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Response of organic manures and bio fertilizers on floral characters in tuberose (*Polyanthus tuberosa*) var. Shringar

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Abstract
The present investigation on response of organic manures and bio fertilizers on floral characters in tuberose was conducted at Model Floriculture Centre, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, during 2010 to 2012. The experiment was laid out in Randomized Block Design with four replications. The treatment was comprised of Organic Manures and Bio Fertilizers (Poultry manure, vermicompost, *Trichoderma harzianum* and *Pseudomonas fluoroscens*). *Trichoderma harzianum* (40 g/ m^2) resulted in maximum diameter of lowest floret in pooled value (4.27) while the minimum diameter of lowest floret in pooled value was observed in treatment poultry manure (1 kg/ m^2) (2.51). Pooled value recorded maximum rachis length (23.24 cm) in treatment vermicompost (2 kg/ m^2) whereas, treatment poultry manure (1 kg/ m^2) recorded minimum rachis length (17.46 cm). Pooled performance of both the years showed that treatment poultry manure (0.5 kg/ m^2) attained maximum total number of florets per spike (39.06) and it was minimum in treatment poultry manure (1 kg/ m^2) (31.33). The pooled data for both the years of study showed that maximum number of opened florets per spike was recorded in treatment *Trichoderma harzianum* (20 g/ m^2) (25.64) and minimum number of opened florets per spike was observed in treatment vermicompost (2 kg/ m^2) (22.61). Mean performance for minimum number of unopened florets per spike was recorded in poultry manure (0.5 kg/ m^2) (8.72) treated plants and maximum in untreated control (14.16) plants. The pooled value of yield of spikes per square meter showed the maximum value (66.25) for treatment vermicompost (2 kg/ m^2).

Keywords: organic manures, bio fertilizers, tuberose, Shringar

Introduction
Growing of flowers in India has been a time honored and traditional activity, largely for religious purpose, perfume industry and landscape. Now, it is poised for a transformation owing to increase in demand, innovative technology, policy, environment and above all growing consciousness and demand for quality flowers (Singh *et al*., 2001) [11]. After green revolution, the continuous use of fertilizers has led to an increase in crop production. This was achieved due to improved varieties and high dosage of fertilizers. But, continuous use of fertilizers has some drawbacks, as it adversely affects the environment, soil structure and fauna. Therefore, now there is awareness worldwide about alternative or natural or organic agriculture practices, in view of energy storage, food safety and environmental concerns arising out of conventional farming.
Due to energy crisis, high cost of chemical fertilizers and poor purchasing power of marginal and small farmers, it is imperative to develop strategies for using organic manures, bio-fertilizers and wastes to their maximum potential with proper technology to meet the shortage of fertilizers and improving soil fertility. The use of organic manures and bio-fertilizers has an advantage of converting, unusual surplus or waste into useful product, for use in floriculture. The organic manures that are in use are FYM, compost of farm waste, crop residue, cattle dung, poultry manure, green manures, cakes, sewage sludge, municipal city compost, vermicompost and bio-fertilizers which include VAM, *Pseudonomas sp.*, Phospobacteria, *Trichoderma*, P-solubizer, *Azolla*, *Azospirillum* and *Rhizobium*.

Material and Methods
The present investigation was conducted at Model Floriculture Centre, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, during 2010 to 2012. Pantnagar is geographically situated in the *Tarai* region at the foot hills of Himalayas at 29° N latitude and

79.3° E longitude and at an altitude of 243.83 meters above the mean sea level. The crop was raised under open field conditions by planting the bulb in 1x1 m size plot at 30 cm x 20 cm spacing. The Experiment was laid out in a randomized block design with four replications. The details of the treatments are as follows:

