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ECONOMIC FEASIBILITY AND PROFITABILITY OF MARIGOLD (*Tagetes erecta* L.) YIELD AND BIOMETRIC PARAMETERS UNDER PROTECTED CONDITION

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ABSTRACT

Demand for Marigold cut flower is increasing popularity with an improved sense of esthetics and a higher socio-economic level among the population. Because of its ever-increasing demand at a fast rate, global growth capacity has now generated ample prospects in the future. The present investigation was therefore, carried out under naturally ventilated greenhouse to determine the economic feasibility of the commercially cut flower crop production. The annual establishment and maintenance cost for cultivation of marigold under soil, soil + sawdust and soil + coir pith was worked out as Rs. 2,36,141acre^{-1}, Rs. 2,46,219acre^{-1} and Rs. 2,52,331acre^{-1} respectively. Among the treatment studied highest gross returns were obtained from Soil + Coir pith @ 100 % ETc (Rs. 8,15,915.00 acre^{-1}), followed by Soil + Coir pith @ 125 % ETc (Rs. 7,48,484.00 acre^{-1}) and Soil + Coir pith @ 75 % ETc (Rs. 7,14,769.00 acre^{-1}) with a net return of Rs. 5,63,584.00, 4,96,153.00, and Rs. 4,62,438.00 acre^{-1}, respectively compared to other treatments grown under greenhouse.Among the treatment combinationS highest plant height, stem girth, plant spread and number of branches plant^{-1} were observed in Soil + Coir pith @ 100 % ETc followed by Soil + Coir pith @ 125 % ETc and Soil + Coir pith @ 75 % ETc respectively. Similar trends were followed in shortest day to flower bud appear and flower bud open. The highest yield plant $^{-1}$ (1.21 kg plant $^{-1}$) were recorded in treatment Soil + Coir pith @ 100 % ETc.The investment in the Marigold crop has been found to be economically stable and highly profitable as these growing media generate the highest yield unit^{-1} area resulting in a maximum B: C ratio of 3.20, 3.00 and 2.80 respectively, thus the same can be utilized for commercial cultivation to meet the demand.

(Key words: B: C ratio,economics,marigold, protected cultivation and soilless media)

INTRODUCTION

Today Marigold (*Tagetes erecta* (L.)) seems to have attained the traditional reputation of one of the most economically valuable flowers across the world.In the Indian sub-continent, it accounts for more than half of the nation's loose flower production, used for making garlands, beautification, religious offerings, social functions and other purposes. From the point of view of commercial marketing and revenue generation Marigold has an edge over the loose flowers in vogue, the rank order being followed by chrysanthemum, jasmine, tuberose, crossandra and barleria (Bhattacharjee, 2003).

It is commonly grown for their exquisite blooms, extraction of natural dye and essential oils and it has therapeutic values. The principal pigment in the flowers is xanthophyll, particularly lutein accounts for 80-90 per cent. Marigold carotenoids are the major source of pigment for poultry industry as a feed additive to intensify the yellow colour of egg yolks, broiler skin (Scott *et al.,* 1968). The main demand for marigold today comes from the recent trend towards the use of natural dyes throughout the world. Marigold plant has a domestic value as a nematode controller. It contains a variety of potentially bioactive substances, which consider á-therthienyl as one of the most harmful to nematodes. This sulfur-containing compound is abundant in marigold tissues, including roots. Thus, nematodes may either be destroyed by reaching the root system of a marigold plant or by touching soil containing the bioactive compounds of marigold. Therefore, marigold production manages the root knot nematodes and at the same time raises the level of the economy.

