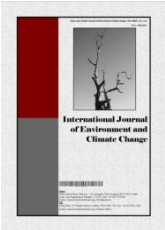

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Economic Analysis of Marigold Flower in Research Farm of IGKV Raipur, Chhattisgarh, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

In floriculture, marigold is one of India's most important commercially grown flower crops, which ranked third in number after Roses and Chrysanthemum. The present experiment was carried out during the winter season of the year 2019-2020 & 2020-2021 in the laboratory field of the Dept. of SWE, SVCAET &RS, IGKV, Raipur (C.G.) India. To study the economical analysis of Marigold crop cultivation with major constraints, three kinds of growing media was used like Cocopeat, soil and Farm Yard Manure (FYM) in three different growing containers viz: Reusable flour bags, conventional grow bags and plastic bottles with all the same growing conditions. In marigold crop production shows that the Reuseable Flour Bag (RFB) produced 13.65 MT flower, followed by plastic bottle (PB) 13.18 MT and Conventional Grow Bag (CGB) 13.03 MT in the same way the net benefit was calculated as highest as 296997.89 ₹/ha in RFB, 249095.86 ₹/ha in plastic bottle and 131078.79 ₹/ha in RFB. The benefit-cost ratio was found to be highest in plastic bottles as 2.093, followed by 1.847 in RFB and 1.277 in CGB.

Keywords: Growing media; growing containers; economics of marigold; benefit-cost ratio; grow bag; plastic bottles.

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1. INTRODUCTION

India has a long floriculture tradition; flowers have been depicted in ancient paintings. However, the social and economic aspects were recognised later in the last three decades with changing lifestyles and increased urban affluence. The production of high value cash crops such as flowers has always been more beneficial to the farmers than the traditional crops but the marketing, post-harvest management and value addition significantly affected the income of the cultivators/farmers [1,2]. In India, about 342 thousand ha of the area is under floriculture producing 1.76 million MT of flowers and 0.77 million MT of cut flowers annually [3].

In floriculture, marigold is one of India's most important commercially grown flower crops, which ranked third in number after roses and chrysanthemum. It belongs to the family Asleraceae. Marigold is broadly classified into African marigold (*Tagetes erecta* L.) and French marigold (*Tagetes patula* L.). It is used to make garlands, which are extensively utilised in religious and social functions [4]. It is also grown as ornamental cut flowers and landscape plants and as a source of natural caretenoid pigment for poultry feed. The area under marigold in Chhattisgarh state has recorded as 5097 hectare and it produces 40460 MT of flower in financial year of 2020-2021 [5].

A growing media is a material that allows roots to develop and extract water and nutrients. Soil is commonly utilised as growing medium cause it is the cheapest and easiest to get another growing media is Farm yard manure (FYM), which is a strong source of nutrients and contributes to the organic matter in the soil. It is created from a degraded mixture of animal dung, urine, and leftover waste from feed supplied to cattle and has good physical features. Cocopeat is an agricultural by-product obtained after extracting fiber from the coconut husk, which has good physical properties for plant growth.

2. MATERIALS

A field experiment was carried out during the winter season of the year 2019-2020 & 2020-21 in the laboratory field of the Department of Soil and Water Engineering, Swami Vivekanand College of Agricultural Engineering and Technology and Research Statiom, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) India. The experimental site is at Latitude $21^{o}14'6"$ N and Longitude $81^{o}43'10"$ E, and at an altitude of 302 meters above the mean sea level. There were three kinds of growing media used to cultivate marigolds as different treatments: Cocopeat, FYM, and Soil. With three kinds of growing containers viz: Reusable flour bags (RFB), Conventional grow bags (CGB) and Plastic bottles (PB).

2.1 Growing Containers

Reusable flour bag (RFB): Plastic bags are extensively used as packaging material for all kinds of food and packaging items. Most of these packing materials are not single-use plastic bags, but after a food item is removed, these bags are thrown anywhere and treated as single-use plastic. This packaging material can be used as reusable plastic bags for growing plants.

Conventional grow bags (CGB): Conventional grow bags are small polythene pots used to grow plants. It has several advantages: they are lightweight, easy to handle, and low in price. There are many types of grow bags available in the market.