Treatments

T_1: Control (40g N, 20g P, 20g K per m^2)
T_2: Poultry manure (0.5 kg/m^2)
T_3: Vermi compost (1 kg/m^2)
T_4: *Trichoderma harzianum.* (20 g/m^2)
T_5: *Pseudomonas fluoroscens.* (20 g/m^2)
T_6: Poultry manure (1 kg/m^2)
T_7: Vermi compost (2 kg/m^2)
T_8: *Trichoderma harzianum.* (40 g/m^2)
T_9: *Pseudomonas fluoroscens.* (40 g/m^2)

The treatments used in this research were added at the time of planting. Observations on Days taken to spike emergence (days), Spike length (cm), Spike weight (g), Rachis length (cm), Diameter of lowest floret, Total number of florets per spike, Number of opened florets per spike, Number of unopened florets per spike, Yield of spikes per square meter were recorded from five randomly selected plants of each replication using standard procedure. Data were subjected to analysis of variance.

Results and Discussion

The days taken to spike emergence was significantly affected by the application of organic manures and bio fertilizers (Table.1). It is evident from the data that treatment that T_8 [*Trichoderma sp.* (40 g)] resulted in earliest spike emergence (102.75 days) whereas, treatment T_6 [poultry manure (1 kg)] took maximum number of days for spike emergence (115.15 days)

The flowering of the plant is affected by the balanced uptake of nitrogen and the availability of micronutrients and growth hormones and promotes the translocation of phytohormones to the shoots resulting in early flower initiation (Marschner, 1983). The application of bio fertilizers *viz.*, vermicompost and *Pseudomonas* will help in uptake of micronutrients and provide essential plant growth promoting substances (Vasanthi and Kumaraswamy, 1999). Hence the earliest flowering was found in vermicompost and *Pseudomonas*.

A perusal of data presented in Table. 1 shows that the spike length was enhanced significantly due to the treatments of organic manures and biofertilizers. The maximum spike length revealed that it was maximum in T_3 [vermicompost (1 kg)] (66.20cm) and minimum spike length was recorded in T_5 [*Pseudomonas sp.* (20 g)] (59.00cm).

The results of spike length were in line with Shankar *et al.* (2010), who found that the application of vermicompost (1 kg/m^2) and PSB (2 g/bulb) in tuberose cv. Single resulted in highest spike length. Srivastava *et al.* (2006) also observed longer duration of flowering with combined application of Azotobacter, FYM and vermicompost in tuberose cv. Double.

The results reveal that all the organic manures and bio fertilizers treatments significantly increased the spike weight (Table.1). The maximum spike weight was recorded in T_2 [poultry manure (0.5 kg)] (59.35 g) and minimum was recorded in T_7 [vermicompost (2 kg)] (54.07 g).

The above results were in accordance with earlier reports of Bhora (2011) who reported that longer spike weight was found with poultry manure + *Trichoderma* in chrysanthemum cv. Little Darling. Preetham *et al.*, (2009) [8] also reported maximum spike weight and spike length in poultry manure (0.5 kg/m^2) treatment in gladiolus var. White Prosperity. All these above significant results may be due to the balanced supply of nitrogen from bio fertilizers and organic sources which promote the translocation of phytohormones to the shoots resulting in early flower initiation (Marschner, 1983) [5]. The influence of VAM (5 g) + PSB (15 g) on the flower yield which are in line with the findings of Wange and Patil (1994) [12] in tuberose cv. Single.

The data pertaining to rachis length is presented in Table.2. All the treatments significantly enhanced rachis length over control. Among the different treatments, maximum rachis length was recorded in T_7 [vermicompost (2 kg)] (23.24 cm) and it was minimum in T_6 [poultry manure (1 kg)] (17.46 cm).

Vermicompost might have role in supply of macro and micronutrients, enzymes and growth hormones and provides the micronutrients such as Zn, Fe, Cu, Mn, etc in an optimum level which help in proper flower development (Vasanthi and Kumaraswamy, 1999). Barman *et al.* (2003) [1] observed increased rachis length (21.33 and 31.08 % respectively) when plants were treated with FYM + bio fertilizers as compared to the untreated plants in tuberose cv. Single.

