



Plant Archives

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

DOI Url : <https://doi.org/10.51470/PLANTARCHIVES.2026.v26.supplement-1.425>

EFFECTS OF ORGANIC NUTRIENTS AND BIO-STIMULANTS ON AFRICAN MARIGOLD (*TAGETES ERECTA* L.) UNDER RED LATERITIC SOIL OF WEST BENGAL INDIA

Rohan Kundu¹, Adarsh Thapa^{1*}, Amit Lohar², Sangeet Chettri¹ and Abid Hayat¹

¹Department of Horticulture, School of Agriculture, Seacom Skills University Kendradangal Birbhum West Bengal 731236, India

²Department of Horticulture, MSSSoA- CUTM (Centurion University of Technology and Management), Odisha-761211, India.

*Corresponding author E-mail: adimangarthapa@gmail.com

(Date of Receiving : 24-10-2025; Date of Acceptance : 03-01-2026)

ABSTRACT

The present investigation entitled “effects of organic nutrients and bio-stimulants on African marigold (*Tagetes erecta* L.) under red lateritic soil of west Bengal.” was undertaken during 2022–2024 at the Instructional Farm of Seacom Skills University, Birbhum, West Bengal. The experiment was conducted in a Randomized Block Design with ten treatments and three replications to evaluate the effect of different organic inputs and bio-stimulants With respect to growth, productivity, and economic sustainability of African marigold. Among the different treatment’s combinations, T₉ (Poultry manure + seaweed extract @ 3% + humic acid @ 3%) showed a significant among all the measured traits. Similarly, treatment T₉ also showed a significantly highest returns in case of economics of production. Therefore, from the findings it can be concluded that integration of organic manure with biofertilizers can enhance the growth and productivity due to better nutrient availability and physiological stimulations for sustainable marigold cultivation in West Bengal.

Keywords: African marigold, Organic nutrients, Bio-stimulants, Profitability, Sustainable agriculture.

Introduction

African marigold (*Tagetes erecta* L.) is one of the most economically important loose flowers cultivated in India. It is a robust annual belonging to the Asteraceae family (2n = 24), originates from Central and South America, with Mexico being its primary centre of origin. Growing 60–90 cm tall and completing its life cycle in 3-4 months, it is widely cultivated in India due to its adaptability, ease of cultivation, and high market demand (Upadhyaya *et al.*, 2022). it is widely used in garlands, religious ceremonies, weddings, and decorative landscaping. Beyond floriculture, marigold is an important industrial raw material for extraction of xanthophylls such as lutein, which are in high demand in the food, pharmaceutical and poultry industries. According to National Horticulture Board (NHB), in 2022-23 Indias total estimated loose marigold production was

approximately 728,530 MT from 73,150 hectares (NHB 2022-23). Madhya Pradesh is the leading state with a production of 224.6 kt followed by Karnataka (121.9 kt), Gujarat (83.3 kt) and Andhra Pradesh (76.4 kt). According to National Horticulture Board (2022-23) West Bengal shows substantial cultivated covering an area of 11,370 hectares, the crop is cultivated with a total production of 76 kt, raking 5th nationwide. Despite its economic significance, marigold production in many parts of India is constrained by declining soil fertility and imbalance use of chemical fertilizers and pesticides on a large scale has caused a number of problems for both agriculture and the environment. Using synthetic inputs on a regular basis lowers the fertility of the soil, changes the activity of microbes, and throws off the balance of nutrients, which makes the land less productive. In addition, chemical residues on flowers can be bad for your health, especially when people touch them directly, like when they are used in

religious ceremonies or as decorations. Using too many chemical sprays also makes pests resistant and pollutes the environment, especially through leaching and runoff. These challenges are particularly prominent in the red lateritic soils of West Bengal. This soil type, predominant in districts such as Birbhum, Bankura, and Purulia, is characterized by low organic carbon, poor water-holding capacity, high porosity, and inherently low fertility. Such conditions limit nutrient availability and adversely affect growth and yield performance of nutrient-responsive crops like marigold. Therefore, adopting soil-improving and environmentally sustainable nutrient management strategies is essential for optimizing marigold productivity in this region. Organic farming, on the other hand, is a long-term solution that makes the soil healthier, the flowers better, and the environment safer (Swathi *et al.*, 2017). Organic inputs such as farmyard manure, vermicompost, poultry manure, and biofertilizers not only enrich the soil with essential nutrients but also promote long-term productivity (Singh *et al.*, 2017). These inputs enhance soil structure, increase water retention, stimulate microbial activity, and facilitate gradual nutrient release, thereby improving nutrient-use efficiency. Bio stimulants, including seaweed extracts, humic substances act as metabolic enhancers that promote root development, nutrient uptake, photosynthesis, and stress resilience. Their synergistic action with organic nutrients can significantly improve growth, flower production, and quality attributes. Although several studies have reported the individual effects of organic manures and bio stimulants on field crops and vegetables, scientific information on their combined influence on African marigold, particularly under red lateritic soil conditions, remains limited. Furthermore, standardized combinations and optimal doses of organic inputs and bio stimulants suitable for sustainable marigold cultivation in West Bengal are not well established. Addressing this knowledge gap is essential for developing eco-friendly nutrient management strategies that enhance productivity while minimizing chemical fertilizer dependency. In light of these advantages, the present investigation was undertaken. This research seeks to evaluate the efficacy of selected organic nutrient sources on the vegetative growth, flowering behaviour, and overall yield quality of African marigold under local agro-climatic conditions.

