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Effect of different growing media and planting methods on growth and yield of sweet potato variety Indira Madhur under grow bag condition

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Abstract
The present investigation entitled "Effect of different growing media and planting methods on growth and yield of sweet potato variety Indira Madhur under grow bag condition" was carried out during 2022-23 at premise (lobby) of Department of Vegetable Science, under Pt. Kishori Lal Shukla College of Horticulture and Research Station, Rajnandgaon, Chhattisgarh. The research was framed in Factorial Completely Randomized Design (FCRD) with 12 treatments which were replicated thrice. There were 2 factors, first factor with 4 levels of different growing media *viz*, M_1 (Black soil), M_2 (Black soil: Vermicompost: Sand: Paddy husk 1:1:1:1), M_3 (Black soil: Vermicompost: Sand: Cocopeat 1:1:1:1), M_4 (Black soil: Vermicompost: Red Soil: Cut paddy straw 1:1:1:1) and second factor with 3 levels of level of planting method *viz* V_1 (Vertical planting method), V_2 (Horizontal planting method) and V_3 (Folded planting method). The experiment was exempted to find out the treatment combination M_2V_2 was found superior for growth and yield parameters *viz* maximum vine length (162.22 cm), number of branches per plant (12.39), number of leaves per plant (263.13), at 120 days after planting respectively, fresh weight of foliage per plant (567.83 g), dry weight of foliage per plant (103.97 g), number of tubers per plant (9.37), length of tuber (15.47 cm), girth of tuber (5.30 cm), marketable tuber yield per plant (464.67 g), unmarketable tuber yield per plant (97.33 g), total tuber yield per plant (562 g) while maximum harvest index (46.87%) was recorded in treatment combination M_3V_1.

Keywords: Sweet potato, growing media, planting method

Introduction
Sweet potato (*Ipomoea batatas* L.) is commonly known Sakarkand belongs to family Convolvulaceae and the only member of the genus Ipomoea whose roots are edible. It is native of South America. It is a hexaploid species with chromosome number 2n = 6x = 90.

Sweet potato is a dicotyledonous, herbaceous plant with creeping perennial vines and adventitious swollen roots. It is grown as a starchy food crop throughout the tropical, subtropical and frost free temperate climate zones in the world. Sweet potato is the sixth most important food crop of the world after rice, wheat, potato, maize and cassava (FAO, STAT, 2010) [2]. Among the root crops grown in the world, sweet potato ranked second after cassava (Ray and Ravi, 2005) [18]. About 90 percent of the sweet potatoes grown in the world are produced in Asia, five percent in Africa and the rest are on other continents (Horton *et al*. 1989) [8]. China accounts for highest sweet potato production in the world followed by Uganda and Nigeria.

In India, the cultivated area under sweet potato is 118 thousand hectare with production of 1,206 thousand MT. In India Odisha, Kerala, West Bengal and Uttar Pradesh contributed 88% production in 89% area among this Odisha is the largest producer of sweet potato (Ministry of Agriculture and farmers welfare 2021). In Chhattisgarh state sweet potato occupied an area of 4,798 hectare with production of 54,532 MT. Kondagaon is leading district in area and production while Korba district has the highest productivity. (Directorate of Horticulture and Farm Forestry C.G. 2022).

Sweet potato is a very nutritive vegetable, producing substantially high edible energy per hectare per day as compared to rice, wheat, maize and cassava. It rich source of Carbohydrates, fiber, minerals as well as good source of vitamin A and C.

It contains starch 12.6 g, sugar 4.2 g, vitamin A 14200 IU, vitamin C 2.4 mg, protein 1.6 g, calcium 30 mg, magnesium 25 mg, phosphorus 47 mg, potassium 337 mg, sodium 55 mg per 100 g of edible part of sweet potato (USDA, 2019). It is also contains phytochemicals with various pharmaceutical activities including antioxidant (Teow *et al*., 2007) [21], anticancer (Karna *et al*., 2011) [11], anti-diabetic (Kusano and Ab, 2000) [13], and anti-inflammatory properties.

