

# EFFECT OF BIOFERTILIZERS ON GROWTH, FLOWERING, QUALITY AND YIELD OF CHRYSANTHEMUM (*DENDRANTHEMA GRANDIFLORA* T.) CV. SNOWBALL UNDER OPEN FIELD CONDITIONS OF PRAYAGRAJ

## ABSTRACT

The present experiment was carried out during September, 2022 to January, 2023 in Research Field, Department of Horticulture, SHUATS, Prayagraj. The research was conducted with an aim to identify the most suitable biofertilizer treatment under the agroclimatic conditions of Prayagraj was carried out in Randomized Block Design (RBD), with ten treatments, replicated thrice. From the present experimental findings, it was observed that treatment T<sub>7</sub> (60 % NP + 100 % K + Azotobacter 0.3g/plant + PSB 0.5g/plant) found best in all the parameters like plant height (42.3cm), plant spread (22.8 cm), number of primary branches (6.7), days taken to first bud initiation (60.5), days taken to 50% flowering (97 days), bud length (0.72), bud diameter (1.22 cm), flower diameter (16.4 cm), stalk length (32.5 cm), vase life (6.1), number of cut flowers stalks per plant (4.6), number of cut flowers stalks per plot (41.5), number of cut flower stalks per hectare (511111). In terms of maximum gross returns (Rs. 2,044,444 per ha), net returns (Rs. 1,412,733 per ha) and benefit-cost ratio (3.23) is found in treatment T<sub>7</sub> followed by T<sub>4</sub> (80 % NP + 100 % K + Azotobacter 0.3g/plant + PSB 0.5g/plant), whereas minimum is recorded in treatment T<sub>1</sub>-Control.

**Keywords:** *Chrysanthemum*, *NPK*, *Azotobacter*, *Phosphorus solubilizing bacteria*, *open field*

## 1. INTRODUCTION

*Chrysanthemum* (*Dendranthema grandiflora* T.) belongs to the Asteraceae family. It is believed to be native to the northern hemisphere chiefly Europe and Asia and was believed to have been originated in China (Carter 1990). The basic chromosome number of chrysanthemum is 9, while  $2n$  ranges from 36 to 75, though most of them are hexaploidy. The word chrysanthemum is derived from the Greek word “chryos” means gold and “anthemon” or “anthos” means flower.

In the trade of global flower market, chrysanthemum is the second largest cut flower after rose (Bhattacharjee and De, 2003) and holds fifth rank as pot plant. The species is also suitable as cut flowers due to the most important characteristics of its attractive color, long vase life, tough flowers, uniform opening, long erect stem, long internodes and normal spray with high central bloom and easy to open flower buds at the destination.

In the current scenario, lower productivity and inferior flower quality of chrysanthemum is due to use of chemical fertilizers, especially the quick-release nitrogenous fertilizers. In order to minimize these ill effects, biofertilizers practices involving azotobacter, phosphate solubilizing microorganisms, etc. must be adopted for sustainable production.

Biofertilizers or more appropriately called microbial inoculants are the preparations containing live or latent cells of efficient strains of microorganisms. These bio-fertilizers are a cost effective, eco-friendly, renewable energy source and plays a crucial role in reducing the inorganic fertilizer application and at the same time increasing the quality of crop products and safeguarding the soil health (Choudhary and Trivedi, 2008). Common biofertilizers used in horticulture crops are Azotobacter, Azospirillum, Bacillus, Phosphorous solubilizing bacteria (PSB) and Vesicular arbuscular mycorrhizal (VAM) fungi. From these common biofertilizers Azotobacter is important nitrogen fixer inoculants. These bacteria utilize atmospheric nitrogen gas for their cell protein synthesis.