Materials and Methods

The study was carried out between 2022 and 2024 at the Instructional Farm of the School of Agriculture, Seacom Skills University, located at Birbhum, West Bengal, India (23.702063° N, 87.639956° E, at an

elevation of 9.75 meters above mean sea level). The region experiences a subtropical climate with high relative humidity (86%), moderate temperature fluctuations between 8.3°C and 31°C, minimal rainfall (2 mm) during the experimental period, and a distinct winter season from September to March. The experiment was conducted using a Randomized Block Design (RBD), comprising ten different treatment combinations, each replicated three times. The treatments included: T₁ – Absolute control, T₂ – Farmyard manure (FYM @ 10 t/ha), T₃ (Vermicompost @ 5 t/ha), T₄ (Poultry manure @ 2.5 t/ha) T₅ (Mustard cake @ 2.5 t/ha), T₆ (T₁ + Foliar spray of Seaweed @ 3% + Humic Acid @ 3%), T₇ (T₂ + Foliar spray of Seaweed @ 3% + Humic Acid @ 3%), T₈ (T₃ + Foliar spray of Seaweed @ 3% + Humic Acid @ 3%), T₉ (T₄ + Foliar spray of Seaweed @ 3% + Humic Acid @ 3%) and T₁₀ (T₅ + Foliar spray of Seaweed @ 3% + Humic Acid @ 3%). All other standard crop management practices were carried out according to the recommended package of practices specific to the crop and agro-climatic conditions of the region. Data on growth, yield and quality were subjected to analysis of variance (ANOVA) for Randomized Block Design to assess treatment effects. Fisher and Snedecor's 'F' Test with probability at 0.05 % level of significance was used to determine the least significant source of variation using Fisher and Yates' statistical tables (1963). All analyses were carried out using INDOSTAT version 8.1 (Indostat Services, Hyderabad, India).

Results and Discussion

The influence of various treatments on growth and floral characteristics is summarized in Table 1. After perusal of data a significant variation among all the treatments combination were observed for all measured traits. The highest plant height (69.52 cm), Primary branches (18.55), Plant spread (38.22 cm), No. of flowers per plant and Flower diameter (7.75 cm) were observed in treatment T₉ (Poultry manure + seaweed + humic acid @ 3 %) which was followed by treatment T₁₀ (Mustard cake + seaweed + humic acid @ 3%) with a value of Plant height (67.59 cm), number of primary branches (17.89), plant spread (37.79 cm), number of flowers per plant (44.44), and flower diameter (7.00 cm) whereas, the treatment with no or minimal nutrient supply T₁ (Absolute control) followed by treatment T₆ (absolute control + foliar spray of seaweed extract and humic acid @ 3 %) recorded the lowest value regarding growth and floral parameters in marigold. Similarly, the different organic inputs also showed a significant difference on Days to 50 % flowering in marigold. Treatment T₉ (Poultry manure + seaweed +

humic acid @ 3 %) recorded the minimum days to harvest the 50 % produce (40.31 days) which was followed by treatment T₁₀ (Mustard cake + sea weed extract and humic acid @ 3 %) 41.70 days. Incorporation of poultry manure and bio-stimulant (Seaweed extract and humic acid) recorded maximum growth and floral parameters, as poultry manure supply plentiful amount of plant nutrients including potassium, phosphorous and nitrogen. These elements specially nitrogen is an important component of nucleic acids, a significant component of enzymes and proteins and also an organizer of hormone action which is critical for cell division and biological functions. Bio-stimulants improve nutrient uptake by facilitating the movement of micronutrients in the plant which improves the availability and uptake of nutrients which supports plant growth and development (Khan *et al.*, 2018). The early flowering was recorded with combined application of bio-stimulants and poultry manure followed by mustard cake and vermicompost enhanced vegetative growth along with a balanced carbon-to-nitrogen (C:N) ratio may contribute to increased carbohydrate synthesis, which in turn can stimulate earlier and more abundant flowering. Comparable results have also been documented by Garg *et al.* (2020), Buthe *et al.* (2022) and Gupta *et al.* (2023).