The growing media is one of important factor influencing growth and tuber production in urban areas as terrace crops in pots, it is necessary to supply all the nutrients they require. Nutrients are essential for proper growth, development and tuber production with high quality produce, and these nutrients are supplied through growing media. In urban area, where space is scarce sweet potato can be grown on the terrace by using of different growing media with minimal space and can provide organic toxic free produce (Annapurna *et al*, 2022) [1].

Planting methods of sweet potato in grow bag condition can affect vegetative growth and tuber yield attributes. Chagonda *et al*. (2014) [5] reported higher tuber yields when cuttings were planted with horizontal planting method, whereas Dlamini *et al*. (2021) [6] reported higher tuber yield in case of vertical planting method. The effect of planting methods (horizontal, vertical, and folded method) have not been evaluated for sweet potato production in grow bag conditions. Depending on the experience, farmers use different planting method without clear justification. Thus this study was undertaken to determine the effect of different growing media and vine planting methods on growth and yield of sweet potato under grow bag condition.

Materials and Methods

The experiment was conducted under premises (lobby) of Department of Vegetable Science at Pt. K.L. Shukla College of Horticulture and Research Station Rajnandgaon (C.G.) during the *Kharif* season of year 2022-2023. The experiment was laid out in Factorial Completely Randomized Design (FCRD) with 12 treatments which were replicated thrice. There were two factors, first factor with four levels of growing media i.e., M_1 (Black soil), M_2 (Black soil: Vermicompost: Sand: Paddy husk 1:1:1:1), M_3 (Black soil: Vermicompost: Sand: Cocopeat 1:1:1:1), M_4 (Black soil: Vermicompost: Red Soil: Cut paddy straw 1:1:1:1) and second factor with 3 level of planting method i.e., V_1 (Vertical planting method), V_2 (Horizontal planting method), V_3 (Folded planting method). A combination of the above growing media was filled in the grow bags according the treatment. Thereafter, vines were planted with different planting methods *viz:* V_1 (Vertical planting method), V_2 (Horizontal planting method), V_3 (Folded planting method). The collected data for different parameters were statistically analyzed as described by Panse and Sukhatme (1985) [15] and significance was tested by 'F' test.

Results and Discussion

Effect of growing media

The experimental data presented in table 1 revealed that the various growth parameters such as Vine length (cm), number of branches per plant, number of leaves per plant, Fresh weight of foliage per plant (gm.), Dry weight of foliage per plant (gm.), was found significant among different growing media. Maximum vine length (156.89 cm), number of branches per plant (11.39), number of leaves per plant (255.148) at 120 DAP, respectively, were observed in growing media M_2 and growing media M_3 recorded maximum harvest index (46.05%). While growing media M_1 (Black soil) recorded minimum Vine length (118.90 cm), number of branches per plant (7.58), number of leaves per plant (177.7) at 120 DAP respectively, fresh weight of foliage per plant (393.61 gm.), dry weight of foliage per plant (85.21 gm.) and minimum harvest index **(**36.73%) was observed in growing media M_1.

Maximum vine length number of branches per plant, number of leaves per plant, Fresh weight of foliage per plant (gm.), Dry weight of foliage per plant (gm.) in growing media M_2 may be due to vermicompost and paddy husk vermicompost and paddy husk in growing media improves soil structure, aeration, water holding capacity of soil and provide almost all essential macro and micro plant nutrients. Vermicompost and paddy husk enhanced the activity of beneficial microbes. The presence of nitrogen in vermicompost and paddy husk will boost their uptake and high silica contain in paddy husk provide strength to plant, this helped better vegetative growth. This outcomes are consistent with findings of Sitawati *et al.(*2017) [20], Koodi *et al.* (2017) [12], Rahmawati *et al*. (2022) [17] and Annapurna *et al.* (2022) [1]

The experimental data presented in table 1 revealed that the various yield parameters such as number of tuber per plant, marketable tuber yield per plant (gm.), unmarketable tuber yield per plant (gm.), total tuber yield per plant (gm.) was found significant among different growing media. Maximum Number of tubers per plant (8.03), Marketable tuber yield per plant (444.92 g), Unmarketable tuber yield per plant (92.53 g), Total tuber yield per plant (537.46 g) and maximum harvest index (46.05%) recorded in growing media M_3.

