

Vegetative growth of marigold under open field conditions as influenced by rooting media

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ABSTRACT

An experiment was carried out in factorial concept with two factors *i.e.*, varieties at two levels and rooting media at eight levels thus making 16 combinations which were replicated twice. The effect of varieties, rooting media and their interactions were found to be significant with regard to percentage establishment of rooted cuttings (%), plant height (cm), number of primary branches per plant, number of secondary branches per plant, plant spread (cm²), stem diameter (cm) and total dry weight of plant at harvest in open field (g). The variety Bidhan Marigold 1 exhibited greater percentage establishment of rooted cuttings (96.13%) than Bidhan Marigold 2 (94.17%) at 30 days after shifting into the main field. At 90 DAS, the variety Bidhan Marigold 1 exhibited highest plant height (59.03 cm), maximum number of primary branches per plant (4.66), secondary branches per plant (12.95), plant spread (945.55 cm²), stem diameter (1.28 cm) and highest total dry weight of plant (63.03 g), than Bidhan Marigold 2.

Key words: Bidhan marigold varieties, days after shifting (DAS), marigold.

INTRODUCTION

Marigold (*Tagetes erecta* L.) is one of the most important commercial flower crops grown in India. The crop is said to be native of Mexico. It belongs to the family *Asteraceae* and propagated by seed and terminal cuttings. Marigold flowers are extensively used as loose flowers for making garlands, beautification, religious offerings, social functions and other purposes such as pigment and oil extraction and therapeutic uses. Apart from these uses, marigold is widely grown in gardens and pots for display purpose. The crop also finds industrial application in several areas like preparation of natural dyes and

essential oils. It is a highly suitable bedding plant and also used as trap crop against nematodes and pests in some crops. It is found in different colors and fragrances but yellow is the most common flower color.

Rooting media are essential for improvement in rooting percentage and hence the selection and combination of media components assumes greater significance for success in vegetative propagation (Laubscher, 1990). Moisture holding capacity and optimum aeration have been regarded as the most essential characteristics for rooting medium. The medium used for rooting of cuttings should be also firm so as to hold the

plant/cutting in position. Therefore an ideal rooting medium should be porous enough to allow good aeration and should possess high water holding ability. The type of rooting medium determines to some extent, the nature of roots which are produced on the cutting and consequently its survival. Thus medium for rooting has gained lot of importance in propagation of marigold.

The rooting media has been reported to influence the success of propagation in several crops through vegetative parts. Influence of media in turn was shown to be under the control of its biological properties since the media necessarily happens to be an eco-system. As the rhizospheric eco-system has a bearing on the rooting property of crop, a natural inquisitiveness is quite justifiable on the significance of former's influence on later's performance during major part of cropping period.

MATERIALS AND METHODS

The experiment was carried out at college farm, College of Horticulture, Dr. Y.S.R. Horticultural University, Venkataramannagudem, West Godavari District of Andhra Pradesh during Rabi, 2017-2018. Experiment was laid out in completely randomised design with factorial concept. Factor one consisted of two levels of marigold varieties (V), one being Bidhan Marigold - 1 (B M 1) and another Bidhan Marigold - 2 (B M 2) and factor two consists of 8 levels of rooting media (M): M₁ - soil, M₂ - soil + mycorrhiza, M₃ - soil: vermicompost (1:1) v/v + mycorrhiza, M₄ - soil: vermicompost: coco peat (1:1:1) v/v + mycorrhiza, M₅ - soil: vermicompost: rice husk (1:1:1) v/v + mycorrhiza, M₆ - soil: vermicompost: coco peat: rice husk (1:1:1:1) v/v + mycorrhiza, M₇ - soil: vermicompost: saw dust (1:1:1) v/v + mycorrhiza and M₈ - soil: vermicompost: coco peat: saw dust

(1:1:1:1) v/v + mycorrhiza. Thus, there were 16 treatment combinations and were repeated twice. Mycorrhiza was applied at the rate of 2 g per plant (Neelima *et al.*, 2016). Vegetative Parameters observations like percentage establishment of rooted cuttings (%), plant height (cm), number of primary branches per plant, number of secondary branches per plant, plant spread (cm²), stem diameter (cm) and total dry weight of plant at harvest in open field (g). The experimental data pertaining to all the characters studied were subjected to statistical analysis of variance technique as described by Panse and Sukhatme (1997).