The data presented in Table 2 revealed that the application of different organic nutrient source observed a significant variation on yield and self-life of marigold. Upon analysis of the data, the maximum flower yield per plant (458.29 g) and the highest yield per hectare (21.65 q/ha) was recorded in treatment T₉ (Poultry manure + bio-stimulants @ 3 %) which was followed by treatment T₁₀ (Mustard cake + bio-stimulants @ 3 %) with a value of 423.11 g (Flower weight/plant) and 20.01 t (Flower yield/ha) whereas, the minimum flower yield per plant (168.66 g) and the lowest yield per hectare (7.69 t/ha) were observed in treatment T₁ (Absolute control) which was followed by treatment T₆ (Foliar application of humic acid + seaweed extract @ 3 %) with a value of 198.08 g flower yield /plant and 10.15 t/ha flower yield/ha respectively. The superior performance on yield of marigold was observed with combination of poultry manure and bio-stimulants might be, Poultry manure is rich in readily available nutrients like NPK which supported robust growth and early bud initiation. Its rapid mineralization released nutrients were quickly absorbed by the plant which support higher biomass

and flowering, while bio-stimulants enhance physiological efficiency, root activity and stress tolerance. Comparable findings were reported by Buthe *et al.* (2022) and Halder *et al.* (2023). However, the different organic nutrient sources and bio-stimulants also showed a significant variation and recorded a highest self-life (5.26) in treatment comprising of Poultry manure + seaweed extract + humic acid (T₉) which was closely followed by treatment T₁₀ (Mustard cake + seaweed extract + humic acid) with a value of 5.00. Similar findings were also confined by Halder *et al.* (2023) and Miceli *et al.* (2023). The economic evaluation of various treatments revealed substantial differences among treatments (Table 3). After perusal of data treatment T₉ (Poultry manure + seaweed extract + humic acid) showed a superior result and the highest net return of Rs. 3,01,916 and a benefit-cost (B:C) ratio of 3.30 were achieved, followed closely by treatment T₁₀ (Mustard cake + seaweed extract + humic acid), which yielded a net return of Rs. 2,45,366 and a B:C ratio of 2.58. Treatment T₈ (Vermicompost + bio stimulants) also performed well, with a net return of Rs. 2,13,616 and a B:C ratio of (2.31). However, the least performance was observed in treatment T₁ (Absolute control) with a net return (46380) and B:C ratio (1.43). Malik *et al.* (2021), similar findings were confined were they observed that incorporation of organic inputs (Poultry manure) in marigold cultivation gives the profitable outcomes.

Conclusion

The present study clearly demonstrated that the application of organic nutrient sources, particularly when integrated with bio-stimulants significantly enhanced the development, productivity, and floral quality of African marigold. Among all the treatments, T₉ (Poultry manure + seaweed extract @ 3% + humic acid @ 3%) consistently outperformed others by recording the superior result on all the measured traits. It also registered the maximum net returns and the highest benefit-cost ratio which was followed by T₁₀ (Mustard cake + seaweed extract @ 3% + humic acid @ 3%) establishing it as the most economically viable treatment. The study concludes that integrated use of organic manures and bio-stimulants not only improves crop productivity and quality but also ensures environmental sustainability and higher profitability. Therefore, such integrated organic nutrient management practices should be promoted among farmers for sustainable marigold cultivation in similar agro-climatic regions.

Table 1: Effect of different organic nutrient and bio-stimulants on growth and floral parameters of marigold.

Treatments	Plant height (cm)	Primary branches	Plant spread (cm)	Days to 50% flowering	Number of flowers per plant	Flower diameter (cm)
T ₁	55.65	10.05	26.72	55.30	24.65	4.00
T ₂	61.84	14.77	33.00	50.55	36.11	5.00
T ₃	62.04	15.00	33.65	48.85	37.89	5.25
T ₄	64.78	15.33	35.00	47.00	40.78	5.85
T ₅	63.16	15.15	34.25	47.98	38.68	5.55
T ₆	57.55	11.65	28.85	54.65	30.55	4.65
T ₇	66.20	15.66	36.53	45.65	42.22	6.15
T ₈	67.02	16.55	36.89	43.70	43.11	6.65
T ₉	69.52	18.55	38.22	40.30	46.00	7.75
T ₁₀	67.59	17.89	37.79	41.70	44.44	7.00
SE (m) ±	0.88	0.21	0.47	0.64	0.54	0.08
C. D. at 5%	2.62	0.64	1.42	1.91	1.62	0.25

Table 2: Effect of different organic nutrient and bio-stimulants on yield and self-life of marigold.

