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

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ABSTRACT

The present investigation was carried out with the aim to find out the effect of integrated nutrient management on growth 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 year 2022-2023. The study consisted of Bio-fertilizers (Azotobactor and PSB) and the recommended dose of inorganic fertilizer (RDF) (100:100:100 kg NPK/ha). The experiment was laid out in Randomized Block Design (RBD) and comprised of eleven (11) treatments replicated thrice. Among the various treatments, maximum plant height 30 DAT (64.47 cm), 60 DAT (72.15 cm), maximum stem girth 30 DAT (1.67 cm), 60 DAT (4.33 cm), maximum plant spread in N-S direction 30 DAT (24.75 cm), 60 DAT (55.26 cm), maximum spread in E-W direction 30 DAT (26.70 cm), 60 DAT (40.40 cm) and maximum number of branches 30 DAT (8.43), 60 DAT (19.28) in treatment T_5 comprising of 75% RDF + Azotobacter + PSB has been obtained better growth as compared to control.
Keywords : French marigold, Bio-fertilizers, Azotobacter, PSB, Inorganic fertilizer.

Introduction

Flowers are regarded as nature's most beautiful creation. They have been linked with humanity since the beginning of existence. Flowers are utilized for a variety of purposes in our daily lives, including worship, religious and social gathering, meeting decorating, and ornamentation. Aside from that, flowers are utilized to express our emotions. Marigold (*Tagetes sp.*) is the most commonly 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 occasion. *Tagetes* comes from the Etruscan *Tages*, who was named after plugging the ground. It is most likely related to how rapidly plants in this genus arise each year, either from seeds produced the previous year or from stems that renew from the stump that is already there. The English name "Marigold" is derived from "Mary's gold which was originally used to a similar European plant, *calendula officinalis*. The flowers were mainly cultivated for aesthetic appeal, different forms, colors and industrial uses. These can be used for decoration adornment and landscape beautification. So, there is always a quest for selecting new genotype/variety leads to evaluation of available genotype to get ultimate yield, quality and variable flower. Marigold (*Tagetes spp.*) commonly known as 'Gainda' also called as receptacle less flower. It is known to be originated from Central to South America especially in Mexico. The generic name is 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 Mari gold (Yadav *et al.* (2018). Flower it is one of the most popular and widely adopted multipurpose flowering plant belong to family compositae. It is a commonly grown crops because of its spectacular flowers, brilliant delightful appearance myriads of sizes, shapes, forms etc. (Naik *et al.,* 2019). African marigold is a diploid species with chromosome number of 24 and French marigold is a Tetraploid species with chromosome number of 48. The other species are *Tagetes tenuifolia*, *T. lacera, T. limmmonni, T. luceda, T. minuta* and *T. pusilla.*

French marigold (*Tagetes patula* L.) is an important flower as far as its uses are concerned. Marigold is also effective in controlling the *Parthenium* grass. Marigold is extensively cultivated for loss flower production the leaves of marigold are coated with oily glands that produce pungent smell. Marigold is effective in controlling nematodes. It is one of the important species grown commercially for loss flower in different part of India especially in the tropical and sub- tropical regions. Marigold is also use for extraction of carotenoid pigments which is added in poultry diet to intensify the yellow color of egg yolk (Sreekala *et al*., 2003). The species is grown around field crops to control pest activity (Terechuk *et al*.,1997). Carotenoid pigments are used in food industry (Vasudevan *et al*., 1997). Carotenoid pigments have beneficial role for treatment of skin tumor, dermatological disease and cancer in human being (Bosma *et al.,* 2003). Marigold is grown as an ornamental crop for its flowers, which are sold in the market as loose flower in bulk as specialy cut flower, or for making garlands it is also one of the most important natural sources of xanthophylls for use as 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 color flower have higher xanthophylls as compared with yellow. Lutein ($C_{14}H_{56}O_2$) is the primary xanthophylls pigment comprising 90 % of the petals identified pigments (Quackenbush and Miller, 1972). This Lutein, having antioxidant properties, is also useful in eye health protection (Vankar *et al.,* 2009). Marigold has been most commonly used by the poultry industry to augment the xanthophylls present in corn and alfalfa feed to standardize the feed's xanthophylls contents (Delgado-Vergas *et al.,* 1998). Keeping in view the importance of integrated nutrient management (INM) and the research gap with regards to integrated nutrient management approach 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 year 2022-2023. The experiment was laid out in Randomized Block Design with three replication and 11 treatments. The treatment combination were T_1(control), T_2(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), T_{11} (25% RDF + Azotobacter +PSB). The plot size was 1.80 m X 1.20 m and spacing followed was 45 cm X 30 cm to keep 12 plants per plot for each treatment. The land was brought to a fine tilth through ploughing. Bunds and irrigation channels were maintained properly. The seedlings were transplanted after seedling treatment through Bio- fertilizer in the main field. Light irrigation was given after transplanting. All recommended cultural practices were followed to raise healthy crop. The observation was recorded of tagged plants for each replication on morphological traits viz., Plant height (cm), stem girth (cm), number of branches per plant, plant spread North - South direction (cm), plant spread East -West direction (cm). The data based on the mean of individual plants selected for observation were statistical analysis. 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