RESULTS AND DISCUSSION

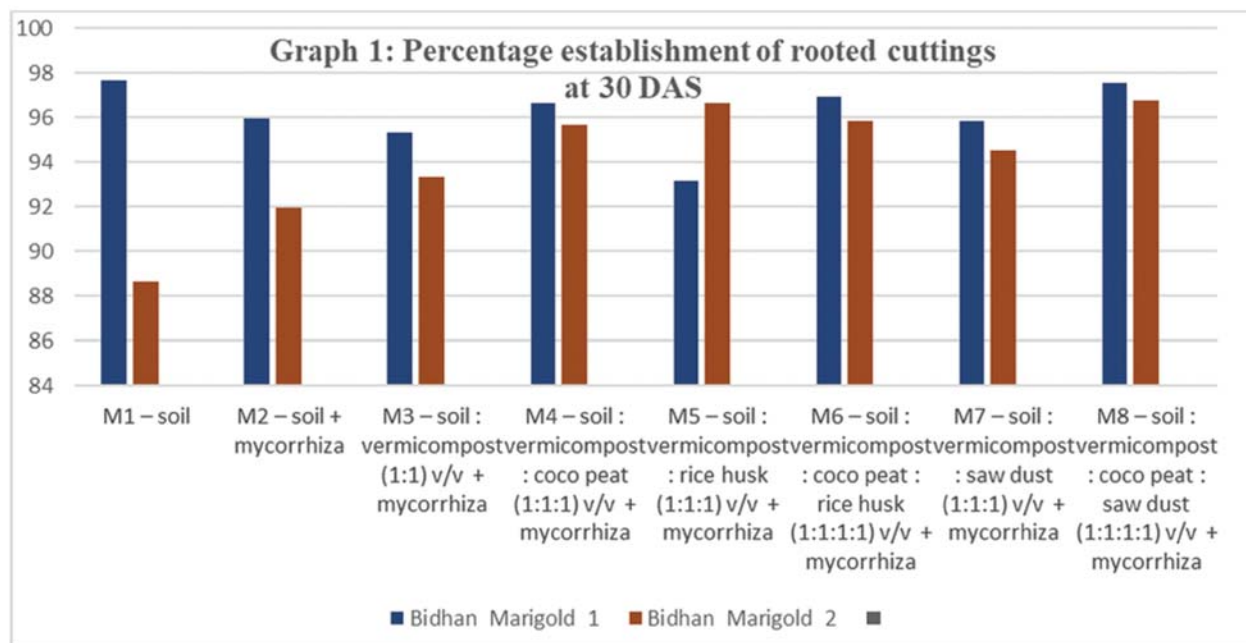
Percentage establishment of rooted cuttings (%) : It is evident from the data presented in the (Table 1), that there were significant variations among the varieties, rooting media and their interactions with regard to percentage establishment of rooted cuttings. The variety Bidhan Marigold 1 exhibited greater percentage establishment of rooted cuttings (96.13%) than Bidhan Marigold 2 (94.17%) at 30 days after shifting into the main field. Among the rooting media, the percentage establishment of rooted cuttings (97.15%) was recorded highest by M₈ - soil: vermicompost: coco peat: saw dust (1:1:1:1) v/v + mycorrhiza which was on par with M₆ - soil: vermicompost: coco peat: rice husk (1:1:1:1) v/v + mycorrhiza (90.94%) followed by M₄ - soil: vermicompost: coco peat (1:1:1) v/v + mycorrhiza (96.15%) but significantly superior to M₃ - soil: vermicompost (1:1) v/v + mycorrhiza (94.34%). The lowest percentage establishment of rooted cuttings (93.15%) was recorded on (with) M₁ - soil.

Among the rooting media, the terminal cuttings planted in coco peat recorded the maximum field survival at 30 days after shifting into the main

Table 1: Percentage establishment of rooted cuttings at 30 DAS, Plant height (cm) at 90 DAS and Number of primary branches per plant at 90 DAS as influenced by rooting media in marigold varieties.

