Plant Archives Vol. 25, No. 1, 2025 pp. 2527-2531 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org

DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2025.v25.no.1.365

EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON YIELD ATTRIBUTES OF FRENCH MARIGOLD (*TAGETES PATULA* L.) CV. RUSTY RED

Pankaj Kumar, R.S. Verma*, M.L. Meena, Praveen Kumar and Rahul

*Department of Horticulture, School of Agricultural sciences and Technology, Babasaheb Bhimrao Ambedkar University, Lucknow, (U.P) - 226025, India.

*Corresponding author mail: ravihort.009@gmail.com

(Date of Receiving-12-12-2024; Date of Acceptance-03-03-2025)

ABSTRACT

The present investigation was carried out with the aim to find out the effect of integrated nutrient management on yield attributes of French marigold (*Tagetes patula* L.) cv. Rusty Red at the Horticultural Research Farm, Department of Horticulture, Babasaheb Bhimrao Ambedkar University, Lucknow, (U.P.)-226025 during the years 2022-2023. The study consisted of biofertilizers (*Azotobacter* and PSB) and the recommended dose of inorganic fertilizers (RDF) (100:100:100 kg NPK/ha). The experiment was laid out in Randomized Block Design (RBD) and comprised of eleven (11) treatments replicated three times. Among the various treatments Number of days taken for first flower bud initiation in T_5 (33.72 DAT), number of days taken for 50% flowering was observed in T_5 (45.75 DAT), longer flowering duration of T_5 (45.88 days), maximum flower diameter in T_5 (2.52 cm), maximum number of flowers plant in T_5 (104.32), maximum weight of flower in T_5 (3.28 g), maximum flower yield per plant in T_5 (112.44 g), maximum flower yield per plot in T_5 (7.80kg), maximum flower yield per hectare in T_5 (13.16 t./ha.), maximum vase life of flower in T_5 (5.76 days), maximum number of seeds per flower in T_5 (103.67), maximum test weight (Weight of 1000 seeds) in T_5 (2.95 g), maximum fresh weight of flower in T_5 (58.82), maximum dry weight of flower in T_5 (15.62) is better than control.

***Key words*:** French marigold, Biofertilizers, *Azotobacter*, PSB, Inorganic fertilizer.

Introduction

Marigold (*Tagetes* sp.) related to Family Asteraceae is the most used flower in our daily lives, accounting for the majority of loose flowers. It is one of the most widely produced flowers and is often utilized in religion and social occasions. *Tagetes* comes from the Etruscan *Tages*, who was named after plugging the ground. It is known to originate from Central to South America, especially in Mexico. The generic name Tagetes was given after "Tages," a demigod known for his beauty. The genus Tagetes consists of 33 spp. Marigolds are broadly divided into two groups, namely, African and French Marigold (Yadav *et. al.*, 2017). French marigold is a tetraploid species with a chromosome number of 48. Marigold is also used for the extraction of caretenoid pigments, which are added to poultry diets to intensify the yellow color of egg yolks (Sreekala *et al*., 2003). Caretinoid pigments have a beneficial role for the treatment of skin tumors, dermatological diseases, and cancer in humans (Bosma *et al.,* 2003). Marigold is grown as an ornamental crop for its flowers, which are sold in the market as loose flowers in bulk as specialty cut flowers, or for making garlands. It is also one of the most important natural sources of xanthophylls for use as a natural food additive to brighten egg yolks and polarity skin (Bosma *et al.,* 2003). Moreover, it is also being used effectively to dye fabrics commercially, where its ethanol-based flower extracts produce different colors on fabrics (Vanker *et al.,* 2009). Deineka *et al.,* (2007) have reported that marigold cultivars with orange-colored flowers have higher xanthophylls as compared with yellow. Lutein ($C_{14}H_{56}O_2$) is the primary xanthophyll pigment, comprising 90% of the identified pigments in the petals (Quackenbush and Miller 1972). This lutein, having

antioxidant properties, is also useful in eye health protection (Vankar *et al.*, (2009). Keeping in view the importance of integrated nutrient management (INM) and the research gap with regards to integrated nutrient management approaches for marigold.