Plant height (cm)

The data regarding the height of the plant recorded at 30, 60, and 90 days after transplanting (DAT) are presented in Table:1. At 30 DAT, the plant height varied significantly by integrated nutrient management in French marigold. Maximum plant height (64.47 cm) was recorded under the application of 75% RDF + Azotobecter + PSB (T_5) and second maximum plant height (61.79) was recorded under the application of 50% RDF + Azotobacter + PSB (T_8) significantly superior to rest of the treatments. Minimum plant height (31.84 cm) was recorded in the (T_1) control plots. The treatment comprising 75% RDF + Azotobacter + PSB (T_5) recorded the tallest plants (72.15cm) at 60 DAT and was followed by (T_8), (62 cm). However, Plants receiving 50% RDF + Azotobacter + PSB, (T_1) recorded the minimum plant height (49.8 cm). At 90 DAT also, plant height varied significantly due to the influence of integrated nutrient management. The (T_5) 75% RDF +Azotobacter + PSB recorded the highest plant height of (90.20 cm) which was followed by (T_8) (85.78 cm). However, the treatment receiving 50% RDF + Azotobacter + PSB, (T_1) registered the lowest plant height (61.20 cm). Plant growth is a dynamic process and is affected by the complex interaction between environmental factors and physiological processes. Besides these factors, nutrition plays a very important role. Judicious and balanced uses of nutrients are known to result in overall improvement of growth parameters in many of the flowering annuals (Mantrova *et al.,* 1976).

Table 1 : Effect of integrated nutrient management on plant height and stem girth of French marigold

Treatments	Plant height (cm)			Stem girth (cm)		
	30 DAT (cm)	60 DAT (cm)	90 DAT (cm)	30 DAT (cm)	60 DAT (cm)	90 DAT (cm)
T_1- Control	31.84	49.81	61.20	0.99	3.15	5.33
T_2- 100% RDF	55.84	53.75	70.42	1.08	3.50	6.85
T_3- 75% RDF + Azotobacter	61.17	61.48	85.11	1.30	3.84	8.08
T_4- 75% RDF + PSB	59.35	57.47	78.11	1.29	3.89	7.33
T_5- 75% RDF + Azotobacter + PSB	64.47	72.15	90.20	1.67	4.33	8.37
T_6- 50% RDF + Azotobacter	59.40	58.95	83.77	1.30	3.65	7.49
T_7- 50% RDF + PSB	56.46	56.97	74.70	1.20	3.88	7.01
T_8- 50% RDF + Azotobacter + PSB	61.79	62.00	85.78	1.38	3.90	8.18
T_9- 25% RDF + Azotobacter	50.89	52.39	62.86	1.07	3.48	7.66
T_{10}- 25% RDF + PSB	50.81	52.10	62.83	1.02	3.47	6.21
T_{11}- 25% RDF + Azotobacter + PSB	49.05	50.29	61.68	1.06	3.43	5.65
CD (P=0.05)	**8.65**	**6.83**	**8.35**	**0.31**	**0.57**	**1.81**
SE m-+	**2.91**	**2.30**	**2.81**	**0.13**	**0.19**	**0.60**

