



# EFFECT OF VAM AND AZOTOBACTER ON GROWTH AND YIELD CHARACTERS OF AFRICAN MARIGOLD (*TAGETES ERECTA* LINN.) CV. POORNIMA YELLOW

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## Abstract

An experiment was carried out to study the “Effect of VAM and Azotobacter on growth and yield characters of African marigold (*Tagetes erecta* Linn.) cv. Poornima yellow” in the Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai nagar. This experiment was laid out with seven treatments and three replications in a randomized block design. The effect of treatment combination were studied based on their influence on plant height, number of primary branches, number of flowers per plant, flower diameter, individual flower weight, flower yield. Result revealed that among the seven treatment combinations performance of plants treated with treatment T<sub>2</sub> (RDF 50% NPK/ha+ VAM 2.5kg/ha+ *Azotobacter* 1kg/ha) plants showed the greatest plant height (65.3cm). Whereas plants treated with T<sub>4</sub> (RDF 75% NPK/ha + VAM 5kg/ha+ *Azotobacter* 1.5kg/ha) were superior in other characters such as number of primary branches (15), number of flowers per plant (19), flower weight (1.47 g), flower diameter (10.4) and flower yield (t). It is concluded that plants treated with T<sub>4</sub> (RDF 75% NPK/ha + VAM 5kg/ha+ *Azotobacter* 1.5kg/ha) were found to have strong synergistic effect on all parameters.

**Key words:** Azotobacter, yield character, African marigold.

## Introduction

African marigold (*Tagetes erecta* L.) belongs to family Asteraceae or Compositae and is a popular flower crop grown in India on commercial scale. Therefore, there is a strong need to boost the production of this flower crop. Plant of marigold species vary in height from 0.1 to 2.2m. Most species have pinnate green leaves, blooms naturally occur in golden, orange, yellow and white colors, often with maroon highlights. Among the different marigold species *Tagetes erecta* L. (African Marigold) is a major flower producing species which is grown throughout India and produces good quality flowers. It is grown on small farms all over the country under open field condition, for centuries. A large number of African marigold varieties are grown successfully throughout India. African marigold is majorly grow in Madhya Pradesh and Karnataka. In Tamil Nadu area of production of African marigold is 1,502 ha.

*Azotobacter*, a free living heterotrophic nitrogen fixing bacterium, belongs to the family Azotobacteriaceae. *Azotobacter* species are found in soil, water, rhizosphere etc. It is a gram-negative motile soil organism and can be isolated and cultured ex-situ conveniently. It is larger

compared to other prokaryotes (4-7 pm in diameter) and has yeast like in appearance. *Azotobacter* grows best in neutral to alkaline soil, but does not grow when the pH is below 6 and hence not present in acidic soil. It forms cysts that serve as resting bodies. Vesicular Arbuscular mycorrhizal (VAM) have the ability to form symbiotic association with plants that benefit both partners through acquisition and absorption of nutrient especially phosphorus from the soil. VAM interact with other soil microbes like free nitrogen fixer and helps in the biochemical cycling of elements to the host plants. (Barea *et al.*, 2011).

The combined application of PSB, *Azotobacter* and FYM along with nitrogen and phosphorus has been proved to be beneficial for robust growth of plants. This might be due to nitrogen and phosphorus fertilization in combination of bio inoculants (*Azotobacter* and PSB) and FYM proved to be beneficial to fix the atmospheric nitrogen and solubilize fixed phosphorus in soil and also secrete growth substances like auxins, which stimulated the plant metabolic activities and photosynthetic efficacy leading better growth and development of plant. (N.C. Pushkar *et al.*, 2008). In this study, an attempt was made

to visualize the combined effect of *Azotobacter* and VAM on the productivity and flower quality of African marigold flower.

### Materials and Methods

The present investigation entitled “Effect of VAM and Azotobacter on growth and yield of African marigold (*Tagetes erecta* linn.) cv. Poornima yellow” was carried at Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai nagar. The experiment was laid out in randomized block design with a plant spacing of about 60 × 45cm. The treatment combination used in this study are (T<sub>1</sub>) RDF50% NPK/ha+VAM 2.5kg/ha + Azotobacter 1kg/ha,(T<sub>2</sub>) RDF50%NPK/ha+VAM 2.5kg/ha + Azotobacter 1.5kg/ha, (T<sub>3</sub>) RDF 75% NPK/ha +VAM 5kg/ha +Azotobacter 1 kg/ha, (T<sub>4</sub>) RDF 75% NPK/ha +VAM 5 kg/ha + Azotobacter 1.5 kg/ha, (T<sub>5</sub>) RDF100% NPK/ha +VAM 10 kg/ha + Azotobacter 1 kg/ha, (T<sub>6</sub>) RDF100% NPK/ha+ VAM 10 kg/ha +Azotobacter 1.5 kg/ha,( T<sub>7</sub>) Control. Three replications were maintained for each treatment.

The seedlings of African marigold were raised in nursery beds. The experimental area was ploughed twice with the help of tractor drawn implements in both directions and harrowing was done to break the clods. The field was leveled and divided into plots of 4.7 sq.m, channels and bunds. The recommended dose of well decomposed farm yard manure as mentioned in the treatment details were applied as basal dose to different plots. Along with FYM the fixed quantities of VAM and azotobacter was also given as basal dose. 30 days old uniform healthy seedlings of Poornima yellow were transplanted at a distance of 60 × 45 cm singly in experimental plots .Gap filling was done after 5 days of planting to replace the damaged ones just to maintain uniform crop stand in all the plots. Irrigation was given at 10 days interval depending upon the soil moisture conditions. To make critical analysis of crop performance as affected by different treatments five plants were tagged by random method in each plot.