Plastic bottle (PB): These are constructed from high-density or low-density plastic, typically used to store water, soft drinks, motor oil, cooking oil, medicine, etc.

2.2 Treatments Details

The experiment was laid out in a Split Plot Design (SPD), having three types of growing containers RFB, CGB, and used plastic 2-litre bottle (PB). The gross plot area was taken as 16 m × 20 m (320 m^2), and the net sown area was 14.5 m × 18 m (261 m^2). The treatment details are given below.

M_1 (irrigation by drip system) + reusable plastic bag (90-110 µ)

M_2 (irrigation by drip system) + conventional grow bag (150 µ)

M_3 (irrigation by drip system) + used plastic bottle (410 µ)

Primary data was collected from the marigold field through regular inspections, and collected data were tabulated according to the need and purpose of the study. Simple tabular analysis was made to workout economics of marigold

production, various costs as fixed and variable costs, namely: Cost for the growing system, cost of growing media, cost of plant seedling, bag filling and arrangement cost, transplanting of seedling, water-soluble NPK (19:19:19), plant protection cost, like fungicides, insecticides, labour cost for spreading fertilizers and plant protect, gap filling, water cost, weeding cost, land rent, harvesting cost and miscellaneous cost were estimated thoroughly then overall cost, gross benefit and net benefit and the benefit-cost ratio was estimated with mathematical calculations.

3. RESULTS AND DISCUSSION

3.1 Cost of Cultivation with Different Containers

The present study was laid in 261 m^2 (net shown area) field. Cost calculation is done in 1 hactare of land because it is easy to understand all the parameters.

Marigold production in ceusable flour bags (CFB) containers needed 46000-flour bags per hectare at a rate of 2.5 ₹ per bag, with costs of 115000 ₹ . In growing media, soil, FYM and Cocopeat were used. In RFB bags with FYM, it filled by 1.68 kg per bag at the rate of 1.5 ₹/kg was cost as 115920 ₹ and with cocopeat was filled 0.30 kg per bag at the cost of 8 ₹/kg where total cost was as 128800 ₹/ha. In one hectare of land, 46000 seedlings were used at a spacing of 0.3 x 0.3 plant to plant of the marigold crop, and its cost was 18400 ₹/ha at the rate of 0.4 ₹ per plant. The arrangement of growing bags in one hectare of land needed 256 labours (lbr) at a rate of 281 ₹/lbr at the cost of 71936 ₹. After arrangement and filling of growing media bags are ready for Transplanting the seeds of the marigold crop, the labour needed for transplanting was 48 labours /ha, at a rate of 281 ₹/lbr, the total costs for transplanting was 13488 ₹/ha, afterwords for fertilising (NPK) the land it needed 45 bags of fertilizer (NPK) the rate of fertilizer was accounted as 100 ₹/kg was cost as 4500 ₹ /ha, for plant protection operations Fungicide and insecticide were used as 0.5 kg and 1.2 kg respectively at the rate of 510 ₹/kg and 500 ₹/kg were cost as 255 ₹/ha and 600₹ /ha respectively. For spreading plant protection liquids, two labours were needed at a rate of 281 ₹/lbr was a cost of 430 ₹/ha. For gap filling in the field needed, three labours were at a rate of 281 ₹/lbr costs 483 ₹/ha, and the cost of water in the marigold field per hectare of land was 1435 ₹/ha. The weeding operation per hectare of land needed three labours at the rate of 281 ₹/labour cost 568 ₹/ha. The land rent cost was 8000 ₹/ha for a growing season. The harvesting operation of marigold needed six labours at a rate of 281 ₹ /labour was, cost as 15455 ₹/ha.