Treatments	Flower yield per plant (g)	Flower yield (t/ha)	Shelf life (days)
T ₁	168.66	7.69	2.55
T ₂	257.11	13.66	3.00
T ₃	276.04	14.45	3.20
T ₄	325.15	15.55	3.69
T ₅	283.83	15.00	3.38
T ₆	198.08	10.15	3.00
T ₇	373.68	17.64	4.65
T ₈	402.22	18.86	4.00
T ₉	458.29	21.65	5.26
T ₁₀	423.11	20.01	5.00
SE (m) ±	15.03	0.24	0.18
C. D. at 5%	5.02	0.71	0.06

Table 3: Effect of different organic nutrient and bio-stimulants on economics of production of marigold.

Treatments	Cost of cultivation	Gross return	Net return	B:C ratio
	(Rs/ha)	(Rs/ha)	(Rs/ha)	
T ₁	107420	153800	46380	1.43
T ₂	147420	273200	125780	1.85
T ₃	157420	289000	131580	1.84
T ₄	124920	311000	186080	2.49
T ₅	148670	300000	151330	2.02
T ₆	113881	203000	89119	1.78
T ₇	153584	352800	199216	2.30
T ₈	163584	377200	213616	2.31
T ₉	131084	433000	301916	3.30
T ₁₀	154834	400200	245366	2.58

Acknowledgement

This research received no external funding. The authors acknowledge Uttar Banga Krishi Vishwavidyalaya, Dept. of Vegetable Science for providing laboratory and field facilities.

Author's contribution

The research was conceptualized by (AL and AT). Experimental materials were provided by (SC and

AH). Field experimentation and data collection were carried out by (RK). Data analysis and interpretation were performed by (AL and RK), while the manuscript was prepared by (AT).

Conflicts of Interest

All authors declare that they have no conflict of interest relevant to the content of this manuscript.

References

- Anonymous. (2023). *Indian horticulture database*. National Horticulture Board.
- Buthe, M., Sarkar, I., Kishore, B. G., Maitra, S., Khan, A. M., Chatterjee, R., & Roy, A. (2022). Effect of organic nutrients on growth and flowering attributes of African marigold (*Tagetes erecta* L.) under Terai region of West Bengal. *Int. J. Environ. Clim. Change*, **12**(11), 1473–1483.
- Fisher, S. R. A., & Yates, F. (1963). *Statistical tables for biology, agricultural and medical research* (6th ed.). Oliver & Boyd.
- Garge, V. C., Malik, S., Awasthi, M., Singh, S. P., Chaudhary, M., & Kumar, A. (2020). Effect of integrated nutrient management on flower quality of French marigold (*Tagetes patula* L.) cv. Pusa Arpita. *Int. Res. J. Pure Appl. Chem.*, **21**(24), 154–156.
- Gupta, N. K., Ngaich, K. N., Pandey, D. K., & Mishra, S. N. (2023). Impact of organically produced manure on growth, flowering, yield and quality of African marigold (*Tagetes erecta* L.) in Bhopal agro-climatic conditions cv. Pusa Narangi. *Int. J. Plant Soil Sci.*, **35**(17), 290–303.
- Halder, S., Sultana, N., & Islam, M. S. (2023). Effect of different organic manures on the growth and flowering of marigold (*Tagetes erecta* L.). *J. Biosci. Agric. Res.*, **38**(02), 3149–3157.
- Khan, A., Abbas, M. W., Ullah, S., Ullah, A., Ali, S., Khan, A. U., & Khan, M. (2018). Effect of pinching on growth and flower production of marigold. *Int. J. Environ. Sci. Nat. Res.*, **15**(1), 21–23.
- Malik, M., Kumar, T., Jawla, S. K., & Sahrawat, A. (2021). Economic analysis of marigold production under different applications of organic manures. *Pharma Innov. J.*, **10**(3), 155–157.
- Miceli, A., Moncada, A., D'Anna, F., & Vetrano, F. (2023). Effects of microbial bio-stimulants in combination with organic fertilization on growth and ornamental quality of *Tagetes patula* L. *Agro.*, **13**(10), 2522.
- Singh, H., Kumar, P., & Verma, A. (2017). Integrated nutrient management in marigold (*Tagetes erecta*). *Indian J. Hort.*, **74**(3), 521–525.
- Swathi, K., Sarkar, I., Maitra, S., & Sharma, S. (2017). Organic manures and bio-inoculants mediated influence on growth and flowering of African marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gaiinda. *Int. J. Bio-resource Stress Manag.*, **8**(3), 429–432.
- Upadhya, A. K., Singh, R., Singh, P. K., Sengar, R. K., Kumar, M., & Singh, N. V. (2022). Effect of integrated nutrient management on plant growth and flower yield of African marigold (*Tagetes erecta* L.). *Pharma Innov. J.*, **11**(5), 2064–2069.