

## EFFECT OF BALANCED NUTRITION AND BIO-INOCULANTS ON FLOWER YIELD AND QUALITY ATTRIBUTES OF CHRYSANTHEMUM (*DENDRANTHEMA GRANDIFLORA TZVELEV*)

Mahantesh Biradar<sup>1\*</sup>, B. Hemla Naik<sup>2</sup>, M. Ganapathi<sup>3</sup> and K.M. Asha<sup>4</sup>

*Department of Floriculture & Landscape Architecture, College of Horticulture, Mudigere -577132  
University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka, India  
Email: mahantagoudahort9@gmail.com*

*Received-13.11.2017, Revised-04.12.2017*

**Abstract:** A field experiment was conducted to know the response of Chrysanthemum (*Dendranthema grandiflora Tzvelev*) to balanced nutrition with bio-inoculants at the, College of Horticulture, Mudigere during 2015-16. Plants treated with (T<sub>22</sub>) *Bacillus megaterium* + *Bacillus mucilaginosus*+ MgSO<sub>4</sub>+Micronutrient mixture recorded significantly maximum flowers per plant (100), flower yield per plant (627.20 g), flower yield per plot (61.46 kg), flower yield (30.73 t/ha) and individual flower weight (6.27 g),flower diameter (7.25 cm),number of petals per flower (136.50),shelf life (15.25 days),vase life(22 days) followed by *Azotobacter* + *Bacillus mucilaginosus*+ MgSO<sub>4</sub>+ Micronutrient mixture and *Azotobacter* + *Bacillus megaterium*+ MgSO<sub>4</sub>+Micronutrient mixture over the control(RDF) respectively.

**Keywords:** Chrysanthemum, Bio-inoculants, MgSO<sub>4</sub>, Micronutrient mixture, RDF

### INTRODUCTION

Chrysanthemum (*Dendranthema grandiflora Tzvelev*) belongs to the family compositae (2n=18).It occupies a prominent place in ornamental horticulture, as it is one of the commercially exploited traditional and modern flower crops. It is a short duration crop which produces wide spectrum of flowers, eye-catching color, shape, size and keeping quality and attracted the attention of flower growers. It is used both as cut as well as traditional flower; in the preparation of garlands and vase decorations, also has great demand as potted plant in the International market. The indiscriminate and continuous use of chemical fertilizers in chrysanthemum has led to imbalance nutrient in soil. Therefore this study has been conducted to ensure the effectiveness of microbial bio-inoculants along with the balanced use of chemical fertilizers which helps to improve physic-chemical and biological properties of the soil, besides improving the efficiency of applied fertilizers for optimum yield and quality of mums.

### MATERIAL AND METHOD

An experiment was conducted under outdoor condition during 2015-16 at College of Horticulture, Mudigere, Chikkamagaluru, and Karnataka. Rooted terminal cuttings - mum *var.* Kolar local. Planting method is ridges and furrows, plot size is 5m x 4m and spacing is about 45 x 45cm (98 plants/plot).The experiment was laid out with RCBD. There were 22 treatments viz.,T<sub>1</sub> – Control (RDF), T<sub>2</sub> – MgSO<sub>4</sub>, T<sub>3</sub> – Micronutrient mixture, T<sub>4</sub> –MgSO<sub>4</sub>+ Micronutrient mixture, T<sub>5</sub> – *Azotobacter*, T<sub>6</sub> –*Bacillus megaterium*, T<sub>7</sub> –*Bacillus mucilaginosus*,T<sub>8</sub> –MgSO<sub>4</sub> + *Azotobacter*, T<sub>9</sub> – MgSO<sub>4</sub>+ *Bacillus megaterium*, T<sub>10</sub> – MgSO<sub>4</sub>+*Bacillus mucilaginosus*, T<sub>11</sub>–Micronutrient