Next to nitrogen, phosphorous is also one of the master key elements for plant merely 15 to 20 per cent of applied phosphorus is recovered by the crop plants and remaining gets fixed in the soil. The fixed form does not contribute to the available phosphorous content in the soil. It has been established that there are specific groups of soil microorganisms known as “phosphobacteria” which increase the availability of phosphate (Singh *et al.*, 2014) to plants not only by mineralizing organic phosphorus compounds but also by rendering phosphorus compounds more available to them e.g., PSB, Mycorrhiza. So keeping in view of the above facts, this experiment was planned to study the effect of biofertilizers on growth,

flowering & yield of chrysanthemum and to work out the economics of different treatments.

## **2. MATERIALS AND METHODS**

### **2.1 Geographical location of the experimental site**

The experimental site is located at a latitude of 25.41° North and longitude of 81.84 ° East, with an altitude of 98 meters above the mean sea level (MSL).

### **2.2 Climatic conditions of the experimental area**

The area of Prayagraj comes under humid sub-tropical climate, which experiences warm humid monsoon, hot dry summer and cold dry winter. The annual mean temperature is 26.1°C while monthly mean temperatures are 18-29°C. The daily average maximum temperature is about 22°C and the minimum temperature is 9°C. The average annual rainfall received is 1042.2 mm. At this location, the temperature reaches upto 46°C-48°C and the minimum temperature recorded is 4°C-5°C. The relative humidity ranges in this location ranges between 20-94%. The meteorological data (September, 2022-January, 2023) with respect to maximum and minimum temperatures, total rainfall and relative humidity.

### **2.3 Experimental details**

The experiment was conducted in Randomized Block Design (RBD) with 10 treatments of Biofertilizers with three replications in the Departmental Research Field of Department of Horticulture, Sam Higginbottom University of Agriculture, Technology And Sciences, Prayagraj during September, 2022 to January, 2023. Total number of treatments were ten *viz.* T<sub>1</sub> (Control), T<sub>2</sub> (80 % N + 100 % PK + Azotobacter 0.3g/plant), T<sub>3</sub> (80 % P + 100 % NK + PSB 0.5g/plant), T<sub>4</sub> (80 % NP + 100 % K + Azotobacter 0.3g/plant + PSB 0.5g/plant), T<sub>5</sub> (60 % N + 100 % PK + Azotobacter 0.3g/plant), T<sub>6</sub> (60 % P + 100 % NK + PSB 0.5g/plant), T<sub>7</sub> (60 % NP + 100 % K + Azotobacter 0.3g/plant + PSB 0.5g/plant), T<sub>8</sub> (40 % N + 100 % PK + Azotobacter 0.3g/plant), T<sub>9</sub> (40 % P + 100 % NK + PSB 0.5g/plant), T<sub>10</sub> (40 % NP + 100 % K + Azotobacter 0.3g/plant + PSB 0.5g/plant). The treatments were supplemented with recommended dose of 25 t/ha FYM. Chrysanthemum cultivar Snowball was planted on 28<sup>th</sup> September, 2022 at a spacing of 30 cm x 30 cm.

### 3. RESULTS AND DISCUSSIONS

#### **Plant height (cm) and Plant spread (cm)**

Maximum plant height (42.3cm) and plant spread (22.8cm) was observed from the plants grown in treatment T<sub>7</sub> containing 60% NP + 100% K + Azotobacter 0.3g/plant + PSB 0.5g/plant significantly superior to rest of the treatments. The enhanced plant height may be due to the presence of more readily available form of nitrogen due to the use of Azotobacter, which might have triggered the vegetative growth of plant (Kumar *et al.*, 2013). This increase in the plant spread might be due to the use of combination of RDN with Azotobacter which gave an additive effect and due to secretion of certain growth promoting substances like auxin, gibberellins, vitamins, and organic acids in soil. Asokan *et al.* (2000) also reported that phosphate solubilizing bacteria secretes some organic acids such as lactic, glycolic, fumaric & succinic acids which convert insoluble phosphates into soluble forms.

