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# Response of Tuberose cv Prajwal to Integrated Nutrient Management

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**Abstract** The present experiment aims to find out the response of tuberose (*Polianthes tuberosa* Linn.) cv Prajwal to Integrated Nutrient Management. Earliest sprouting, plant height, leaf number per plant, leaf area, fresh weight and dry weight of individual leaf and chlorophyll content was found maximum in response to treatment $T_4$ (75% RDF + FYM (1 kg/$m^2$) + Vermicompost (300 g / $m^2$)+ *Azospirillum* + PSB) respectively. Regarding the leaf nutrient analysis, maximum nitrogen and phosphorus content was obtained in treatment $T_4$ while treatment $T_3$ (75% RDF +FYM (1 kg/ $m^2$) Vermicompost (300 g/$m^2$) gave highest potassium content of leaf. In respect to the flowering parameters, earliest spike emergence and minimum days required for opening of first floret from spike emergence along with maximum number of florets per spike was observed under the treatment $T_7$ (50% RDF + FYM (1 kg / $m^2$) +Vermicompost (300 g / $m^2$) +*Azospirillum* + PSB). The self life of flowers was more prolonged (25.14 days) in treatment $T_4$ along with the length of the spike. However the treatments rendered no significant effect on the parameters rachis length and spike diameter. The parameters, weight of spike (g), weight of ten florets and number of spikes per plot were significantly influenced by the treatment $T_4$ which yielded best result.

**Keywords** Integrated, Vermicompost, *Azospirillum*, PSB.

## Introduction

Among the commercially grown flowers in India, tuberose occupies prime position because of its popularity as a cut flower, loose flower as well as its potential in perfume industry. Tuberose is botanically known as *Polianthes tuberosa* Linn. which belongs to family Amaryllidaceae. It has a great economic potential for cut flower trade and essential oil industrial [1]. In recent years the commercial importance of flowers has been realized throughout the world. In view of this increasing significance of floriculture in our country as well as state of West Bengal, it has become necessary to increase the production of these flowers from limited land resources through optimum utilization of the productivity of the soils. However, continuous, imbalanced and indiscriminate use of chemical fertilizers not only adversely affects soil health and environment but also reduce the productivity of the crop. But the judicious use of inorganic fertilizers with organic manure is the present day need. Efficacy of inorganic fertilizers was pronounced when combined with organic manures [2]. Keeping the above considerations in view, the present experiment was undertaken with an objective to evaluate the effect of inorganic, organic and biofertilizers on growth and flowering in tuberose cv Prajwal.

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**Table 1.** Effect of organic, inorganic and bio-fertilizer on vegetative, chlorophyll and nutrient content (NPK) of tuberose (*Polianthes tuberosa* Linn.) cv Prajwal.

| Treatments | Days to sprout | Plant height (cm) | Leaf number | Leaf area (cm sq) | Fresh wt of individual leaf (g) | Dry wt of individual leaf (g) | Nitrogen content of leaf (%) | Phosphorus content of leaf (%) | Potassium content of leaf (%) | Chlorophyll content of leaf (mg g-1) |
|---|---|---|---|---|---|---|---|---|---|---|
| $T_1$ | 22.20 | 46.43 | 26.11 | 130.77 | 7.16 | 0.72 | 1.76 | 0.41 | 3.23 | 2.60 |
| $T_2$ | 24.20 | 49.00 | 26.52 | 126.13 | 6.44 | 0.72 | 1.51 | 0.22 | 3.33 | 2.62 |
| $T_3$ | 20.97 | 49.62 | 26.69 | 134.73 | 6.94 | 0.72 | 1.55 | 0.35 | 3.97 | 2.66 |
| $T_4$ | 16.83 | 51.18 | 30.53 | 135.90 | 7.32 | 0.93 | 1.80 | 0.56 | 3.71 | 3.33 |
| $T_5$ | 26.30 | 46.31 | 25.73 | 128.20 | 6.72 | 0.66 | 1.44 | 0.16 | 3.16 | 1.90 |
| $T_6$ | 18.40 | 49.19 | 27.62 | 132.43 | 5.42 | 0.58 | 1.72 | 0.17 | 3.26 | 2.32 |
| $T_7$ | 17.13 | 48.37 | 28.50 | 130.73 | 6.88 | 0.78 | 1.77 | 0.46 | 3.31 | 2.96 |
| Sem (±) | 0.92 | 0.46 | 0.23 | 1.14 | 0.48 | 0.07 | 0.05 | 0.02 | 0.32 | 0.23 |
| CD at 5% | 2.64 | 1.32 | 1.26 | 3.28 | 1.39 | 0.20 | 0.14 | 0.06 | 0.65 | 0.67 |