It may due to application of vermicompost and paddy husk in growing media improves soil structure, aeration, water holding capacity of soil and provide almost all essential macro and micro plant nutrients, in paddy husk high silica content presence which provide strength to plant. Vermicompost enhanced the activity of beneficial microbes like N_2 fixers and colonization by mycorrhiza fungi and hence play a significant role in N_2 fixation and phosphate mobilization leading to better uptake by plant which result maximum vine length, branches and leaves ultimately leaves implying photosynthesis rate and photo-assimilation on tubers increase the number of tuber per plant, marketable tuber yield per plant, unmarketable tuber yield per plant, total tuber yield per plant. These outcomes are consistent with findings of Singh *et al* (2018) [19] and Annapurna *et al* (2022) [1].

Effect of planting methods

The experimental data presented in table 1 revealed that the various growth parameters such as Vine length (cm), number of branches per plant, number of leaves per plant, Fresh weight of foliage per plant (gm.), Dry weight of foliage per plant (gm.), was found significant among different planting methods. Maximum vine length (142.59 cm), number of branches per plant (10.33), number of leaves per plant (227.47) at 60, 90 and 120 DAP respectively, fresh weight of foliage per plant (473.83 gm.) and Dry weight of foliage per plant (94.09 gm.) were recorded in V_2 (Horizontal planting method) and maximum harvest index (42.65%) was recorded in Folded planting method V_3. While in planting method V_1 (vertical planting method) recorded minimum Vine length ((132.18 cm), number of branches per plant (8.78), number of leaves per plant(208.44), fresh weight of foliage per plant (436.05 gm.) and dry weight of foliage per plant (89.44 gm.).

Maximum vine length in horizontal planting method (V_2) may be due to horizontal planted vines being evenly spaced and having a larger area from which to tap water and nutrients

towards vine growth. On the other hand, vertical planted vines having a limited area from which water and nutrients could be tapped for photosynthesis, hence reduced vine growth. Similar results were also reported by Parwada *et al*. (2011) [16], Idoko *et al*. (2018) [10], Pakkies *et al.* (2018) [14], Dlamini *et al*. (2021) [6]. The branching formation depends mostly on vine length of plant, the larger vine length produce numerous nodes available this might be as a result of exposing more nodes to light which may active branching initiation in plant. The results obtained in the present study are supported by the works of Idoko *et al*. (2017) [9]. Significant more number of leaves in horizontal planting method V_2 could be attributed to the larger vine length, high number of branches that produce numerous nodes available for leaves initiation. Similar results were reported by Essilfie *et al.* (2016) [7], Dlamini *et al*. (2021) [6]. Maximum fresh and dry foliage per plant in horizontal planting method may due to horizontal planting method produced maximum vine length, larger vine length produce numerous nodes available for branching and leaves initiation in plant. Increase in vine length, branches and leaves as result of higher foliage production. Similar results were also reported by Parwada *et al*. (2011) [16], Idoko *et al*., Pakkies *et al*. (2018) [10] and Dlamini *et al*. (2021) [6].

Interaction effect of growing media and planting methods

Vine length (cm): The interaction effect between growing media and planting method showed significant impact on vine length. The maximum vine length (162.22 cm) was observed in treatment combinations M_2V_2 which was at par with treatment combination M_2V_3 (158.41 cm). While treatment combinations M_1V_1 recorded minimum vine length (110.83 cm) at 120 DAP, respectively.