mixture+ *Azotobacter*, T<sub>12</sub> – Micronutrient mixture + *Bacillus megaterium*, T<sub>13</sub> – Micronutrient mixture + *Bacillus mucilaginosus*, T<sub>14</sub>–*Azotobacter* + *Bacillus megaterium* + MgSO<sub>4</sub>, T<sub>15</sub> – *Azotobacter* + *Bacillus mucilaginosus*+ MgSO<sub>4</sub>, T<sub>16</sub> – *Bacillus megaterium* +*Bacillus mucilaginosus*+ MgSO<sub>4</sub>,T<sub>17</sub> – *Azotobacter* + *Bacillus megaterium*,+ Micronutrient mixture, T<sub>18</sub> – *Azotobacter* + *Bacillus mucilaginosus*+ Micronutrient mixture, T<sub>19</sub> – *Bacillus megaterium* + *Bacillus mucilaginosus*+ Micronutrient mixture, T<sub>20</sub> – *Azotobacter* + *Bacillus megaterium*,+ MgSO<sub>4</sub> +Micronutrient mixture, T<sub>21</sub>– *Azotobacter* + *Bacillus mucilaginosus*+ MgSO<sub>4</sub> + Micronutrient mixture, T<sub>22</sub>– *Bacillus megaterium* + *Bacillus mucilaginosus*+ MgSO<sub>4</sub>+Micronutrient mixture and replicated twice.

These bioinoculants were applied along with secondary nutrient (MgSO<sub>4</sub>), Micronutrient mixture with RDF. At the time of transplanting the rooted cuttings were dipped in bioinoculant solution according to treatments and after 30 DAP bioinoculants with MgSO<sub>4</sub>, Micronutrient mixture, were applied, and the observations on flower yield and quality parameters were recorded and the data were analyzed scientifically and interpreted the results and discussed as below.

### RESULT AND DISCUSSION

The different bioinoculants with MgSO<sub>4</sub> and Micronutrient mixture treatments had a significant effect on number of flowers per plant (100), flower yield per plant (627.20 g), flower yield per plot (61.46 kg), flower yield (30.73 t/ha) followed by T<sub>21</sub>, T<sub>20</sub> and T<sub>19</sub>, respectively and these treatments were found on par with each other. However, T<sub>1</sub> with uninoculated control (RDF) recorded minimum alone (Table 1) .The other treatments were also found

\*Corresponding Author

statistically significant over the control for all the parameter. The possible reason for better performance of yield attributes and higher yield could be due to the regular supply of nutrients leads to more vegetative growth leading to increase in photosynthetic area, which in turn resulted in more synthesis and accumulation of dry matter in the flower Bosali et al. [1]. Moreover, presence of growth promoting substances such as auxin, gibberellins and cytokinin due to presence of biofertilizers would have also contributed in development and accumulation of sink resulting in better growth and subsequently higher number of flowers per plant and higher flower yield per hectare. The results are in agreement with the earlier findings of Thumhar et al. [2] and Jadhav et al. [3] in marigold, Patanwar et al. [4] in chrysanthemum, Kirar et al. [5] in china aster and Sheergojri et al. [6] in gladiolus. And (T<sub>22</sub>) *Bacillus megaterium* + *Bacillus mucilaginosus* + MgSO<sub>4</sub> + Micronutrient mixture showed the highest individual flower weight (6.27 g), flower diameter (7.25 cm), number of petals per flower (136.50) followed by T<sub>21</sub>, T<sub>20</sub> and T<sub>19</sub>, respectively and these treatments were found on par with each other. However, T<sub>1</sub> with un-inoculated control (RDF) recorded minimum (Table 2). The other treatments were also found statistically significant over the control for all the parameter. This might be due to better physical condition of soil and

increased population of microflora, thereby enhanced availability of nutrients through mineralization process. Moreover, biofertilizers produce the growth stimulating substances viz., auxin, gibberellins and cytokinins which contribute towards vigorous growth of the plant. This in turn increases photosynthesis and enhances food accumulation and also diversion of photosynthates towards sink resulting in better quality flowers. The earlier study of Panchal et al. [7] and Swaroop [8] also confirms these findings in marigold. And (T<sub>22</sub>) *Bacillus megaterium* + *Bacillus mucilaginosus* + MgSO<sub>4</sub> + Micronutrient mixture showed the maximum shelf life (15.25 days) and vase life (22 days) followed by T<sub>21</sub>, T<sub>20</sub> and T<sub>19</sub>, respectively and these treatments were found on par with each other. However, T<sub>1</sub> with un-inoculated control (RDF) recorded minimum (Table 3). The other treatments were also found statistically significant over the control for all the parameter. It might be due to overall food nutrient status of flowers under this treatment. Application of balanced nutrition and bio inoculants influences flower longevity due to the increased nutrient uptake by plants and greater of water conducting tissue. It might also be due to the presence of ethylene inhibitors or due to the presence of cytokinins which delay senescence of flowers. These findings are matching with those of Bhatia and Gupta [9] in gerbera.

