YIELD POTENTIALITY AND ECONOMIC PROFITABILITY AS INFLUENCED BY CONJOINT APPLICATION OF SPENT MUSHROOM COMPOST, BIOFERTILIZERS AND MONO POTASSIUM PHOSPHATE (MKP) IN MARIGOLD

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ABSTRACT

The present investigation was carried out under open field conditions during the year 2018-19 to ascertain the influence of spent mushroom compost, biofertilizers and foliar application of water soluble fertilizer, Mono Potassium Phosphate (MKP) on flower yield and economics of French marigold 'Local'. The results revealed that the overall cost of cultivation as well as the economics of marigold flower production was significantly influenced by various Integrated nutrient management (INM) schedules. French marigold 'Local' plants supplied with 75 % RDF + Spent mushroom compost (1 kg/m^2) + Biofertilizers + 1% foliar spray of MKP (00:52:34) produced maximum yield of saleable flowers (25000 Kg/ha) followed by 75 % RDF + Biofertilizers + 1% foliar spray of MKP (23000 Kg/ha) which was significantly superior over the 100 % RDF recording 20000 Kg/ha flower yield. Both the above mentioned treatments also recorded maximum net returns of Rs.339171.60/ha. The highest benefit : cost (B: C) ratio of 2.81 was recorded with the treatment 75 % RDF + Biofertilizers + 1% foliar spray of MKP.

Keywords: French marigold, INM, water soluble fertilizers, biofertilizers, spent mushroom compost, economics

1. INTRODUCTION

"Marigold (*Tagetes spp.)*, a member of the family Asteraceae is one of the most popular and versatile loose flower crop of Jammu region. Popularly known as 'Gainda', flower has a huge demand during various festive occasions and attracts the attention of flower growers in the state. Jammu region witnessed a huge demand of marigold flowers for garland making, offering in temples and other decorative purposes. Ever increasing demand of the flowers cannot be met out as is evident form procurement of flowers worth several lakhs from neighbouring states during festive occasions. The varied agro-climatic conditions of the state are highly suitable for the cultivation of marigold. To fulfill the demand, it necessiates to increase the production through improved production technologies. The continued use of high doses of chemical fertilizers resulted in to poor health of the soil" (Patel *et al.* 2009, Singh and Singh 2009), "nutrient imbalances and ultimately poor fertilizer use efficiency. Therefore, such strategies should be developed and used which aimed at sustainability and eco-friendliness. Integrated nutrient management maintains the soil fertility and plant nutrient supply to an optimum level for sustaining the desired crop production through optimization of benefits from all possible sources of plant nutrients" (Chaudhary *et al*. 2004, Gruhn *et al*. 2005, Afagh *et al*. 2019).

"Keeping in view the importance of crop and the present demand of quality flower, the investigations was carried out with the view to optimize a suitable Integrated Nutrient Management schedule for enhancing economic profitability of French marigold in Jammu region". (Dogra S *et al*. 2022)

2. MATERIAL AND METHODS

Location and Site:

The experimental field of Division of Vegetable Science and Floriculture, SKUAST, Jammu is situated at 32^{o} 40'N latitude and 74^{o} 58' E longitude and has an elevation of 332 m above mean sea level. Agro climatically the location represents Zone V of Jammu and Kashmir and is characterized by subtropical climate. The place experiences hot dry summer, hot and humid rainy season and cold winter months, the maximum temperature goes up to 45°C during summers (May to June) and the minimum temperature falls to 1°C during winters

Treatment Details:

