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Field performance of marigold rooted (*Tagets patula* L.) cuttings on growth and flowering obtained from different growing media

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Abstract
A field investigation entitled "Field performance of marigold rooted (*Tagets patula* L.) cuttings on growth and flowering obtained from different growing media" was conducted at Floriculture Unit, Department of Horticulture, Dr. PDKV, Akola during the years, 2016-17 and 2017-18. The experiment was laid out in Randomized Block Design with three replications. The treatments comprised of twelve different propagating medias *viz*. soil, sand, vermicompost, FYM, cocopeat, soil + sand (1:1), soil+ vermicompost (1:1), soil + FYM (1:1), sand + vermicompost (1:1), sand + FYM (1:1), soil + sand + vermicompost (1:1:1) and soil + sand + FYM (1:1:1).The results of the experiment revealed that, performance of transplanted marigold plants in respect of growth parameters *viz*. plant height, leaves plant^{-1}, branches plant^{-1},weight of fresh biomass as well as leaf area were noticed maximum in the plants obtained from the vermicompost media. Also similar results in respect of flowering parameters, significantly minimum days for emergence of first flower bud, days to 50 per cent flowering, days to first harvesting and maximum blooming period of marigold were observed in the plants obtained from vermicompost media. Whereas, significantly maximum plant spread was noted under the plants obtained from cocopeat media.

Keywords: Marigold, rooting media, vermicompost, cocopeat

Introduction
Marigold is an important commercial flower of India. Marigold can be grown in various types of climate and almost any part of the year in Maharashtra. It is commercially propagated by seeds in Maharashtra. But in last few years, farmers are using local variety which is widely adapted among the local farmers and is propagated through stem cuttings. There has been considerable increase in its area. However, good rooting percentage and crop establishment has been a major problem. Growing media is a substrate that provides physical support, moisture and aeration to the growing plant, which also play a vital role in growth and development of plants.

For the maximization of yield and quality of any flower crop, selection of suitable propagation media, genotype and proper cultural and management practices like irrigation, plant protection and optimum dose of manures and fertilizers along with some micronutrients are very important. Therefore, use of growing media offers a valuable alternative to conventional use of soil for quality flower production due to their good water holding capacity, good aeration and better nutrient status.

Vermicompost is a preferred nutrient source for organic farming. It is eco-friendly, non-toxic, consumes low energy input for composting and is a recycled biological product. It enhances germination, plant growth, crop yield, improves root growth and structure. It enriches soil with micro-organisms. Cocopeat is also called coco dust, is a byproduct of cutting and shifting of coconut for fibre production. It has an excellent pore space (25-30%) and fine structure required for proper growth and development of the roots for seedling. It is also rich source of nutrients and can easily be mixed with other growing media as reported by Bhattacharjee (2006) [2].

In Maharashtra, growing floricultural crops commercially in media is picking up at a modest rate. Due to rapid urbanization and improvement in the aesthetic sense, there is an increased desire to buy quality produce from market. Soilless media offers good quality produce at reasonable cost. Till date no work has been done on standardization of media required for optimum rooting of marigold cuttings and It's production.

The present study was therefore, undertaken to find out the suitable media for marigold production under Vidharbha conditions.

Materials and Methods

This experiment was conducted in Randomized Block Design with three replications at Floriculture Unit, Department of Horticulture, Dr. PDKV, Akola during the years 2016-17 and 2017-18.The allotment of treatments to the various plots were done randomly in each replication. The treatments comprised of twelve different propagating medias *viz*. soil, sand, vermicompost, FYM, cocopeat, soil + sand (1:1), soil + vermicompost (1:1), soil + FYM (1:1), sand + vermicompost (1:1), sand + FYM (1:1), soil + sand + vermicompost (1::1:1) and soil + sand + FYM (1:1:1).

Propagation was done by using the terminal cuttings (8-10 cm).The cuttings were soaked in tap water for 15 - 20 minutes for better turgidity and earlier rooting. The cuttings were treated with 0.1 per cent carbendazim for 30 minutes and then planted in the pots filled with different media as per treatments. These pots were kept under shed. The foliage of cuttings were kept moist by spreading water (3-5 times every day to maintain 75-80 per cent relative humidity). A regular watering, weeding and plant protection measures were carried out as and when required. After one month, all the rooted cuttings of uniform size were selected and transplanted in main field and the relevant data were recorded particularly for plant height (cm), leaves plant^{-1}, branches plant^{-1}, weight of fresh biomass (g), leaf area (cm^2), plant spread (cm), days for emergence of first flower bud, days to 50 per cent flowering, days to first harvesting and blooming period (days). Recorded pooled data were analyzed as per statistical procedure of RBD for comparison of means.

Results and Discussion

Data presented in Table 1 and 2 exhibited significant effect on field performance of marigold rooted (*Tagets patula* L.) cuttings on growth and flowering obtained from different growing media during the years 2016-17 and 2017-18, respectively.

Table 1: Field performance of marigold plants in respect of plant height, number of leaves plant^{-1}, number of branches plant^{-1}, Plant spread (cm) and leaf area (cm^2) obtained from different growing media.

