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Targeted Yield Equation for Marigold in Laterite Soils of Odisha

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ABSTRACT

Background: Floriculture has emerged as a thriving agribusiness, enhancing land productivity, generating diverse employment opportunities from cultivation fields to retail outlets and ultimately raising the incomes of farmers and business owners. Among the commercially cultivated loose flowers worldwide, the marigold (*Tagetes spp.*), belonging to the Asteraceae family, holds significant importance. One of the main factors influencing marigold development and yield among the many agro-techniques is nutrition. Soil testing offers essential insights into the nutrient content of the soil and identifies any imbalances, while fertilizer recommendations are designed to address these imbalances based on the crop's specific requirements. The targeted yield approach has proven effective by promoting balanced fertilization that accounts for both the soil's nutrient status and the crop's needs. While fertilizer prescription equations have been developed for vegetable crops such as pumpkin, okra, tomato and chili under Odisha's soil conditions, similar equations have not been established for flower crops.

Methods: A total of 24 treatment combinations were designed by using four levels of nitrogen, phosphorus and potassium (0, 60, 80 and 100 kg/ha) with two levels of farmyard manure (5 and 10 tonnes/ha) and a control treatment with no fertilizer application.

Result: Data from all 24 plots of the African marigold variety BM-2 were collected for each season and analyzed. The nutrient requirements to produce one quintal of marigold flowers are approximately 0.55 kg of nitrogen, 0.09 kg of phosphorus and 0.56 kg of potassium. The contributions to the required nutrients come from soil (23.07%, 48.01% and 40.01% for N, P and K, respectively), fertilizer (54.92%, 17.51% and 87.40% for N, P and K, respectively) and farmyard manure (27.55%, 8.21% and 7.82% for N, P and K, respectively), to achieve the targeted yield.

Key words: African marigold, Nutrient requirement, Nutrient uptake, Target yield.

INTRODUCTION

Due to a greater focus on food grain farming, India's floriculture business has grown relatively slowly throughout the first 40 years of independence. However, following the liberalization of economic policies in the 1990s, there was a notable increase in the production of loose flowers in floriculture, with production rising from 233 thousand tonnes in 1993-1994 and only 53 thousand hectares in 1993-1994 to an astounding 3.09 lakh hectares in 2016-17 (Kumar *et al.,* 2011). In Odisha, marigold production experienced remarkable growth, increasing from 14,581 quintals in 2003-04 to 2,45,810 quintals in 2013-14 (Das *et al.,* 2020). The state has 2.05 thousand hectares dedicated to marigold cultivation, with a production output of 12.82 thousand metric tons (Indian Horticulture Database, 2017). Apart from agro-climatic advantage our country also enjoys the geographic advantage of being situated between two big markets Europe and South-East Asia, which makes trade easy (Verma and Singh, 2021).

The marigold (*Tagetes spp.*), a member of the Asteraceae family, is a significant loose flower farmed commercially worldwide. African marigold has gained popularity because flower farmers have been drawn to its vast range of eye-catching colors, shapes and good-keeping qualities. One of the most significant commercial loose flower crops, marigold is farmed in practically every Indian state. Odisha has a good capacity for production because of the appropriate soil and climate conditions.

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Nutrition is one of the key factors affecting the growth and yield of marigold among various agro-techniques. While soil testing has become a vital tool for recommending fertilizer dosages for different crops in India, its effectiveness relies on a comprehensive understanding of the interactions between soil, crop variety, fertilizer and climate management in a specific context (Kanwar, 1971). The targeted yield strategy has proven to be more precise, facilitating the

recommendation of balanced fertilization that aligns crop requirements with the soil's available nutrient status. This approach is highly effective as it integrates the nutrient availability in the soil with the crop's needs. The concept of targeted yield is based on a significant linear relationship between crop yield and nutrient uptake. It was first proposed by Troug (1960) and later refined by Ramamoorthy *et al.* (1967).