The observation on vegetative characters such as plant height, number of primary branches, number of flowers per plant, flower diameter, individual flower weight were recorded at 30<sup>th</sup>,45<sup>th</sup> and 60<sup>th</sup> days after transplanting. Flower yield were calculated at weekly intervals. The data on various parameters were analyzed statistically as per the procedure suggested by Panse and Sukhatme (1978).

### Results and Discussion

The various doses of VAM and Azotobacter along

with recommended dose of fertilizers significantly increased the plant growth and yield of African marigold. The data on the growth parameter as per (T<sub>1</sub>) and yield revealed that maximum plant height as observed in (T<sub>2</sub>) RDF50%NPK/ha+VAM2.5kg/ha+azotobacter1kg/ha recorded the highest plant height (65.3cm). While control recorded the lowest plant height (46.3cm). Similar increase in plant height a obtained by in marigold by Chandrikapure *et al.*, (1999). Pushkar *et al.*, (2008) also recorded in their studies in marigold that plant height as increased due to application of VAM.

The data on the number of primary branches showed significant variance in number of branches as influenced by biofertilizer. Maximum number of primary branches was observed in plants treated under T<sub>4</sub> (15). Least number of branches were observed in control (10). Bhaskaran *et al.*, (2002) also observed similar increase in primary branches influenced by application of azotobacter.

The data on the number of flowers per plant revealed that maximum number of flowers were observed in plants treated under T<sub>4</sub> (19). Least number of flowers were recorded in control. Pushkar and Rathore (2011) also reported an increase in number of flowers due to application of VAM . The results were in line with the above findings. Similar results were also observed by Mittal *et al.*, (2010) in his studies on growth and yield of African marigold (*Tagetes erecta* L.).

The results on the individual flower weight showed that among the different treatments increased weight as recorded in T<sub>4</sub> plants ( 14.9) followed by T<sub>6</sub> plants . The lowest weight of individual flowers were observed in T<sub>7</sub>. Thumar *et al.*, (2013) in his studies on marigold that flower quality has been increased due to application of Azotobacter . Kumari *et al.*, (2013) also reported similar results in his studies on African marigold. The data on the flower diameter recorded that maximum diameter was observed in plants treated under T<sub>4</sub> (9.2) followed by T<sub>3</sub> (9.0). Lowest flower diameter is observed in control. Similar results was recorded by Zaredost *et al.*, (2014) in studies that flowers quality of marigold is improved by application of biofertilizers.

The data on the flower yield shows that among the seven treatments highest flower yield was obtained in plants treated under T<sub>4</sub> (5.88 kg/plot) and the total yield (12 t/ha). The plot yield was observed in T<sub>7</sub>. This reveals that application of biofertilizers has significantly increased the flower yield. The results found were in accordance with Gupta *et al.*, (1999) in his studies on marigold that application of bio inoculants has significantly increased

**Table 1:** Effect of VAM and Azotobacter on growth and yield characters of African marigold (*Tagetes erecta* L.).

| Treatment  | Plant height (cm) | Number of primary branches | Number of flowers per plant | Flower weight (g) | Flower diameter (cm) | Yield (kg) |
|--|-------------------|----------------------------|-----------------------------|-------------------|----------------------|------------|
| T <sub>1</sub> (RDF50 % NPK/ha+VAM 2.5kg/ha +Azotobacter 1kg/ha)     | 54.7              | 11.6                       | 11.3                        | 11.1              | 9.0                  | 375        |
| T <sub>2</sub> (RDF50%NPK/ha+VAM 2.5kg/ha +Azotobacter 1.5kg/ha)     | 65.3              | 11.6                       | 14.3                        | 11.3              | 9.1                  | 375        |
| T <sub>3</sub> (RDF75% NPK/ha +VAM 5 kg/ha +Azotobacter 1 kg/ha)     | 52.1              | 11.7                       | 16.3                        | 13.5              | 9.3                  | 461        |
| T <sub>4</sub> (RDF 75% NPK/ha +VAM 5 kg/ha + Azotobacter 1.5 kg/ha) | 59.5              | 15                         | 19                          | 14.7              | 9.4                  | 487.6      |
| T <sub>5</sub> (RDF100% NPK/ha +VAM 10 kg/ha + Azotobacter 1 kg/ha)  | 48.5              | 11.0                       | 15                          | 13.8              | 8.5                  | 478.6      |
| T <sub>6</sub> (RDF100% NPK/ha+VAM10 kg/ha +Azotobacter 1.5 kg/ha)   | 53.2              | 10.2                       | 14                          | 14.0              | 8.7                  | 481.0      |
| T <sub>7</sub> Control   | 46.3              | 10.1                       | 11                          | 11.0              | 8.0                  | 322        |
| Grand mean   | 54.2              | 11.6                       | 12.1                        | 12.8              | 8.8                  | 425.7      |
| S.Ed   | 1.3               | 1.3                        | 1.42                        | 0.35              | 2.96                 | 8.8        |

the yield of African marigold.

The combined application of VAM, *Azotobacter* and FYM along with nitrogen and phosphorus has been proved to be beneficial for robust growth and enhanced flower yield and quality. This might be due to nitrogen and phosphorus fertilization in combination of bio inoculants (*Azotobacter* and VAM) and FYM proved to be beneficial to fix the atmospheric nitrogen and solubilize fixed phosphorus in soil and also secrete growth substances like auxins, which stimulated the plant metabolic activities and photosynthetic efficacy leading better growth and development of plant (N.C. Pushkar *et al.*, 2008). The present investigation indicates that the application of biofertilizers in the combination of RDF 75% NPK/ha+VAM 5KG/ha+*Azotobacter* 1.5kg/ha increased the growth and yield parameters in African marigold (*Tagetes erecta* L.).

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