A randomized block design was used to evaluate the effect of twenty three different nutritional treatments replicated thrice viz., T_1 = Farmers practice (i.e. no fertilizer application); T_2 = Control (Recommended dose fertilizer 200 kg N, 100 kg P_2O_5 and 100 kg K_2O/ha); T_3 = 75 % RDF + Spent mushroom compost (1 kg/m^2); T_4 = 75 % RDF + Biofertilizers; T_5 = 75 % RDF + 1% foliar spray of MKP (00:52:34); T_6 = 75 % RDF + Spent mushroom compost (1 kg/m^2) + Biofertilizers; T_7 = 75 % RDF + Spent mushroom compost (1 kg/m^2) + 1% foliar spray of MKP (00:52:34); T_8 = 75 % RDF + Biofertilizers + 1% foliar spray of MKP (00:52:34); T_9 = 75 % RDF + Spent mushroom compost (1 kg/m^2) + Biofertilizers + 1% foliar spray of MKP (00:52:34); T_{10}= 50 % RDF + Spent mushroom compost (1 kg/m^2); T_{11}= 50 % RDF + Biofertilizers;T_{12}= 50 % RDF + 1% foliar spray of MKP (00:52:34);T_{13}= 50 % RDF + Spent mushroom compost (1 kg/m^2) + Biofertilizers; T_{14}= 50 % RDF + Spent mushroom compost (1 kg/m^2) + 1% foliar spray of MKP (00:52:34); T_{15}= 50 % RDF + Biofertilizers + 1% foliar spray of MKP (00:52:34); T_{16}= 50 % RDF + Spent mushroom compost (1 kg/m^2) + Biofertilizers + 1% foliar spray of MKP (00:52:34); T_{17}= 25 % RDF + Spent mushroom compost (1 kg/m^2);T_{18}= 25 % RDF + Biofertilizers; T_{19}= 25 % RDF + 1% foliar spray of MKP (00:52:34); T_{20}= 25 % RDF + Spent mushroom compost (1 kg/m^2) + Biofertilizers; T_{21}= 25 % RDF + Spent mushroom compost (1 kg/m^2) + 1% foliar spray of MKP (00:52:34); T_{22}= 25 % RDF + Biofertilizers + 1% foliar spray of MKP (00:52:34) and T_{23}= 25 % RDF + Spent mushroom compost (1 kg/m^2) + Biofertilizers + 1% foliar spray of MKP (00:52:34) on yield potentiality and economic profitability of marigold.

Field layout / Planting procedure and treatment application:

Seedlings of marigold were transplanted in the experimental plots at a spacing of 40 cm x 40 cm thereby accommodating 21 seedlings per bed size of 2.80 m × 1.20 m. Biofertilizers viz.

Azotobacter chroococcum and phosphorous solubilizing micro-organisms (*Bacillus polymyxa* +*Pseudomonas striata*) were applied by dipping the roots of marigold seedlings into a slurry of 200 g of the inocula dissolved in one litre of 10 % sugar solution at the time of planting. Foliar spray of 1% MKP (Mono potassium phosphate; 00:52:34 water soluble fertilizer) was given twice during the experiment. First application was given at 30 days after transplanting and second application at 60 days after transplanting (DAT).

"One year old spent mushroom compost from which the crop of button mushroom has been harvested was procured from Mushroom Research and Training Centre, Division of Plant Pathology, SKUAST-Jammu. Spent mushroom compost before incorporation into the field was treated with 4% formalin and kept covered with polythene for 48 hours. After 48 hours the cover was removed and the spent mushroom compost was turned upside down frequently so as to release the fumes of formalin. Once the spent mushroom compost becomes free of formalin fumes, it was incorporated into the plots. Irrigations were given as and when required during crop growth. Pinching was done after 35 days of transplanting. The experimental plots were kept clean by regular hand weeding. No insect pest and disease incidence was observed during the experiment. Data on various parameters were recorded and statistically analyzed by applying the technique of analysis of variance using Randomized Block Design" (Gomez and Gomez 1985). The level of significance for t-test was kept at 5% (P=0.05). (Dogra S *et al*. 2022)

Calculation of economics:

The yield of loose flowers was calculated for one hectare area and expressed in Kilograms. The economics of the individual treatment was calculated based on the total cost of cultivation and gross income. The expenditures both recurring and non recurring incurred during the cropping period were computed based on the investment on preparatory cost including planting materials. Cost of production was calculated by taking into account the cost of land preparation, material inputs, irrigation, harvesting and assembling expenses etc. with labour charges taken as Rs. 325 per manday. For calculating the gross monetary return, sale price of the loose flower have been taken as Rs.25/kg. Gross monetary returns (Rs./ha) was worked out for different treatments as:

Gross monetary returns (Rs. / ha) = Total saleable flowers/ ha × Market rate

Net returns (Rs. / ha) = Gross returns/ ha – Total expenditure/ ha

Benefit: Cost ratio: Net returns/Total expenditure

3. RESULTS AND DISCUSSION

The most important single factor which decides the adoption of any improved cultural practice by the grower is its cost of cultivation. The cost-benefit ratio of treatments is another most important factor that determines its usefulness and acceptance by the grower. A treatment should not only be effective but also should be profitable in proposition to be accepted by a grower. In the present study, the different treatments showed clear impact on the comparative economics of the production of flowers in French marigold. The details pertaining to costs and returns are given in Table 1.