Maximum vine length in growing media M_2 may be due to vermicompost and paddy husk contain high C:N ratio and all other plant nutrients. The presence of nitrogen in vermicompost and paddy husk will boost their uptake and high silica contain in paddy husk provide strength to plant, this helped increased vine length. whereas Maximum vine length in horizontal planted vine may be due to vines being evenly spaced and having a larger area from which to tap water and nutrients towards vine growth (Bose *et al*. 2003) [3].

Number of branches per plant: The interaction effect between growing media and planting method showed significant impact on number of branches per plant. The maximum number of branches per plant (12.39) was observed in treatment combinations M_2V_2 which was at par with treatment combination M_2V_3 (511.95). While treatment combinations M_1V_1 recorded minimum number of branches per plant (6.43) at respectively.

Growing media increases adequate aeration, water holding capacity, supplies a significant quantity of macro and micro plant nutrients through root absorption which converts to photosynthesis and stimulating axillary buds for produces branches (Kodi *et al*.), and second factor horizontal planting method produce larger vine length with numerous nodes available this might be as a result of exposing more nodes to light which may active branching initiation in plant (Bose *et al*. 2003) [3].

Number of leaves per plant: The interaction effect between growing media and planting method showed significant impact on number of leaves per plant. Maximum number of leaves per plant (263.13) was observed in treatment combinations M_2V_2 which was at per with treatment combination M_2V_3 (256.67). While treatment combinations M_1V_1 recorded minimum number of leaves per plant (165.33) at 120 DAP respectively.

The interaction between growing media and planting method had a positive effect on number of leaves per plant. This could be due to the application of vermicompost and paddy husk in growing media, which may have supplied all macro and micro plant nutrients directly to plant (Pandey *et al* 2019) which stimulating vine length, high number of branches that produce numerous nodes available for leaves initiation (Essilfie *et al* 2016) [7].

Fresh weight of foliage per plant (gm.): The interaction effect between growing media and planting method showed significant impact on fresh weight of foliage per plant. Maximum fresh weight of foliage per plant (567.83 gm.) was observed in treatment combinations which was at par with treatment combination M_2V_3 (542.00 gm.), While minimum fresh weight of foliage per plant (380.17 gm.) was observed in treatment combinations M_1V_1.

Dry weight of foliage per plant (gm.): The interaction between growing media and planting method showed non-significant impact on dry weight of foliage per plant. Maximum dry weight of foliage per plant (103.97 gm.) was observed in treatment combinations, which was at par with (98.86 gm.) treatment combination M_2V_3. While minimum dry weight of foliage per plant (83.05 gm.) was observed in treatment combinations M_1V_1.

Maximum fresh and dry foliage per plant in growing media M_2 may due to application of vermicompost and paddy husk in growing media improves soil structure, aeration, water holding capacity of soil and provide almost all essential plant nutrients. vermicompost and paddy husk enhanced the activity of beneficial microbes like N_2 fixers and colonization by mycorrhiza fungi and hence play a significant role in N_2 fixation and phosphate mobilization leading to better uptake by plant which result more photosynthetic production, maximum plant growth ultimately maximum foliage production. Whereas Maximum fresh and dry foliage per plant in horizontal planting method may due to horizontal planting method produced maximum vine length, larger vine length produce numerous nodes available for branching and leaves initiation in plant. Increase in vine length, branches and leaves as result of higher foliage production.

Number of tuber per plant: The interaction between growing media and planting method showed significant impact on number of tuber per plant. Maximum number of tuber per plant (8.94) was observed in treatment combinations M_2V_2 which was at par with (7.93) treatment combination M_2V_3. While minimum number of tuber per plant (4.48) was observed in treatment combinations M_1V_1.

It may due to application of vermicompost and paddy husk improves physical, chemical and biological properties of growing media. It increase microbial activates, water holding capacity, soil aeration and availability of macro and micro plant nutrient to plant. Vermicompost has considerate accounts of humic substance which improves plant nutrition. While sand particles improved drainage system and also provide pore space for good aeration that help a tuber to increase very well in media and horizontal planted vines have more subterranean nodes it could be attributable to the numerous sprouting points which is necessary conditions for growth and tuber formation. Other hand

vertical planted vines having a limited subterranean node for tuber development.