Treatments	Plant height			Number of leaves plant^{-1}			Number of branches plant^{-1}			Plant spread (cm)			Leaf area (cm^2)		
	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled
T_1 –Soil	47.93	49.03	48.48	132.60	136.16	134.38	32.53	34.26	33.40	38.80	40.63	39.71	6.20	6.14	6.17
T_2 –Sand	60.23	61.13	60.68	155.33	157.63	156.48	37.53	38.16	37.85	51.60	53.63	52.61	6.63	6.48	6.56
T_3 –Vermicompost	82.73	83.47	83.10	186.00	188.73	187.36	47.20	48.60	47.71	53.86	54.56	54.21	7.38	7.45	7.41
T_4 –FYM	71.33	71.93	71.63	164.00	164.90	164.45	40.66	42.06	41.36	54.33	54.60	54.46	7.02	7.00	7.01
T_5 – Cocopeat	80.66	81.40	81.03	178.33	179.96	179.15	47.00	47.23	47.30	59.53	61.80	60.66	6.83	6.64	6.73
T_6 -Soil + Sand (1:1)	52.06	52.23	52.15	145.26	147.60	146.43	37.73	38.63	38.18	46.26	46.30	46.28	6.39	6.45	6.42
T_7 -Soil + Vermicompost (1:1)	52.66	53.96	53.31	133.66	136.23	134.95	40.40	41.12	40.83	47.06	46.93	47.00	6.64	6.82	6.73
T_8- Soil + FYM (1:1)	59.86	60.16	60.01	140.20	142.93	141.56	37.00	38.13	37.56	48.46	50.00	49.23	6.58	6.67	6.63
T_9-Sand + Vermicompost(1:1)	77.90	78.70	78.30	151.66	154.23	152.95	45.93	46.23	46.08	54.00	54.20	54.10	6.52	6.49	6.51
T_{10}-Sand +FYM (1:1)	61.40	62.23	61.81	145.66	149.36	147.51	43.46	44.23	43.85	53.20	54.30	53.75	6.84	6.74	6.79
T_{11}-Soil+sand+Vermicompost (1:1:1)	68.93	69.83	69.38	140.00	151.46	145.73	40.66	41.60	41.13	52.93	54.60	53.76	6.84	6.79	6.81
T_{12}-Soil+sand +FYM (1:1:1)	58.43	58.70	58.56	142.66	148.80	147.46	38.93	39.90	39.41	48.66	50.50	49.00	6.84	6.85	6.85
'F' Test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m) ±	1.95	1.96	1.95	4.38	4.55	4.43	1.24	1.41	1.31	1.47	1.52	1.56	0.20	0.20	0.19
CD at 5%	5.72	5.77	5.73	12.86	13.34	13.00	3.64	4.15	3.86	4.31	4.48	4.58	0.59	0.59	0.57

Table 2: Field performance of marigold plants in respect of weight of fresh biomass plant^{-1}(g), days for emergence of first flower bud, days for 50 per cent flowering, total blooming period (days) and days to first harvesting obtained from different growing media

Treatments	Weight of fresh biomass plant^{-1} (g)			Days for emergence of first flower bud (days)			Days for 50 per cent flowering (days)			Total blooming period (days)			Days to first harvesting		
	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled
T_1 –Soil	213.20	212.53	212.86	61.00	61.26	61.13	84.26	84.43	84.35	100.60	102.43	101.51	87.26	88.26	87.76
T_2 –Sand	375.80	377.46	376.63	45.86	45.56	45.71	72.86	73.20	73.03	104.46	104.26	104.36	75.80	77.53	76.66
T_3 –Vermicompost	490.46	491.80	491.13	40.00	40.23	40.11	55.26	55.20	55.23	126.00	126.50	126.25	71.66	73.06	72.36
T_4 –FYM	410.20	411.26	410.73	44.40	45.03	44.71	66.00	66.53	66.26	110.80	111.83	111.31	78.66	80.10	79.38
T_5 – Cocopeat	468.66	470.33	469.50	42.00	43.20	42.60	57.80	58.90	58.35	121.33	122.50	121.91	71.66	73.23	72.45
T_6 -Soil + Sand (1:1)	233.66	235.00	234.33	54.93	55.83	55.38	80.73	81.93	81.33	108.40	109.83	109.11	80.40	82.16	81.28
T_7 -Soil + Vermicompost (1:1)	285.00	280.00	282.50	50.00	51.16	50.58	78.40	79.53	78.96	105.80	107.16	106.48	79.33	80.96	80.15
T_8- Soil + FYM (1:1)	232.46	233.53	233.00	58.60	59.53	59.06	80.60	81.56	81.08	102.66	104.50	103.58	85.66	87.33	86.50
T_9-Sand + Vermicompost(1:1)	425.60	427.00	426.30	44.93	45.60	45.26	62.06	62.53	62.30	116.00	120.10	118.05	79.00	80.36	79.68
T_{10}-Sand +FYM (1:1)	339.66	341.66	340.66	47.86	49.03	48.45	75.80	76.90	76.35	104.26	103.23	103.75	77.73	79.20	78.46
T_{11}-Soil+sand+Vermicompost (1:1:1)	398.33	400.33	399.33	45.66	46.90	46.28	66.86	67.90	67.38	108.66	107.76	108.21	75.66	77.23	76.45
T_{12}-Soil+sand +FYM (1:1:1)	321.60	322.66	322.13	50.40	50.86	50.63	80.46	81.60	81.03	108.86	107.76	108.31	79.13	80.56	79.85
'F' Test	Sig.	Sig.	Sig.	Sig	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m) ±	10.11	10.26	10.13	1.46	1.47	1.46	2.12	2.16	2.13	3.21	3.29	3.20	2.31	2.48	2.39
CD at 5%	29.67	30.11	29.72	4.28	4.32	4.28	6.24	6.34	6.26	9.42	9.66	9.39	6.78	7.29	7.03