## Materials and Methods

The investigation was carried out at Horticultural Research Station, Mondouri, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal in the year 2012-2013. The experiment was laid out in randomized block design with 7 treatments and three replications. The different treatments were $T_1$: 100% RDF+FYM (2 kg / $m^2$/ year) ; $T_2$ : 75% RDF + FYM @ 2 kg/$m^2$/ year ; $T_3$: 75% RDF + FYM (1 kg/$m^2$) +Vermicompost (300 g/$m^2$) ; $T_4$ : 75% RDF+FYM (1 kg/$m^2$) + Vermicompost (300 g/$m^2$) +*Azospirillum* + PSB ; $T_5$ : 50% RDF+FYM (1 kg/$m^2$) ; $T_6$ : 50% RDF+FYM (1 kg/$m^2$)+Vermicompost (300 g/$m^2$) ; $T_7$ : 50% RDF+FYM (1 kg/$m^2$ )+Vermicompost (300 g/$m^2$)+*Azospirillum* +PSB. The recommended dose of fertilizer (RDF) is 200 : 150 : 150 kg/ha N, P and K respectively. Half dose of nitrogen and full dose of phosphorus and potash were applied as basal dose. The remaining half dose of nitrogen was applied at interval of 45 days after application of basal dose. Farm yard manure, Vermicompost biofertilizers viz. *Azospirillum* and PSB and given as basal were incorporated in the soil according to the treatments of respective plots. The biofertilizers were applied @ 5 g/ plant and was applied through slurry method at the time of planting. Observations on growth and flowering parameters were recorded and was subjected to analysis of variance.

## Results and Discussion

Perusal of the data in Table 1 reveals that the different treatments significantly influenced the days to sprouting. The plots receiving the treatment $T_4$ (75% RDF + FYM (1 kg / $m^2$) + Vermicompost (300 g/$m^2$) + *Azospirillum* + PSB) sprouted early (16.83 days) followed closely by treatment $T_7$ i.e. 17.13 days. The treatments $T_5$ (50% RDF + FYM (1 kg/$m^2$) recorded delayed sprouting (26.30 days). In general the plants treated with *Azospirillum* sprouted early in the range of 16.83 to 17.13 days. Earliness in sprouting could be attributed to early uptake of nitrogen and phosphorus due to the application of growth promoting hormones *Azospirillum* and PSB. The results are in conformity with the findings of Kashyap et al. [3]. $T_4$ consisting of 75% RDF + FYM (1 kg / $m^2$) + Vermicompost (300 g/$m^2$) + *Azospirillum* + PSB recorded maximum plant height i.e. 51.18 cm, highest leaf number (30.53) respectively while treatment $T_5$ 50% RDF + FYM (1 kg/$m^2$) recorded shorter plant height (46.31 cm) and minimum number of leaves (25.73). Increased plant height may be attributed to the beneficial effect of *Azospirillum* and PSB, which helps in cell division and cell enlargement thus positively influencing linear growth. Better nutrient uptake, photosynthesis, source sink relationship, excellent physiological and biochemical activities due to the presence of *Azospirillum* and PSB may also be