Marketable tuber yield per plant (gm.): The interaction effect between growing media and planting method showed significant impact on marketable tuber yield per plant. Maximum marketable tuber yield per plant (464.67 gm.) was observed in treatment combinations M_2V_2 which was at par with (448.67 gm.) treatment combination M_2V_3.While minimum marketable tuber yield per plant (209.33 gm.) was observed in treatment combinations M_1V_1.

Unmarketable tuber yield per plant (gm.): The interaction effect between growing media and planting method showed significant impact on unmarketable tuber yield per plant. Maximum unmarketable tuber yield per plant (97.33 gm.) was observed in treatment combinations M_2V_2 which was at par with (92.11 gm.) treatment combination M_2V_3. While minimum unmarketable tuber yield per plant (55.44 g) was observed in treatment combinations M_1V_1.
Maximum marketable and unmarketable tuber yield in growing media M_2 might be due to positive effect of growing media on sweet potato plant. Application of vermicompost and paddy husk improves physical, chemical and biological properties of growing media. It increase microbial activates, water holding capacity, soil aeration and availability of macro and micro plant nutrient to plant. Sand also increases porosity and drainage in growing media that also help a tuber to increase very well in media. Whereas maximum marketable and unmarketable tuber yield in horizontal vine planting method might be due to horizontal planted vine having more subterranean nodes, with evenly spaced and having a larger area from which to tap water and nutrients thereby producing maximum vine length, branches and leaves ultimately leaves implying photosynthesis rate and photo- assimilation on tubers.

Total tuber yield per plant (gm.): The interaction effect between growing media and planting method showed significant impact on total tuber yield per plant. Maximum total tuber yield per plant (562.00 gm.) was observed in treatment combinations M_2V_2, which was at par with (540.11 gm.) treatment combination M_2V_3.While minimum total tuber yield per plant (264.77 gm.) was observed in treatment combinations M_1V_1.
It may due to application of vermicompost and paddy husk in growing media improves soil structure, aeration, water holding capacity of soil and provide almost all essential macro and micro plant nutrients, in paddy husk high silica content presence which provide strength to plant. Vermicompost enhanced the activity of beneficial microbes like N_2 fixers and colonization by mycorrhiza fungi and hence play a significant role in N_2 fixation and phosphate mobilization leading to better uptake by plant which result maximum vine length, branches and leaves ultimately leaves implying photosynthesis rate and photo-assimilation on tubers increase the total tuber yield. and horizontal planted vine having more subterranean nodes, with evenly spaced and having a larger area from which to tap water and nutrients thereby producing maximum vine length, branches and leaves ultimately leaves implying photosynthesis rate and photo- assimilation on tubers increase the total tuber yield.

Harvest Index (%): Among various treatment combinations, maximum harvest index (46.87%) was observed in treatment combinations M_3V_1 which was at par with (46.37%) treatment combination M_3V_3. While treatment combinations M_1V_1 recorded minimum harvest index (35.96%).

Table 1: Main effect of different growing media and planting methods on growth and yield of sweet potato variety Indira Madhur under grow bag condition.

Treatment	Vine length (cm)	Number of branches per plant	Number of leaves per plant	Fresh weight of foliage per plant (gm.)	Dry weight of foliage per plant (gm.)	Number of tuber per plant	Marketable tuber yield per plant (gm.)	Unmarketable tuber yield per plant (gm.)	Total tuber yield per plant (gm.)	Harvest index %
Effect of growing media										
M_1	118.90	7.58	177.70	393.61	85.21	5.01	221.58	61.62	282.98	36.74
M_2	156.90	11.40	255.27	541.44	99.71	8.17	444.93	92.54	537.47	45.15
M_3	141.11	10.19	230.83	470.22	94.07	7.31	406.38	80.53	486.16	46.06
M_4	132.77	8.95	207.46	408.80	87.79	6.09	279.44	73.56	353.00	40.31
SEM	1.37	0.22	3.94	3.58	0.56	0.10	2.85	0.81	3.31	0.61
CD at 5%	3.99	0.63	11.50	10.45	1.65	0.30	8.33	2.36	9.66	1.77
Effect of planting methods										
V_1	132.18	8.78	208.44	436.05	89.44	6.04	327.01	73.44	399.90	42.02
V_2	142.59	10.33	227.47	473.83	94.33	7.27	349.02	81.51	430.28	41.52
V_3	137.50	9.48	217.53	450.67	91.32	6.62	338.21	76.23	414.52	42.66
SEM	1.18	0.19	3.41	3.10	0.49	0.09	2.47	0.70	2.87	0.53
CD at 5%	3.45	0.55	9.95	9.05	1.43	0.26	7.21	2.04	8.36	NS

