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EFFECT OF INTEGRATED NUTRIENT MANAGEMENTS ON ECONOMIC FEASIBILITY OF AFRICAN MARIGOLD (*TAGETES ERECTA* L.) CV. PUSA NARANGI GENDA

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ABSTRACT

A field experiment was conducted during the winter season of 2020-21 and 2021-22 to study the effect of Integrated Nutrient Managements on economic feasibility of African marigold (*Tagetes erecta* L.) cv. Pusa Narangi Genda. The experiment was conducted at the Department of Horticulture, Research Farm No.-1, Babasaheb Bhimrao Ambedkar University, Vidya-Vihar, Rae-Bareli Road, Lucknow, Uttar Pradesh, India. Three biofertilizers (*Azotobacter, Azospirillum* and PSB), three levels of vermicompost (2.0, 3.0 and 4.0 t ha^{-1}) and three levels of NPK (75, 60 and 45% of RDF) were included in the treatments. The experiment was laid out in a Randomized Block Design with three replications and eleven different treatment combinations of inorganic, organic and biofertilizers nutrients to calculate the economics of marigold crop cultivation. Among the different treatments studied, highest gross return (402980 Rs/ha) was obtained from treatment T_8 (60% RDF + 3 t ha^{-1} Vermicompost + *Azotobacter* + *Azospirillium* + PSB) followed by T_5 (75% RDF + 2 t ha^{-1} Vermicompost + *Azotobacter* + *Azospirillium* + PSB) (Rs 373620 /ha), T_3 (75% RDF + 2 t ha^{-1} Vermicompost + *Azotobacter* + PSB) (Rs 352670/ha) and minimum gross return was recorded from treatment T_1 (Control) (Rs. 111100/ha) with a net return of Rs. 291207/ha (T_8), Rs. 265514/ha (T_5), Rs 244939 /ha (T_3) and Rs 70350 /ha (T_1), respectively. The investment in marigold crop was found to be economically sound and highly remunerative as these treatments produce highest flower yield per hectare resulted in maximum B:C ratio of 2.60 (T_8) followed by 2.45 (T_5), 2.27 (T_3) and 0.77 (T_1) respectively, hence the same can be exploited for commercial cultivation to meet the increasing global demand as well as to increase income of the growers.

***Key word*:** Economic feasibility, INM, Marigold, Profit, Yield.

Introduction

Flowers are regarded as a source of aesthetic, affection and natural prosperity. We use flowers to evoke positive emotions like joy and love. Marigold native to South and Central America, predominantly Mexico and belongs to Composite family. The marigold exhibited larvicidal, antibacterial and antimicrobial activities. In India, major flower growing states are West Bengal, Tamil Nadu, Karnataka and Uttar Pradesh etc. About 305-thousand-hectare area under floriculture with production estimated to 2301 thousand MT of loose flower and 762 thousand MT of cut flower. Among these flowers, marigold is the leading loose flower of India (Anomous, 2020-2021). There are three species of the genus *Tagetes* that are frequently grown viz., *Tagetes erecta* (African marigold), *Tagetes patula* (French marigold) and *Tagetes minuta*. *Tagetes erecta* and *Tagetes patula* are two of these that are more frequently grown for their ornamental qualities, *Tagetes minuta* for the high amount of essential oil. The oil of *T. minuta* was reported to possess bronchoditary, tranquilizing, spasmolytic and anti-

inflammatory properties (Chandhoke and Ghatok, 1969). Marigolds have a long, upright growth habit. Plants can grow to a height of 30 to 90 cm. Deep orange, light orange, golden yellow, bright yellow and lemon yellow etc. are the color of the flowers of these species. Flowers can range in size from 4 to 6 cm of diameter (Singh and Sisodia, 2017). Loose flowers mostly used for the purpose of weaving garlands, decoration buildings, gates and pandals for social events, wedding ceremonies, worshipping and creating floral rangoli, it is used as cut flowers for vase decoration and other arrangements.

