RESEARCH ARTICLE

# EFFECT OF ORGANIC AND INTEGRATED SOURCES OF NUTRIENT ON GROWTH AND FLOWERING OF FRENCH MARIGOLD (*TAGETES PATULA* L.) UNDER NORTH WESTERN PLAIN ZONE OF UTTER PRADESH


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**Abstract:** An experiment was conducted at Horticultural Research Canter, Sardar Vallabhbhai Patel University of Agriculture &Technology, Meerut, Uttar Pradesh, India during 2019-2020, to evaluate the performance of French Marigold var. 'Pusa Arpita' with organic and integrated sources of nutrients. The results revealed that maximum plant height(57.47 cm), diameter of stem(18.21 mm), number of primary branches per plant ( 21.96), number of flowers per plant(143.89), spread of plant (41.17 cm), circumference of flower (12.64cm), minimum days took to first flowering (41.39 days), maximum number of flowers per plant (38.56), flower yield per plant(133.58g), flower yield per plot (5.98 kg), yield of flower per ha (402.09q), flowering duration (60.68 days), number of florets per flower (136.55), length of flower stalk (6.44cm) and vase life of flowers(7.47days) were recorded with half recommended dose of 150:60:60 kg/ha(N:P:K) with half dose of PSB and half dose of vermicompost which was significantly superior to the other treatments and control



**Keywords**: PSB, Vermicompost, RDF, NPK


## INTRODUCTION

Marigold (*Tagetes patula* L.) is commonly used for loose flowers in India, because of its easy cultivation, adaptability to varying soil and climatic conditions with long duration of flowering and excellent keeping quality. Marigold is most popular and commercial flower in India. Marigold is originated from South America and belongs to the family Compositeae or Asteraceae. Flowers of marigold are extensively used for decoration in various religious and social function, beautification of garden and for other commercial purposes like extraction of perfume. Marigold is known as different name indifferent region i.e., friendship flower in United States, student enablement (student flower) in Germany, dead flower in Latin America and Shayapatri in Nepal. Marigolds utilize as cut flower for vase decoration and other arrangement besides loose flower for making garlands, decoration of buildings, gates, pandals during social functions, marriage ceremonies, worships and rangoli. The main reason for marigold popularity, because of its wide climatic adaptability and can be grown round the year. The main growing period for marigold in plains is winter season (August-January). It can be cultivated in other season like spring (November-April) summer season (February-July) and rainy season (May-October).The major source of pigment in marigold plant is xanthophyll particularly lutein and extracted from petals. The marigold flower extract is considered as blood purifier, a cure of bleeding piles and is a decent solution for eye infection, and ulcers (Bose and Yadav, 1993). To take proper growth and development, nutrients play an important role for growth and flower yield of marigold. The use of organic manure and bio fertilizers along with the balanced use of chemical fertilizers is known for improving physico-chemical and biotic properties of soil, besides improving the efficiency of applied fertilizers. The integrated source of nutrients approaches not only for improving the quality of the produce but, also the helping to maintain the soil fertility (Kumar and Chaudhary, 2018). Organic manures like F.Y.M., Vermicompost, are extremely popular among the farmers because of its eco-friendly nature and simply availability. These products are helpful in minimizing the environmental hazards and increase of soil fertility. Vermicompost is an excellent soil conditioning agent. Incorporation of vermicompost in soil improves the texture, structure, permeability, and water holding capacity of soil. Bio-fertilizers play an important role of chemical transformation in soil and thus influence the availability of major nutrient like, Nitrogen, Phosphorus, Potassium and Sulphur inside the plants. *Azotobacter* is a symbiotic nitrogen fixing oval or spherical shaped bacteria, have deep seated effects on fundamental growth process of an organism and involve both beneficial as determinable effects. *Azotobacte*r also accelerated production of antifungal and antibacterial compounds in soil. Thus, the present study was carried out to determine the effect of organic and integrated sources of nutrients on growth and flowering of French marigold in view of maintaining soil health and the environment.

## MATERIALS AND METHODS

The field experiment conducted at Horticultural Research Canter, Department of Horticulture, Sardar Vallabhbhai Patel University of Agriculture &


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Technology, Modipuram, Meerut, UttarPradesh, India, during the year 2019- 2020 to evaluate the performance of marigold var. 'PusaArpita' with various manures and fertilizers levels. The experimental soil was sandy loam having low available nitrogen, medium available phosphorous and high available potassium with neutral pH. The experiment was laid out in randomized block design with eleven treatments and replicated thrice. Individual plot size was made 1.8 m x 1.2 m and spacing was kept 45 cm x 30 cm. The recommended management practices of raising a healthy crop were followed. The treatments included an inorganic form of N in the form of urea (150 kg/ha), $P_2O_5$ as superphosphate (60 kg/ha) and $K_2O$ as muriate of potash (60 kg/ha) as 100% of the recommended dose of fertilizer (RDF). NPK was applied in two parts, half the N and the full amount of P and K at the time of transplanting, and the remaining half of N was applied 40 days after transplanting. Other treatments consisted of vermicompost @10q/ha, FYM@30 t/ha, and PSB @500 ml/ha, Azotobacter @ 700 ml/ha. Seeds were sown in the month of September and transplanted in the main field with having 2-3 true leaf stage. Observations were recorded on growth and yield characters. Collected data were statistically analyzed using the described methods of Gomez and Gomez (1984), Panse and Sukhantne (1989) and using online software OPSTAT.