M_1 :	Black soil	V_1 :	Vertical planting method
M_2 :	Black soil : Vermicompost : Sand : Paddy husk (1:1:1:1)	V_2 :	Horizontal planting method
M_3 :	Black soil : Vermicompost : Sand : Cocopeat (1:1:1:1)	V_3 :	Folded planting method
M_4 :	Black soil : Vermicompost : Red Soil : Cut paddy straw (1:1:1:1)		

Table 2: Interaction effect of different growing media and planting methods on growth and yield of sweet potato variety Indira Madhur under grow bag condition.

Treatment	Vine length (cm)	Number of branches per plant	Number of leaves per plant	Fresh weight of foliage per plant (gm.)	Dry weight of foliage per plant (gm.)	Number of tuber per plant	Marketable tuber yield per plant (gm.)	Unmarketable tuber yield per plant (gm.)	Total tuber yield per plant (gm.)	Harvest Index%
Interaction effect of growing media and planting methods										
M_1V_1	110.83^{g}	6.43^{h}	165.33^{g}	380.17^{g}	83.05^{g}	4.48^{g}	209.33^{g}	55.44^{h}	264.77^{g}	35.97^{c}
M_1V_2	128.42^{f}	8.47^{fg}	192.43^{ef}	403.67^{ef}	87.54^{def}	5.51^{f}	231.94^{f}	69.39^{g}	300.33^{f}	36.25^{c}
M_1V_3	117.46^{g}	7.84^{g}	175.33^{fg}	397^{fg}	85.04^{fg}	5.05^{fg}	223.47^{fg}	60.03^{h}	283.84^{fg}	38^{bc}
M_2V_1	150.05^{b}	9.85^{cde}	245.65^{ab}	514.5^{c}	96.3^{b}	7.22^{c}	422.12^{c}	88.17^{bc}	510.29^{c}	44.83^{a}
M_2V_2	162.22^{a}	12.39^{a}	263.13^{a}	567.83^{a}	103.97^{a}	9.37^{a}	464.67^{a}	97.33^{a}	562^{a}	44.81^{a}
M_2V_3	158.41^{a}	11.95^{ab}	257.03^{a}	542^{b}	98.86^{b}	7.93^{b}	448^{b}	92.11^{b}	540.11^{b}	45.8^{a}
M_3V_1	137.07^{de}	10.28^{cd}	227.67^{bcd}	447.67^{d}	92.52^{c}	7.08^{cd}	401.43^{d}	77.5^{de}	476.68^{d}	46.87^{a}
M_3V_2	144.44^{bc}	10.93^{bc}	234.33^{bc}	503.67^{c}	96.59^{b}	7.58^{bc}	415.36^{cd}	84.83^{c}	500.19^{c}	44.92^{a}
M_3V_3	141.83^{cd}	9.37^{def}	230.5^{bc}	459.33^{d}	93.11^{c}	7.27^{c}	402.34^{d}	79.27^{d}	481.61^{d}	46.38^{a}
M_4V_1	130.78^{ef}	8.57^{fg}	195.11^{ef}	401.88^{ef}	85.89^{efg}	5.38^{f}	275.17^{e}	72.67^{fg}	347.84^{e}	40.39^{b}
M_4V_2	135.26^{def}	9.55^{def}	220^{cd}	420.17^{e}	89.2^{d}	6.63^{de}	284.12^{e}	74.5^{ef}	358.62^{e}	40.09^{b}
M_4V_3	132.29^{ef}	8.73^{efg}	207.27^{de}	404.35^{ef}	88.29^{de}	6.24^{e}	279.03^{e}	73.52^{efg}	352.53^{e}	40.47^{b}
SEM	1.94	0.20	3.07	6.20	0.97	0.17	4.94	1.40	5.73	1.05
CD at 5%	5.68	0.61	8.96	18.10	NS	0.69	14.42	4.08	16.73	NS
CV%	3.24	4.98	3.21	3.06	2.42	5.97	3.19	4.13	3.04	5.69