A perusal of data presented in Table. 2 reveals that the diameter of lowest floret had significantly effect of applied organic cultures and bio fertilizers. The diameter of lowest floret pooled over two years was maximum in T_8 [*Trichoderma sp.* (40 g)] (4.27 cm) whereas, it was minimum in T_6 [poultry manure (1 kg)] (2.51 cm)

Maximum florets diameter was observed in *Trichoderma* and vermicompost due to the presence of microorganisms in soil. Increase in number and diameter of florets could be attributed to its increased ability towards cell division. Misra (1997) [6] reported similar results in *Gladiolus hybrida* cv. Melody when applied PSB and *Trichoderma* before planting of gladiolus corms. Increase in the number of florets per spike of gladiolus might be due to more nutrient uptake caused by the presence of phosphate solubilizing bacteria and fungi, thus increasing the availability of the phosphate ion.

The data regarding total number of florets per spike is depicted in Table. 2 The pooled over two years data revealed the similar trend with maximum total number of florets per spike (39.06) in T_2 [poultry manure (0.5 kg)] which was significantly higher than rest of the treatments whereas, minimum total number of florets per spike was recorded in T_6 [poultry manure (1 kg)] (31.33).

Poultry manure is good source of nitrogen and other nutrients and which releases nitrogen at slower rate and which is helpful for the plant growth at later stages of the plant (Joshi and Prabakar shetty, 2005) [3]. In marigold, maximum flowering duration, flower diameter, number of petals per flower, number of flowers per plant, were obtained in the treatment poultry manure (12.5%) (Shubha, 2006) [10].

The data presented in Fig. 1 showed that there was a significant variation among different treatments of organic manures and bio fertilizers during both 2010 and 2011. The maximum number of opened florets per spike was recorded in T_4 [*Trichoderma sp.* (20 g)] (25.64) and minimum number of opened florets per spike was observed T_7 [vermicompost (2 kg)] (22.61).

The results were in accordance with Kukde *et al.* (2006) [4] who reported that the tuberose bulb treated with *Trichoderma viride* and phosphate-solubilizing bacteria at 2.5 g/kg bulb gave maximum early opening of first pair of florets, better flower quality parameters and maximum yield of flowers/ha. Pandhare *et al.* (2009) [7] also reported the similar results in tuberose cv. Single with the application of 75 per cent recommended N, P and 100 per cent K *i.e.*, 150:225:200 kg per ha along with pre-planting treatment of bulbs with *Trichoderma* and PSB.

The data pertaining to Number of unopened florets per spike are shown in Fig 2, that there was significant variation in number of unopened florets per spike among different treatments of organic manures and bio fertilizers during both the years of study showed that minimum number of unopened florets per spike was recorded in T_2 [poultry manure (0.5 kg)] (8.72) and maximum number of unopened florets per spike was in observed T_1 [control] (14.16).

The Fig. 3 represents the spikes per square meter revealed that there was significant variation among different treatments of organic manures and bio fertilizers. The yield of spikes per square meter indicated that it was maximum in T_7 [vermin compost (2 kg)] (66.25) while minimum was observed in T_6 [poultry manure (1 kg)] (57.50). Singh *et al.* (2006) [11] found that the treatment (300 kg vermicompost + 1.0 kg urea + 1.8 kg SSP + 0.5 kg MOP/100 m^2) produced more number of florets per spike (8.88) in gladiolus cv. American Beauty. Bisht (2010) [2] also reported in chrysanthemum cv. Mother Teresa that the floral attributes viz., number of flowers per plant, flower diameter and duration of flowering were superior in the pots having the combination of cocopeat + sand + FYM + vermicompost (2:1:0.5:0.5).