## RESULTS AND DISCUSSIONS

### Growth parameters

The data presented in (Table. 1) indicated that the maximum plant height (57.47 cm) was noted with ½RDF + ½ *Azotobacter* + ½ Vermicompost,which was statistically at par with treatment (55.41 cm) with the treatment ½ RDF+ ½ PSB, while minimum plant height (40.62 cm) was registered with control. The maximum diameter of main stem (18.21 mm) was noted with½ RDF + ½ *Azotobacter* + ½ Vermicompost, which was statically at par (16.66 mm) with the treatment ½ RDF + ½ PSB however, minimum diameter of main stem (12.15 mm) was noted with control. Maximum number of primary branches (21.96) was recorded with ½ RDF + ½ PSB + ½ Vermicompost, followed by, (20.67, 20.26, and 19.66 branches) with ½ RDF + ½ *Azotobacter*, ½ RDF + ½ PSBand ½ PSB + ½ Vermicompost respectively while minimum number of primary branches (16.23) had been recorded with control. The effect of organic and integrated sources of nutrient on plant height and diameter of main stem highest might be due to proper translocation of nutrients from the soil and enhanced the supply of micro and macro nutrients. This might have favoured the stimulation and production of auxiliary bud formation resulting in the formation of a greater number of branches. These findings are in conformity with the findings of Kumar et al., 2013 and 2015, Tiwari et al., (2018 and 2018 a) in marigold in marigold and Verma *et al*.(2011) and Kumar, 2015 in chrysanthemum, Singh et al., (2013 and 2014), Kumar, 2014, Kumar, 2015 in gladiolus, Kumar, (2014) in tuberose, Singh et al (2015),.

The data presented in (Table- 1) indicated that the effect of organic and integrated sources of nutrients sources had significant effect on numbers of leaves per plant. Maximum number of leaves (143.89) was noted with ½ RDF + ½ PSB + ½ Vermicompost, which was significantly at par (127.02) with treatment ½ RDF + ½ PSB, and 123.03 with treatment ½ RDF + ½ *Azotobacter,* while minimum number of leaves (66.48) under control. More number of leaves might be due to synthesis of protein and increases the cell division and cell enlargement which result in the increased growth of the plant also increase the number of leaves per plant. Similar results were obtained by Tiwari *et al*. (2018) in marigold, Similarly, maximum spread of plant (41.17 cm) was recorded with ½ RDF + ½ PSB + ½ Vermicompost, which was statically at par (39.63 cm) with the treatment ½ RDF + ½ PSB, and (39.79 cm) under the treatment ½ RDF + ½ *Azotobacter*, while minimum plant spread (24.51 cm) had been registered with control. Maximum spread of plant might be due to large canopy and a greater number of leaves. Similar results were also reported by Verma *et al.* (2011). Minimum days took to first flowering (41.39 days) were recorded with ½ RDF + ½ PSB ½ Vermicompost, which was significantly at par (43.76 days) under the treatment ½ RDF + ½ PSB and ½ PSB + ½ *Azotobacter*. while maximum days took for flower initiation (59.70) noted with control. This might have been due to the early completion of the early vegetative growth and the fast transition of the vegetative phase to the reproduction phase might have induced early bud initiation. Similar findings have been recorded in Rolaniya *et al*.(2017) in marigold. Maximum number of flowers per plant (38.56) had been recorded with ½ RDF+ ½ PSB+ ½ Vermicompost, which was significant at par (35.56), (32.72), and (32.62) with the treatments viz. ½ RDF+ ½ PSB, Azotobacter @ 700 ml/ha., and ½ RDF + ½ Vermicompost respectively while the lowest number of flowers per plant (14.69) was noted under control. This increase in number of flowers might be attributed to the integrated approach of the fertilizers, Vermicompost and *Azospirillum* which might have resulted in making the nutrients available to the plants easily and better food accumulation in the plants subsequently leading to a greater number of flowers. These findings are close conformity with the findings of Sunitha et al. (2007), Tiwari et al. (2018, 2018a) in marigold and Verma *et al.(2011)* in chrysanthemum.