According to soil taxonomy, the soils of Odisha are classified into four orders: Inceptisols (49%), Alfisols (35%), Entisols (10%) and Vertisols (6%) (Sahu and Mishra, 2005). Approximately 60% of Odisha's soils have medium organic carbon content, while 40% are low in organic carbon. In terms of available phosphorus (P), 73% of soils are medium and 27% are low. For potassium (K), 7% of soils are low, 86% are medium and 7% are high. Fertilizer prescription equations have been developed for field crops such as Pumpkin (Gogoi *et al.,* 2011), Okra (Mishra *et al.,* 2013), Tomato (Mishra *et al.,* 2013), Chilli (Mishra *et al.,* 2013) and French Bean (Pogula *et al.,* 2016). While several crops, including have performed well under Odisha's soil conditions, no equivalent fertilizer prescription equations have been established for flower crops.

MATERIALS AND METHODS

The field and laboratory investigation was conducted from October 2019 to June 2022 at the Biotechnology-cum-Tissue Culture Center (BTCC), Department of Floriculture and Landscaping, College of Agriculture, Odisha University of Agriculture and Technology, Bhubaneswar, Odisha.

All the treatments were randomized separately in each replication. The experimental design followed was randomized block design (RBD). The 24 treatments were selected with three replicates each consisting of T_1 NPK 0:80:80 kg/ha, T_2 NPK 60:60:60 kg/ha, T_3 NPK 60:60:80 kg/ha, T_4 NPK 60:80:80 kg/ha, T_5 NPK 60:80:80 kg/ha, T_6 NPK 80:0:80 kg/ha, T_7 NPK 80:60:60 kg/ha, T_8 NPK 80:60:80 kg/ha, T_9 NPK 80:80:0 kg/ha, T_{10} NPK 80:80:60 kg/ha, T_{11} NPK 80:80:100 kg/ha, T_{12} NPK 80:80:100 kg/ha, T_{13} NPK 80:100:60 kg/ha, T_{14} NPK 80:100:100 kg/ha, T_{15} NPK 60:100:80 kg/ha, T_{16} NPK 100:80:60 kg/ha, T_{17} NPK 100:80:100 kg/ha, T_{18} NPK 100:80:100 kg/ha, T_{19} NPK 80:60:100 kg/ha, T_{20} NPK 80:100:80 kg/ha, T_{21} NPK 100:100:100 kg/ha, T_{22} (Control No organic No chemical), T_{23} FYM 5 tons/ha and T_{24} FYM 10 tons/ha.

Samples of pre-sowing and post-harvest soil were obtained from the top layer (0-15 cm) in a Soil samples, both pre-sowing and post-harvest, were collected from the topsoil layer (0-15 cm). Harvesting began when the first flower reached full bloom and continued every alternate day. Tagged plants were harvested and the number of flowers from each plant was recorded separately. After harvesting, the tagged plants were uprooted, dried properly and processed along with flower samples for laboratory analysis. To estimate yield per hectare, a one-square-meter sample of the marigold crop was taken from each of the 72 treatments. The fresh weight of the flowers and plants was measured. Plant samples were partially shade-dried, then dried at 70°C in a hot air oven and stored for chemical analysis. The nitrogen content in plant and flower samples was determined using the micro-Kjeldahl method (Jackson, 1973). Bray's No. 1 method was used to measure the available phosphorus in soil samples (Bray *et al.,* 1945). Potassium in the acid digest of plant samples and available potassium in the soil were analyzed using a Systronics flame photometer (Model 128).

Fertilizer prescription equations were created for the targeted yield concept using data on initial soil test results, fruit/flower yield, biomass yield and crop nutrient uptake. The essential basic data required for formulating fertilizer recommendations for targeted yield are Nutrient requirement in kg q^{-1} of produce, grain, or other economic produce (NR), Per cent contribution from the soil available nutrients (C_S), Per cent contribution from the applied fertilizer nutrient (C_f) and per cent contribution from the applied organic matter (C_{FYM}).