Materials and Methods

The present investigation was carried out at the Horticulture Research Farm, Department of Horticulture, School of Agricultural Sciences and Technology at Babasaheb Bhimrao Ambedkar University (A Central University), Vidya-Vihar, Rae Bareli Road, Lucknow (UP) during the years 2022-2023. The experiment was laid out in a randomized block design with three replications and 11 treatments. The treatment combinations were T1 (control), T2 (100% RDF), T_3 (75% RDF + *Azotobacter*), T_4 (75% RDF + PSB), T_5 (75% RDF + *Azotobacter* + PSB), T_6 (50% RDF + *Azotobacter*), T_7 (50% RDF + PSB), T_8 (50% RDF + *Azotobacter* + PSB), T_9 (25% RDF + *Azotobacter*), T_{10} (25% RDF + PSB), and T_{11} (25% RDF + *Azotobacter* + PSB). The plot size was 1.80 m by 1.20 m, and the spacing followed was 45 cm by 30 cm to keep 12 plants per plot for each treatment. The land was brought to a fine tilth through plowing. Bunds and irrigation channels were maintained properly. The seedlings were transplanted after seedling treatment through biofertilizer in the main field. Light irrigation was given after transplanting. All recommended cultural practices were followed to raise healthy crops. The observations were recorded of tagged plants for each replication on morphological traits, *viz.*, Number of days taken for first flower bud initiation, number of days taken for 50% flowering was observed, longer flowering duration, maximum flower diameter, maximum number of flowers planted in, maximum weight of flower, maximum flower yield per plant, maximum flower yield per plot, maximum flower yield per hectare, maximum vase life of flower, maximum number of seeds per flower, maximum test weight (weight of 1000 seeds), maximum fresh weight of flower, and maximum dry weight of flower are better than control. The data based on the mean of individual plants selected for observation were statistically analyzed. Statistical analysis and interpretation of data were done by following the Fisher analysis of variance technique as outlined by Panse and Sukhatme (1985), and results were tested at 5% level of significance.

Results and Discussion

Number of days taken for first flower bud initiation (days)

Significant differences were noticed among the treatments in French marigold for the number of days taken for the first flower bud initiation. In T5,, where the plants were supplied with 75% RDF + *Azotobacter* + PSB, the first to show visible flower buds (33.72 DAT). The result agrees with the finding of Chaitra (2006), who reported that the combined application of 50% RDF+ *Azotobacter*+ PSB+ VC resulted in minimum days needed for flower bud initiation, 50% flowering, and maximum duration of flowering in China aster.

Time taken for 50 percent flowering (days)

The time taken for 50% flowering was influenced by integrated nutrient management treatments. The least number of days taken for 50% flowering was observed in treatment (T_5) (45.75 DAT). The result is agreement with the finding of Chaitra (2006), who reported that the combined application of 50% RDF+ *Azotobacter*+ PSB+ VC resulted in minimum days needed for flower bud initiation, 50% flowering, and maximum duration of flowering in China.

Flowering duration (days)

Data presented in revealed significant variation among different treatments for flowering duration. In the treatment where the plants were treated with 75% RDF + *Azotobacter* + PSB (T_5) recorded significantly longer flowering duration of 45.88 days. Early flowering (23.33 days) and longer duration of flowering (61 days) were noticed with the application of 135:90:60 kg N: P: K, ha^{-1} + *Azotobacter* + VAM in calendula (Shasidhara and Gopinath, 2005).

Flower Diameter (cm).\

Data from the maximum flower diameter (2.52 cm) was found in treatment receiving 75% RDF+ *Azotobacter* + PSB (T_5). The maximum flower diameter was recorded in T5 (100% RDF+ 100% FYM+ *Azospirillum* and PSB each @ 6 kg ha''). The results are supported by the findings of Swaroop *et al.*, (2007). Pushkar *et al.*, (2006). Kumar *et al.*, (2006) and Anuradha *et al.*, (1990) in Marigold and Mogal *et al.*, (2006). in China aster.

Number of flower plants

The number of flower plants was A significantly higher number of flowers per plant (104.32) was recorded in plants supplied with 75% RDF+ *Azotobacter* + PSB (T_5). Similar results of higher numbers of flower production per plant have been reported by Gupta *et al.*, (1999). and Sunitha *et al.*, (2007). in Marigold and Kumar *et al.*, (2003). in China.