Every home garden, park and garden in the nation regularly grows marigold as a garden plant for bedding and pot culture, herbaceous border, hanging baskets and window boxes. To increase the yellow colour of egg yolks, carotenoid pigment from marigold is a useful source for chicken feed. Marigold is also used in the manufacturing of essential oils and natural colours. It serves as a nematode and mosquito repellent (Bose and Yadav, 1993). The planting of marigolds has been effective in nematode population reduction, mainly for *Meloidogyne* species. The chemical alphaterthienyl, one of the most naturally occurring toxic compounds, is released from the root of *Tagetes* species (Gommers and Bakker, 1988). This substance prevents nematode eggs from hatching when it is present. Growing *Tagetes erecta* and *Tagetes patula* led to a noticeably reduced rate of nematode multiplication. Thiopenes, which marigolds produce and are employed as trap crops in tomato, brinjal, tobacco and other plants, are toxic to nematodes (Raghava, 2000).

Marigold required adequate nutrients for good flower yield and most of Indian soils are deficient in major and micro nutrients. Indiscriminate use of conventional fertilizers by farmers for increasing crop productivity causes several problems like – water contamination, environmental pollution, soil degradation and food toxicity that caused health hazards for human beings and animals also. Among the different options, integrated nutrient management is a technique that encourages the judicious and efficient application of chemical fertilizers along with the addition of organic manures and bio-fertilizers. An integrated nutrient management system (INMS) may play a vital role in sustaining both soil health and flower production on long term basis, which may be achieved through combined use of all possible sources of nutrition. Integration of chemical fertilizers with organic manures and bio-fertilizers can maintain soil health and soil productivity (Bhandari *et al.*, 2012).

The economic factors of any agricultural recommendation, including the flower yield (q/ha), cost of cultivation (Rs/ha), grass profit (Rs/ha), net profit (Rs/ha) and benefit: cost ratio are very essential for its adaptation to the farming community. The ultimate goal of producers is to maximize their profits, which depends on crop output. The application of input and other cultural practices directly affected the yield.

Materials and Methods

During the winter seasons of 2020-21 and 2021-22, the present investigation was conducted at the Department of Horticulture, Research Farm No.-1, Babasaheb Bhimrao Ambedkar University, Vidya-Vihar, Rae-Bareli Road, Lucknow-226025. The seeds were obtained from seed production unit, IARI, New Delhi. Thirty days old seedlings of African marigold variety Pusa Narangi Gainda were transplanted at 45×45 cm in well-prepared seedbed (1.8m × 1.8m) in the month of December. Fertilizers were applied at the rate of 200:80:80kg NPK/ha. 50% of nitrogen and full dose of phosphorous, potash and vermicompost were applied just before transplanting of seedlings according to the treatment combinations and remaining 50% of nitrogen was applied at 45 days after planting. The seedlings roots were dipped for 30 minutes in the prepared solution of bio-fertilizers (*Azospirillum, Azotobactor* and PSB) for 30 minutes @ 5 ml/liter of water before transplanting. The present experiment comprised with eleven treatments *i.e.* T_1 (Control), T_2 (100% RDF), T_3 (75% RDF + 2 t ha^{-1} Vermicompost + *Azotobacter* + PSB), T_4 (75% RDF + 2 t ha^{-1} Vermicompost + *Azospirillium* + PSB), T_5 (75% RDF + 2 t ha^{-1} Vermicompost + *Azotobacter* + *Azospirillium* + PSB), T_6 (60% RDF + 3 t ha^{-1} Vermicompost + *Azotobacter* + PSB) T_7 (60% RDF + 3 t ha^{-1} Vermicompost + *Azospirillium* + PSB), T_8 (60% RDF + 3 t ha^{-1} Vermicompost + *Azotobacter* + *Azospirillium* + PSB), T_9 (45% RDF + 4 t ha^{-1} Vermicompost + *Azotobacter* + PSB), T_{10} (45% RDF + 4 t ha^{-1} Vermicompost + *Azospirillium* + PSB) and T_{11} (45% RDF + 4 t ha^{-1} Vermicompost + *Azotobacter* + *Azospirillium* + PSB) these treatments were replicated thrice in Randomized Block Design (RBD). The cost of cultivation (Rs. /ha), gross income (Rs. /ha), net profit (Rs. /ha) and the Cost: Benefit ratio were used to calculate the economic aspects of various treatments. The cost of cultivation was calculated by current market rate. The obtained data was statistically analyzed adopting procedure as given by Panse and Sukhatme (1985) and treatment means were statistically compared at 5% level of significance.

