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

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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_{22}) *Bacillus megaterium* + *Bacillus mucilaginosus*+ $MgSO_4$ +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*+ $MgSO_4$ + Micronutrient mixture and *Azotobacter* + *Bacillus megaterium*+ $MgSO_4$ +Micronutrient mixture over the control(RDF) respectively.

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.

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MATERIALS AND METHODS

An experiment was conducted under outdoor condition during 2015-16 at College of Horticulture, Mudigere, Chikkamagaluru, and Karnataka (India). Rooted terminal cuttings –of mum var. Kolar local used for planting on ridges and furrows in plot plot size of 5m x 4m with spacing 45 x 45cm (98 plants/plot).The experiment was laid out with RCBD. There were 22 treatments viz., T1 – Control (RDF-Check), T2 – MgSO4, T3 – Micronutrient mixture, T4 – MgSO4 + Micronutrient mixture, T5 – Azotobacter, T6 – Bacillus megaterium, T7 – Bacillus mucilaginosus, T8 – MgSO4 + Azotobacter, T9 – MgSO4 + Bacillus megaterium, T10 – MgSO4+Bacillus mucilaginosus, T11 – Micronutrient mixture+ Azotobacter, T12 – Micronutrient mixture + Bacillus megaterium, T13 – Micronutrient mixture + Bacillus mucilaginosus, T14 –Azotobacter + Bacillus megaterium + MgSO4, T15 – Azotobacter + Bacillus mucilaginosus+ MgSO4, T16 – Bacillus megaterium +Bacillus mucilaginosus+ MgSO4, T17 – Azotobacter + Bacillus megaterium+ Micronutrient mixture, T18 – Azotobacter + Bacillus mucilaginosus+ Micronutrient mixture, T19 – Bacillus megaterium + Bacillus mucilaginosus+ Micronutrient mixture, T20 – Azotobacter + Bacillus megaterium,+ MgSO4 +Micronutrient mixture, T21 – Azotobacter + Bacillus

mucilaginosus+ MgSO4 + Micronutrient mixture, T22 – Bacillus megaterium + Bacillus mucilaginosus+ MgSO4 +Micronutrient mixture and replicated twice.These bioinoculants were applied along with secondary nutrient ($MgSO_4$), Micronutrient mixture with RDF. At the time of transplanting the rooted cuttings were dipped in bioinoculant solution according to treatments and after 30 DAP bioinoulants with $MgSO_4$, 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.

RESULTS AND DISCUSSION

The different bioinoculants with $MgSO_4$ 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 per hectare (30.73 t/ha) followed by T_{21}, T_{20} and T_{19}, respectively and these treatments were found on par with each other. However, T_1 with un-inoculated control (RDF) recorded minimum alone (Table 1). The other treatments were also found statistically significant over the control for all the parameters. The possible reason for better performance of yield attributes and higher

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_1	RDF (control)	62.50	331.25	32.46	16.23
T_2	$MgSO_4$	70.85	393.21	38.53	19.26
T_3	Micronutrient mixture	74.25	404.66	39.65	19.82
T_4	$MgSO_4$ + Micronutrient mixture	76.25	438.43	42.96	21.48
T_5	*Azotobacter*	78.50	412.12	40.38	20.19
T_6	*B. megaterium*	80.15	428.80	42.02	21.01
T_7	*B. mucilaginous*	82.15	435.39	42.66	21.33
T_8	$MgSO_4$ + *Azotobacter*	79.10	446.91	43.79	21.89
T_9	$MgSO_4$ + *B. megaterium*	85.35	465.15	45.58	22.79
T_{10}	$MgSO_4$ + *B. mucilaginous*	93.55	458.39	44.92	22.60
T_{11}	M. mixture + *Azotobacter*	94.50	477.22	46.76	23.38
T_{12}	M. mixture + *B. megaterium*	89.15	450.20	44.11	22.05
T_{13}	M. mixture + *B. mucilaginous*	90.05	477.26	46.77	23.38
T_{14}	*Azotobacter* + *B. megaterium* + $MgSO_4$	91.05	509.88	49.96	24.98
T_{15}	*Azotobacter* + *B. mucilaginous* + $MgSO_4$	92.15	525.55	51.50	25.75
T_{16}	*B. megaterium* + *B. mucilaginous* + $MgSO_4$	93.05	539.69	52.88	26.44
T_{17}	*Azotobacter* + *B. megaterium* + M. mixture	93.65	561.90	55.06	27.53
T_{18}	*Azotobacter* + *B. mucilaginous* + M. mixture	94.10	555.19	54.40	27.20
T_{19}	*B. megaterium* + *B. mucilaginous* + M. mixture	95.75	555.35	54.42	27.21
T_{20}	*Azotobacter* + *B. megaterium* + $MgSO_4$ + M. mixture	96.55	593.78	58.19	29.09
T_{21}	*Azotobacter* + *B. mucilaginous* + $MgSO_4$+ M. mixture	98.05	614.77	60.24	30.12
T_{22}	*B. megaterium* + *B. mucilaginous* + $MgSO_4$+ M. mixture	100.00	627.20	61.46	30.73
	S. Em ±	0.86	11.00	0.22	0.58
	C D @ 5 %	2.53	31.88	0.65	1.72

