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Standardization of growing medium composition for pot plant production of African marigold (*Tagetes erecta* L.) var 'Double Orange'

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Abstract

Standardization of suitable growing medium composition for pot plant production of African marigold (*Tagetes erecta* L.) variety Double Orange was carried out at the Department of Floriculture and Landscaping, College of Agriculture,Vellanikkara, Kerala, India during 2020-21. Five growing media *viz.,* M_1: cocopeat (60%) + vermicompost (20%) + vermiculite (10 %) + rice husk (10%), M_2: cocopeat (60%) + FYM (20%) + vermiculite (10%) + rice husk (10%), M_3: cocopeat (40%) + soil (20%) +vermicompost (20%) + vermiculite (10%) + rice husk (10%), M_4: cocopeat (40%) + soil (20%) +FYM (20%) + vermiculite (10%) + rice husk (10%) and M_5: soil: FYM: sand (1:1:1) were tested to assess the suitability for pot plant production of marigold. Experiment was laidout in completely randomized block design. Parameters such as plant spread (cm), number of branches per plant, number of leaves per branch, number of flowers per plant, flower diameter, flowering duration and field life of individual flowers which decide the attractiveness of the potted African marigold were observed. Medium (M_4) consisting of cocopeat (40%) + soil (20%) +FYM(20%) + vermiculite (10%) + rice husk (10%) was found to satisfy all these criteria. Hence Medium (M_4) can be recommended as a suitable growing medium for production of compact potted African marigold plants.

Keywords: Cocopeat, FYM, Ricehusk, Vermicompost, Vermiculite.

Introduction

Floriculture, the aesthetic branch of horticulture has emerged as a commercial activity after globalization of Indian economy. One of the present trends in floriculture is the production and marketing of potted ornamental plants. Main advantage of producing plants in pots are compactness, flexibility and portability to the areas of requirement.

African marigold (*Tagetes erecta* L.) is one of the most popular and commercial flowering annuals cultivated throughout the world. These plants with their attractive flower colours, bloom for a considerably long period and also adapted to a wide range of soil and climatic conditions. All these favorable factors make marigold, the most acceptable annual flowers in India for garden display. Attractive and vividly coloured marigold varieties are widely utilized for various landscaping purposes such as bedding, edging and also as potted plants.

Growth, compactness and blooming of potted ornamental plants are influenced by the potting media. They should have properties such as good drainage, water holding capacity, aeration, light weight and free from weed seeds. Despite the fact that soil is the most widely utilized potting media component, it is heavier and can harbour soil borne pathogens causing diseases. For easy handling of potted plants, light weight media are required. Hence this study was carried out to standardize suitable growing medium composition for pot plant production of African marigold.

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Materials and Methods

The present study was carried out at the Department of Floriculture and Landscaping, College of Agriculture, Vellanikkara, Kerala, India from October 2020 to May 2021. Popular African marigold variety 'Double Orange' was used for the study. Four week old seedlings of marigold were raised in pots of 8 inch size. Pots were filled with five different combinations of growing media viz., M_1: cocopeat (60%) + vermicompost (20%) + vermiculite (10 %) + rice husk (10%), M_2: cocopeat (60%) + FYM (20%) + vermiculite (10%) + rice husk (10%), M_3: cocopeat (40%) + soil (20%) + vermicompost (20%) + vermiculite (10%) + rice husk(10%), M_4: cocopeat (40%) + soil (20%) +FYM (20%) + vermiculite (10%) + rice husk (10%) and M_5: soil: FYM: sand (1:1:1). Uniform management practices were adopted for all the treatments. NPK @7.4:13:4.2 g/pot was applied after two weeks of planting and at the time of flowering in two equal splits. Fortnightly spraying with 19:19:19 was also done. Observations on vegetative parameters were recorded at the time of flower bud initiation and the floral characters were recorded throughout the flowering period. Physical properties of the media such as water holding capacity, bulk density and porosity were estimated before the experiment while the chemical properties like pH, EC and available N, P and K were estimated before and after the experiment.