Medium / Variety	Percentage establishment of rooted cuttings at 30 DAS			Plant height (cm) at 90 DAS			Number of primary branches per plant at 90 DAS		
	Bidhan Marigold 1	Bidhan Marigold 2	Mean	Bidhan Marigold 1	Bidhan Marigold 2	Mean	Bidhan Marigold 1	Bidhan Marigold 2	Mean
M ₁ - soil	97.65	88.65	93.15	53.30	48.30	50.80	3.90	4.10	4.00
M ₂ - soil + mycorrhiza	95.95	91.95	93.95	56.40	51.80	54.10	4.20	4.40	4.30
M ₃ - soil : vermicompost (1:1) v/v + mycorrhiza	95.34	93.35	94.34	54.65	57.65	56.15	4.70	3.95	4.33
M ₄ - soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza	96.65	95.65	96.15	59.15	55.45	57.30	4.80	4.75	4.78
M ₅ - soil : vermicompost : rice husk (1:1:1) v/v + mycorrhiza	93.15	96.65	94.9	58.50	54.75	56.63	4.90	4.25	4.58
M ₆ - soil : vermicompost : coco peat : rice husk (1:1:1:1) v/v + mycorrhiza	96.95	95.85	96.4	64.65	52.80	58.73	4.45	5.10	4.78
M ₇ - soil : vermicompost : saw dust (1:1:1) v/v + mycorrhiza	95.84	94.55	95.19	56.45	56.95	56.70	4.70	4.65	4.68
M ₈ - soil : vermicompost : coco peat : saw dust (1:1:1:1) v/v + mycorrhiza	97.55	96.75	97.15	69.15	59.80	64.48	5.60	4.25	4.93
Mean	96.13	94.17	95.15	59.03	54.69	56.86	4.66	4.43	4.54
Factor	S Em $\pm$	CD at 5%	S Em $\pm$	CD at 5%	S Em $\pm$	CD at 5%	S Em $\pm$	CD at 5%	
Variety (V)	0.25	0.74	1.02	3.00	0.05	0.15			
Medium (M)	0.34	0.98	0.78	2.28	0.06	0.18			
V x M	0.47	1.38	1.23	3.63	0.11	0.32			

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field. It might be due to its corresponding merit at early stages because of rich nutrient content, high water holding capacity, good drainage and high porosity of coir pith. These qualities facilitated for an early advantage of sprouting and gaining good amount of strength by terminal cuttings that would have helped further during the development of root system resulting in higher chances for their better field establishment.

A good rooted cutting should have reasonable amount of dry matter partitioned into roots and could win the race in better search and imbibition of food material from the growing media thus leading to better survival as well as field establishment at later stages of study.

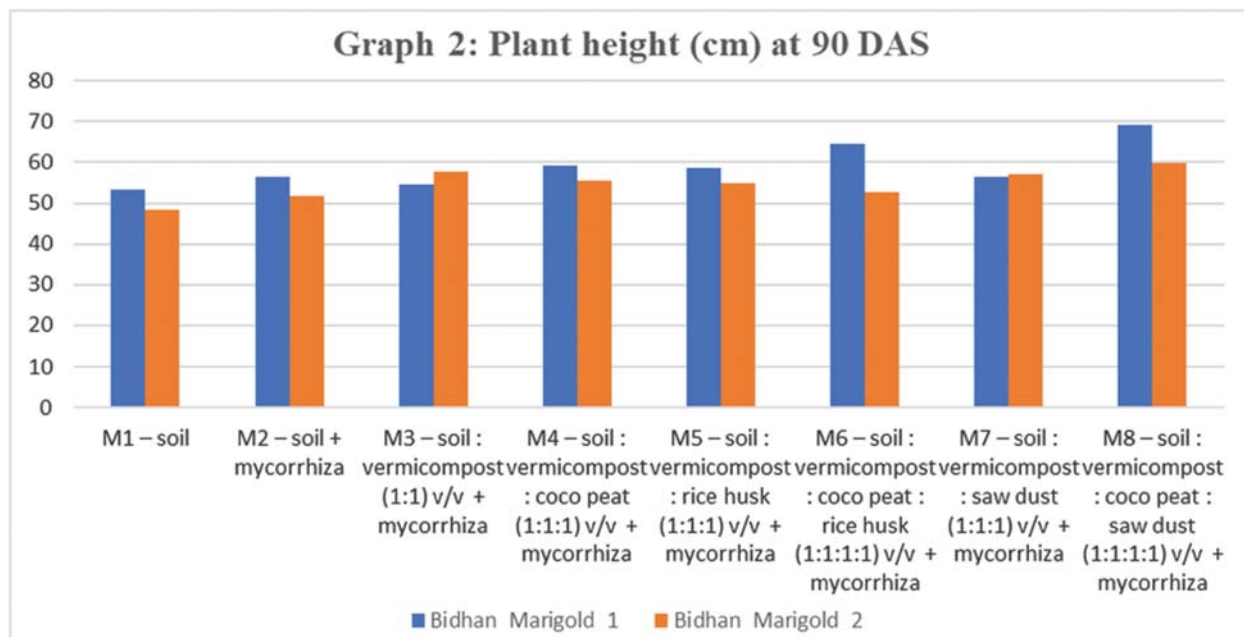
Plant height (cm) : The highest plant height was found to increase from 27.75 cm (at 30 DAS) to 64.48 cm (90 DAS). At 90 DAS, the variety Bidhan Marigold 1 exhibited highest plant height (59.03 cm) than Bidhan Marigold 2 (54.69 cm). Among the rooting media, at 90 DAS the highest plant height (54.69 cm) was recorded by M₈ - soil : vermicompost : coco peat : saw dust (1:1:1:1) v/v + mycorrhiza followed by M₆ - soil