Likewise, the production of Marigold in CGB containers needed 46000-grow bags per hectare at a rate of 10 ₹ per bag, with costs of 460000 ₹. Soil, FYM and Cocopeat were used as growing media. CGB were filled with 1.05 kg per bag of FYM at the rate of 1.5 ₹/kg, and it had a total cost of 72450 ₹/ha. In the case of cocopeat, it filled by 0.30 kg per bag at the cost of 8 ₹/kg, where the total cost was 77280 ₹/ha. In one hectare of land, 46000 seedlings were used at a spacing of 0.3 x 0.3 plant to plant of the marigold crop, and its cost was 18400 ₹/ha at the rate of 0.4 ₹ per plant. The bag filling and arrangement of growing bags in one hectare of land needed 242 labours they worked at a rate of 281 ₹/lbr, which cost 68002 ₹./ha. After arrangement and filling of growing media, bags are ready for Transplanting the seeds of the marigold crop, it needed 55 lbr /ha at a rate of 281 ₹/lbr, the total costs for transplanting was 15455 ₹ /ha, afterwords for fertilising (NPK), one hectare of land needed 45 bags of fertilizer (NPK) the rate of fertilizer was as 100 ₹/kg was cost as 4500 ₹ /ha. for plat protection operations Fungicide and insecticide were used as 0.5 kg and 1.2 kg respectively at the rate of 510 ₹/kg and 500 ₹ /kg, were cost as 255 ₹ /ha and 600 ₹ /ha respectively. For spreading plant protection liquid and fertilizer, it needed two labours at a rate of 281 ₹ /labour the total cost of this operation was 430 ₹/ha. For gap filling in the field it needed three labours at a rate of 281 ₹ /labour costs 483 ₹/ha. The cost of water in the marigold field per hectare of land was 1435 ₹/ha. For weeding operation per hectare of land needed three labours at the rate of 281 ₹/labour the total cost was 568 ₹/ha. The land rent cost was 8000 ₹ /ha for a growing season. The harvesting operation of marigold needed six labours at a rate of 281 ₹/lbr was the cost of 15455 ₹/ha.

Marigold production in plastic bottle containers also accounts for 46000-bottles for one hactere of land at the rate of 2 ₹/ha it had a total cost of 92000 ₹/ha. The same growing media viz: Soil, FYM and Cocopeat were used in plastic bottles. The plastic bottle it filled with 0.28 kg per bottle of FYM at the rate of 1.5 ₹/kg, it had a total cost of 19320 ₹/ha. In the case of cocopeat, it was filled by 0.060 kg per bottle at the cost of 8 ₹/kg,

Table 1. Cost analysis for drip irrigation cost per hectare

1	Particulars	Grow Containers	Inputs	Unit Rate	Cost
	Cost of grow bags	RFB	46000/ha	2.5 ₹/bag	115000
		CGB		10 ₹/bag	460000
		PB		2 ₹/bottle	92000
2	Cost of plant seedling (40rs/100)		46000/ha	0.4/plant	18400
A	Cost of FYM	RFB	1.68 kg	1.5 ₹/ kg	115920
		CGB	1.05 kg		72450
		PB	0.28 kg		19320
B	Cost of cocopeat	RFB	0.350kg	8 ₹/kg	128800
		CGB	0.240kg		77280
		PB	0.060kg		22080
	Bag filling and arrangement cost	RFB	256 lbr	281 ₹/lbr	71936
		CGB	242 lbr	281 ₹/lbr	68002
		PB	219 lbr	281 ₹/lbr	61539
	Transplanting of seedling	RFB	48 lbr	281 ₹/lbr	13488
		CGB	55 lbr	281 ₹/lbr	15455
		PB	61 lbr	281 ₹/lbr	17141
5	Water soluable NPK (19:19:19) 100 kg/ha @ ₹ 45/kg		100 kg/ha	45	4500
6	Plant protection cost				
A	fungicides @ ₹ 510 per kg		0.5 kg/ha	510 kg	255
B	insecticides @ ₹ 500/kg		1.2 kg/ha	500 kg	600
7	Labour cost for spreading Ferti.and plant protect.		2 labour	281 ₹/lbr	430
8	Gap filling		3	281	843
9	Water Cost			1435	1,435
10	Weeding cost	RFB	3 labour	281/br	568
		CGB			610
		PB			374
11	Land rent		1 ha	8000	8000
12	Harvesting cost	RFB	6	281/lbr/day	15455
		CGB			14536.7
		PB			12599.5
TOTAL COST (in ₹)*				RFB	495630
				CGB	742797
				PB	**259516**