Results and Discussion

1. *Influence of growing medium on vegetative characters of African marigold*

Plants with more branches and dwarf stature are the desirable characters of potted ornamentals. In the present study, growing medium M_4 [cocopeat (40%) + soil (20%) +FYM(20%) + vermiculite (10%) + rice husk (10%)]was found superior with respect to vegetative parameters viz., plant spread (21.77 cm), number of branches per plant (6.47) and number of leaves per branch (9.52) (Table 1.). This might be due to the influence of components of the medium on vegetative growth of the plants. About 40 per cent of the medium $M_4$was cocopeat. Addition of cocopeat was found to enhance the texture of the media and also avoid compaction. Cocopeat increases water holding capacity of the medium due to its high porosity. High cation exchange capacity (CEC) of cocopeat allows easy absorption and slow release of nutrients as per requirement of the plants. Apart from this, cocopeat contains substantial amount of nutrients such as N, P, K, Ca and Mg required for plant growth. Beneficial effect of cocopeat on growth and yield of flowering ornamentals had been reported in zinnia (Riaz et al., 2008) and calendula (Thakur et al., 2013).

Twenty per cent of medium M_4 was FYM, which is rich in organic matter. Beneficial effect of FYM on vegetative parameters may be attributed due to balanced supply of nutrients in accessible form after decomposition. This leads to greater root development and easier absorption of nutrients, resulting in improved vegetative growth of plants. When amended with other components in the growing medium, FYM provides conducive environment for root growth, absorption and translocation of nutrients. In addition to cocopeat and FYM, rice husk was one of the components in the medium M_4. Rice husk is a byproduct of rice

Table 1. Effect of growing media on vegetative characters of African marigold var. 'Double Orange'

Growing media	Plant height (cm)	Plant spread (cm)	Number of branches per plant	Number of leaves per branch
M_1	25.43	15.04	4.92	6.52
M_2	26.23	16.92	5.71	7.90
M_3	26.54	18.02	5.57	7.91
M_4	26.62	21.77	6.47	9.52
M_5	27.42	20.69	6.23	8.52
CD(0.05)	0.28	0.24	0.31	0.37
SE(m)	0.10	0.08	0.11	0.13

Table 2. Effect of growing medium on floral characters of African marigold var. 'Double Orange'

Growing media	Days taken for flower bud emergence	Days taken from flower bud emergence to opening	Number of flowers per plant	Flower diameter (cm)	Flowering duration (days)	Field life of individual flowers (days)
M_1	29.67	21.64	4.02	3.25	83.67	7.88
M_2	27.48	19.48	7.43	3.39	84.36	7.66
M_3	29.43	21.43	7.67	3.44	85.38	8.11
M_4	30.11	22.31	10.14	4.61	86.53	9.21
M_5	34.26	26.26	8.77	3.64	81.79	9.07
CD(0.05)	0.88	0.84	0.52	0.09	NS	0.39
SE(m)	0.30	0.29	0.18	0.03	1.93	0.13

milling industry. Rice husk is rich in SiO_2. When added to the growing medium, rice husk improved the porosity of the medium. Rice husk is reported to absorb heavy metals from growing medium as well as irrigation water and alter the pH of the medium into a range favourable for plant growth. Beneficial effects of rice husk in various ornamentals were reported by Meng et al. (2012), Chauhan et al. (2014) and Giree and Shrestha (2018).

Vermiculite (10%) was also one of the components of medium M_4 in the present study. Vermiculite is hydrated phyllosilicate mineral having good aeration and water retention capacity as well as low bulk density. When added to growing medium, it was found to alter the physical and chemical properties of the medium into conditions favourable for plant growth. Use of vermiculite in the growing medium enable the plants in easy absorption of ammonium, potassium, calcium and magnesium. Beneficial influence of vermiculite on plant growth were reported by Manish et al. (2000) in lilium and Sindhu et al. (2010) in gerbera.

In the present study, 20 per cent of the medium M_4 was soil. Soil is rich in organic matter and it supplies all the nutrients for plant growth and also provide habitat to many beneficial micro organisms. In combination with other components in the growing medium, soil act as excellent media for plant growth.