Results and Discussion

During the period 2020-21, the maximum flower yield (206.07 q/ha) was observed (Table 1) under thetreatment

Table 1: Effect of integrated nutrient management on flower yields of African marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gainda.

S. N.	Treatment	Flower yield per plant (g)			Flower yield per ha (q)		
		2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
T_1	Control	164.88	162.20	163.54	81.17	79.93	80.55
T_2	100% RDF	331.94	318.15	325.05	163.78	156.89	160.34
T_3	75% RDF + 2 t ha^{-1} Vermicompost + *Azotobacter* + PSB	358.51	356.12	357.32	176.95	175.72	176.34
T_4	75% RDF + 2 t ha^{-1} Vermicompost + *Azospirillium* + PSB	334.26	327.20	330.73	165.01	161.42	163.22
T_5	75% RDF + 2 t ha^{-1} Vermicompost + *Azotobacter* + *Azospirillium* + PSB	377.21	380.11	378.66	186.07	187.55	186.81
T_6	60% RDF + 3 t ha^{-1} Vermicompost + *Azotobacter* + PSB	278.71	263.83	271.27	137.44	130.04	133.74
T_7	60% RDF + 3 t ha^{-1} Vermicompost + *Azospirillium* + PSB	319.94	297.87	308.91	157.81	146.91	152.36
T_8	60% RDF + 3 t ha^{-1} Vermicompost + *Azotobacter* + *Azospirillium* + PSB	417.60	399.10	408.35	206.07	196.91	201.49
T_9	45% RDF + 4 t ha^{-1} Vermicompost + *Azotobacter* + PSB	261.02	255.19	258.11	128.70	125.82	127.26
T_{10}	45% RDF + 4 t ha^{-1} Vermicompost + *Azospirillium* + PSB	237.24	231.15	234.20	117.07	113.99	115.53
T_{11}	45% RDF + 4 t ha^{-1} Vermicompost + *Azotobacter* + *Azospirillium* + PSB	294.56	276.78	285.67	145.37	136.52	140.95
SE (m)±		13.37	13.18	13.28	6.59	6.50	6.55
CD (p=0.05)		39.73	39.16	35.88	19.60	19.32	17.70

T8 (60% RDF + 3 t ha^{-1} Vermicompost + *Azotobacter* + *Azospirillium* + PSB) followed by the treatment T5. While, minimum flower yield per ha (81.17 q/ha) was observed in the treatment T_1 (Control). Similarly, during the period of 2021-22, the maximum flower yield (196.91 q/ha) was observed under thetreatment T8 (60% RDF + 3 t ha^{-1} Vermicompost + *Azotobacter* + *Azospirillium* + PSB) followed by the treatment T5. While, minimum flower yield per ha (79.93 q/ha) was observed in the treatment T_1 (Control). The maximum pooled value of flower yield per ha was observed in treatment T_8 (201.49 q/ha), followed by treatment T_5 and the minimum flower yield per ha (80.55 q/ha) in treatment T_1 (Control). This may be because biofertilizers produce substances that promote growth, such as IAA, gibberellin-like substances, vitamin B 12, thiamine, and riboflavin (B 2), which improve soil fertility when vermicompost is applied with a balanced dose of inorganic fertilizers. This increases the availability of vital plant nutrients, which promotes root and shoot development and, ultimately, growth. After then, it may have affected the reproductive stage and induced flowering, increasing the number of flowers per plant, flower yield plot, and per hectare. These findings are in accordance with those of Gupta (1983), Kapadiya *et al.*, (2008), Patel *et al.*, (2008), Naik *et al.*, (2008), Dodake *et al.*, (2007) and Sunitha *et al.*, (2007) in marigold, Kulkarni *et al.*, (1996), Panchal (2006) and Chaitra and Patil (2007) in China aster, Parmar (2006) in gaillardia.