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In India, the total area under flower cultivation during 2018 has been estimated as 2,55,000 ha with the production of 2,29,7000 MT of loose flowers and 543 Million numbers of cut flowers. Marigold was grown in India on an region of 55, 890 hectares with a output of 5,11,310 MT among the loose flower crops. Karnataka occupied first position among the states with an region of 9,100 ha and Madhya Pradesh reported the highest marigold output of about 85,070 MT (Anonymus, 2018). In a country such as India, which has a number of geographical locations, a varied form of climate, besides the availability of vast land and labour-power, there is great potential for the commercial development of cutflower in protected structure viz., polyhouse, glasshouse etc. Polyhouse is a built system that is robust enough to cultivate crops under partial or completely regulated environmental conditions to achieve optimal growth and maximum productivity. This often includes the alteration of the soil medium by adding retainable moisture and biodegradable growth materials such as sawdust, coconut peat, peat moss, woodchips, fleece, marc, bark, etc. Sawdust media for seedless cultivar is the best soilless growing media and the cheapest compared to other solid media (Ahmad, 2019). Coirpith is the coconut waste that consists of dust andshort fibers and is produced annually about 12 million tons worldwide (Nichols, 2013). Coconut Coir has slowly become the most possible alternative substratum cultivation due to its strong water preservation and aeration characteristics. Therefore, there is an enormous need to determine the effect of soilless media on the parameter of plant growth for their quantitative and qualitative yield. An in-depth research on the environment and promotion of floriculture was not carried out. However, some researchers have conducted economics and marketing studies of floriculture (Sudhagar, 2013). Since the cultivation of Marigold is an upcoming business opportunity, especially in India, it is important to work out the economics which ultimately represents the cost of cultivation and finally to prescribe the optimal soilless media to produce the required quantity and quality of flowers for both the domestic and export markets. Having regard to all these factors, the present research was carried out in order to find out the economics of the Marigold cultivation under low costnaturally ventilated polyhouse of 72 meter square for one year, at Department of Soil and Water Conservation Engineering, Agriculture Engineering College and Research Institute, Kumulur.

MATERIALS AND METHODS

The present investigation was carried out in the Department of Soil and Water Conservation Engineering, Agriculture Engineering College and Research Institute, Kumulur, under naturally ventilated polyhouse of 72 m^2 area is oriented in North-South direction. The frame is composed of galvanized iron pipe coated with 200 micron UV polyethylene stable film. Two sides are lined with a 60 mesh insect-proof net for natural ventilation and protect against insect pest entry.The shade net of 50 per cent shade was set out in the polyhouse above the headspace to control the light intensity and temperature throughout the summer. The experiment was laid out in Randomized Complete Block Design (RCBD) and replicated thrice. Three different types of growing media (Soil, Soil + Sawdust (2:1) and Soil + Coirpith (2:1)) with three irrigation levels (ETc 125%, 100% and 75%) were taken as a treatment. Marigold was grown on 30 cm high beds with a width of 1.2 meters at a spread of 60 cm between the rows and 40 cm between the plants using regular cultivation practices.The benefit : cost ratio was calculated when the present value of the profit stream was divided by the total cost stream value (Kothari *et al.,* 2006). Cost elements were classified as expense of non-recurring contingency (NRC) and recurring contingency (RC). Non-recurring contingency involves the expense of polyhouse construction, galvanized iron (GI) supporting frames, cladding equipment, shade nets and planting materials whereas, Recurring expenses includes soil sterilization, bed preparation costs, fertilizer and plant maintenance charges, supervision, repair and processing, transportation costs etc. (Sreedhara *et al.,* 2013). Total cost includes total recurring costs, depreciation charges and interest on capital cost. Therefore, in the sense of practicability Benefit: Cost Ratio (BCR) was estimated for 1 acre of all the treatments under naturally ventilated polyhouse and it was evaluated to assess the economic (110 days) viability of Marigold production. In the growing period observations on plant height, stem girth, plant spread, number of branches $plant^{-1}$, numbers of days to flower bud appear, number of flower bud open and yield $plant^{-1}$ were recorded.

