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Soil chemical properties as influenced by standardization of growing media in vertical planting of marigold (*Tagetes erecta* L.)

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Abstract
Standardization of growing media for vertical planting of marigold was started at High Tech Floriculture Project farm, College of Agriculture, Pune, during *Rabi* 2023-2024. The present investigation was undertaken on marigold crop during *Rabi* 2023-2024, with a view to evaluate the soil chemical properties in growing media of marigold in vertical planting. The experiment was laid in Randomized Block Design comprising three replications with nine treatments. The results of present investigation concluded that treatment T_4: [Red Soil 50% + Cocopeat 25% + Spent Mushroom 25% (v/v)] followed by T_2: [Red Soil 50% + Spent Mushroom 50% (v/v)] is beneficial to increase growth, flowering and yield quality of marigold compared to all other treatments and in vertical planting and absolute control.

Keywords: Marigold, growing media, vertical planting, cocopeat, spent mushroom, bagasse, red soil

Introduction
India has a long history and tradition with flowers. It is said in India that a man is born with flowers and dies with flowers as well. Flowers also contribute to human well-being, with studies showing their ability to improve mood, reduce stress and enhance overall mental health. Marigold (*Tagetes erecta* L.) is an immensely popular annual flower crop, widely grown throughout the world. Marigold belongs to the family composite and the genus *Tagetes*. The genus *Tagetes* comprises about 33 species, of which *Tagetes erecta* (African marigold) and *Tagetes patula* (French marigold) are under commercial cultivation in India. Marigold is native to Central and South America, especially Mexico. The chromosome number is X = 12 and 2n = 24. The other species introduced in India are *Tagetes signata* Linn. *Tagetes minuta* Linn, *Tagetes lucida*, and *Tagetes tenuifolia*. Marigold is a major loose flower crop that can be grown in different media. Proper media formulation typically includes a blend of organic and inorganic components that provide adequate aeration, drainage and nutrient retention. Vertical planting offers several advantages for marigold cultivation. It improves air circulation around the plants, reducing the risk of fungal diseases, and allows for better drainage, preventing root rot (Roper *et al*., 2018) [7]. Thus, keeping the above facts in view, the experiment was conducted to study the effect of growing media on growth, flowering and yield attributes were studied in marigold (*Tagetes erecta* L.) in vertical planting.

Materials and Methods
The information pertaining to the details of the experiment, materials used, methodology adopted and statistical techniques followed during the investigation entitled "Standardization of Growing Media for Vertical Planting of Marigold (*Tagetes erecta* L.)*"* is systematically outlined in this chapter. The present investigation was undertaken in the month of January 2023–2024 at High Tech Floriculture, College of Agriculture, Pune, Maharashtra. The experiment was conducted with the African marigold variety Seracole.

The UV-stabilized polypropylene bags of size 22" x 38" were used for growing the marigold crop for this experiment. For experimental purposes, different media such as red soil, cocopeat, spent mushroom and bagasse were used in various combinations as treatments in UV stabilized polybags. The planting material were obtained from reliable sources and planted. The planting of Marigold seedlings was done on 28th January, 2024.The experiment was laid out in a randomized block design with three replications and nine treatments. Treatment details are:
T_1: Red Soil 50% + Cocopeat 50% (v/v), T_2: Red Soil 50% + Spent Mushroom 50% (v/v), T_3: Red Soil 50% + Bagasse 50% (v/v), T_4: Red Soil 50% + Cocopeat 25% + Spent Mushroom 25%(v/v), T_5: Red Soil 50% + Cocopeat 25% + Bagasse 25% (v/v), T_6: Red Soil 50% + Spent Mushroom 25% + Bagasse 25% (v/v), T_7: Red Soil 25% + Cocopeat 25% + Spent Mushroom 25% + Bagasse 25% (v/v), T_8: Red Soil 100% (v/v), T_9: Absolute control. The data generated from present investigation were analyzed with Z test by using standard methods described as by Panse and Sukhatme (1985) [3].

Results and Discussion

Chemical analysis of growing media

pH (Table 1): Highest final pH after harvesting was observed in T_9 whereas lowest pH was observed in T_3 treatment.

Electrical Conductivity (Table 1): Highest final EC after harvesting was observed in T_2 whereas lowest EC was observed in T_9 treatment.

Available Macronutrients (kg/ha), (Table 1): Nitrogen was given to plant in split doses in which treatment T_4 was recorded with maximum nitrogen per cent whereas T_9 was recorded lowest nitrogen content in soil after harvesting. Phosphorous (kg/ha)-Maximum phosphorous per cent was observed in T_4 was recorded and lowest was observed in T_9 and T_3 treatments. Potassium (kg/ha)-Maximum Potassium content was observed in T_4 and lowest potassium per cent was observed in treatment T_9 after final harvesting.