**Table 1.** Effect of balanced nutrition and bioinoculants on flower yield parameters of chrysanthemum

	Treatment	No. of flowers/plant	Flower yield/plant (g)	Flower yield (kg/plot)	Flower yield (t/ha)
T <sub>1</sub>	RDF (control)	62.50	331.25	32.46	16.23
T <sub>2</sub>	MgSO <sub>4</sub>	70.85	393.21	38.53	19.26
T <sub>3</sub>	Micronutrient mixture	74.25	404.66	39.65	19.82
T <sub>4</sub>	MgSO <sub>4</sub> + Micronutrient mixture	76.25	438.43	42.96	21.48
T <sub>5</sub>	<i>Azotobacter</i>	78.50	412.12	40.38	20.19
T <sub>6</sub>	<i>B. megaterium</i>	80.15	428.80	42.02	21.01
T <sub>7</sub>	<i>B. mucilaginosus</i>	82.15	435.39	42.66	21.33
T <sub>8</sub>	MgSO <sub>4</sub> + <i>Azotobacter</i>	79.10	446.91	43.79	21.89
T <sub>9</sub>	MgSO <sub>4</sub> + <i>B. megaterium</i>	85.35	465.15	45.58	22.79
T <sub>10</sub>	MgSO <sub>4</sub> + <i>B. mucilaginosus</i>	93.55	458.39	44.92	22.60
T <sub>11</sub>	M. mixture + <i>Azotobacter</i>	94.50	477.22	46.76	23.38
T <sub>12</sub>	M. mixture + <i>B. megaterium</i>	89.15	450.20	44.11	22.05
T <sub>13</sub>	M. mixture + <i>B. mucilaginosus</i>	90.05	477.26	46.77	23.38
T <sub>14</sub>	<i>Azotobacter</i> + <i>B. megaterium</i> + MgSO <sub>4</sub>	91.05	509.88	49.96	24.98
T <sub>15</sub>	<i>Azotobacter</i> + <i>B. mucilaginosus</i> + MgSO <sub>4</sub>	92.15	525.55	51.50	25.75
T <sub>16</sub>	<i>B. megaterium</i> + <i>B. mucilaginosus</i> + MgSO <sub>4</sub>	93.05	539.69	52.88	26.44
T <sub>17</sub>	<i>Azotobacter</i> + <i>B. megaterium</i> + M. mixture	93.65	561.90	55.06	27.53
T <sub>18</sub>	<i>Azotobacter</i> + <i>B. mucilaginosus</i> + M. mixture	94.10	555.19	54.40	27.20
T <sub>19</sub>	<i>B. megaterium</i> + <i>B. mucilaginosus</i> + M. mixture	95.75	555.35	54.42	27.21
T <sub>20</sub>	<i>Azotobacter</i> + <i>B. megaterium</i> + MgSO <sub>4</sub> + M. mixture	96.55	593.78	58.19	29.09
T <sub>21</sub>	<i>Azotobacter</i> + <i>B. mucilaginosus</i> + MgSO <sub>4</sub> + M. mixture	98.05	614.77	60.24	30.12

T <sub>22</sub>	<i>B. megaterium</i> + <i>B. mucilaginous</i> + MgSO <sub>4</sub> + M. mixture	100.00	627.20	61.46	30.73
<b>S. Em ±</b>		<b>0.86</b>	<b>11.00</b>	<b>0.22</b>	<b>0.58</b>
<b>C D @ 5 %</b>		<b>2.53</b>	<b>31.88</b>	<b>0.65</b>	<b>1.72</b>