: vermicompost : coco peat : rice husk (1:1:1:1) v/v + mycorrhiza (58.73 cm) and M₄ - soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza (57.30 cm). The lowest plant height (50.80 cm) was recorded on M₁ - soil.

The cocopeat amended media gave maximum plant height on account of high porosity, nutritional value and good water holding capacity. Norman and Edward (2005) studied the effect of vermicompost on plant growth and reported that vermicompost is a rich source of mineral nutrition and its addition to media increases quality of media by increasing microbial activity and microbial biomass which are key components in nutrient cycling and production of plant growth regulators. Further, the association may also increase the phytoavailability of micronutrients, viz. e.g., iron, copper, zinc, manganese etc. as the hyphal structures permeate the soil and obtain scarce and relatively immobile elements and makes them available to the plant more effectively than the root hairs of a normal non-mycorrhizal infected plant roots thus leading to a better growth

Table 2: Number of secondary branches per plant at 90 DAS, Plant spread (cm²) at 90 DAS and Stem diameter (cm) at 90 DAS as influenced by rooting media in marigold varieties.

Medium / Variety	Number of secondary branches per plant at 90 DAS			Plant spread (cm ²) at 90 DAS			Stem diameter (cm) at 90 DAS		
	Bidhan Marigold 1	Bidhan Marigold 2	Mean	Bidhan Marigold 1	Bidhan Marigold 2	Mean	Bidhan Marigold 1	Bidhan Marigold 2	Mean
M ₁ - soil	11.90	10.20	11.05	680.71	550.19	615.45	1.01	0.79	0.90
M ₂ - soil + mycorrhiza	13.00	10.35	11.68	725.84	674.64	700.24	0.89	1.32	1.11
M ₃ - soil : vermicompost (1:1) v/v + mycorrhiza	11.90	12.55	12.23	780.87	735.34	758.11	0.97	1.32	1.15
M ₄ - soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza	14.05	11.55	12.80	1058.45	1019.49	1038.97	1.64	1.00	1.32
M ₅ - soil : vermicompost : rice husk (1:1:1) v/v + mycorrhiza	13.00	12.20	12.60	1015.68	920.48	968.08	1.58	0.89	1.23
M ₆ - soil : vermicompost : coco peat : rice husk (1:1:1:1) v/v + mycorrhiza	13.90	13.40	13.65	1143.12	1132.36	1137.74	1.53	1.20	1.36
M ₇ - soil : vermicompost : saw dust (1:1:1) v/v + mycorrhiza	11.60	13.00	12.30	982.46	963.21	972.84	1.12	1.38	1.25
M ₈ - soil : vermicompost : coco peat : saw dust (1:1:1:1) v/v + mycorrhiza	13.25	12.85	13.05	1177.24	1189.38	1183.31	1.51	1.21	1.36
Mean	12.95	12.01	12.48	945.55	898.14	921.84	1.28	1.15	1.21
Factor	S Em+	CD at 5%		S Em+	CD at 5%		S Em+	CD at 5%	
Variety (V)	0.22	0.64		16.69	49.09		0.03		0.09
Medium (M)	0.13	0.41		70.94	208.65		0.03		0.09
V x M	0.28	0.82		85.88	252.58		0.06		0.20