RESULTS AND DISCUSSION

Flower yield

Variation was observed in the range of 559.15-1008.3 g for the weight of flowers per plant. The highest value for this character was for the nutrient dose T21 NPK 100:100:100 kg/ha (1008.31 g). The range and mean values of flower yield and nutrient uptake in African Marigold for 3 seasons are presented in Table 1.

NPK plays a vital role in boosting flower yields in ornamental plants (Kashif, 2001). Various factors influence yield, including plant height, number of leaves, lateral branches, flowers per plant, flower weight and nutrient uptake by the plant (Naik, 2015) and (Baskaran and Abirami 2017). Increasing NPK dosages significantly improved both the number and weight of flowers per plant (g) and per hectare, along with the overall accumulation of fresh and dry plant biomass. The positive impact of potassium on marigold growth can be attributed to its role in peptide bond synthesis, protein and glucose metabolism and promoting rapid cell division and differentiation (Pal and Ghosh, 2010; Panwar, 2016). These findings align with studies by Durga *et al.* (2017); Tripathi *et al.* (2020); Naik (2015); Ahmad *et al.* (2011) and Sonklien *et al.* (2020) which reported increased yields with higher doses of N, P and K.

Nutrient uptake

The nutrient uptake was increased with increased fertilizer application. Maximum nitrogen uptake (241.38), phosphorous uptake (49.99) and potassium uptake (210.71) was obtained with an application of NPK (100-100-100). Table 1 shows the range and mean values of nutrient uptake in African Marigold.

In a study, Anuradha *et al.* (1988) observed that the nutrient content in African marigolds (*Tagetes erecta* L.) varied not only with different nutrient levels but also across distinct growth stages. Their findings revealed that nitrogen

(N) concentration at 30, 60 and 90 days after transplanting (DAT) significantly increased as nitrogen levels rose from 0 to 90 kg ha^{-1}. The uptake of nitrogen (N), phosphorus (P) and potassium (K) peaked during the full bloom stage and declined during the harvest stage. Moreover, positive interaction between organic (FYM) and inorganic (NPK) nutrients might have hastened the soil nutrient status, which in turn increased the efficiency of nutrient uptake thereby enhancing the yield as reported by Patil and Dhaduk (2009).

Nutrient requirement

The target yield model offered valuable insights into key factors such as nutrient requirements (NR) and the contributions of soil, fertilizer and farmyard manure (FYM) to total nutrient uptake. For the production of one quintal of marigold flowers, the nutrient requirements were determined to be 0.55 kg of nitrogen (N), 0.09 kg of phosphorus (P) and 0.56 kg of potassium (K), as shown in Table 2. The reduced phosphorus requirement may be due to the increased contribution from the soil, likely from the residual effects of the previous crop. Additionally, FYM improved phosphorus availability by reducing fixation and enhancing its efficiency (Mahajan *et al.,* 2014).

Soil efficiency, fertilizer efficiency and organic matter efficiency of marigold

The per centage contribution of fertilizer nutrients was observed in the order of K > N > P, as mentioned in Table 2 aligning closely with the findings of Durga *et al.* (2017) and Tripathi *et al.* (2020). The contribution of farmyard manure

Table 1: Range and mean values of flower yield nutrient uptake in African marigold.