Note: \*RDF is constant for all the treatments. \*B=*Bacillus*, M=Micronutrient

**Table 2.** Effect of balanced nutrition and bioinoculants on flower quality parameters of chrysanthemum

	Treatment	Flower Weight (g/flower)	Flower diameter (cm)	Number of petals per flower
T <sub>1</sub>	RDF (control)	5.30	3.95	89.25
T <sub>2</sub>	MgSO <sub>4</sub>	5.55	4.20	94.25
T <sub>3</sub>	Micronutrient mixture	5.45	4.40	99.75
T <sub>4</sub>	MgSO <sub>4</sub> + Micronutrient mixture	5.75	4.55	100.75
T <sub>5</sub>	<i>Azotobacter</i>	5.25	5.10	105.25
T <sub>6</sub>	<i>B. megaterium</i>	5.35	4.96	102.75
T <sub>7</sub>	<i>B. mucilaginous</i>	5.30	4.95	104.90
T <sub>8</sub>	MgSO <sub>4</sub> + <i>Azotobacter</i>	5.65	5.25	106.75
T <sub>9</sub>	MgSO <sub>4</sub> + <i>B. megaterium</i>	5.45	5.45	109.50
T <sub>10</sub>	MgSO <sub>4</sub> + <i>B. mucilaginous</i>	4.90	5.65	111.05
T <sub>11</sub>	M. mixture + <i>Azotobacter</i>	5.05	5.00	113.25
T <sub>12</sub>	M. mixture + <i>B. megaterium</i>	5.05	5.35	109.00
T <sub>13</sub>	M. mixture + <i>B. mucilaginous</i>	5.30	5.84	110.25
T <sub>14</sub>	<i>Azotobacter</i> + <i>B. megaterium</i> + MgSO <sub>4</sub>	5.60	6.10	112.15
T <sub>15</sub>	<i>Azotobacter</i> + <i>B. mucilaginous</i> + MgSO <sub>4</sub>	5.70	5.75	117.00
T <sub>16</sub>	<i>B. megaterium</i> + <i>B. mucilaginous</i> + MgSO <sub>4</sub>	5.80	5.33	119.15
T <sub>17</sub>	<i>Azotobacter</i> + <i>B. megaterium</i> + M. mixture	6.00	6.10	121.00
T <sub>18</sub>	<i>Azotobacter</i> + <i>B. mucilaginous</i> + M. mixture	5.90	6.35	122.50
T <sub>19</sub>	<i>B. megaterium</i> + <i>B. mucilaginous</i> + M. mixture	5.80	6.45	129.80
T <sub>20</sub>	<i>Azotobacter</i> + <i>B. megaterium</i> + MgSO <sub>4</sub> + M. mixture	6.15	6.60	130.00
T <sub>21</sub>	<i>Azotobacter</i> + <i>B. mucilaginous</i> + MgSO <sub>4</sub> + M. mixture	6.27	6.90	131.00
T <sub>22</sub>	<i>B. megaterium</i> + <i>B. mucilaginous</i> + MgSO <sub>4</sub> + M. mixture	6.27	7.25	136.50
<b>S. Em ±</b>		<b>0.04</b>	<b>0.13</b>	<b>0.79</b>
<b>C D @ 5 %</b>		<b>0.12</b>	<b>0.38</b>	<b>2.33</b>

Note: \*RDF is constant for all the treatments. \*B=*Bacillus*, M=Micronutrient

**Table 3.** Effect of balanced nutrition and bioinoculants on flower shelf and vase life of chrysanthemum

	Treatment	Shelf life (days)	Vase life (days)
T <sub>1</sub>	RDF (control)	6.00	7.25
T <sub>2</sub>	MgSO <sub>4</sub>	6.25	8.30
T <sub>3</sub>	Micronutrient mixture	6.75	9.10
T <sub>4</sub>	MgSO <sub>4</sub> + Micronutrient mixture	7.30	10.05
T <sub>5</sub>	<i>Azotobacter</i>	7.90	12.00
T <sub>6</sub>	<i>B. megaterium</i>	8.18	10.00
T <sub>7</sub>	<i>B. mucilaginous</i>	8.40	9.25
T <sub>8</sub>	MgSO <sub>4</sub> + <i>Azotobacter</i>	7.60	11.25
T <sub>9</sub>	MgSO <sub>4</sub> + <i>B. megaterium</i>	7.85	10.95
T <sub>10</sub>	MgSO <sub>4</sub> + <i>B. mucilaginous</i>	8.70	12.15
T <sub>11</sub>	M. mixture + <i>Azotobacter</i>	8.90	12.70
T <sub>12</sub>	M. mixture + <i>B. megaterium</i>	9.20	13.20
T <sub>13</sub>	M. mixture + <i>B. mucilaginous</i>	8.10	14.00
T <sub>14</sub>	<i>Azotobacter</i> + <i>B. megaterium</i> + MgSO <sub>4</sub>	9.40	12.75
T <sub>15</sub>	<i>Azotobacter</i> + <i>B. mucilaginous</i> + MgSO <sub>4</sub>	9.65	13.45
T <sub>16</sub>	<i>B. megaterium</i> + <i>B. mucilaginous</i> + MgSO <sub>4</sub>	10.15	14.25
T <sub>17</sub>	<i>Azotobacter</i> + <i>B. megaterium</i> + M. mixture	10.75	15.00
T <sub>18</sub>	<i>Azotobacter</i> + <i>B. mucilaginous</i> + M. mixture	11.65	16.00
T <sub>19</sub>	<i>B. megaterium</i> + <i>B. mucilaginous</i> + M. mixture	12.80	17.00
T <sub>20</sub>	<i>Azotobacter</i> + <i>B. megaterium</i> + MgSO <sub>4</sub> + M. mixture	13.75	18.25