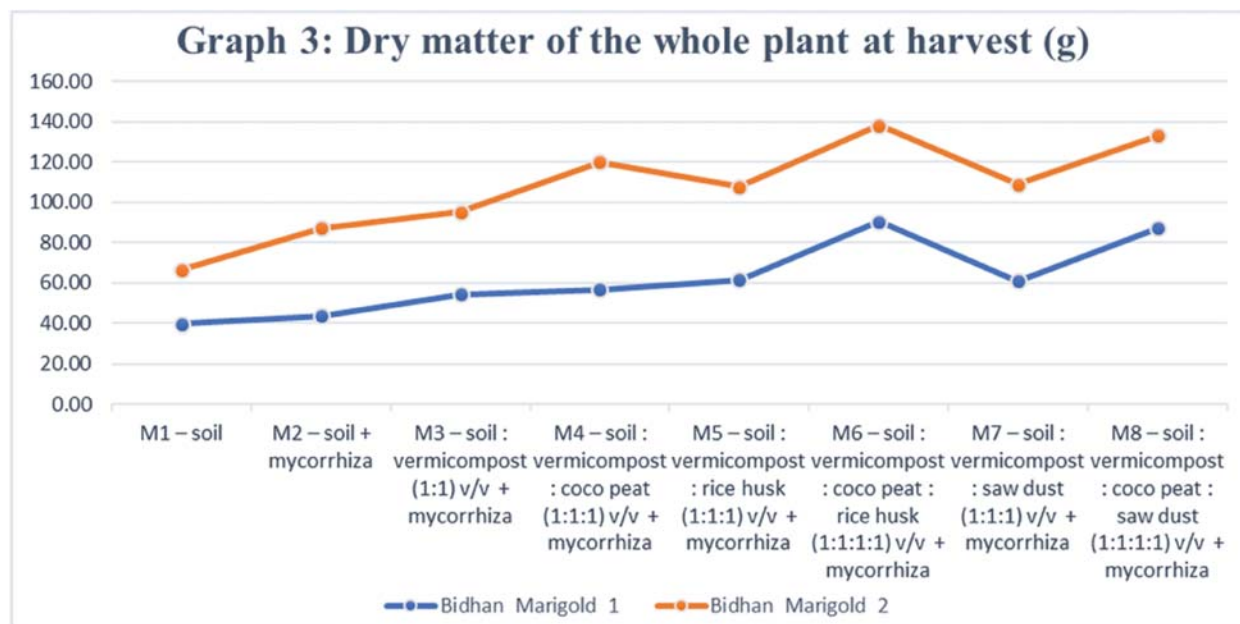
(Smith and Read, 2008).

Number of primary branches per plant : The maximum number of primary branches per plant was found to increase from 2.80 (at 30 DAS) to 4.93 (90 DAS). At 90 DAS, the variety Bidhan Marigold 1 exhibited maximum number of primary branches per plant (4.66) than Bidhan Marigold 2 (4.43). Among the rooting media, at 90 DAS the maximum number of primary branches per plant (4.93) was recorded by M₈ - soil : vermicompost : coco peat : saw dust (1:1:1:1) v/v + mycorrhiza which was on par with M₆ - soil : vermicompost : coco peat : rice husk (1:1:1:1) v/v + mycorrhiza (4.78) and M₄ - soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza (4.78). The minimum number of primary branches per plant (4.0) was recorded on M₁ - soil.

Number of secondary branches per plant : The maximum number of secondary branches per plant was found to increase from 4.30 (at 30 DAS) to 13.05 (90 DAS). At 90 DAS, the variety Bidhan Marigold 1 exhibited maximum number of secondary branches per plant (12.95) than

Bidhan Marigold 2 (12.01). Among the rooting media, at 90 DAS the maximum number of secondary branches per plant (13.65) was recorded by M₆ - soil : vermicompost : coco peat : rice husk (1:1:1:1) v/v + mycorrhiza followed by M₈ - soil : vermicompost : coco peat : saw dust (1:1:1:1) v/v + mycorrhiza (13.05) and M₄ - soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza (12.80). The minimum number of secondary branches per plant (11.55) was recorded on M₁ - soil.

Plant spread (cm²) : The maximum plant spread was 588.65 cm² (at 30 DAS) and it increased to 1183.31 cm² (at 90 DAS). At 90 DAS, the variety Bidhan Marigold 1 exhibited maximum plant spread (945.55 cm²) than Bidhan Marigold 2 (898.14 cm²). Among the rooting media, at 90 DAS the maximum plant spread (1183.31 cm²) was recorded by M₈ - soil : vermicompost : coco peat : sawdust (1:1:1:1) v/v + mycorrhiza followed by M₆ - soil : vermicompost : coco peat : ricehusk (1:1:1:1) v/v + mycorrhiza (1137.74 cm²) and M₄ - soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza (1038.97



cm²). The minimum plant spread (615.45 cm²) was recorded on M₁ - soil.