**Table 1.** Effect of organic and integrated sources of nutrients on vegetative growth of African marigold

| Treatments | Plant height (cm) at 85 DAT | Diameter of main stem (mm) at 85 DAT | Number of primary branches per plant at 85 DAT | Number of leaves | Spread of plant (cm) | Days Taken first flowering (days) | Number of flowers/plants |
|---|---|---|---|---|---|---|---|
| Control | 40.62 | 12.15 | 16.23 | 66.48 | 24.51 | 59.70 | 14.69 |
| RDF-150:60:60 kg/ha N:P:K | 44.26 | 13.98 | 17.86 | 88.56 | 26.26 | 57.53 | 24.58 |
| FYM @ 30 t/ha | 43.96 | 13.22 | 17.36 | 88.37 | 28.48 | 54.40 | 22.76 |
| Vermicompost @ 10Q/ha | 45.04 | 13.43 | 18.23 | 124.20 | 29.37 | 51.40 | 25.79 |
| *Azotobacter* @ 700 ml/ha | 47.10 | 13.32 | 18.24 | 120.39 | 30.47 | 50.32 | 32.72 |
| PSB @ 500 ml/ha | 47.81 | 14.24 | 19.33 | 137.39 | 31.43 | 48.62 | 31.63 |
| ½ RDF + ½ FYM | 51.07 | 14.62 | 19.64 | 124.10 | 33.31 | 47.43 | 29.62 |
| ½ RDF + ½ Vermicompost | 52.76 | 15.58 | 19.66 | 131.02 | 35.81 | 46.72 | 31.65 |
| ½ RDF + ½ *Azotobacter* | 53.13 | 15.63 | 20.67 | 123.03 | 38.79 | 43.76 | 32.62 |
| ½ RDF + ½ PSB | 55.41 | 16.66 | 20.26 | 127.02 | 39.63 | 43.76 | 35.56 |
| ½ RDF + ½ PSB + ½ Vermicompost | 57.47 | 18.21 | 21.96 | 143.89 | 41.17 | 41.39 | 38.56 |
| S.E.(m)± | 0.35 | 0.39 | 0.36 | 0.44 | 0.45 | 0.62 | 0.52 |
| C. D. at 5% | 1.06 | 1.18 | 1.09 | 1.32 | 1.33 | 1.85 | 1.56 |

**Yield characters:**

The data given in T(able 2) clearly indicates that the organic and integrated sources of nutrients significantly affected the yield parameters of marigold. The maximum flower weight per plant (133.58 g) was noted with ½ RDF + ½ PSB + ½ Vermicompost, which was statistically at par (128.22 g) with the treatment ½ RDF + ½ PSB, and 120.54 g with ½ RDF + ½ Vermicompost, while minimum flower yield per plant (80.59 g) had been registered under control. Maximum yield of flowers per plot (5.98 kg) was recorded with ½ RDF + ½ PSB + ½ Vermicompost, which was statistically at par (5.56 kg) with the treatment ½ RDF + ½ PSB and 4.54 kg with ½ RDF + ½ *Azotobacter* while untreated plants (control) produced minimum flower yield (1.20 kg). Plants treated with ½ RDF+ ½ PSB +Vermicompost had maximum yield of flowers per hectare (402.09 q/ha) which was significantly at par (385.41 q/ha) with the treatment ½ RDF + ½ PSB + ½ Vermicompost while, the minimum yield of the flowers per hectare (151.41 q/ha) had been registered with control. Increase in the yield of the flowers of marigold may be due to the better growth of the plants such as height, diameter, number of branches, higher number of flowers per plants, and flower circumference hence, subsequently the yield per hectare was increased. These results are in close conformity with Verma *et al.* (2011) in chrysanthemum, Tiwari et al. (2018, 2018a) in marigold.

**Table 2.** Effect of organic and integrated sources of nutrients on flower yield parameters

| Treatments | Yield of flowers per plant (g) | Yield of flowers per plot (kg) | Yield of flower per ha (q) |
|---|---|---|---|
| Control | 80.59 | 1.20 | 151.41 |
| RDF-150:60:60 kg/ha N:P:K | 86.42 | 1.76 | 208.35 |
| FYM @ 30 t/ha | 94.30 | 2.80 | 292.47 |
| Vermicompost @10Q/ha | 108.59 | 2.47 | 181.32 |
| *Azotobacter* @700 ml/ha | 115.05 | 3.80 | 248.28 |
| PSB @500 ml/ha | 116.79 | 3.65 | 222.48 |
| ½ RDF + ½ FYM | 108.50 | 4.47 | 327.87 |
| ½ RDF + ½ Vermicompost | 127.60 | 4.12 | 340.61 |
| ½ RDF + ½ *Azotobacter* | 120.54 | 4.54 | 352.76 |
| ½ RDF + ½ PSB | 128.22 | 5.56 | 385.41 |
| ½ RDF + ½ PSB + ½ Vermicompost | 133.58 | 5.98 | 402.09 |
| S.E.(m)± | 0.49 | 0.39 | 0.57 |
| C. D. at 5% | 1.47 | 1.17 | 1.71 |

## CONCLUSION

It can be concluded that the application of ½ RDF + ½ PSB + Vermicompost was found to be the best treatment among all the treatments to increase the growth, yield and quality of French marigold

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