Available Micronutrients (ppm), (Table 2): There was a subtle difference in number of micronutrients in growing media in Cu, Mn, Fe and Zn. Calculating nutrient status in soil is essential for standardizing growing media in the vertical planting of marigolds, as it ensures optimal growth conditions by identifying the right balance of macronutrients and micronutrients required for healthy plant development. This process allows researchers to develop standardized media that enhance uniformity and flower quality while promoting sustainability through informed use of organic amendments and fertilizers. Additionally, understanding nutrient levels helps evaluate the impact of different media on plant performance, improving disease and pest resistance, which is crucial in vertical farming settings. Ultimately, this research contributes valuable insights into plant physiology and urban agriculture, supporting economic viability and fostering innovative cultivation practices.

Table 1: Effect of growing media on chemical properties of growing media (pH, EC, NPK and micronutrients) in marigold cv. '*Seracole'* in vertical planting system

Treatments		Ph		EC		Nitrogen (Kg/Ha)		Phosphorous (Kg/Ha)		Potassium (Kg/Ha)	
		Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
T_1	Red Soil 50% + Cocopeat 50% (v/v)	6.68	6.56	1.62	0.92	244.89	282.49	27.33	23.33	206.80	168.70
T_2	Red Soil 50% + Spent Mushroom 50% (v/v)	6.42	6.27	2.81	2.13	416.60	463.99	19.27	22.13	540.23	455.80
T_3	Red Soil 50% + Bagasse 50% (v/v)	6.82	5.81	1.16	1.03	252.92	287.08	14.47	16.67	167.37	159.98
T_4	Red Soil 50% + Cocopeat 25% + Spent Mushroom 25% (v/v)	6.64	6.81	2.17	2.06	429.00	479.37	20.33	25.00	527.17	460.70
T_5	Red Soil 50% + Cocopeat 25% + Bagasse 25% (v/v)	6.85	6.28	1.82	1.29	236.89	308.43	16.67	21.07	200.07	184.56
T_6	Red Soil 50% + Spent Mushroom 25% + Bagasse 25% (v/v)	7.04	6.87	2.03	1.85	322.02	381.09	17.00	22.17	508.55	450.52
T_7	Red Soil 25% + Cocopeat 25% + Spent Mushroom 25% + Bagasse 25% (v/v)	6.73	A.	1.44	1.21	308.27	314.73	14.67	17.67	478.67	416.94
T_8	Red Soil 100% (v/v)	6.82	6.99	0.85	0.51	243.38	282.49	19.33	24.33	193.16	160.28
T_9	Absolute Control	7.25	7.02	0.83	0.47	236.70	246.14	12.67	16.67	109.50	142.24
S.E.± (m)		-		-		-	21.52	-	0.84	-	8.48
C.D. at 5%		-		-		-	64.51	-	2.53	-	25.44

Table 2: Effect of growing media on chemical properties of growing media (Available micronutrients) in marigold cv. '*Seracole'* in vertical planting system

Treatments		Micronutrients (Ppm)							
		Cu		Mn		Fe		Zn	
		Initial	Final	Initial	Final	Initial	Final	Initial	Final
T_1	Red Soil 50% + Cocopeat 50% (v/v)	3.15	3.17	12.87	12.83	15.46	15.57	3.47	3.46
T_2	Red Soil 50% + Spent Mushroom 50% (v/v)	3.74	3.76	12.62	12.61	10.96	10.96	5.48	5.50
T_3	Red Soil 50% + Bagasse 50% (v/v)	3.46	3.49	12.64	12.64	23.17	23.58	3.11	3.12
T_4	Red Soil 50% + Cocopeat 25% + Spent Mushroom 25% (v/v)	2.85	2.84	12.86	12.84	22.24	22.62	3.34	3.39
T_5	Red Soil 50% + Cocopeat 25% + Bagasse 25% (v/v)	3.94	3.95	12.91	12.95	24.68	24.79	5.49	5.43
T_6	Red Soil 50% + Spent Mushroom 25% + Bagasse 25% (v/v)	3.61	3.57	12.83	12.81	22.34	22.45	3.34	3.36
T_7	Red Soil 25% + Cocopeat 25% + Spent Mushroom 25% + Bagasse 25% (v/v)	3.93	3.95	12.82	12.83	21.49	21.04	5.44	5.53
T_8	Red Soil 100% (v/v)	2.85	2.84	12.89	12.88	19.86	19.13	2.85	2.83
T_9	Absolute Control	2.68	2.64	12.74	12.76	11.23	11.31	2.10	2.16
S.E.± (m)		-	0.09	-	0.04	-	0.89	-	0.25
C.D. at 5%		-	0.27	-	0.14	-	2.67	-	0.75

Conclusion

Conclusions are drawn from the observations and are given here. Based on the results obtained from the present study, it may be concluded that, among all the treatments of media standardization applied in the study, the treatment T_2 [Red Soil 50% + Spent Mushroom 50% (v/v)] followed by T_4 [Red Soil 50% + Cocopeat 25% + Spent Mushroom 25% (v/v)] was found to be most effective in improving the shelf life of marigold and treatment T_6 [Red Soil 50% + Spent Mushroom 25% + Bagasse 25% (v/v)] followed by T_7 [T_7: Red Soil 25% + Cocopeat 25% + Spent Mushroom 25% + Bagasse 25% (v/v)] in improving membrane stability index in marigold cv. 'Seracole' in vertical planting.

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