Stem girth (cm)

The stem girth at 30 DAT varied significantly due to different treatments. Amongst different treatment combinations, the maximum stem girth (1.67 cm) was recorded in treatment (T5) 75% RDF + Azotobacter + PSB and second highest stem girth in treatment (T8) (1.38 cm). While, the plants receiving 50% RDF + Azotobacter + PSB and recorded the minimum stem girth (0.99 cm) and was at par with treatment (T_1). The maximum stem girth (4.33 cm) was recorded in treatment (T5) 75% RDF + Azotobacter + PSB at 60 DAT which was significantly superior to all other treatments, but was on at par with (T8) (3.9 cm) 50% RDF + Azotobacter + PSB. However, the minimum stem girth was observed in the plants height in (T1) (2.15 cm). At 90 DAT, the maximum stem girth (5.37 cm) was recorded with the application of 75% RDF + Azotobacter + PSB(T_5) and was significantly superior to all other treatments, but was at par with treatment (T_8) (5.18 cm), application of 50% RDF + Azotobacter + PSB, However, the minimum stem girth (3.33 cm) was recorded in control treatment Increase in the main stem diameter may be ascribed to more availability of nutrients such as nitrogen, phosphorus and potassium and their assimilation as evident from the Table 1 which might have led to increased formation of plant metabolites that help to build the plant Issues and this might have led to increased stem girth. It may also be due to stimulation of root system which consequently helps in greater absorption and translocation of nutrients due to favourable and additive effect of the bio-fertilizers. The results obtained are in close accordance with the findings of Chandrikapure *et al.* (1999), Gupta *et al.* (1999), Gotmare *et al.* (2007) and Pushkar *et al.* (2008) in marigold.

Plant spread North – South direction

At 30 DAT, it was observed that the plants receiving 75% RDF + Azotobacter + PSB (T5) registered the maximum plant spread of (24.75) cm and was significantly superior over rest of the treatments. Minimum plant spread (15.50 cm) was observed in (T1) which was second highest plant spreading treatment in application of 50% RDF + Azotobacter + PSB (T8) (22.49 cm). Similar trend was also noticed in 60 DAT. significantly maximum plant spread was noticed in (T5) (55.26 cm). The lowest plant spread (38.37 cm) was recorded in the (T1) control treatment. Second highest plant spread in (T8) (42.71) application of 50% RDF + Azotobacter + PSB. Plant spread at 90 DAT varied from minimum plant spread in (T_1) (41.00cm) to the maximum plant spread in (T_5) (54.10) cm and was significantly influenced by different treatments. Maximum plant spread (54.10 cm) was recorded in plants receiving 75% RDF + Azotobacter + PSB and it was significantly superior over rest of the treatments. However, the second highest plant spread (T_8) (49.50 cm) was recorded in treatment receiving of 50% RDF + Azotobacter + PSB.

Plant spread East – West direction

At 30 DAT, it was observed that the plants receiving 75% RDF + Azotobacter + PSB (T5) registered the maximum plant spread of (26.70 cm) and was significantly superior over rest of the treatments. Minimum plant spread (15.70 cm) was observed in (T1) which was second highest spreading treatment in application of 50% RDF + Azotobacter + PSB (T8) (25.90 cm). Similar trend was also noticed in 60 DAT. significantly maximum plant spread was noticed in (T5) (40.40 cm). The lowest plant spread (30.00 cm) was recorded in the (T1) control treatment. Second highest plant spread in (T8) (40.00) application of 50% RDF + Azotobacter + PSB. Gupta *et al.* (1999) reported similar results in marigold. Plant spread at 90 DAT varied from minimum plant spread in (T_1 39.94cm to the maximum plant spread in (T_5) (50.04 cm) and was significantly influenced by different treatments. Maximum plant spread was recorded in plants receiving 75% RDF + Azotobacter + PSB. and it was significantly superior over rest of the treatments. However, the second highest plant spread (T_8) (48.05 cm) was recorded in treatment receiving of 50% RDF + Azotobacter + PSB. Spread of plant exhibited high positive response to the combined application of inorganic fertilizers along with bio-fertilizers than their individual application. Cumulative increased in plant spread was the highest with the plots receiving 75% RDF+ Azotobacter + PSB (T5). Increased plant height and a greater number of branches might have contributed to the increased plant spread. The results obtained are in confirmation with the findings of Gayathri *et al*. (2004), who reported that the combined application of bio-fertilizers, vermicompost with inorganic fertilizers significantly increased the plant spread. Similar results have also been reported by Pushkar *et al*. (2008). Sharma *et al.* (2006) in marigold and Mogal *et al.* (2006) in China aster.