Treatment	NPK	Yield	Nitrogen uptake	Phosphorous uptake	Potassium uptake
	(kg/ha)	q/ha	(kg/ha)	(kg/ha)	(kg/ha)
T_1	0-80-80	203.80	75.47	17.41	116.69
T_2	60-60-60	219.23	89.12	16.44	107.92
T_3	60-60-80	225.12	94.48	16.64	128.13
T_4	60-80-60	230.90	103.89	19.47	117.62
T_5	60-80-80	231.23	105.15	21.12	133.26
T_6	80-0-80	216.50	98.88	15.49	119.85
T_7	80-60-60	241.56	133.24	21.15	131.10
T_8	80-60-80	245.49	138.59	21.33	140.99
T_9	80-80-0	210.93	104.45	17.57	92.01
T_{10}	80-80-60	261.89	149.38	23.05	143.99
T_{11}	80-80-80	261.13	141.01	23.82	154.03
T_{12}	80-80-100	275.98	172.13	26.57	171.21
T_{13}	80-100-60	277.15	179.01	31.12	163.60
T_{14}	80-100-100	262.68	187.57	29.69	158.23
T_{15}	60-100-80	239.48	115.17	26.08	138.74
T_{16}	100-80-60	284.62	219.32	27.40	157.59
T_{17}	100-80-80	286.63	217.38	27.92	173.64
T_{18}	100-80-100	290.38	207.37	30.97	195.05
T_{19}	80-60-100	252.97	158.71	22.94	154.11
T_{20}	80-100-80	281.59	184.66	34.47	168.32
T_{21}	100-100-100	292.97	241.38	49.99	210.71
T_{22}	Control	154.45	53.52	11.29	73.13
T_{23}	5 tons FYM/ha	180.11	62.71	11.86	80.60
T_{24}	10 tons FYM/ha	186.15	67.87	14.17	93.13
	Range	154.45-292.97	241.38-53.52	49.99-11.29	210.71-73.13
	Average	242.21	137.52	23.25	138.48
	SE(m)	3.16	9.08	0.67	4.33
	CV	2.26	8.34	4.99	5.42

Table 2: Nutrient requirement and per cent contribution of nutrients for formulating yield equation.

Basic parameters	N	P_2O_5	K_2O
Nutrient requirement (NR) of flower (kg/q)	0.55	0.093	0.56
Per cent contribution from available soil nutrients (C_S)	23.07	48.01	40.01
Per cent contribution from fertilizer nutrients (C_f)	54.92	17.51	87.40
Per cent contribution from farm yard manure (C_{FYM})	27.55	8.21	7.82

Table 3: Prescribed fertilizer dose of marigold based on a targeted approach.

Available soil nutrients (kg/ha)			Fertilizer nutrient required(kg/ha)											
			Targeted yield (150 q/ha)			Targeted yield (200 q/ha)			Targeted yield (250 q/ha)			Targeted yield (300 q/ha)		
N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
100	4	100	108	65.54	50	158	91.04	82	208	116.54	114	258	142.04	146
120	8	120	99.6	54.58	40.8	149.6	80.08	72.8	199.6	105.58	104.8	249.6	131.08	136.8
140	12	140	91.2	43.62	31.6	141.2	69.12	63.6	191.2	94.62	95.6	241.2	120.12	127.6
160	16	160	82.8	32.66	22.4	132.8	58.16	54.4	182.8	83.66	86.4	232.8	109.16	118.4
180	20	180	74.4	21.7	13.2	124.4	47.2	45.2	174.4	72.7	77.2	224.4	98.2	109.2
200	24	200	66	10.74	4	116	36.24	36	166	61.74	68	216	87.24	100
220	28	220	57.6	0	0	107.6	25.28	26.8	157.6	50.78	58.8	207.6	76.28	90.8

Table 4: Targeted yield equation for marigold.

Particulars	NPK alone	NPK+ FYM
FN	1.0T- 0.42 SN	1.0 T- 0.42 SN- 0.50 FYMN
FP	0.51 T- 2.74 SP	0.51 T- 2.74 SP- 0.47 FYMP
FK	0.64 T- 0.46 SK	0.64 T- 0.46 SK- 0.09 FYMK

Where, FN, FP, FK- Fertilizer N, P and K(kg/ha) respectively; SN, SP, SK- Soil test value of available N, P and K (kg/ha); FYMN, FYMP and FYMK- Amount of N, P and K applied through Farmyard manure; T- Targeted yield (quintal/ha) of marigold.

(FYM) was highest for nitrogen (N), followed by phosphorus (P) and potassium (K), with values of 27.55%, 8.21% and 7.82%, respectively.