Stem diameter (cm) : The maximum stem diameter was found to increase from 0.42 cm (at 30 DAS) to 1.36 cm (90 DAS). At 90 DAS, the variety Bidhan Marigold 1 exhibited maximum stem diameter (1.28 cm) than Bidhan Marigold 2 (1.15 cm). Among the rooting media, at 90 DAS the maximum stem diameter (1.36 cm) was recorded by M₈ - soil : vermicompost : coco peat : saw dust (1:1:1:1) v/v + mycorrhiza followed by M₆ - soil : vermicompost : coco peat : ricehusk (1:1:1:1) v/v + mycorrhiza (1.36 cm) and M₄ - soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza (1.32 cm). The minimum stem diameter (0.90 cm) was recorded on M₁ - soil.

The tissues determining the diameter of stem are the two lateral meristems viz. vascular cambium and cork cambium. The vascular cambium is completely secondary in origin. It originates from the tissue located just below the phloem bundles, a portion of pericycle tissue, above the protoxylem forming a complete and continuous wavy ring, which later becomes

circular it increases the girth (diameter) of the organs by the activity of the vascular cambium and the cork cambium. The formation of such type of tissues to the maximum extent may be due to all favourable conditions needed for increasing stem diameter. Nutrients (macro and micro essential elements) are required by plants for the synthesis of protoplasm and act as source of energy. These results are supported by the findings of Bano *et al.* (1987), who reported that vermicompost is rich in plant nutrients (N, P₂O₅, and K₂O), secondary elements (Ca and Mg) and vital micronutrients like Fe, B, Zn and Mo.

Total dry weight of plant at harvest in open field (g) : The variety Bidhan Marigold 1 exhibited the highest total dry weight of plant (63.03 g) than Bidhan Marigold 2 (45.30 g). Among the rooting media, the highest total dry weight of plant (69 g) was recorded by M₆ - soil : vermicompost : coco peat : rice husk (1:1:1:1) v/v + mycorrhiza which was on par with M₈ - soil : vermicompost : coco peat : saw dust (1:1:1:1) v/v + mycorrhiza (66.50 g) followed by M₄ - soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza (60 g). The lowest total dry

Table 3: Dry matter of the whole plant at harvest (g) as influenced by rooting media in marigold varieties.

Medium/Variety	Dry matter of the whole plant at harvest (g) at 90 DAS		
	Bidhan Marigold 1	Bidhan Marigold 2	Mean
M ₁ - soil	39.60	26.80	33.20
M ₂ - soil + mycorrhiza	43.60	43.60	43.60
M ₃ - soil : vermicompost (1:1) v/v + mycorrhiza	54.40	40.80	47.60
M ₄ - soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza	56.80	63.20	60.00
M ₅ - soil : vermicompost : rice husk (1:1:1) v/v + mycorrhiza	61.60	46.20	53.90
M ₆ - soil : vermicompost : coco peat : rice husk (1:1:1:1) v/v + mycorrhiza	90.40	47.60	69.00
M ₇ - soil : vermicompost : saw dust (1:1:1) v/v + mycorrhiza	60.80	48.20	54.50
M ₈ - soil : vermicompost : coco peat : saw dust (1:1:1:1) v/v + mycorrhiza	87.00	46.00	66.50
Mean	63.03	45.30	54.16
Factor	S Em±	CD at 5%	
Variety (V)	3.98	11.70	
Medium (M)	4.40	12.93	
V x M	7.29	21.43	

weight of plant (33.20 g) was recorded in M₁ - soil.

CONCLUSION

The variety Bidhan Marigold 1 exhibited greater percentage establishment of rooted cuttings (96.13%) than Bidhan Marigold 2 (94.17%) at 30 days after shifting into the main field. At 90 DAS, the variety Bidhan Marigold 1 exhibited highest plant height (59.03 cm), maximum number of primary branches per plant (4.66), secondary branches per plant (12.95), plant spread (945.55 cm²), stem diameter (1.28 cm) and highest total dry weight of plant (63.03 g), than Bidhan Marigold 2.

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