Performance of transplanted marigold plants during both the years (2016-17 and 2017-18) of experimentation in respect of plant height (82.73 and 83.47 cm), number of leaves plant^{-1} (186.00 and 188.73), number of branches plant^{-1} (47.20 and 48.60), weight of fresh biomass (490.46 and 491.80 g) and leaf area (7.45 and 7.41 cm^2) were found significantly maximum in vermicompost media and this was found statistically at par with the cocopeat media *viz*. plant height (80.66 and 81.40 cm), number of leaves plant^{-1} (178.33 and 179.96), number of branches (47.00 and 47.23), weight of fresh biomass (468.66 and 470.33 g) and in respect of leaf area (7.45 and 7.41 cm^2).

Whereas, maximum plant spread (59.53, 61.80 cm) in cocopeat media was found significantly superior than rest of all the treatments and this was followed by FYM (54.33 and 54.60 cm) media during 2016-17 and 2017-18, respectively.

On the other hand, significantly minimum plant height (47.93 and 49.03 cm), number of leaves plant^{-1} (132.60 and 136.16), number of branches (32.53 and 34.26), weight of fresh biomass (213.20 and 212.53 g), plant spread (38.80 and 40.63 cm) and leaf area (6.20 and 6.14 cm^2) were recorded in soil (control) media during both the years of the experimentation.

In flowering parameters, performance of transplanted marigold plants during both the years (2016-17 and 2017-18) of experimentation in respect of days for emergence of first flower bud (40.00 and 40.23 days), days for 50 per cent flowering (55.26 and 55.20 days) and days to first harvesting (71.66 and 73.06 days) were recorded significantly minimum in vermicompost medium and in respect of total blooming period (126.00 and 126.50 days) was found significantly maximum in vermicompost media and this was found statistically at par with the cocopeat media in respect of days for emergence of first flower bud (42.00 and 43.20 days), days for 50 per cent flowering (57.80 and 58.90 days), days to first harvesting (71.66 and 73.23 days) and blooming period (121.33 and 122.50 days) during both the years of the experimentation.

Whereas, significantly maximum days for emergence of first flower bud (61.00 and 61.26 days), days for 50 per cent flowering (84.26 and 84.43 days), days to first harvesting (87.26 and 88.26 days) and significantly minimum blooming period (100.60 and 102.43 days) were recorded in soil (control) media during 2016-17 and 2017-18 respectively.

On the basis of above findings, it can be concluded that, either vermicompost or cocopeat alone exhibited better rooting media for field performance of marigold (*Tagets patula* L.) cuttings.

Vermicompost provided most optimum conditions for various growth parameters, producing more number of leaves plant^{-1} with maximization of photosynthesis which helped in maintaining optimum health of the plant. Increased number of leaves on media amended with vermicompost has also been reported by Moghadam *et al.*, (2012) [4] in lilium Asiatic hybrid 'Navona'. Maximum number of leaves might be due to vermicompost, which is rich in humus and contains valuable vitamins, enzymes and hormones like Auxins, Gibbrellins, etc. for better growth and development (Shadanpour *et al.*, 2011) [5].

Vermicompost has little amount of solvable mineral than primitive material i.e. more humic acid and more capacity for cation exchange. Activity of earthworms accelerates organic matter, mineralization, decomposition of polysaccharides increase humans materials, reducing C: N ratio, reducing availability of heavy elements. By adding vermicompost it increases colony formation of mycorrhiza. Vermicompost contains nitrogen, phosphorus and potassium mostly 5 to 11 times more than soil, during processing calcium and magnesium and micronutrients can also increases also it contains more organic matter (%) which facilitate availability of essential nutrients resulted to increase in cell division, elongation and cell size.

Cocopeat helps in maintaining the appropriate texture of the growing media and prevents compaction, there by resulting in better root growth and shoot growth. This might be also due to the higher water holding capacity, aeration and available organic matter of the cocopeat medium. The results are in line with the findings of Awang *et al.* (2010) [1] in *Celosia cristata* and Mane and Bhosale (2008) [2] in *Arabidopsis thaliana*.

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