Formulation of targeted yield equation and ready reckoner

Following the approach outlined by Ramamoorthy *et al.* (1967), calculations were made for initial soil nutrient status, yield, nutrient uptake, nutrient requirement (NR), soil efficiency (C_S), fertilizer efficiency (C_f) and organic matter efficiency (C_{FYM}). These parameters were incorporated into three separate equations for nitrogen (N), phosphorus (P_2O_5) and potassium (K_2O) to determine the required fertilizer doses for achieving specific yield targets, considering each nutrient individually.

A ready reckoner based on marigold equations was created to provide farmers with a simple, practical tool for immediate use, as shown in Table 3. To use this ready reckoner, farmers must first assess the initial nutrient status of their soil and set a feasible yield target. This tool then recommends the appropriate fertilizer doses for marigold cultivation, customized to the desired yield and the soil's nutrient status. The targeted yield equation for marigold is provided in Table 4.

CONCLUSION

This study resulted in the creation of fertilizer prescription equations for marigold, designed for both NPK alone and integrated nutrient management under the climatic conditions of Odisha. The nutrient requirements to produce one quintal of marigold flowers are approximately 0.55 kg of nitrogen (N), 0.09 kg of phosphorus (P) and 0.56 kg of potassium (K). The contributions to the required nutrients come from soil (23.07%, 48.01% and 40.01% for N, P and K, respectively), fertilizer (54.92%, 17.51% and 87.40% for N, P and K, respectively) and farmyard manure (27.55%, 8.21% and 7.82% for N, P and K, respectively), to achieve the targeted yield.

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Disclaimers

The views and conclusions expressed in this article are solely those of the authors and do not necessarily represent the views of their affiliated institutions. The authors are responsible for the accuracy and completeness of the information provided, but do not accept any liability for any direct or indirect losses resulting from the use of this content.

Informed consent

All animal procedures for experiments were approved by the Committee of Experimental Animal Care and Handling Techniques were approved by the University of Animal Care Committee.

Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this article. No funding or sponsorship influenced the design of the study, data collection, analysis, decision to publish or preparation of the manuscript.

REFERENCES

Anuradha, K., Pampapathy, K. and Narayan, N. (1988). Effect of N and P_2O_5 on the nutrient composition and uptake by marigold (*Tagetes erecta* L.). *South Indian Horticulture.* **36:** 209-211.

Ahmad, I., Asif, M., Amjad, A. and Ahmad, S. (2011). Fertilization enhances growth, yield and xanthophyll contents of marigold. *Turkish Journal of Agriculture and Forestry.* **35(6):** 641-648.

Baskaran, V., Abirami, K. (2017). Effect of pinching on yield of African marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gainda under Andaman conditions. *Agricultural Science Digest.* **37(2):** 148-150. doi: 10.18805/asd.v37i2.7992.

Bray, R.H. and Kurtz, L. (1945). Determination of total, organic and available forms of phosphorous in soils. *Soil Science.* **59:** 39-45.

Das, P.K. (2020). A brief study on Marigold production in Odisha. *International Journal of Research in Engineering, Science and Management.* **3(1):** 156-157.

Durga, M.L., Raju, D.V.S., Pandey, R.N., Singh, K.P., Kumar, P. (2017). Soil test and targeted yield based primary nutrient management of marigold (*Tagetus patula*) in an Inceptisol. *Indian Journal of Agricultural Sciences.* **87(4):** 500.

Gogoi, A., Mishra, A. and Jena, B. (2011). Soil test-based fertilizer recommendation for targeted yield of pumpkin (*Cucurbita moschata*) under rice-pumpkin cropping system in an inceptisol of Odisha. *Environment and Ecology.* **29(2):** 574-576.

Indian Horticulture Database, (2017). Final Area and Production Estimates for Horticulture Crops. National Horticulture Board, Gurgaon.

Jackson, M.L. (1973). Soil Chemical Analysis. Prentice Hall, New Delhi. pp. 111-126.

Kanwar, J.S. (1971). Soil Testing Service in India Retrospect and Prospect. In: Proceedings of International Symposium on Soil Fertility Evaluation. New Delhi. pp: 1103-1113.