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_1	RDF (control)	5.30	3.95	89.25
T_2	$MgSO_4$	5.55	4.20	94.25
T_3	Micronutrient mixture	5.45	4.40	99.75
T_4	$MgSO_4$ + Micronutrient mixture	5.75	4.55	100.75
T_5	*Azotobacter*	5.25	5.10	105.25
T_6	*B. megaterium*	5.35	4.96	102.75
T_7	*B. mucilaginous*	5.30	4.95	104.90
T_8	$MgSO_4$ + *Azotobacter*	5.65	5.25	106.75
T_9	$MgSO_4$ + *B. megaterium*	5.45	5.45	109.50
T_{10}	$MgSO_4$ + *B. mucilaginous*	4.90	5.65	111.05
T_{11}	M. mixture + *Azotobacter*	5.05	5.00	113.25
T_{12}	M. mixture + *B. megaterium*	5.05	5.35	109.00
T_{13}	M. mixture + *B. mucilaginous*	5.30	5.84	110.25
T_{14}	*Azotobacter* + *B. megaterium* + $MgSO_4$	5.60	6.10	112.15
T_{15}	*Azotobacter* + *B. mucilaginous* + $MgSO_4$	5.70	5.75	117.00
T_{16}	*B. megaterium* + *B. mucilaginous* + $MgSO_4$	5.80	5.33	119.15
T_{17}	*Azotobacter* + *B. megaterium* + M. mixture	6.00	6.10	121.00
T_{18}	*Azotobacter* + *B. mucilaginous* + M. mixture	5.90	6.35	122.50
T_{19}	*B. megaterium* + *B. mucilaginous* + M. mixture	5.80	6.45	129.80
T_{20}	*Azotobacter* + *B. megaterium* + $MgSO_4$ + M. mixture	6.15	6.60	130.00
T_{21}	*Azotobacter* + *B. mucilaginous* + $MgSO_4$+ M. mixture	6.27	6.90	131.00
T_{22}	*B. megaterium* + *B. mucilaginous* + $MgSO_4$+ M. mixture	6.27	7.25	136.50
	S. Em ±	0.04	0.13	0.79
	C D @ 5 %	0.12	0.38	2.33

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_1	RDF (control)	6.00	7.25
T_2	$MgSO_4$	6.25	8.30
T_3	Micronutrient mixture	6.75	9.10
T_4	$MgSO_4$ + Micronutrient mixture	7.30	10.05
T_5	*Azotobacter*	7.90	12.00
T_6	*B. megaterium*	8.18	10.00
T_7	*B. mucilaginous*	8.40	9.25
T_8	$MgSO_4$ + *Azotobacter*	7.60	11.25
T_9	$MgSO_4$ + *B. megaterium*	7.85	10.95
T_{10}	$MgSO_4$ + *B. mucilaginous*	8.70	12.15
T_{11}	M. mixture + *Azotobacter*	8.90	12.70
T_{12}	M. mixture + *B. megaterium*	9.20	13.20
T_{13}	M. mixture + *B. mucilaginous*	8.10	14.00
T_{14}	*Azotobacter* + *B. megaterium* + $MgSO_4$	9.40	12.75
T_{15}	*Azotobacter* + *B. mucilaginous* + $MgSO_4$	9.65	13.45
T_{16}	*B. megaterium* + *B. mucilaginous* + $MgSO_4$	10.15	14.25
T_{17}	*Azotobacter* + *B. megaterium* + M. mixture	10.75	15.00
T_{18}	*Azotobacter* + *B. mucilaginous* + M. mixture	11.65	16.00
T_{19}	*B. megaterium* + *B. mucilaginous* + M. mixture	12.80	17.00
T_{20}	*Azotobacter* + *B. megaterium* + $MgSO_4$ + M. mixture	13.75	18.25
T_{21}	*Azotobacter* + *B. mucilaginous* + $MgSO_4$+ M. mixture	14.40	20.05
T_{22}	*B. megaterium* + *B. mucilaginous* + $MgSO_4$+ M. mixture	15.25	22.00
	S. Em ±	0.18	0.38
	C D @ 5 %	0.53	1.12

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

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*. (2014). Moreover, presence of growth promoting substances such as auxin, gibberllins 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*. (2014) and Jadhav *et al*. (2014) in marigold, Patanwar *et al*. (2014) in chrysanthemum, Kirar *et al*. (2014) in china aster and Sheergojri *et al*. (2013) in gladiolus. And (T_{22}) *Bacillus megaterium* + *Bacillus mucilaginosus* + $MgSO_4$ + 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 $T_{21,}$ T_{20} and T_{19}, respectively and these treatments were found on par with each other. However, T_1 with un-inoculated control (RDF) recorded minimum (Table 2). The other treatments were also found statistically significant over the control for all the parameters.

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*. (2010) and (2011) also confirms these findings in marigold. And (T_{22}) *Bacillus megaterium* + *Bacillus mucilaginosus* + $MgSO_4$ + Micronutrient mixture showed the maximum shelf life (15.25 days) and vase life(22 days) followed by $T_{21,}$ T_{20} and T_{19}, respectively and these treatments were found on par with each other. However, T_1 with un-inoculated control (RDF) recorded minimum (Table 3).

The other treatments were also found statistically significant over the control for all the parameters. 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 (2007) in gerbera.

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