Yield analysis

The yield data pertaining to flower production under the influence of different integrated nutrient management treatments comprising of combinations of organic manure, inorganic fertilizers, biofertilizers and water soluble fertilizers are appended in Table 2. From the data, it is evident that the treatment T_9 comprising of 75 % RDF + Spent mushroom compost (1 kg/m^2) + Biofertilizers + 1% foliar spray of MKP recorded significantly highest flower yield of 25000 Kg/ha compared to other treatments followed by 23000 Kg/ha in treatment T_8 (75 % RDF + Biofertilizers + 1% foliar spray of MKP and 20000 Kg/ha in treatment T_2 (100% RDF) whereas, the lowest yield (9500 Kg/ha) was recorded in Farmers practice (T_1).The economics under various treatments are worked out on the basis of yield under each individual treatment.Different studies conducted have reported increased in yield of cut/loose flowers under application of organic, inorganic, biofertilizers in combination or alone. Kore *et al*. (2003) reported "highest flower yield with water soluble fertilizer AQUAFERT, 19:19:19, NPK at 75% of the recommended dose of fertilizer in China aster". Barman *et al*. (2006) also recorded "highest flower yield per m^2/annum with 200 and 300 kg N and K_2O $ha^{-1}year^{-1}$ through water soluble fertilizers in rose". Enhanced flower yields in commercial flower crops by application of 75% RDF along with FYM (2 kg/m^2), Vermicompost (300 g/ m^2) + *Azospirillum* (2 g/plant/year) + PSB (2 g/plant/year) were reported by Majumder *et al* (2014). "Carnation cv. Master plants fertilized with 250 ppm N and K fertigation through urea and MOP + 250 ppm NPK foliar spray through a water soluble fertilizer Sujala (19 : 19 : 19 NPK) once a week is improved yield parameters and proved superior over the earlier recommended practices and the rest of the treatments" (Singh *et al* 2013 and Singh *et al.* 2015). Kumari and Prasad (2016) reported "maximum number of flowers/plant with conjoint application of *Azotobactor* + PSB +PMB + 100% doses of NPK in petunia".

Total expenditure

Among all the treatments, the highest gross expenditure of Rs. 160828.43 per ha was incurred in 75 % RDF + Spent mushroom compost (1 kg/m^2) + Biofertilizers + 1% foliar spray of MKP (T_9) followed by Rs. 160626.83 in treatment T_6, Rs. 160328.43 in T_7 and Rs. 160126.83 in T_4 and lowest of Rs. 111875.00 per ha with Farmers practice (T_1).

***Gross return*.**

Highest gross returns in monetary terms (Rs.500000/ha) was recorded with T_9 comprising of 75 % RDF + Spent mushroom compost (1 kg/m^2) + Biofertilizers + 1% foliar spray of MKP followed by Rs. 460000/- in treatment T_8 (75 % RDF + Biofertilizers + 1% foliar spray of MKP) and Rs. 400000/- in treatment T_2 (100% RDF). Lowest gross return of Rs.1,90,000/- was recorded in farmers practice (T_1).