2. *Influence of growing medium on floral charactersof African marigold var. 'Double Orange'*
Earliness in flowering and shortest time for flower opening are desirable characters for potted flowering ornamentals. In the present study,early emergence of flower bud (27.48 days) and less number of days (19.48 days) from flower bud initiation to flower opening were noticed in medium M_2 [cocopeat (60%) + FYM (20%) + vermiculite (10%) + rice husk (10%) (Table 2). Early emergence of flower bud in M_2 might be due to the easy availability of nutrients from FYM and cocopeat which advances the translocation of phytohormones to the shoot apex resulting in early emergence of flower buds. Media components viz., cocopeat, vermiculite and rice husk might also have increased the porosity of the medium resulting in better uptake of nutrients by the plant.

Number of flowers and size of the flowers determine the beauty of flowering pot plants. More number of flowers per plant as well as more flower diameter were observed in medium M_4 [cocopeat (40%) + soil (20%) + FYM (20%) + vermiculite (10%) + rice husk (10%)] compared to other growing media.Enhanced floral growth in terms of more flowers and flower diameter might be due to the change in physical properties of the medium with the addition of cocopeat, vermiculite and rice husk which might have resulted in more nutrient uptake and vegetative growth leading to more flower production. Presence of soil and FYM also might have increased the availability of nutrients to the plants. Similar findings were reported by Pushkar and Singh (2012) in marigold and Singh et al. (2010) in geranium.

Growing media had no significant effect on

Table 3. Physical properties of growing medium

Growing media	Bulk density (g/cm^3)	Porosity (%)	Water holding capacity(%)
M_1	0.13	92.74	333.96
M_2	0.17	90.61	247.88
M_3	0.28	86.79	148.24
M_4	0.31	86.92	122.38
M_5	0.67	72.19	40.71

flowering duration. Field life of individual flowers is an important parameter which decides the period up to which the potted flowering ornamentals remains in presentable form. More number of days with respect to field life of individual flowers was found in medium M_4 [cocopeat (40%) + soil (20%) + FYM (20%) + vermiculite (10%) + rice husk (10%)].

Bulk density (g/cm^3), porosity (%) and water holding capacity (%) are the properties which determine the physical nature of the growing medium. Lower the bulk density, higher will be the porosity. Low bulk density was observed in M_1 [cocopeat (60%) + vermicompost (20%) + vermiculite (10 %) + rice husk (10%)] which favoured higher porosity (Table 3). Water holding capacity of the media was found more in M_1 (333.96 %) and least in M_5 (40.71 %). In the present study, lower bulk density of medium M_1 may be due to the presence of cocopeat which constitute 60 per cent of the composition of the growing medium. In addition to this, presence of vermiculite and rice husk might have also contributed in lowering the bulk density.

pH is an indication of acidity - alkalinity scale. It affects the availability of nutrients and the capacity of the plants to absorb the nutrients. The ideal pH range for growth and flower productionof marigold is 5.8 to 6.2. The pH levels of the different growing media used in the study were in the favourable range before and after the completion of experiment (Table 4). Electrical conductivity (EC) is a measure of soluble salts in the medium. EC directly influence the nutrient absorption. Optimum electrical conductivity for marigold should be less than 1.5 dS/m and all the growing media were in the favourable range of EC before and after the experiment. This might be due to the changes in pH level due to complementary effects of media components. Available N, P and K (%) are essential for the growth and flowering of the marigold. Available nitrogen (%) and phosphorus (%) were highest in M_4 [cocopeat (40%) + soil (20%) + FYM (20%) + vermiculite (10%) + rice husk (10%)] before and after the experiment (Table 5). Available K (%) was found highest in M_4 before the experiment and in M_3 [cocopeat (40%) + soil (20%) + vermicompost (20%) + vermiculite (10%) + rice husk (10%)] after the experiment. Available nitrogen and phosphorus were found to have influenced shoot and root growth as well as plant spread. Increased availability of potassium helped to increase the translocation of carbohydrates to the root system of the plants resulting in better absorption of nutrients and subsequent plant growth.

