Government of the People's Republic of Bangladesh for financial supporting this research.

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