Table 2 : Effect of integrated nutrient management on plant spread North – South and East – West direction

Treatments	Plant Spread N - S direction (cm)			Plant spread E – W direction (cm)		
	30 DAT (cm)	60 DAT (cm)	90 DAT (cm)	30 DAT (cm)	60 DAT (cm)	90 DAT (cm)
T_1- Control	15.50	38.37	41.00	15.70	30.00	39.94
T_2- 100% RDF	18.55	40.05	44.90	21.10	32.80	45.71
T_3- 75% RDF + Azotobacter	21.12	42.63	48.30	23.70	38.90	47.35
T_4- 75% RDF + PSB	20.14	41.41	47.30	22.90	36.80	46.86
T_5- 75% RDF + Azotobacter + PSB	24.75	55.26	55.90	26.70	40.40	50.04
T_6- 50% RDF + Azotobacter	20.50	42.00	48.20	23.20	34.70	47.19
T_7- 50% RDF + PSB	19.07	40.79	54.20	22.50	33.90	46.76
T_8- 50% RDF + Azotobacter + PSB	22.99	42.71	49.50	25.90	40.00	48.05
T_9- 25% RDF + Azotobacter	18.50	39.88	44.40	19.00	32.50	45.96
T_{10}- 25% RDF + PSB	18.37	39.86	41.80	18.20	31.50	44.89
T_{11}- 25% RDF + Azotobacter + PSB	18.35	38.62	41.10	16.20	30.90	42.80
CD	**2.48**	**3.87**	**4.42**	**3.97**	**3.33**	**5.05**
SE m-+	**0.83**	**1.29**	**1.49**	**1.33**	**1.22**	**1.68**

Table 3 : Effect of integrated nutrient management on number of branches per plant

Treatments	Number of branches per plant		
	30 DAT	60 DAT	90 DAT
T_1- Control	5.10	9.70	12.90
T_2- 100% RDF	6.34	15.87	14.40
T_3- 75% RDF + Azotobacter	8.00	18.41	17.30
T_4- 75% RDF + PSB	7.07	17.35	15.30
T_5- 75% RDF + Azotobacter + PSB	8.43	19.38	23.50
T_6- 50% RDF + Azotobacter	7.22	17.35	16.30
T_7- 50% RDF + PSB	6.41	16.84	14.50
T_8- 50% RDF + Azotobacter + PSB	8.29	18.96	18.60
T_9- 25% RDF + Azobacter	6.31	15.70	13.80
T_{10}- 25% RDF + PSB	5.73	15.55	13.33
T_{11}- 25% RDF + Azotobacter + PSB	5.80	13.75	13.40
CD (P=0.05)	**1.20**	**3.58**	**4.34**
SE m-$^+$	**0.40**	**1.20**	**1.46**

Number of branches per plant

There was a significant difference observed among the treatments with respect to number of branches per plant at 30 DAT. Application of 75% RDF + Azotobacter + PSB (T_5) registered significantly highest number of branches per plant (8.43) which was found to be at par with treatment (T_8) (8.23). However, the lowest number of branches per plant (5.10) was observed in branches per plants in control treatment (T_1). At 60 DAT, the highest number of branches per plant was found in (T_5), 75% RDF +Azotobacter + (19.30 cm). At 90 DAT, the highest number of the branches per plant was recorded in (T_5) application of 75% RDF + Azotobacter + PSB (23.50) second highest number of branches of treatment T_8 (20.60). While the lowest number of branches per plant was seen in (T_1), in control treatment (12.90). At the same time the lowest number of branches per plant was recorded in treatment (T_1) was control treatment the maximum number of branches due to combined application of NPK + VAM + Phosphobacterin has been reported by Gotmare *et al.* (2007) in China aster.