Treatment details

T_1- Soil @ ETc 125% ; T_2- Soil @ ETc 100% ; T_3- Soil @ ETc 75% ; T_4- Soil + Sawdust 2:1 @ ETc 125% ; T_5- Soil + Sawdust 2:1 @ ETc 100% ; T_6- Soil + Sawdust 2:1 @ ETc 75% ; T_7- Soil + Coirpith 2:1 @ ETc 125% ; T_8- Soil + Coirpith 2:1 @ ETc 100% ; T_9- Soil + Coirpith 2:1 @ ETc 75%

RESULTS AND DISCUSSION

Flower quality parameter assessed the significance of suitability of the growing media, for commercial cultivation. The significant biometric characteristics that decide the size and quality of the flowers are plant height, stem girth, number of flowers $plant^{-1}$ and flower yield $plant^{-1}$(Satish gouda *et al.,*2012). Significant differences were observed among the growing media for these flower quality parameters and the same is depicted in Table 1. From the table the result showed that the treatment T_8(Soil + Coirpith @ 100 per cent ETc) recorded highest plant height, stem girth, number of branches $plant^{-1}$ as 61.76 cm, 3.20 cm, 33.60 cm and 29.00 numbers respectively. Similarly, shortest days were taken to flower bud appear and open (28.66 and 34.00 days) respectively. As well as highest flower yield $plant^{-1}$ (1.21 kg $plant^{-1}$) was also recorded in the same treatment

T_8 followed by treatment T_7 (Soil + Coirpith @ 125 per cent ETc) and T_6 (Soil + Coirpith @ 75 per cent ETc). This result might be due to sufficient amount of water in the growing media which might have increased various physiological processes, better plant nutrient uptake, higher rates of photosynthesis, which might reflect on more number of flowers and higher flower weight.

Table 1. Flower yield and biometric parameters in different growing media of Marigold grown under protected cultivation

Treatments	Plant height (cm)	Stem girth (cm)	Plant spread (cm)	No. of branches plant^{-1}	No. of days to flower bud appear	No. of days to flower bud open	Yield plant $^{-1}$ (kg)
T_1	51.90	2.40	27.36	23.00	33.33	38.66	0.83
T_2	51.96	2.50	28.26	23.66	32.00	38.00	0.88
T_3	46.76	2.06	25.13	19.33	34.33	41.66	0.75
T_4	54.36	2.63	29.53	26.00	31.00	37.33	0.94
T_5	55.20	2.70	30.26	27.00	30.00	36.33	0.98
T_6	47.83	2.23	28.23	21.00	34.33	39.66	0.82
T_7	59.00	2.96	31.93	29.66	29.33	34.33	1.10
T_8	61.76	3.20	33.60	31.33	28.66	34.00	1.21
T_9	57.30	2.93	31.66	29.00	30.33	35.00	1.05
SE(d) ±	0.28	0.04	0.12	0.16	0.38	0.16	0.003
CD @ 5%	0.58	0.08	0.26	0.33	0.65	0.37	0.006

Table 2. Economics of flower production of different growing media under naturally ventilated polyhouse (NVPH) of 40460 m^2 for one year

Treatments	Total cost (Rs.)	Flower yield plant^{-1} (kg)	Flower yield acre^{-1} (kg)	Gross Returns (Yield acre^{-1} X Crop year^{-1} X Rs. 10 kg^{-1}) (Rs.)	Net Returns (Rs.)	B:C Ratio
T_1	236141	0.84	18880.68	566420	330280	2.4
T_2	236141	0.89	20004.53	600136	363995	2.5
T_3	236141	0.75	16857.75	505733	269592	2.1
T_4	246219	0.94	21128.38	633851	387632	2.6
T_5	246219	0.99	22252.23	667567	421348	2.7
T_6	246219	0.82	18431.14	552934	306715	2.2
T_7	252331	1.11	24949.47	748484	496153	3.0
T_8	252331	1.21	27197.17	815915	563584	3.2
T_9	252331	1.06	23825.62	714769	462438	2.8

Table 3. Agronomic practice followed for establishment and management of Marigold crop under 4046 meter square polyhouse was analyzed and rents are given below