**Table 2.** Effect of organic, inorganic and bio-fertilizer on reproductive parameters of tuberose cv Prajwal.

| Treatments | Days spike emergence | Days to 1st floret opening from spike emergence | Self life (days) | Spike length (cm) | Spike diameter (cm) | Rachis length (cm) | No. of florets spike | Wt of 100 florets/ (g) | Fresh wt of spike (g) | No. of spikes plot (2.7 $m^2$) |
|---|---|---|---|---|---|---|---|---|---|---|
| $T_1$ | 192.72 | 31.03 | 24.00 | 109.89 | 1.85 | 35.05 | 51.53 | 176.21 | 177.00 | 81.67 |
| $T_2$ | 191.00 | 29.08 | 23.44 | 109.45 | 1.83 | 38.54 | 53.22 | 190.93 | 143.00 | 70.00 |
| $T_3$ | 187.67 | 30.25 | 24.72 | 112.97 | 1.81 | 35.50 | 54.08 | 185.71 | 165.00 | 78.00 |
| $T_4$ | 186.58 | 25.66 | 26.84 | 117.99 | 1.82 | 40.50 | 55.08 | 194.21 | 180.83 | 86.67 |
| $T_5$ | 193.03 | 29.89 | 19.80 | 106.08 | 1.84 | 33.78 | 53.61 | 180.64 | 163.60 | 71.33 |
| $T_6$ | 185.33 | 29.50 | 22.39 | 113.00 | 1.84 | 38.57 | 55.00 | 182.03 | 146.93 | 79.00 |
| $T_7$ | 184.17 | 25.17 | 22.03 | 116.89 | 1.84 | 39.25 | 55.95 | 191.75 | 179.67 | 84.00 |
| Sem (±) | 0.80 | 0.22 | 0.66 | 1.32 | 0.02 | 3.85 | 1.40 | 1.22 | 1.47 | 0.87 |
| CD at 5% | 2.28 | 0.63 | 1.89 | 3.78 | NS | NS | 4.01 | 3.51 | 4.23 | 2.50 |

the factors to influence the trait. The results were in consonance with the earlier findings [4, 5]. They also reported that the biofertilizers used with increased levels of inorganic fertilizers (N, P and K) increases the plant height in tuberose. The increased leaf number in $T_4$ may be attributed to the application of *Azospirillum* which may have increased the activity of plant growth substances like gibberelic acid, indole acetic acid and dehydrozeatin that might have been responsible for increased vegetative growth. Similar results were reported earlier [6, 7]. $T_4$(75% RDF +FYM (1 kg/$m^2$) + Vermicompost (300 g/$m^2$) + *Azospirillum* + PSB) recorded largest leaf size (135.90 $cm^2$), highest fresh weight (7.32 g) and dry weight of individual leaf (0.93 g). The nitrogen (1.80%), phosphorus (0.56%) and chlorophyll (3.33%) content of leaves as seen in Table 1 was maximum in treatment $T_4$. The high nitrogen (1.80%) and phosphorus content (0.56%) in treatment $T_4$ can be attributed to application of Vermicompost and the action of biofertilizers such as PSB. This is because the PSB stimulates root colonization thus resulting in increased root surface area and hence leading to the absorption of inorganic nutrients such as nitrogen and phosphorus. Also Vermicompost enhances the mineralization of soil nitrogen making it more readily available to the plants. The results are in conformity with the findings of Shivputra et al. [8]. As the content of chlorophyll is related to the N status of the leaf, maximum leaf nitrogen may have influenced the chlorophyll content positively. Highest potassium content (3.97%) was obtained in treatment $T_3$ (75% RDF + FYM @ 1 kg/$m^2$) + Vermicompost @ 300 g/$m^2$). Early emergence of spike (184.17 days) was notes in the treatment $T_7$ (50% RDF + FYM (1 kg/$m^2$) + Vermicompost (300 g/$m^2$)+ *Azospirillum* + PSB) which was statistically at par with treatment $T_6$, $T_4$ and $T_5$. Therefore, it can be discussed in the light that Vermicompost in the treatments influenced or promoted early flowering since Vermicompost alone or along with *Azospirillum* and PSB makes nitrogen and phosphorus available to plants. Besides *Azospirillum* is known to produce hormones like IAA [9] and giberellic acids [10] that hasten the growth of the plants. The treatments $T_7$ (25.17 days) and $T_4$ (25.66 days) were almost at par regarding first floret opening while $T_1$ (100% RDF + FYM @ 2 kg/$m^2$ year) reported delayed floret opening (31.03 days). Early initiation of flowering is probably due to the role of Vermicompost in improving flowering [11] suggested that plants which received Vermicompost either alone or in combination with half recommended dose of inorganic fertilizer resulted in early flowering. The plants under the treatment $T_4$ took more number of days for opening of last floret and thus prolonged the spike longevity to 26.84 days followed by treatment $T_3$ (24.72 days). The treatment $T_4$ registered almost 7 days more longevity of spike in the field compared to treatment $T_5$. The maximum