Treatment combination

M_1V_1	Black soil + Vertical planting method	M_3V_1	Black soil : Vermicompost : Sand : Cocopeat (1:1:1:1) + Vertical planting method
M_1V_2	Black soil + Horizontal planting method	M_3V_2	Black soil : Vermicompost : Sand : Cocopeat (1:1:1:1) + Horizontal planting method
M_1V_3	Black soil + Folded planting method	M_3V_3	Black soil : Vermicompost : Sand : Cocopeat (1:1:1:1) + Folded planting method
M_2V_1	Black soil : Vermicompost : Sand : Paddy husk (1:1:1:1) + Vertical planting method	M_4V_1	Black soil : Vermicompost : Red soil : Cut paddy straw (1:1:1:1) + Vertical planting method
M_2V_2	Black soil : Vermicompost : Sand : Paddy husk (1:1:1:1) + Horizontal planting method	M_4V_2	Black soil : Vermicompost : Red soil : Cut paddy straw (1:1:1:1) + Horizontal planting method
M_2V_3	Black soil : Vermicompost : Sand : Paddy husk (1:1:1:1) + Folded planting method	M_4V_3	Black soil : Vermicompost : Red soil : Cut paddy straw(1:1:1:1) + Folded planting method

Conclusion

1. Based on the results of the studies presented, the growing medium M_2 (Black soil : Vermicompost : Sand : Paddy husk 1:1:1:1) performed the best and resulted in superior growth and yield parameters like Vine length (cm), number of branches per plant, number of leaves per plant, Fresh weight of foliage per plant (gm.), Dry weight of foliage per plant (gm.), number of tuber per plant, marketable tuber yield per plant (gm.), unmarketable tuber yield per plant (gm.), total tuber yield per plant (gm.).Thus, it can be concluded that this growing media is best for growth and yield of sweet potato under grow bag condition.
2. Based on the results observed across various parameters that the V_2: Horizontal planting method performed better than the vertical and folded methods. Horizontal planting method led to various growth and yield parameters like Vine length (cm), number of branches per plant, number of leaves per plant, Fresh weight of foliage per plant (gm.), Dry weight of foliage per plant (gm.), number of tuber per plant, marketable tuber yield per plant (gm.), unmarketable tuber yield per plant (gm.), total tuber yield per plant (gm.) Therefore, among the different planting methods horizontal method can be considered superior and recommended for sweet potato cultivation under grow bag condition.
3. The treatment combination M_2V_2 (Black soil : Vermicompost : Sand : Paddy husk (1:1:1:1) + Horizontal planting method) was found superior for growth and yield parameters like Vine length, Number of branches per plant, Number of leaves per plant, Girth of vine, Internode length, Petiole length, Fresh weight of foliage per plan, Dry weight of foliage per plant, Number of tuber per plant, Length of tuber Girth of tuber, Marketable tuber yield per plant, Unmarketable tuber yield per plant, Total tuber yield per plant.

Therefore growing media M_2: Black soil: Vermicompost: Sand: Paddy husk (1:1:1:1) along with the V_2: Horizontal planting method, can be recommended based on the findings of this study for sweet potato cultivation under grow bag condition.

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