Weight of flower (g)

Treatments differed significantly with respect to the

Table 1: Effect of integrated nutrient management on yield attributes of French marigold var. Rusty Red.

Treatments	1	2	3	4	5	6	7	8	9	10	11	12	13	14
T_1- Control	67.11	45.75	38.31	1.18	86.89	1.65	97.44	5.54	7.20	3.29	68.67	1.30	20.55	3.68
T_2- 100% RDF	43.72	53.10	44.54	1.36	94.80	2.01	102.96	5.14	9.19	3.33	83.67	1.59	48.65	7.82
T_3- 75% RDF + *Azotobacter*	46.69	56.14	44.67	1.35	99.91	2.50	104.02	6.06	11.70	5.08	99.67	2.54	55.80	10.78
T_4- 75% RDF + PSB	37.99	53.36	44.65	1.32	97.16	2.28	103.07	5.69	10.86	4.75	96.33	2.23	52.95	9.39
T_5- 75% RDF + *Azotobacter* + PSB	33.72	64.60	45.88	2.52	104.32	3.28	112.44	7.80	13.16	5.76	103.67	2.95	58.82	13.62
T_6- 50% RDF + *Azotobacter*	60.07	54.46	44.76	1.44	95.18	2.49	104.47	5.78	11.62	4.83	96.33	2.37	52.79	10.17
T_7- 50% + PSB	57.16	53.39	44.61	1.31	95.16	2.04	101.48	5.18	9.68	4.21	91.33	2.08	47.66	7.82
T_8- 50% RDF + *Azotobacter* + PSB	43.87	57.47	44.83	2.19	100.17	2.71	106.51	6.54	12.30	5.45	100.67	2.72	56.62	12.65
T_9- 25% RDF + *Azotobacter*	66.19	50.91	44.15	1.38	91.86	1.92	99.31	4.90	8.60	3.97	86.67	1.56	30.07	6.79
T_{10}- 25% + PSB	64.73	48.26	41.94	1.36	89.02	1.90	99.07	4.60	7.71	3.89	84.33	1.54	34.20	6.70
T_{11}- 25% RDF + *Azotobacter* + PSB	63.05	47.74	40.88	1.21	88.36	1.70	99.84	4.47	6.37	3.51	70.33	1.50	29.18	4.30
CD	**7.04**	**5.07**	**3.91**	**0.52**	**8.79**	**0.73**	**5.09**	**0.80**	**1.71**	**1.32**	**7.32**	**0.29**	**7.16**	**1.40**
SE m-$^+$	**2.37**	**1.70**	**1.31**	**0.17**	**2.96**	**0.24**	**1.71**	**0.27**	**0.57**	**0.44**	**2.46**	**0.10**	**2.41**	**0.47**

(1). Flower bud initiation (days); **(2).** 50% Flowering (days); **(3).** Flowering Duration (days); **(4).** Flower diameter (cm); **(5).** No. of flower per plant; **(6).** Weight of flower (g); **(7).** Flower yield/plant (g); **(8).** Flower yield/plot (Kg); **(9).** Total flower yield (t./ha.); **(10.)** Vase life (Days); **(11).** No. of seeds perflower; **(12).** Test wt. (Wt. of 1000 seeds) (g); **(13).** Fresh wt. of flower (g); **(14).** Dry wt. of flower (g)

weight of the flower (3.28 g), respectively. The plants receiving 75% RDF+ *Azotobacter* + PSB (T_5) recorded the significantly highest flower weight (3.28 g). Kumawat *et al.*, (2017) reported a significantly higher number of flowers/plants, weight of flower, *viz.*, yield per plant, by conjoint application of 75% RDF + FYM + *Azotobacter* + PSB in African marigold.

Flower yield per plant (g)

Integrated nutrient management treatments significantly influenced flower yield per plant. The data presented in revealed that significantly maximum flower yield per plant (112.44 g) was recorded in (T_5), 75% RDF + *Azotobacter* + PSB. More production of branches per plant, increased plant spread, and higher accumulation of dry matter coupled with increased flower weight might have led to increased flower yield per plant and per ha. (Table 1). Similar observations were made by Anuradha *et al.*, (1990). and Chandrikapure *et al.*, (1999). in African marigold.