Net return

Adoptability of any farming system is decided by the net returns which are regarded as the main parameter deciding its sustainability. The highest net income of Rs. 339171.60 per ha was recorded with treatment T_8 (75 % RDF + Biofertilizers + 1% foliar spray of MKP) and T_9 (75 % RDF + Spent mushroom compost (1 kg/m^2) + Biofertilizers + 1% foliar spray of MKP) followed by Rs.287022.50 in 100% RDF (T_2), whereas as the lowest net income of Rs.78125.0 was recorded in Farmers practice (T_1). Verma *et al.* (2011) recorded "highest net returns and B: C ratio/ha with azospirillum, PSB, vermicompost and 50% recommended dose of NPK in chrysanthemum". Angadi (2014) reported "highest net income and benefit cost ratio with azospirillum+PSB+ 50 % vermicompost equivalent to RDN + 50 % recommended NPK in garland chrysanthemum. Dalwai and Naik (2017) reported application of 75% RDF+ azospirillum+PSB+ vermicompost +FYM resulted in maximum net returns and highest benefit cost ratio with carnation cv.Soto. Similar results of increased yields and higher benefit cost ratios were also reported by" Kumar *et al*. (2016) and Tiwari *et al.* (2018) in marigold.

Benefit- cost analysis

In the present investigations, economic analysis of different treatments revealed that application of T_8 comprising of 75 % RDF + Biofertilizers + 1% foliar spray of MKP gave maximum returns with benefit cost ratio of 2.81 closely followed by 2.54 in 100 % RDF. The economic value of a crop is determined by its yield and quality. If growing conditions provide required microclimate and nutrition, plants exhibit full expression of genetic potential, yield and quality for long period. The acceptance of any package by farmers depends largely on the comparative economics of a practice and also feasibility of adoption as well as its effect on yield and quality as well. This increase in monetary return may be attributed to higher yield and improved quality of flowers which fetches higher price in the market. The variation in net returns and cost: benefit ratio might be due to the difference in yield, price of flowers and other inputs like spent mushroom compost, biofertilizers and MKP. Jadhav *et al.* (2014) reported the maximum benefit cost ratio with the application of 75% RDN + *Azotobacter* in marigold cv. Pusa Basanti Gainda. Rao *et al.* (2015) reported application of 75% RDF in integration with farm yard manure, vermicompost, Azospirillum and phosphate solubilizing bacteria recorded maximum B: C ratio in tuberose while application of *Azospirilium*+ PSB+ 5 % cow urine + 50 % recommended dose of N through vermicompost +50 % recommended dose of NPK recorded highest B:C ratio in African marigold (Sharma *et al.* 2017). Similar findings have also been reported by Laishram *et al* (2016) in chrysanthemum and Singh *et al* (2016) in carnation. Diwivedi *et al.* (2018) reported maximum Gross return, net return and cost benefit ratio with conjoint application of organic and inorganic fertilizers in jasmine. Shruthi and Vishwanath (2018) reported that application of 25:50:25 kg NPK ha^{-1} + foliar application of water soluble fertilizer at branching in Lima Bean recorded significantly higher net returns and B: C ratio.

Table1: DETAILS OF COST OF CULTIVATION (for 1 hectare area)

A. Cost of labour

Sl. No.	Cost components	Quantity/No.	Cost/unit (Rs.)	Total cost (Rs.)
I.	**Land preparation**			
	a. Ploughing	-	-	Rs. 5,000
	b. Lavelling and bed preparation	50 mandays	Rs. 325 per manday	Rs.16,250
II.	**Planting**	25 mandays	Rs. 325 per manday	Rs. 8,125
III.	**Intercultural oprations**			
	a. Fertilizer application	20 mandays	Rs. 325 per manday	Rs. 6,500
	b. Weeding	20 mandays	Rs. 325 per manday	Rs. 6,500
	c. Irrigation	20 mandays	Rs. 325 per manday	Rs. 6,500
IV.	**Harvesting**	40 mandays	Rs. 325 per manday	Rs. 13,000
Total labour charges				**Rs. 61,875**

B. Material cost

Sl. No.	Cost components	Quantity/No.	Cost/unit (Rs.)	Total cost (Rs.)
I.	**Marigold seedlings**	50,000 seedlings	Rs. 1 per seedling	Rs. 50,000
II.	**Inorganic fertilizers**			
	a. Urea	-	Rs. 5.33/kg	-
	b. DAP	-	Rs. 29/kg	-
	c. MOP	-	Rs. 17/kg	-
III.	**Organic fertilizers**			
	a. MKP	-	Rs. 210/kg	-
	b. Azotobacter	-	Rs. 50/kg	-
	c. PSB	-	Rs. 50/kg	-
	d. Spent Mushroom Compost	-		-