The luxurious vegetative growth in terms of plant height, stem girth, plant spread and number of branches during the crop growth period in (T5). might have contributed to more dry matter accumulation. The results obtained by Pushkar *et al.* (2008), Gotmare *et al.* (2007) and Ravindran *et al.* (1986) in marigold confirmed the above-mentioned results.

Conclusion

From the above findings it is concluded that the combination of T_5 (75% RDF + Azotobacter + PSB) resulted in maximum growth of French marigold under Lucknow condition.

References

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

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.

Deineka, V.I. *et al.* (2007). "Flowers of marigold (*Tagetes*) species as a source of xanthophylls." *Pharmaceutical Chemistry Journal* **41**, 540-542.

Delgado-Vargas, F., Paredes-Lopez, O., Avila-Gonzalez, E. (1998). Effect of sunlight illumination on marigold flowers meals and egg yolk pigmentation. *J. Agri Food Chem.,* **46**: 698-706

Gayithri, H.N., Jayaprasad, K.V. and Narayanaswamy, P. (2004). Response of biofertilizers and their combined application with different levels of organic fertilizers in statice. *Journal of Ornamental Horticulture*, **70**: 70-74.

Gotmare, P.T., Damke, M.K., Gonge, V.S. and Deshmukh, S. (2007). Influence of integrated nutrient management on vegetative growth parameters of marigold (*Tagetes erecta* L.). *Asian Journal of Horticulture*, **2**(2): 33-36.

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.

Mantrova, E.Z., Mikitima, G.N. and Zdasuyak, V. (1976). Some characteristics of the mineral nutrition greenhouse conditions. *Canadian Horticulture and Home Magazine*, pp. 67.

Mogal, S.A., Khiratkar, S.D., Chopde, N.K., Dalvi, A.M., Kuchanwar, O.D. and Khobragade, Y.R. (2006). 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.

Naik, P.V. and Seetaramu, G.K. (2019). Evaluations of marigold (*Tagetus erecta* L.) genotypes for flower yield and xanthophyll content under for North Estern dry zone of Karnataka. *IJCS*, **7**(4), 1571-1573.

Padma, S.K. and Sharma, S. (1997). "*Tagetes*: a multipurpose plant." *Bioresource Technology,* **62**.1-2: 29-35.

Panse, V.G. and Sukhantme, P.V. (1985). "*Statistical Methods for Agricultural Workers*. I. C. A. R., New Delhi.

Pushkar, N.C., Rathore, S.V.S. and 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.M. (1972). Composition and analysis of the carotenoids in marigold petals. *Journal of the Association of Official Analytical Chemists,* **55**(3): 617-621.

Ravindran, D.V.L., Rama Rao, R. and Nagabhushaman Reddy, E. (1986). Effect of spacing and nitrogen levels on growth, flowering and yield of African marigold (*Tagetes erecta* L.) *South Indian Horticulture*, **34**(5): 320- 323.

Sharma, D.P., Patil, M. and Gupta, N. (2006) Influnce of nitrogen, phosphorus and pinching on vegetative growth and floral attributies in African marigold (*Tagetes erecta* L.). *Journal of Ornamental Horticulture,* **9**: 25-28.

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

Tereschuk, M.L. *et al.* (1997). "Antimicrobial activity of flavonoids from leaves of *Tagetes minuta*." *Journal of Ethnopharmacology,* **56**(3): 227-232.

Vankar, P.S., Shanker, R. and Wijayapala, S. (2009). Utilization of temple waste flower – *Tagetes erecta* for dyeing of cotton, wool and silk on industrial scale. *J. Textile Apparel Tech Manag*6: 1-15. Vasudevan,

Yadav, K.S. (2018). Effect of different bio-fertilizers on growth and flowering of marigold. *Journal of Pharmacognosy and Phytochemistry* **7**(1): 1548-1550.