#### **Days taken for first flower bud initiation**

In terms of days to first bud initiation treatment T<sub>7</sub> containing 60 % NP + 100 % K + Azotobacter 0.3g/plant + PSB 0.5g/plant recorded minimum days taken to first bud initiation (60.5) whereas the maximum days were recorded in the treatment T<sub>1</sub>-Control (74.4). The earliness might be due to the effect of biofertilizers *viz.*, Azotobacter & PSB, creating a conducive source sink relationship and ultimately causing an increase in the synthesis of cytokinin in the root tissue and its simultaneous transport to auxillary buds would have resulted in better sink for mobilization of photo assimilates at a rapid rate and have helped in the early transformation from vegetative to reproductive phase. Similar results were observed by (Naik and Dalawai, 2004) in Carnation and (Pooja *et al.*, 2012) in China aster cv. 'kamini'.

#### **Flower diameter (cm)**

Data revealed that higher flower diameter was recorded in treatment T<sub>7</sub> containing 60 % NP + 100 % K + Azotobacter 0.3g/plant + PSB 0.5g/plant (16.4 cm) whereas the minimum flower diameter was recorded in the treatment T<sub>1</sub>-Control (9.9 cm). This increase in flower diameter might be due to better nutrient uptake, higher photosynthesis and excellent physiological, biological activities due to presence of Azotobacter and PSB which have resulted in rapid synthesis and translocation of photosynthates from the source to developing flower bud and finally increase in flower diameter (Kumawat *et al.*, 2017).

### **Stalk length (cm)**

Maximum flower stalk length was recorded in treatment T<sub>7</sub> containing 60 % NP + 100 % K + Azotobacter 0.3g/plant + PSB 0.5g/plant (32.5 cm) significantly superior to rest of the treatments. All the treatments involving in combination with various levels of phosphorus were effective considerably as compared to control due to enhanced absorption in biofertilizers inoculated plants, leading to increased availability of assimilates that needed for the improvement in flower stalk length. Laishram *et al.*, (2013) reported similar results in chrysanthemum.

### **Vase Life (Number of days)**

In terms of vase life treatment T<sub>7</sub> containing 60 % NP + 100 % K + Azotobacter 0.3g/plant + PSB 0.5g/plant recorded maximum vase life (6.1) whereas the minimum vase life was recorded in the treatment T<sub>1</sub>-Control (3.5). Biofertilizers increased vase life of Chrysanthemum. The Increased vase life might be due to by triggering of such metabolic activity and Narrowing of the C:N ratio by the significant Accumulation of carbohydrates. Furthermore, These findings are well supported by Meshram *et al.*, (2008), Palagani *et al.*, (2013) and Pandey *et al.*, (2018) in chrysanthemum.

### **Number of flower stalks per plant/hectare**

Yield is an important parameter to decide the efficacy of a treatment. Data recorded on maximum number of flower stalks per plant (4.6) and maximum number of flower stalks per hectare (511111) in treatment T<sub>7</sub> containing 60 % NP + 100 % K + Azotobacter 0.3g/plant + PSB 0.5g/plant. This increase in number of flowers might be due to the effect of bio-fertilizers along with the recommended dose of chemical fertilizers. Azotobacter, which makes the unavailable nitrogen to available form to plants also enhances the uptake of Fe, Zn, Cu and Mo and helps in production of more number of flowers, whereas, Phosphate-Solubilizing Bacteria (PSB) species are also reported to beneficial in increasing the phosphorus availability in soil and thereby increasing yield (Shashidhara and Gopinath, 2005)

**Table 1:** Effects of biofertilizers on Plant height (cm), Plant Spread (cm), Days taken for first flower bud initiation and Flower diameter of Chrysanthemum (*Dendranthema grandiflora* T.)