Sr. No.	Particular	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
I	**Non recurring contingency (NRC)**									
	a. Greenhouse cost of material (4046 sq.m)									
	Life span for 15 years	1869252	1869252	1869252	1869252	1869252	1869252	1869252	1869252	1869252
	For one year	124617	124617	124617	124617	124617	124617	124617	124617	124617
	b. Irrigation system for 5 years	55763	55763	55763	55763	55763	55763	55763	55763	55763
	For one year	11153	11153	11153	11153	11153	11153	11153	11153	11153
	c. Media cost for 4 year	0	0	0	38032	38032	38032	61095	61095	61095
	For one year	0	0	0	9508	9508	9508	15274	15274	15274
	d. Fixed cost	135769	135769	135769	145278	145278	145278	151043	151043	151043
	e. Repair & Maintenance cost (10 %)	13577	13577	13577	13577	13577	13577	13577	13577	13577
	f. Interest on fixed cost (6%)	8146	8146	8146	8717	8717	8717	9063	9063	9063
	Total cost of operation (Per year) (Construction cost of greenhouse + Irrigation system installation cost + Media cost + Repair and maintenance cost + Interest on fixed cost))	157493	157493	157493	167571	167571	167571	173683	173683	173683
II	**Recurring contingency (RC)**									
	a.Total cost of cultivation (Field operation + Transplanting + Weed management + Fertilizer application + Pesticide + Harvesting charges)	78648	78648	78648	78648	78648	78648	78648	78648	78648
III	**Total cost of operation + cultivation (NRC+RC)**	236141	236141	236141	246219	246219	246219	252331	252331	252331

The economic gain is determined by deducting the overall expense and the expense of flower development from the gross profits from the sales of flowers. The economic showed that the highest gross return was achieved from treatment T_8 (Soil + Coir pith @ 100 per cent ETc) Rs. 8,15,915.00 acre^{-1}, followed by treatment T_7 (Soil + Coir pith @ 125 per cent ETc) Rs. 7,48,484.00 acre^{-1} and treatment T_6 (Soil + Coir pith @ 75 per cent ETc) Rs. 7,14,769.00 acre^{-1} with a net return of Rs. 5,63,584.00, 4,96,153.00, and Rs. 4,62,438.00 acre^{-1}, respectively compared to other treatments under polyhouse (Table 2). Such increasing irrigation-level media had a maximum B: C ratio of 3.20, 3.00 and 2.80, respectively under protected cultivation, and are highly remunerative relative to other treatments studied while some of the increasing irrigation-level media had less B: C ratio due to their poor yield efficiency, flowering nature, and biotic susceptibility. Soilless cucumber production is an economically viable alternative to soil-based cucumber production (Engindeniz and Gül, 2009). Similar findings were noticed that the combination of 100 per cent ETc irrigation treatment in tunnel house produced highest benefit cost ratio (3.05 with maximum subsidy) in drip irrigation (Kaushal *et al*., 2011). In media containing only coconut peat, the highest photosynthesis intensity, mesophyll output, flowering stem fresh weight and floret length were observed (Farzad Nazari *et al*., 2011). The net return from the cucumbers grown in a mixture of perlite and zeolite was •1,84 m^{-2}, while in conventional soil-based cultivation it was •1, 48 m^{-2} (Kuscu *et al*., 2009). Coconut coir (CC), an environmentally friendly substance with stable physicochemical and biological properties, was increasingly used in horticultural development as a cultivation substratum (Barrett *et al*., 2016). The bio-degraded coco peat is found to have lower C/N ratio, high cation exchange capacity and humic acid content (Yau and Murphy 2000).Hence, the study concluded that cultivating crops under the greenhouse with soil + coirpith as growing media yielded optimum benefit, this result might due to adequate availability of moisture in the soil that could have increased various physiological processes, better uptake of plant nutrients, higher photosynthesis levels that could represent more flowers and higher flower weight.

Floral business is in progress though on limited scale, but every growing demand of flowers has resulted in need to explore potential for expansion of this enterprise. The study results were highly encouraging with respect to higher economic return of floriculture. The research revealed that the maximum gross returns (Rs. 8,15,915.00acre^{-1}) were obtained from treatment T_8 (Soil + Coir pith @ 100 % ETc) with benefit: cost ratio of 3.20. In brief, from the study it can be concluded that, cultivation of marigold with soil +coirpith (2:1) @ 100% ETc under naturally ventilated polyhouse will be highly economical.Hence, these growing media can be undertaken for commercial production to produce desired quantity and quality of flowers to meet the growing domestic as well as international market for this flower crop.

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