Table 1: Influence of organic culture and bio fertilizers on Days taken to spike emergence, Spike length (cm), Sipke weight (g) in tuberose var. Shringar

Sl. No.	Treatments		Days taken to spike emergence			Spike length (cm)			Spike weight (g)		
			2010	2011	Pooled	2010	2011	Pooled	2010	2011	Pooled
1.	T_1	Control	106.95	107.86	107.40	59.60	61.60	60.60	53.00	55.80	54.40
2.	T_2	Poultry manure (0.5 kg/ m^2)	106.20	108.56	107.38	62.90	65.65	64.27	57.15	61.55	59.35
3.	T_3	Vermicompost (1 kg/ m^2)	106.40	105.81	106.10	65.70	66.70	66.20	52.90	55.25	54.07
4.	T_4	*Trichoderma sp.* (20 g/ m^2)	109.20	108.93	109.06	60.50	62.00	61.25	55.40	58.15	56.77
5.	T_5	*Pseudomonas sp.* (20 g/ m^2)	108.85	111.75	110.30	59.05	59.00	59.02	57.00	59.20	58.10
6.	T_6	Poultry manure (1 kg/ m^2)	111.30	119.00	115.15	60.00	62.75	61.37	54.80	57.72	56.26
7.	T_7	Vermicompost (2 kg/ m^2)	107.55	108.31	107.93	62.80	65.30	64.05	53.50	56.40	54.95
8.	T_8	*Trichoderma sp.* (40 g/ m^2)	104.80	101.06	102.75	63.15	64.40	63.77	54.40	56.80	55.60
9.	T_9	*Pseudomonas sp.* (40 g/ m^2)	103.25	102.25	102.93	61.75	62.50	62.12	54.35	56.70	55.52
SEm±			1.13	0.76	0.54	0.66	0.65	0.46	0.45	0.85	0.44
CD at (5%)			3.13	2.23	1.59	1.95	1.92	1.35	1.33	2.48	1.29

Table 2: Influence of organic culture and bio fertilizers on Rachis length (cm), Diameter of florets (cm), Total no. of florets/ spike in tuberose var. Shringar

Sl. No.	Treatments		Rachis length (cm)			Diameter of florets (cm)			Total no. of florets/ spike		
			2010	2011	Pooled	2010	2011	Pooled	2010	2011	Pooled
1.	T_1	Control	18.99	20.49	19.74	2.75	2.85	2.80	33.83	35.33	34.58
2.	T_2	Poultry manure (0.5 kg/ m^2)	21.16	22.49	22.58	3.37	3.57	3.47	36.81	41.31	39.06
3.	T_3	Vermicompost (1 kg/ m^2)	21.99	23.16	21.83	3.57	3.47	3.52	33.58	34.83	34.20
4.	T_4	*Trichoderma sp.* (20 g/ m^2)	17.23	18.73	17.98	3.62	3.70	3.66	31.50	33.41	32.45
5.	T_5	*Pseudomonas sp.* (20 g/ m^2)	19.99	21.00	20.49	3.59	4.16	3.87	32.91	33.92	33.42
6.	T_6	Poultry manure (1 kg/ m^2)	17.21	17.71	17.46	2.41	2.61	2.51	30.33	32.33	31.33
7.	T_7	Vermicompost (2 kg/ m^2)	22.49	23.99	23.24	3.63	4.19	3.91	34.16	35.58	34.87
8.	T_8	*Trichoderma sp.* (40 g/ m^2)	20.50	20.99	20.74	4.26	4.28	4.27	35.08	37.00	36.04
9.	T_9	*Pseudomonas sp.* (40 g/ m^2)	18.75	19.74	19.24	4.20	4.23	4.21	34.50	35.91	35.20
SEm ±			0.48	0.48	0.31	0.12	0.12	0.11	0.79	0.79	0.47
CD at (5%)			1.42	1.42	0.91	0.35	0.35	0.33	2.32	2.33	1.39