Flower yield per plot (kg)

Flower yield per kilogram (g) was significantly influenced by the integrated nutrient management. Data presented from the study revealed that application of 75% RDF + *Azotobacter* + PSB (T_5) recorded the highest flower yield (kg.) (7.80), which was significantly superior over the rest of the treatments. Kumar and Kumar (2016) reported a significant increase in flower yields of Purnima and Ajay cultivars of chrysanthemum with conjoint application of inorganic fertilizers, vermicompost, and biofertilizers.

Total flower yield per hectare (t/ha)

Flower yield per hectare was significantly influenced by the integrated nutrient management. Data presented from the study revealed that application of 75% RDF + 100% *Azotobacter* + PSB (T_5) recorded the highest flower yield per ha. (13.16 t ha $^{1)}$, which was significantly superior over the rest of the treatments. More production of branches per plant, increased plant spread, and higher accumulation of dry matter coupled with increased flower weight might have led to increased flower yield per plant and per ha. (Table 1). Similar observations were made by Anuradha *et al.*, (1990). and Chandrikapure *et al.*, (1999). in African marigold.

Vase life (days)

Non-significant results were obtained for the vase life with respect to different treatments. However, the maximum vase life was recorded in the plots supplied with 75% RDF + *Azotobacter* + PSB (T_5) (5.76 days). However, a maximum vase life of 5.76 days was recorded with 75% RDF+ *Azotobacter* + PSB (T_5). This is in contradiction to the findings of Anuradha *et al.*, (1990).

Number of seeds per flower

The number of seeds per flower was significantly influenced by INM treatments. Application of 75% RDF + *Azotobacter* + PSB (T_5) produced a greater number of seeds per flower (103.67) and was significantly superior over the rest of the treatments. Bappitodu *et al.*, (2016) reported higher seed yield/plant and higher test weight with the application of 75% NPK + *Azotobacter* + PSB + KMB + 3% HA in *Calendula officinalis*.

Test weight (weight of 1000 seeds) (g)

Test weight (weight of 1000 seeds) was significantly influenced by the different INM treatments. Data presented in the revealed that the maximum 1000 seed weight (2.95 g) was recorded in plants receiving 75% RDF + *Azotobacter* + PSB. Koli *et al.*, (2018) also reported the highest 1000 seed weight and seed yield/ plot with the application of RDF+ FYM+ Arka microbial consortium + VAM + micronutrient foliar spray in marigold cv. Pusa Basanti Gainda.

Fresh weight of flower (g)

Fresh weight of flowers was significantly influenced by the integrated nutrient management. Data presented from the revealed that the application of 75% RDF + *Azotobacter* + PSB in (T_5) recorded the highest fresh weight of flower (58.82). Goutham *et al.* (2018) also reported the maximum fresh weight of flower and highest amount of flowers/plant with the application of RDF + *Azotobacter* + PSB in African marigold cv. Pusa Narangi Gainda

Dry weight of flower (g)

Dry weight of flower was significantly influenced by the integrated nutrient management. Data presented from the revealed that the application of 75% RDF + *Azotobacter* + PSB in (T_5) recorded the highest dry wt. of flower (15.62).

Conclusion

The experimental results have clearly shown that among different treatments, the application of RDF 75% along with *Azotobacter* + PSB has resulted in better yield of the plants. Therefore, it may be concluded from findings that the combined application of 75% RDF + *Azotobacter* + PSB is beneficial in improving the yield attributes of the French marigold (*Tagetes patula L.)* cv. Rusty Red under Lucknow condition. It is advocated to marigold growers to apply 75% RDF + *Azotobacter* + PSB for better yield of marigold in Central Uttar Pradesh.

References

Anuradha, K., Pampapathy K. and Sreenivasalu R. (1990). Effect of nitrogen and phosphorous on flowering and yield of marigold (*Tagetes erecta* L.). *Indian Journal of Horticulture*, **47**, 353-357.

Bappitodu, Rana D.K., Punetha P. and Kumar P. (2016). Efficacy of Integrated nutrient management on seed yield and quality parameters of *Calendula officinalis*. *The Bioscan*. **11(2)**, 1167-1169.

Bosma, T.L., Dole J.M. and Maness N.O. (2003). Crop ecology, management, and quality, optimizing marigold (*Tagetes erecta* L.) petal and pigment yield. *Crop Sci*., **43**, 2118-2124.