T <sub>21</sub>	<i>Azotobacter</i> + <i>B. mucilaginosa</i> + MgSO <sub>4</sub> + M. mixture	14.40	20.05
T <sub>22</sub>	<i>B. megaterium</i> + <i>B. mucilaginosa</i> + MgSO <sub>4</sub> + M. mixture	15.25	22.00
S. Em ±		<b>0.18</b>	<b>0.38</b>
C D @ 5 %		<b>0.53</b>	<b>1.12</b>

Note: \*RDF is constant for all the treatments. \*B=*Bacillus*, M=Micronutrient

## REFERENCES

- Bosali, M., Kumar, P.A. and Kumar, S.** (2014). Impact of integrated nutrient management on post-harvest and corm characters of gladiolus cv. Novalux. *Ann. Hort.* 7 (2) : 109-114.
- Thumar, B.V., Barad, A.V., Neelima, P. and Nilima, B.** (2014). Effect of integrated system of plant nutrition management on growth, yield and flower quality of African marigold (*Tagetes erecta* L.) cv. Pusa Narangi. *The Asian J. Hort.* 8 (2) : 466-469.
- Jadhav, P.B., Singh, A., Mangave, B.D., Patil, N.B., Patel, D.J., Dekhane, S.S. and Kireeti, A.** (2014). Effect of organic and inorganic fertilizers on growth and yield of African marigold (*Tagetes erecta* L.) cv. Pusa Basanti Gaiinda. *Ann. Biol. Res.* 5 (9) : 10-14.
- Patanwar, M., Sharma, G., Banjare, C., Chandravanshi, D. and Sahu, E.** (2014). Growth and development of chrysanthemum (*Dendranthem grandifloratzvelev*) as influenced by integrated nutrient management. *An Int. J. Environ. Sci.* 4 : 459-462.
- Kirar, K.P.S., Lekhi, R., Sharma, S. and Sharma, R.** (2014). Effect of integrated nutrient management practices on growth and flower yield of china aster [*Callistephus chinensis* (L.) Ness] cv. Princess. Excellent Publishing House, pp. 234-237.
- Sheergojri, G.A., Neelofar, Rather, Z.A., Khan, F.U., Nazki, I.T. and Qadri, Z.A.** (2013). Effect of chemical fertilization and bio-inoculants on growth and flowering of dahlia (*Dahlia variabilis* Desf.) cv. 'Pink Attraction'. *Appl. Biol. Res.* 15 (2) : 121-129.
- Panchal, R.V., Parekh, N.S., Parmar, A.B. and Patel, H.C.** (2010). Effect of biofertilizers and nitrogenous fertilizers on growth, flowering and yield of white chrysanthemum (*Chrysanthemum coronarium* L.) under middle Gujarat agro climatic condition. *The Asian J. Hort.* 5 (1) : 22-25.
- Swaroop, K.** (2011). Influence of biofertilizers on growth and productivity of flower and seed yield of Marigold cv. Pusa Narangi Gaiinda. *J. Orn. Hort.* 14 (3&4) : 45-48.
- Bhatia, S. and Gupta, Y.C.** (2007). Studies on use of bio-fertilizers in carnation (*Dianthus caryophyllus* Linn.) flower production. *J. Orn. Hort.* 10 (2) : 131-132.