Table 4. Chemical properties of growing medium before the experiment

Growing media	pH	EC (dS/m)	Available N (%)	Available P (%)	Available K (%)
M_1	6.34	0.71	0.09	0.002	0.024
M_2	6.38	0.47	0.27	0.007	0.053
M_3	6.25	0.52	0.28	0.004	0.057
M_4	6.52	0.62	0.35	0.009	0.091
M_5	6.33	0.45	0.34	0.008	0.087

Table 5. Chemical properties of growing medium after the experiment

Growing media	pH	EC (dS/m)	Available N (%)	Available P (%)	Available K (%)
M_1	6.8	0.35	0.21	0.042	0.41
M_2	6.6	0.27	0.34	0.046	0.38
M_3	6.6	0.22	0.36	0.043	0.56
M_4	6.7	0.24	0.42	0.049	0.45
M_5	6.8	0.20	0.41	0.048	0.54

3. *Influence of growing medium on total chlorophyll content (mg/g of African marigold var. 'Double Orange'*

In this study, growing media had significant influence on total chlorophyll content of the plant. Media, M_4 and M_5 were found to be on par with respect to total chlorophyll content of marigold and

Table 7.Component, quantity and cost details of growing medium

Growing media	Components of media	Quantity of each media component	Weight of growing medium per pot (kg)	Cost of growing medium per pot (Rs.)
M_1	Cocopeat (60%) + vermicompost (20%) + vermiculite (10 %) + rice husk (10%)	Cocopeat (0.96Kg), vermicompost (0.6Kg), Vermiculite (0.16Kg), Rice husk (0.04Kg)	1.76	21.40
M_2	Cocopeat (60%) + FYM (20%) + vermiculite (10%) +rice husk (10%)	Cocopeat (0.96Kg), FYM (0.48Kg), Vermiculite (0.16Kg), Rice husk (0.04Kg)	1.64	16.12
M_3	Cocopeat (40%) + soil (20%) + vermicompost (20%) + Vermiculite (10%) +rice husk (10%)	Cocopeat (0.64Kg), Soil (1Kg), Vermicompost (0.6Kg), Vermiculite (0.16Kg), Rice husk (0.04Kg)	2.44	20.20
M_4	Cocopeat (40%) + soil (20%) +FYM (20%) + vermiculite (10%) +rice husk (10%)	Cocopeat (0.64Kg), Soil (1Kg), FYM (0.48Kg), Vermiculite (0.16Kg), Rice husk (0.04Kg)	2.32	14.92
M_5	Soil: FYM: sand (1:1:1)	Soil(1.7Kg), FYM(0.825Kg), Sand (2.48Kg)	5.00	12.08

this might be due to the increased supply of nitrogen by FYM which might have helped in easy absorption of plant nutrients essential for greening of the leaves (Table 6). Similar findings were reported by Mukesh et al. (2007) and Sharma et al. (2017) in marigold and Thakur and Grewal (2019) in chrysanthemum.

Table 6. Influence of growing medium on total chlorophyll content of African marigold

Growing media	Total chlorophyll content (mg/g)
M_1	0.55
M_2	0.55
M_3	0.58
M_4	0.63
M_5	0.60

4. *Cost of growing medium*

Medium M_5 [soil:FYM:sand(1:1:1)] was found to be the cheapest (Rs.12.08) compared to other growing media, followed by M_4(14.92). Cost of growing medium was highest (21.40) for M_1 [cocopeat (60%) + vermicompost (20%) + vermiculite (10%) + rice husk (10%) (Table 7).

Conclusion

Short stature, more number of laterals and flowers are desirable characters of potted ornamental flowering plants. Growing medium consists of Cocopeat (40%) + soil (20%) +FYM (20%) + vermiculite (10%) +rice husk (10%) was found to be the best for pot plant production of African marigold var. 'Double Orange'in terms of all these characters. In addition, thus growing medium was found to be an alternative to the traditional potting medium for pot plant production as the availability of sand and soil is declining. Lightness of the medium favours easy transportation. Cost of growing medium was also less compared to other growing media tested, and the incidence of soil borne pathogens could be reduced.

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