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Effect of liquid bio-inoculants and fertilizer levels on growth and yield of African marigold (*Tagetes erecta* L.) cv. Calcutta

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Abstract

The present investigation on effect of liquid bio-inoculants and fertilizer levels on growth and yield of African marigold (*Tagetes erecta* L.) cv. Calcutta was carried out at Experimental Farm, Department of Horticulture, VNMKV, Parbhani during 2017-18. The experiment was laid out in Factorial Randomized Block Design with twelve treatments comprising of four levels of RDF (60%, 80%, 100% and 120%) and bio-inoculants viz., Azotobacter, PSB and Azotophos. The results revealed that the vigorous growth in terms of plant height (65.66 cm) number of branches per plant (15.00), number of leaves per plant (276.67), plant spread (54.66 cm²) and maximum flowering duration (100.00) was noted significantly in plants treated with 120% RDF+Azotophos. However, minimum days for first flower bud initiation (50.00) minimum days for flowering (58.00) and maximum yield per hectare (15.56 t) were recorded by plants treated with 120% RDF + PSB. Bio-fertilizers along with chemical fertilizers found beneficial for vigorous growth and better yield of plant in African marigold.

Keywords: Bio-inoculants, Azotobacter, phosphate solubilizing bacteria

Introduction

Marigold (*Tagetes erecta* L.) is one of the most hardy flower crops grown commercially in different parts of world. In, India it is one of the most commonly grown flower and used most extensively in religious and social functions in different forms. It has gained popularity among the gardeners and flower dealers on account of its easy culture and wider adaptability. It is an established fact that nutrition plays an important role in the improvement of growth and development of marigold. Now a days a lot of emphasis is being paid on the use of bio-fertilizers to increase the production of crops. Bio-fertilizers usually contain live or latent cells of microorganisms which includes N fixers, P-solubilizing, mineralization of N and transformation of several elements into available forms. Bio-fertilizers are the new cost effective renewable source of plant nutrients. The use of bio-fertilizers like Azotobacter, Phosphate Solubilizing Bacteria (PSB) along with doses of chemical fertilizers is a recent attempt for increasing the growth and yield of different crops. Hence, present investigation was undertaken to study the effect of different levels of RDF and bio-inoculants on growth and yield of marigold.

Materials and Methods

The experiment was conducted at Experimental Farm, Department of Horticulture, VNMKV, Parbhani during the year 2017-18. The experiment was laid out in Factorial Randomized Block Design with 12 treatment combinations, replicated thrice. The treatment details are as under:

- T1 60% RDF + Azotobacter (1liter/acre)
- T2 80% RDF + Azotobacter (1liter/acre)
- T3 100% RDF + Azotobacter (1liter/acre)
- T4 120% RDF + Azotobacter (1liter/acre)
- T5 60% RDF + PSB (1liter/acre)
- T6 80% RDF + PSB (1liter/acre)
- T7 100% RDF + PSB (1liter/acre)
- T8 120 % RDF + PSB (1liter/acre)
- T9 60% RDF + Azotophos (1liter/acre)

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T₁₀ 80% RDF + Azotophos (1liter/acre)
 T₁₁ 100% RDF + Azotophos (1liter/acre)
 T₁₂ 120% RDF + Azotophos (1liter/acre)

Results and Discussion

Growth Parameters

Growth characters differed significantly for the various levels of NPK and bio-fertilizers. Table 1 shows that, maximum plant height (65.66 cm), number of branches per plant (15.00), number of leaves per plant (276.67) and plant spread (54.66 cm²) were recorded with the application of 120% RDF of NPK + Azotophos, while the minimum plant height (57.00 cm), number of branches per plant (10.00) were recorded with application of 80% RDF + Azotophos. Also minimum number of leaves (251.33) and plant spread (49.66 cm²) were observed in plants treated with 60% RDF + Azotobacter. The positive effect of nutrients supplied through NPK fertilizers on vegetative growth parameters could be described to its effectiveness in providing a balanced nutritional environment favorable both in soil rhizosphere and plant system (Baboo and Singh 2003). Azotobacter and PSB in combined inoculation mutually benefited each other by supplying essential nutrients for their proper activity. Hence, their combined inoculation in this experiment produced better effect on growth parameters in marigold. These findings are in conformity with Panchal *et al.* (2010), Kaushik *et al.* (2013) [13], Ali *et al.* (2014) [1] and Rolaniya *et al.* (2017).

Flowering and yield parameters

Yield characters also differed significantly for various levels of NPK and bio-inoculants. Table 2 shows that, minimum

days taken to appearance of first flower bud initiation (50.00), minimum days taken for first flower appearance (58.00), maximum flower diameter (7.00 cm) and maximum yield per ha (15.56 tones) were recorded with 120% RDF of NPK + PSB.

