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Response of inorganic fertilizer & bio fertilizer on growth and flower yield of tuberose (*Polianthes tuberosa L.*) cv. Prajwal in the plains of West Bengal

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Tuberose is essentially a florist's flower and leading commercial crop because of its multipurpose uses as cut flower, loose flower as well as its potential in perfume industry. Tuberose grows successfully in the warm plains of India. The commercial cultivation of tuberose in India is confined in West Bengal (Ranaghat, Kolaghat and Panskura), Karnataka, Andhra Pradesh, Tamil Nadu and Maharashtra. Among the commercially grown flowers in India, tuberose (*Ploianthes tuberosa* Linn) occupies a prime position .So, in the view of the above; there is utmost need to use of chemical fertilizers in balance proportions along with integration of plant nutrient and their efficient managements. Since, negligible information is available regarding the effect of bio-fertilizers on tuberose, experimental studies were carried out to find out the effect of *Azospirillium brasilense* (a nitrogen fixing bacterium), *Bacillus polymyxa* (a phosphate solubilising bacterium) and *Azotobacter chroococcum* (a nitrogen fixing bacterium) and inorganic nutrient on growth and flowering of Tuberose cv. Prajwal.

The experiment was conducted at the Horticultural Research Station, Bidhan Chandra Krishi Viswavidyalaya, Mondouri, Nadia, West Bengal during February, 2007 to January, 2008. The location of the experimental site at about 23.5° N latitude and 89° E longitude with an average altitude of 9.75 metre above mean sea level. The soil of experimental field was sandy loam having organic carbon 0.346%, available phosphorus 22.61 kg ha^{-1}, available potassium 187.21 kg ha^{-1} and pH 6.8. The treatment comprised of three levels each of nitrogen and phosphorus @0, 5, 10 and 0, 4, 8g m^{-2} respectively along with biofertilizer individually and in combinations of bio-fertilizers namely nitrogen fixer (B1: *Azotobacter chroococcum* and B_2: *Azospirillium brasilense*) and phosphate solubilizer (B3: *Bacillus polymyxa*). Potassium was applied @ 10g.m^{-2} The experimental plot was laid out in factorial randomize block design (FRBD) with three replications. The individual plot size was 1.2 m^2 & spacing 30cm × 30cm. The tuberose mother bulbs (20-25 gm) were cut into six pieces and treated with blitox and planted in the field. FYM was applied about 10 tn.ha^{-1} at the time of final land preparation. Half of the dose of nitrogen was applied as basal and remaining half of nitrogen was applied 30 and 45 days after planting. The bio-fertilizers *viz.*, *Azatobacter* and *Azospirillium* were applied as seed (blub) treatment and PSB (*Bacillus polymyxa*) was applied near root zone at the time of plantings of bulb as slurry. Observations on different vegetative and reproductive parameters were recorded. The analysis for the experimental data was done as per Panse and Sukhatme (1967).

Plant height

The plant height was significantly increased by biofertilizer in combination with chemical fertilizer on tuberose cv. Prajwal over control. The highest plant height was observed in the month of August and then gradually decreased during the entire period of investigation. Among the different biofertilizer in combination with chemical fertilizers, T_{18} (NPK @ 10:8:10 + *Azotobacter*) showed the maximum (68.95 cm) plant height (Table – 1) which was statistically at par with T_{34} (NPK @ 10:0:10 + PSB), and T_{29} (NPK @ 10:4:0+PSB) showed the minimum (59.91 cm) plant height. The results of present findings are in agreement with Barman *et al.* (2003) in Tuberose cv single.

Leaf number

The highest leaf number was also noticed in the month of August and then gradually decreased during the entire period of investigation. Biofertilizers along with chemical fertilizers significantly increased the number of leaves as compared to control. Maximum number (65.45) of leaves were noticed under T_{34} (NPK @ 10:0:10 + PSB) which were statistically at par with T_{17} (NPK @ 10:4:10 + *Azotobacter*), and T_{33} (NPK@ 5:8:10 + PSB) showed the minimum number of leaves (53.48). Similar observation was recorded by Yadav *et al.* (2005) on Tuber rose cv. Double. The PSB, *Azotobacter* or *Azospirillium* alone or in combination produces growth promoting substances such as IAA or GA like substances Vit B_{12}, thiamine, riboflavin (B_2) etc which might have helped to increase number of leaves.

Spike length

It was evident from the data (Table 1) that different combinations of biofertilizers along with nitrogen (N) and phosphate (P), T_{18} (NPK @10:8:10 + *Azotobacter*) recorded maximum (92.50 cm) spike

Short Communication
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length. Minimum spike length (73.40cm) was noticed in T_{19} (NPK @ 5:8:10 + *Azospirillium*). The present findings are in the agreement with Kulkarani and Konde (1990) on aster.

Table 1: Effects of nitrogen, phosphate, biofertlizers on growth and flowering of tuberose cv. Prajwal