** amount of given table is according to state government rules and regulation*

Table 2. Cost analysis of for different treatments

	M_1	M_2	M_3
year variable cost	306570.00	428731.69	183616.48
fixed cost	44228.41	44228.41	44228.41
total	350798.41	472960.10	227844.88
total benefits	647796.30	604038.89	476940.74
NET INCOME	296997.89	131078.79	249095.86
B/C	**1.847**	**1.277**	**2.093**

where the total cost was 22080 ₹/ha. In one hectare of land, 46000 seedlings were used at a spacing of 0.3 x 0.3 plant to plant of the marigold crop, and its cost was as same as other growing containers, 18400 ₹/ha at the rate of 0.4 ₹ per plant. The bag filling and arrangement of growing bags in one hectare of land needed 219 labours they worked at a rate of 281 ₹/lbr, which cost 61539 ₹./ha. After the arrangement and filling of growing media, bags are ready for Transplanting the seeds of the marigold crop, it needed 61 labours /ha at a rate of 281 ₹/lbr, the total costs for transplanting was 17141 ₹/ha. afterwords, for fertilising (NPK), one hectare of land needed 45 bags of fertilizer (NPK) the rate of fertilizer was as 100 ₹/kg was cost as 4500 ₹/ha. for plat protection operations Fungicide and insecticide were used as 0.5 kg and 1.2 kg respectively at the rate of 510 ₹/kg and 500 ₹/kg, were cost as 255 ₹ /ha and 600 ₹ /ha respectively. For spreading plant protection liquid and fertilizer, it needed two labours at a rate of 281 ₹/labour the total cost of this operation was 430 ₹/ha. For gap filling in the field, it needed three labours at 281 ₹/labour costs 483 ₹/ha. The cost of water in the marigold field per hectare of land was 1435 ₹/ha. For weeding operation per hectare of land needed three labours at the rate of 281 ₹/labour the total cost was 568 ₹/ha. The land rent cost was 8000 ₹ /ha for a growing season. For harvesting operation of marigold, it needed six labours at a rate of 281 ₹/lbr was cost as 15455 ₹/ha.

3.2 Income over the Different Costs at Experimental Farms

As shown in Table 2 The total benefit was found highest in RFB as 647796.30 ₹/ha followed by CGB as 604038.89 ₹/ha and lowest recorded in plastic bottles as 476940.74 ₹/ha. in the same way after subtracting the total production cost over the gross benefit the net benefit is calculated as highest as 296997.89 ₹/ha in RFB flowed by 249095.86 ₹/ha in plastic bottles and 131078.79 ₹/ha in CGB. The benefit-cost ratio was found to be highest in plastic bottles as 2.093, followed by 1.847 in RFB and 1.277 in CGB.

3.3 Economics of Production of Winter Marigold under Different Treatments of Grow Containers

The economics of marigold crop is presented in Table 2 It clearly shows that the cost of cultivation per hectare of marigold crop production is highest in conventional grow bags as 472960.10 ₹/ha, followed by reusable flour bags (350798.41 ₹ /ha) and plastic bags (227844.88 ₹ /ha). Whereas the highest yield was found in reusable flour bags (13.65 MT/ha), followed by plastic bottles (13.18 MT/ha) and conventional grow bags (13.03MT/ha).

4. CONCLUSIONS

This research has been prepared to looking all the points like the judicious utilization of precious water resources, judicious utilization of reusable plastic bags, minimizing the carbon and water footprint, production technology for infertile and barren land and keeping in mind the government's *Narva*, *Garwa*, *Ghurva* and *Bari* schemes. In which stored rainwater is used for irrigation and solar energy is used to pump that stored water. For a kitchen garden, barren and infertile land, a portable plant growing system has been developed using waste plastic material to be easily collected in our society.

Conventional grow bags have the highest cost of cultivation per hectare of the marigold crop, as 472960.10 ₹/ha, followed by reusable flour bags (350798.41 ₹/ha) and plastic bags (227844.88 ₹ /ha). The net benefit is calculated as highest as 296997.89 ₹/ha in reusable flour bags flowed by 249095.86 ₹/ha in plastic bags and 131078.79 ₹ /ha in conventional grow bags. Plastic bottles had the highest benefit-to-cost ratio of 2.093, followed by reusable flour bags with 1.847 and conventional grow bags with 1.277.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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