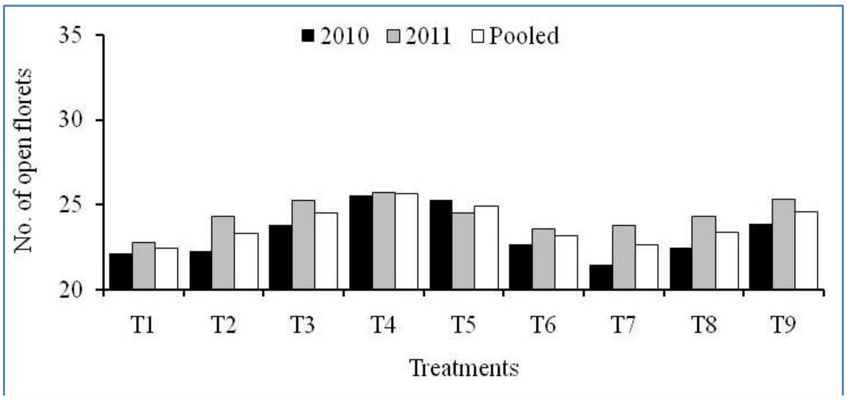

Fig 1: Influence of organic culture and bio fertilizers on Number of opened florets

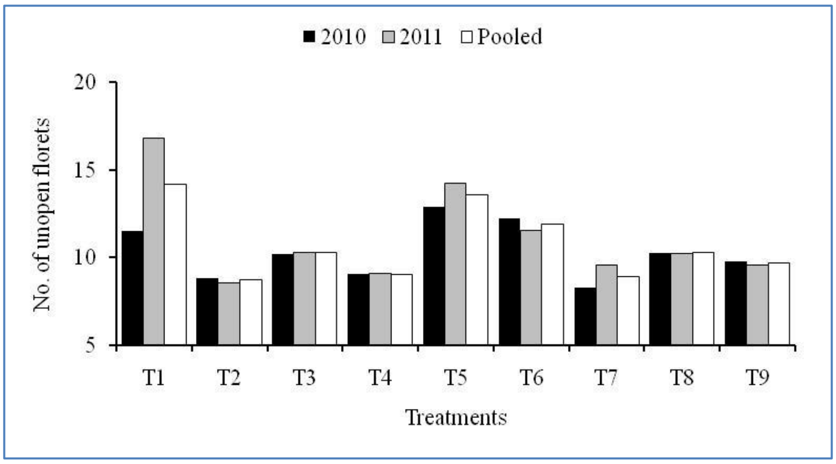

Fig 2: Influence of organic culture and bio fertilizers on Number of unopened florets

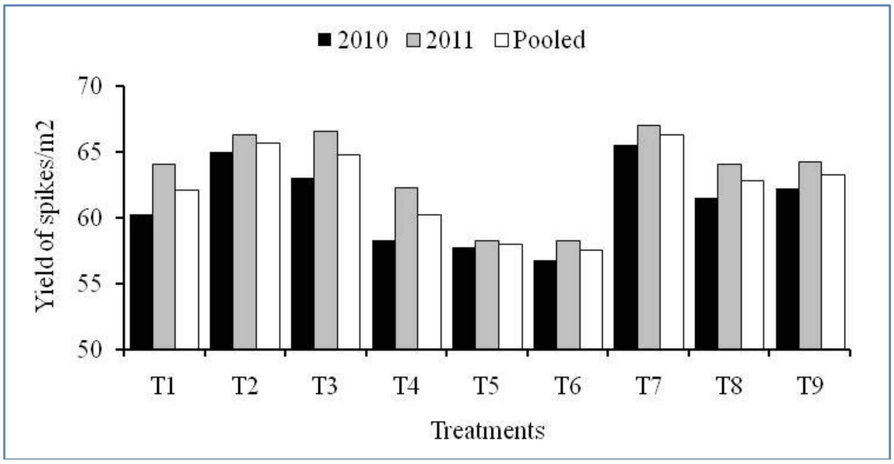

Fig 3: Influence of organic culture and bio fertilizers on Yield of spikes/ m^2

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