**Table 3.** Correlation of chlorophyll and NPK with different parameters of tuberose.

| | Chlorophyll (mg/g) | Plant height (cm) | Leaf no. | Leaf area ($cm^2$) | Days to spike emergence | Nitrogen (%) |
|---|---|---|---|---|---|---|
| Chlorophyll | 1 | | | | | |
| Plant height (cm) | 0.542* | 1 | | | | |
| Leaf no. | 0.711** | 0.282 | 1 | | | |
| Leaf area ($cm^2$) | 0.406 | 0.638** | 0.328 | 1 | | |
| Days to spike emergence | −0.420 | −0.315 | −0.521* | −0.527* | 1 | |
| Nitrogen (%) | 0.471* | 0.614** | 0.457* | 0.786** | −0.420 | 1 |
| Phosphorus (%) | 0.701** | 0.484* | 0.451* | 0.575** | −0.302 | 0.556** |
| Potassium (%) | 0.425 | 0.198 | 0.211 | 0.316 | −0.206 | 0.039 |
| Field life (days) | 0.434** | 0.589** | 0.200 | 0.409 | −0.098 | 0.294 |
| No. Florets | 0.151 | −0.282 | 0.248 | 0.252 | −0.328 | 0.0716 |
| Spike yield/plot | 0.559** | 0.519* | 0.458* | 0.810** | −0.478* | 0.720** |

**Table 3.** Continued.

| | Phosphorus (%) | Potassium (%) | Field life (days) | No. Florets | Spike yield/ plot |
|---|---|---|---|---|---|
| Chlorophyll | | | | | |
| Plant height (cm) | | | | | |
| Leaf no. | | | | | |
| Leaf area ($cm^2$) | | | | | |
| Days to spike emergence | | | | | |
| Nitrogen (%) | | | | | |
| Phosphorus (%) | 1 | | | | |
| Potassium (%) | 0.339 | 1 | | | |
| Field life (days) | 0.306 | 0.191 | 1 | | |
| No. Florets | 0.140 | 0.469* | −0.047 | 1 | |
| Spike yield / plot | 0.816** | 0.207 | 0.326 | 0.206 | 1 |

length of spike (117.99 cm) was recorded in the treatment $T_4$ (75% RDF + FYM (1 kg/$m^2$) + Vermicompost (300 g/$m^2$) + *Azospirillum* + PSB) followed by treatment $T_7$ (116.89 cm). The increase in spike length may be due to fixation of N by *Azospirillum* and release of phosphorus from insoluble phosphate by PSB in addition to the application of inorganic fertilizer and organic manure. Beneficial effect on stem length due to the application of *Azospirillum* and PSB was also reported earlier by Bhatia et al. [12]. The longest rachis length (40.50 cm) was recorded under the treatment $T_4$ followed by treatment $T_7$ (39.25 cm). Results of Table 2 shows that the treatment $T_7$ (50% RDF + FYM (1 kg/$m^2$) + Vermicompost (300 g/$m^2$) + *Azospirillum* + PSB) recorded highest number of florets per spike (55.95) which was statistically at par with $T_4$ (55.08) and $T_6$ (55.00). The increase in floret number per spike may be attributed to the application of inorganic fertilizers along with biofertilizers alone or in combination which helps in easy absorption by the crop. The absorption by the crop has thus led to an increase in the number of florets [13]. Increase in cut flower yield of *P. tuberosa* by inoculating *Azospirillum* and addition of nitrogen was also reported by Wange et al. [14]. The treatment $T_4$ recorded highest weight of 100 florets (194.21 g), fresh weight of spike (180.83 g) and highest number of spikes/plot (2.7 sq m) (86.67). The beneficial effects of application of organic fertilizers with inorganic nutrients on the flower yield are in line with the earlier findings [15—17].

Correlation co-efficient studies

As per the correlation analysis (Table 3), the parameters plant height, leaf number, nitrogen and phosphorus content was significantly and positively correlated to chlorophyll content of leaves. Chlorophyll content was also found to be significantly and positively correlated with the self life and spike yield per plot. The leaf nitrogen content showed significant positive correlation with leaf phosphorus content. The vegetative parameter such as plant height, leaf number, leaf area was also significantly and positively correlated with leaf nitrogen content. Spike yield per plot exhibited significant positive correlation with leaf nitrogen and phosphorus content. A significant positive correlation was observed with potassium content with the number of florets per spike.

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