Kashif, N. (2001). Effect of NPK on growth and chemical effect on vase life of Zinnia. M.Sc Thesis. PMAS Arid Agricultural University, Rawalpindi, Pakistan.

Kumar, B., Mistry, NC., Singh, B. and Gandhi, C.P. (2011). Indian Horticulture Database. National Horticulture Board, Ministry of Agriculture, Government of India, Gurgaon, Haryana.

Mahajan, G.R., Pandey, R.N., Datta, S.C., Kumar, D., Sahoo, R.N. and Parsad, R. (2014). Fertilizer nitrogen, phosphorus and sulphur prescription for aromatic hybrid rice (*Oryza sativa* L.) using targeted yield approach. In: Proceedings of the National Academy of Sciences. *India Section B: Biological Sciences.* **84(3):** 537-547.

Mishra, A., Dash, B.B., Nanda, S.K. and Das, D. (2013). Soil test-based fertilizer recommendation for targeted yield of lady's finger (*Abelmoschus esculentus*) under rice-lady's finger cropping system in an Ustochrept of Orissa. *Environment and Ecology.* **31(1):** 58-61.

Mishra, A., Dash, B.B., Nanda, S.K. and Das, D. (2013). Soil test-based fertilizer recommendation for targeted yield of tomato (*Lycopersicon esculentum*) under rice-tomato cropping system in an Ustochrept of Odisha. *Environment and Ecology.* **31(2A):** 655-658.

Naik, M.R. (2015). Influence of nitrogen and phosphorus on flowering, N and P content of African marigold (*Tagetes erecta* L.) var. Cracker Jack. *International Journal of Farm Sciences.* **5:** 42-50.

Pal, P. and Ghosh, P. (2010). Effect of different sources and levels of potassium on growth, flowering and yield of African marigold (*Tagetes erecta* Linn.) cv. 'Siracole'. *Indian Journal of Natural Products and Resources.* **1:** 371-375.

Panwar, A. (2016). Effect of different levels of potash, nitrogen and spacing on size and weight of African marigold (*Tagetes erecta* Linn.). *International Journal of Scientific Research.* **5(10):** 306-307.

Pogula, S., Truptimayee, S., Mishra, A., Saren, S., Dey, P. (2016). Soil test based fertilizer recommendation for targeted yield of French bean (*Phaseolus vulgaris*) under rice-french bean cropping system. *International Journal of Bio-resources and Stress Management.* **7(5):** 1128-1130.

Patil, S.D. and Dhaduk, B.K. (2009). Response of growth and yield parameters of African marigold (*Tagetes erecta* L.) to organic and inorganic fertilizers. *Journal of Ornamental Horticulture.* **12(2):** 116-122.

Ramamoorthy, B., Narasimham, R.L. and Dinesh, R.S. (1967). Fertilizer application for specific yield targets on Sonora 64 (Wheat). *Indian Farming.* **17(5):** 43-45.

Sahu, G.C. and Mishra, A. (2005). Soil of Orissa and its management. *Orissa Rev.* **16:** 56-60.

Sonklien C., Intanon P., Terapongtanakorn S., Intanon R. (2020). Comparative assessment of fertilizers on yield and quality of marigold (*Tagetes erecta* L.). *Indian Journal of Agricultural Research.* **54(3):** 367-372. doi: 10.18805/IJARe.A-478.

Tripathi, V., Srivastava, A., Singh, M. (2020). Fertilizer prescription based on soil test crop response approach in marigold-urd crop ping system grown in soils of Uttarakhand. *Progressive Agriculture.* **20:** 80-92.

Troug, E. (1960). Fifty Years of Soil Testing. Transactions of 7th International Congress of Soil Science. Madison Wisconsin, USA, Part III-IV. pp 36-45.

Verma, J., Singh, P. (2021). Post-harvest handling and senescence in flower crops: An overview. *Agricultural Reviews.* **42(2):** 145-155. doi: 10.18805/ag.R-1992.