Chaitra, R. and Patil V.S. (2007). Integrated nutrient management studies in China aster (*Callistephus chinensis* (L.) Nees). *Karnataka Journal of Agricultural Sciences*. **20(3)**, 689-690.

Chandrikapure, K.R., Sadawrte K.T., Panchbhai D.M. and Shelke B.D. (1999). Effect of bioinoculants and graded doses of nitrogen on growth and flower yield of marigold (*Tagetes erecta* L.). *Orissa Journal of Horticulture*. **27(2)**, 31-34.

Goutham, B.K., Parul P. and Mamta B. (2018). Efficacy of *Azotobacter* and Phosphate solubilizing bacteria on vegetative and floral attributes of African marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gainda under hilly regions of Uttarakhand. *International Journal of Agriculture sciences*. **10(4)**, 5212-5215.

Gupta, N.S., Sadavarte K.T., Mahorkar V.K., Jadhao B.J. and Dorak S.V. (1999). Effect of graded levels of nitrogen and bioinoculants on growth and yield of marigold (*Tagetes erecta* L.). *Journal of Soils and Crops*.; **9(1)**, 80-83.

Koli, R., Jayanthi R. and Kumari V. (2018). Effect of integrated nutrient management on flower yield and quality of African marigold (*Tagetes erecta* L.) cv. Pusa Basanti Gainda. *International Journal of Chemical Studies*. **6(4)**, 2617-2620.

Kumar, A. and Kumar A. (2016). Effect of Biofertilizers and Nutrients on growth and flower yield of summer season African marigold (*Tagetes erecta* L.) *Plant Archives*. **17(2)**, 10901092.

Kumar, J. *et al*. (2003). *J. Ornamental Hort*. (New series) **6(1)**, 82.

Kumawat, K., Khanderwal S.K., Choudary M.R., Kumawat P.K., Sharma G. and Panwar P. (2017). Effect of integrated nutrient management on growth flowering and yield of

African marigold (*Tagetes erecta* L.) *International Journal of Current Microbiology and Applied Sciences*. **6(8)**, 60-65.

Mogal, S.A., Khiratkar S.D., Chopde N.K., Dalvi A.M., Kuchanwar O.D. and Khobragade Y.R. (22006). Effect of organic manures and biofertilizers with reduced doses of nitrogen on growth, yield, and quality of China aster. *J. Soils and Crops*. **16(1)**, 180-185.

Pushkar, N.C., Rathore S.V.S., Upadhayay D.K. (2008). Response of chemical and biofertilizer on growth and yield of African marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gainda. *Asian Journal of Horticulture*.; **3(1)**, 130-132.

Quackenbush, F.W. and Sharon L. Miller (1972). "Composition and analysis of the carotenoids in marigold petals." *Journal of the Association of Official Analytical Chemists,* **55.3**, 617-621.

Sreekala, C. and Raghava S. (2003). "Exploitation of heterosis for carotenoid content in African marigold (*Tageteserecta* L.) and its correlation with esterase polymorphism." *Theoretical and Applied Genetics*, **106**, 771-776.

Sunitha, H.M., Hunje Ravi, Vyakaranahal B.S. and Bablad H.B. (2007). Effect of plant spacing and integrated nutrient management on yield and quality of seed and vegetative growth parameters in African marigold (*Tagetes erecta* Linn.). *J. Orn. Hort.* **10(4)**, 245-249.

Swaroop, K., Kanwar P., Singh P. and Raju D.V.S. (2007). Vegetative growth, flowering and seed characters of African marigold (*Tagetes erecta* L.) as influenced by different growth substances during mild off seasons. *J. Orn. Hort*. **10(4)**, 268-270.

Vankar, P.S., Shanker R. and Wijayapala S. (2009). Utilization of temple waste flower *Tagetes erecta L.* for dyeing of cotton, wool, and silk on an industrial scale. *J. Textile Apparel Tech Man*.

Yadav, K.S., Pal A.K., Singh A.K., Yadav D. and Mauriya S.K. (2017). Influence of different biofertilizers and its consortium on growth, flowering and seed yield of Marigold. *International Journal of Pure and Applied Bioscience*. **5(6)**, 1660-1665.