Maximum flowering duration observed in plants treated with 120% RDF of NPK +Azotophos, whereas, maximum days taken to first flower bud initiation (57.00), maximum days for flowering (65.00), minimum flower diameter (5.30 cm), minimum flowering duration (79.00) and minimum flower yield per ha observed in plants treated with 60% RDF of NPK + Azotobacter.

The positive effect of nutrients supplied through NPK fertilizers and inoculation of bio-fertilizers on flowering behavior might be ascribed the fact that nitrogen accelerate the development of reproductive phases, increases the protein synthesis and hence promotes the earlier floral primordial development in marigold (Acharya and Dashora 2004). Phosphorus is the component of many energy rich compounds in plant and also increases entire root growth and helps in uptake of other nutrients resulting in increase in yield (Singh *et al.* 2015). Potassium increases the rate of photosynthesis and mobilization of sucrose to the shoots which have positive influence on flower initiation. Azotobacter and PSB are reported to produce growth promoting substances and other acids like acetic, formic, glycolic, fumaric and succinic, which were positively correlated with growth and flowering and helps in branching and development of side buds thus increased early flowering. These findings are in accordance with Mittal *et al.* (2010) and Rolaniya *et al.* (2017).

Table 1: Effect of fertilizer doses and bio-inoculants on growth parameters of African marigold

Treatments	Plant height (cm)	Number of branches plant ⁻¹	Number of leaves plant ⁻¹	Plant spread (cm ²)
T ₁ 60% RDF +Azotobacter	56.33	10.66	251.33	49.66
T ₂ 80% RDF + Azotobacter	58.00	11.66	252.00	52.00
T ₃ 100% RDF + Azotobacter	56.33	11.00	264.67	53.00
T ₄ 120% RDF + Azotobacter	60.66	14.00	269.00	53.00
T ₅ 60% RDF + PSB	56.66	11.00	252.33	50.66
T ₆ 80% RDF + PSB	59.33	10.00	257.67	50.00
T ₇ 100% RDF + PSB	57.66	13.00	266.67	54.66
T ₈ 120% RDF + PSB	62.66	15.00	272.67	52.66
T ₉ 60% RDF + Azotophos	57.00	12.00	253.33	50.00
T ₁₀ 80% RDF + Azotophos	57.00	10.00	261.33	51.00
T ₁₁ 100% RDF + Azotophos	59.00	12.00	265.67	51.00
T ₁₂ 120% RDF + Azotophos	65.66	15.00	276.67	54.66
SE _±	4.9	0.16	0.33	0.21
CD at 5% level	14.57	0.48	0.97	0.61

Table 2: Effect of fertilizer doses and bio-inoculants on flower and yield parameters on African marigold

Treatments	Days for first flower bud initiation	Days for flowering	Flowering duration	Yield hectare ⁻¹ (tones)	Flower diameter (cm)
T ₁ 60% RDF +Azotobacter	57.00	65.00	79.00	13.45	5.30
T ₂ 80% RDF + Azotobacter	56.33	63.00	86.00	13.84	6.29
T ₃ 100% RDF +Azotobacter	55.00	62.33	87.66	14.72	6.56
T ₄ 120% RDF + Azotobacter	53.00	60.00	89.00	15.02	6.60
T ₅ 60% RDF + PSB	57.00	64.00	83.66	13.75	5.50
T ₆ 80% RDF + PSB	56.33	64.33	80.00	13.73	6.00
T ₇ 100% RDF + PSB	53.33	62.00	89.66	14.74	6.66
T ₈ 120% RDF + PSB	50.00	58.00	95.66	15.56	7.00
T ₉ 60% RDF + Azotophos	56.00	64.00	85.66	13.86	5.86
T ₁₀ 80% RDF + Azotophos	55.00	63.00	84.00	14.38	6.30
T ₁₁ 100% RDF + Azotophos	54.00	63.00	85.00	14.40	6.16
T ₁₂ 120% RDF + Azotophos	52.33	60.66	100.00	15.40	6.90
SE _±	0.19	0.17	0.21	0.13	0.18
CD at 5% level	0.56	0.50	0.63	0.40	0.54

Conclusion

On the basis of results obtained in present investigation, it may be concluded that, application of chemical fertilizers along with bio-inoculants enhanced the growth and flower yield in African marigold. A comparison of various treatments taken for study revealed that, application of 120% RDF of NPK + Azotophos registered a significantly higher values of growth and flower yield in marigold.

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