Treatment	Plant height (cm)	Leaf number clump^{-1}	Spike length (cm)	Number of floret spike^{-1}	Number of spike clump^{-1}
T_1 ($N_0P_0B_0$)	50.84	45.12	71.22	32.33	0.74
T_2 ($N_0P_4B_0$)	51.81	50.40	71.33	33.21	0.86
T_3 ($N_0P_8B_0$)	53.94	53.77	71.10	33.23	0.91
T_4 ($N_5P_0B_0$)	56.20	55.31	74.23	33.53	1.01
T_5 (N_5P_4B)	52.97	53.41	74.40	34.10	1.03
T_6 ($N_5P_8B_0$)	56.97	57.40	73.30	34.87	1.22
T_7 $N_{10}P_0B_0$)	56.84	60.99	76.30	32.90	1.06
T_8($N_{10}P_4B_0$)	58.04	62.14	77.53	35.43	1.40
T_9($N_{10}P_8B_0$)	61.38	63.74	76.13	35.63	1.45
T_{10}(N_0P_0B)	60.84	58.88	76.87	35.00	1.21
T_{11}($N_0P_4B_1$)	58.81	56.35	77.90	39.24	1.49
T_{12}($N_0P_8B_1$)	62.91	55.21	79.87	39.22	1.32
T_{13}($N_5P_0B_1$)	63.60	59.28	82.70	40.23	1.76
T_{14}($N_5P_4B_1$)	62.97	58.24	84.39	46.20	1.79
T_{15}($N_5P_8B_1$)	62.48	59.12	86.99	49.31	2.07
T_{16} ($N_{10}P_0B_1$)	64.47	62.36	83.71	41.93	1.77
T_{17}($N_{10}P_4B_1$)	66.46	64.52	89.69	54.61	1.78
T_{18}($N_{10}P_8B_1$)	68.96	63.54	92.50	51.70	2.13
T_{19}($N_5P_8B_2$)	59.37	56.49	73.40	33.47	1.04
T_{20}($N_{10}P_8B_2$)	58.68	55.45	74.99	36.52	1.24
T_{21}($N_0P_0B_2$)	61.90	55.67	76.89	36.22	1.16
T_{22}($N_5P_4B_2$)	61.87	57.34	77.93	37.15	1.46
T_{23}($N_{10}P_4B_2$)	61.80	56.38	79.54	41.12	1.47
T_{24}($N_5P_8B_2$)	61.48	57.37	81.57	45.11	1.71
T_{25}($N_{10}P_8B_2$)	61.87	60.87	78.48	39.13	1.54
T_{26}($N_0P_0B_2$)	61.80	63.40	82.21	43.91	1.48
T_{27}($N_5P_4B_2$)	61.48	63.08	82.87	45.30	1.77
T_{28}($N_0P_0B_3$)	57.65	62.29	74.27	32.67	0.96
T_{29}($N_0P_4B_3$)	55.91	54.53	73.59	33.49	1.04
T_{30} ($N_0P_8B_3$)	58.36	54.45	74.68	34.18	1.06
T_{31}($N_5P_0B_3$)	61.86	64.12	81.14	40.69	1.87
T_{32}($N_5P_4B_3$)	59.65	54.48	76.04	34.51	1.38
T_{33}($N_5P_8B_3$)	60.76	53.48	79.74	35.54	1.74
T_{34}($N_{10}P_0B_3$)	67.36	65.45	82.91	42.18	1.90
T_{35}($N_{10}P_4B_3$)	58.71	58.91	80.66	36.49	1.42
T_{36}($N_{10}P_8B_3$)	60.23	58.56	82.24	38.61	1.83
SEm(±)	**0.69**	**0.12**	**1.04**	**0.81**	**0.05**
LSD(0.05)	**1.94**	**1.62**	**NS**	**2.29**	**0.14**

B_0 = without biofertilzier B_1 = Azotobacter B_2 = Azospirilium B_3 =PSB (Bacillus polymyxa)
N_0 = without nitrogen N_5 = Nitrogen @ 5g m^{-2} N_{10} = Nitrogen @ 10g m^{-2} NS = non significant
P_0 = without phosphate P_4 = Phosphate @ 4g m^{-2} P_8 = Phosphate @ 8g m^{-2}

Number of florets spike^{-1}

The data pertaining to number of florets/spike revealed that all the biofertilizer treatments in combination with chemical fertilizers significantly increased the number of florets spike^{-1} over control (Table 1). The maximum (54.61) number of florets spike^{-1} were obtained in T_{17} (NPK @ 10:4:10 + *Azotobacter*) where as it was minimum (32.62) in T_{19} (NPK @ 5:8:10 + *Azospirillium)*. The present results are in close confirmation with the findings of Wange and Patil (2007) in tuberose.

Number of spikes clump^{-1}

The interaction effect of biofertilizer and chemical fertilizer had significant effect on number of

spikes clump^{-1} over control (Table 1). The maximum number (2.13) of spikes clump^{-1} had been noticed under T_{18} (NPK @10:8:10 + *Azotobacter*) and minimum number (1.04) of spikes clump $^{-1}$were noticed under T_{19} (NPK @ 5:8:10 + *Azospirillium*).The similar result was reported by Wang and Patil (2007) on Tuberose.

The microbial analysis of biofertilizers showed that higher values in respect of both viable cell counts of *Azotobacter*, *Azospirillium* and PSB in the rhizosphere soil were obtained. The results strengthen the observations recorded in growth & flowering character of Tuberose. *Azotobacter* + NPK @ 10:8:10 treated plants had shown good prolific growth of *Azotobacter* which strength the observation found in growth character. From the result, it is noticed that *Azotobacter* found to be synergistic with NPK than *Azospirillium* & PSB. Thus, T_{18} (*Azotobacter* + NPK @ 10:8:10 gave better result because *Azotobacter* absorbed nitrogen from the atmosphere and fixed in the soil. Nitrogen is the main constituent of protein and protoplasm which is responsible for cell division and enlargement. So, better growth was noticed as compared to other treatments.

The result from the experiment showed that treatment which contain *Azotobacter* were found to be beneficial to the growth and flowering of tuberose cv. Prajwal as compared to other treatments. Thus, it may be concluded that the biofertilizers may be incorporated into the nutrient schedule of tuberose (*Polianthes tuberosa*) to obtain a sustainable production.

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