C. Sale price of flower

Loose flower : Rs. 25/kg

Table 2: Economic profitability of French marigold cv. Local flower production as influenced by Integrated Nutrient Management (INM) schedules

	Integrated Nutrient Management Treatments	Flower yield (Kg/ha)	Total expenditure (Rs.)	Gross returns (Rs.)	Net returns (Rs.)	Benefit: Cost ratio
T_1	Farmers practice (no fertilizer)	9500	111875.00	190000	78125.0	0.70
T_2	100% RDF (200 kg N, 100 kg P_2O_5 and 100 kg K_2O/ha)	20000	112977.50	400000	287022.5	2.54
T_3	75 % RDF + Spent mushroom compost (1 kg/m^2)	17000	122877.45	340000	217122.6	1.77
T_4	75 % RDF + Biofertilizers[a]	17500	160126.83	350000	189873.2	1.19
T_5	75 % RDF + 1% foliar spray of MKP[b]	18000	120626.83	360000	239373.2	1.98
T_6	75 % RDF + Spent mushroom compost (1 kg/m^2) + Biofertilizers	13500	160626.83	270000	109373.2	0.68
T_7	75 % RDF + Spent mushroom compost (1 kg/m^2) + 1% foliar spray of MKP	18000	160328.43	360000	199671.6	1.25
T_8	75 % RDF + Biofertilizers + 1% foliar spray of MKP (00:52:34)	23000	120828.43	460000	339171.6	2.81
T_9	75 % RDF + Spent mushroom compost (1 kg/m^2) + Biofertilizers + 1% foliar spray of MKP	25000	160828.43	500000	339171.6	2.11
T_{10}	50 % RDF + Spent mushroom compost (1 kg/m^2)	14500	157376.22	290000	132623.8	0.84
T_{11}	50 % RDF + Biofertilizers	15000	117876.22	300000	182123.8	1.55
T_{12}	50 % RDF + 1% foliar spray of MKP (00:52:34)	13500	117577.82	270000	152422.2	1.30
T_{13}	50 % RDF + Spent mushroom compost (1 kg/m^2) + Biofertilizers	12500	157876.22	250000	92123.78	0.58
T_{14}	50 % RDF + Spent mushroom compost (1 kg/m^2) + 1% foliar spray of MKP	15500	157577.82	310000	152422.2	0.97
T_{15}	50 % RDF + Biofertilizers + 1% foliar spray of MKP	18000	118077.82	360000	241922.2	2.05
T_{16}	50 % RDF + Spent mushroom compost (1 kg/m^2) + Biofertilizers + 1% foliar spray of MKP	17000	158077.82	340000	181922.2	1.15
T_{17}	25 % RDF + Spent mushroom compost (1 kg/m^2)	10500	154625.61	210000	55374.39	0.36
T_{18}	25 % RDF + Biofertilizers	11000	115125.61	220000	104874.4	0.91
T_{19}	25 % RDF + 1% foliar spray of MKP (00:52:34)	13500	114827.21	270000	155172.8	1.35
T_{20}	25 % RDF + Spent mushroom compost (1 kg/m^2) + Biofertilizers	15500	155125.61	310000	154874.4	1.00
T_{21}	25 % RDF + Spent mushroom compost (1 kg/m^2) + 1% foliar spray of MKP	16500	154827.21	330000	175172.8	1.13
T_{22}	25 % RDF + Biofertilizers + 1% foliar spray of MKP	16500	115327.21	330000	214672.8	1.86
T_{23}	25 % RDF + Spent mushroom compost (1 kg/m^2) + Biofertilizers + 1% foliar spray of MKP	15500	155327.21	310000	154672.8	1.00

Biofertilizers[a] = *Azotobacter chroococcum* + phosphorous solubilizing micro-organisms root dip; MKP[b] = MKP (Mono potassium phosphate, 00:52:34 water soluble fertilizer

4. CONCLUSION

For getting maximum profitability and yield potentiality of French marigold 'Local' plants under Jammu subtropical conditions, application of 75 % RDF + Spent mushroom compost (1 kg/m^2) + Biofertilizers + 1% foliar spray of Mono potassium phosphate (MKP 00:52:34) produced the highest yield of saleable flowers/ha (25000 Kg/ha).

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