Treatment Symbols	Treatment Combinations	Plant Height (cm)	Plant Spread (cm)	Days taken for first flower bud initiation	Flower Diameter (cm)
		60 DAP	60 DAP		
T <sub>1</sub>	RDN (125:100:25 kg/ha) NPK	27.3	14.6	74.4	9.9
T <sub>2</sub>	80% N + 100% PK + Azotobacter 0.3g/plant	31.6	18.1	66.2	13.4
T <sub>3</sub>	80% P + 100% NK + PSB 0.5g/plant	30.3	19.1	67.5	10.9
T <sub>4</sub>	80% NP + 100% K + Azotobacter 0.3g/plant + PSB 0.5g/plant	35.2	20.2	65.4	13.8
T <sub>5</sub>	60% N + 100% PK + Azotobacter 0.3g/plant	34.6	18.2	68.8	11.7
T <sub>6</sub>	60% P + 100% NK + PSB 0.5g/plant	32.9	17.1	69.3	12.8
T <sub>7</sub>	60% NP + 100% K + Azotobacter 0.3g/plant + PSB 0.5g/plant	42.3	22.8	60.5	16.4
T <sub>8</sub>	40% N + 100% PK + Azotobacter 0.3g/plant	29.6	16.3	68.4	13.4
T <sub>9</sub>	40% P + 100% NK + PSB 0.5g/plant	31.3	17.3	66.6	12.1
T <sub>10</sub>	40% NP + 100% K + Azotobacter 0.3g/plant + PSB 0.5g/plant	30.2	16.8	71.5	12.5
<b>F-Test</b>		S	S	S	S
<b>SE(d)</b>		3.07	1.12	1.12	1.12
<b>C.V.</b>		11.55	7.60	7.60	10.85
<b>C. D<sub>0.05</sub></b>		6.45	2.35	2.35	2.36

**Table 2:** Effects of biofertilizers on Stalk Length (cm), Vase Life of flowers (no. of days), Number of flower stalks per plant and Number of flower stalks per hectare of Chrysanthemum (*Dendranthema grandiflora* T.)

Treatment Symbols	Treatment Combinations	Stalk Length (cm)	Vase Life	Number of stalks per plant	Number of stalks per hectare
T <sub>1</sub>	RDN (125:100:25 kg/ha) NPK	19.5	3.5	2.8	322221
T <sub>2</sub>	80% N + 100% PK + Azotobacter 0.3g/plant	25.9	4.8	3.4	385185
T <sub>3</sub>	80% P + 100% NK + PSB 0.5g/plant	22.5	4.5	3.2	377777
T <sub>4</sub>	80% NP + 100% K + Azotobacter 0.3g/plant + PSB 0.5g/plant	26.7	5	3.8	422222
T <sub>5</sub>	60% N + 100% PK + Azotobacter 0.3g/plant	21.8	4.6	3.3	370370
T <sub>6</sub>	60% P + 100% NK + PSB 0.5g/plant	24.1	3.8	3.4	355555
T <sub>7</sub>	60% NP + 100% K + Azotobacter 0.3g/plant + PSB 0.5g/plant	32.5	6.1	4.6	511111
T <sub>8</sub>	40% N + 100% PK + Azotobacter 0.3g/plant	26.1	3.6	3.1	348148
T <sub>9</sub>	40% P + 100% NK + PSB 0.5g/plant	20.9	4	2.9	325926
T <sub>10</sub>	40% NP + 100% K + Azotobacter 0.3g/plant + PSB 0.5g/plant	25.3	4	3.2	355555
<b>F-Test</b>		S	S	S	S
<b>SE(d)</b>		2.80	0.48	0.33	37270.8
<b>C.V.</b>		13.98	13.54	12.27	12.095
<b>C. D<sub>0.05</sub></b>		5.89	1.02	0.71	78306

#### 4. CONCLUSION

Based on the present investigation it is concluded that treatment T<sub>7</sub> (60 % NP + 100 % K + Azotobacter 0.3g/plant + PSB 0.5g/plant) performed better in all the parameters like plant height, plant spread, days taken to first bud initiation, flower diameter, stalk length, vase life, number of cut flowers stalks per plant, number of cut flower stalks per hectare followed by T<sub>4</sub> (80 % NP + 100 % K + Azotobacter 0.3g/plant + PSB 0.5g/plant), whereas minimum is recorded in treatment T<sub>1</sub>-Control.

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