Table 2: Effect of integrated nutrient managements on economics of the crop production of Marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gainda.

Treat-ments	Total cost	Gross returns (Rs. / ha.)			Net returns (Rs. / ha.)			B:C ratio		
		2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
T_1	90750	162340	59860	**111100**	71590	69110	70350	0.78	0.76	**0.77**
T_2	99631	327560	313780	**320670**	227928	214149	221038.5	2.28	2.14	**2.21**
T_3	107731	353900	351440	**352670**	246169	243709	244939	2.28	2.26	**2.27**
T_4	107881	330020	322840	**326430**	222139	214959	218549	2.05	1.99	**2.02**
T_5	108106	372140	375100	**373620**	264034	266994	265514	2.44	2.46	**2.45**
T_6	111678	274880	260080	**267480**	163202	148402	155802	1.46	1.32	**1.39**
T_7	111548	315620	293820	**304720**	204072	182272	193172	1.82	1.63	**1.72**
T_8	111773	412140	393820	**402980**	300367	282047	291207	2.68	2.52	**2.60**
T_9	115066	257400	251640	**254520**	142334	136574	139454	1.23	1.18	**1.20**
T_{10}	115216	234140	267980	**251060**	118924	112764	115844	1.03	2.32	**1.67**
T_{11}	115066	290740	273040	**281890**	175674	157974	166824	1.52	1.37	**1.44**

Rate: Urea-5.93Rs/kg,DAP-24Rs/kg, MOP-19Rs/kg, Vermicompost-5.0Rs/kg, *Azotobater*-900Rs/litre, *Azospirillium*-1500Rs/litre, PSB-380Rs/litre, Production Cost- 90750.0, Selling Price of Marigold flowers -20 Rs/kg

The return per hectare was estimated in terms of flower yield per hectare at existing market rate of Lucknow during the year 2020-21 and 2021-22. The economics of the marigold crop cultivation under different treatment combination was worked out on the basis of input-output analysis. The cost of seed, fertilizers, biofertilizers, labor costs, insecticides, pesticides, irrigation, harvesting and other inputs were all directly related to the cost of cultivation. Under several treatments, it was determined that grass profit was directly correlated with the yield of marketable flower. Thus, the results obtained on various components of crop economics were presented in Table 2. Economics of marigold crop production for one-hectare different cost components were evaluated and found that total cost of marigold cultivation was Rs. 90750.0/ha. The data cleary indicated that the highest cost of cultivation was calculated with an expenditure of 115216 Rs/ha while, the minimum cost of cultivation Rs.90750. The maximum gross income of (402980 Rs./ ha) was calculated from T_8 treatment and minimum gross income (111100 Rs./ha) calculated from T_1 treatment. The maximum net returns (291207 Rs. /ha) was recorded with T_8 treatment which is best from other treatments. However, the minimum net returns (70350 Rs./ha) was worked out from T_1 treatment. The maximum cost: benefit ratio (1:2.60) was noted from T_8 treatment. However, minimum cost: benefit ratio (1: 0.77) was recorded from T_1 treatment due to their poor performance in terms of yield, flowering behaviour and susceptibility to biotic factors. The results are in accordance with the findings of Baboo and Sharma (1997) and Hemavathi (1997) in chrysanthemum, Raju and Haripriya (2001) in crssandra, Shasshidhara and Gopinath (2005) in calendula, Kumar *et al*., (2020) and Godse *et al*., (2006) in gladiolus.

Conclusion

On the basis of present investigation the highest net return (291207 Rs/ha) and highest Benefit:Cost ratio (2.60 : 1) was calculated by the application of T_8 treatment (60% RDF + 3 t ha^{-1} Vermicompost + Azotobacter + Azospirillium + PSB).

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