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Effect of growing media of serpentine layering on production of quality planting material of black pepper under Terai zone of West Bengal

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ABSTRACT

Present investigation was outlined to study the effect of different growing media of serpentine layering on production of quality planting materials. It was carried out in the polyhouse at Instructional Farm, Uttar Banga Krishi Viswavidyalaya, West Bengal during 2016-17 and 2017-18. Experiment was laid out in Complete Randomized Design (CRD) with three replications and ten treatments on variety Panniyur-1. Results revealed maximum survivability (94.00 % and 90.17 %) at 30 and 90 days after cutting of layers in media top soil + coir pith + vermicompost @ 1:1:1. Maximum planting material 53.67 per year was also produced by media top soil + coir pith + vermicompost @ 1:1:1 but was statically at par with Top soil + sand + vermicompost @ 1:1:1 and top soil + vermicompost @1:2. So, these three media may be considered for serpentine layer for production of planting materials of black pepper.

***Keywords*:** Growing media, planting materials, propagation, serpentine layering.

Our country India is the largest producer, consumer and exporter of spices in the world. Black pepper ranks one of the most important spices among the 52 spices grown in our country. It is also known as King of spices and belongs to the family Piperaceae. It is a universal table condiment used to zest all types of cuisines worldwide. It is an important ingredient for preparation of traditional medicine and used to treat various diseases. Indian spices exports have been able to record stentorian gains in volume and value. During 2017-18, black pepper contributed to the exports about 16,840 tons valued Rs. 820.78 crores (Mani and Kabiraj, 2019). More than 90% area of black pepper is mainly concentrated in Kerala, Karanataka and Tamil Nadu. It is cultivated in Maharashtra, West Bengal, Andaman and Nicobar Islands and North eastern states to a limited extent. In West Bengal, black pepper is mainly cultivated in Nadia, Alipurduar, Cooch Behar, Jalpaiguri, Dinajpur, Murshidabad, Medinipur, Birbhum covering an area of 230 ha with a production of 55 MT and productivity of 239 kg/ha (Anonymous, 2017). Establishing a good black pepper garden requires good quality planting materials, but the continuous use of low yielding cultivars, non availability of quality planting materials and losses of plants due to severe incidence of biotic and abiotic stress and also non adoption of latest agronomic practices are some of the prominent factors for contributing low productivity in India. Availability of adequate quantity of quality planting material of black pepper for a large scale is one of the major constraints faced by the pepper growers for increasing the production of pepper in India. Use of quality planting material is always an important aspect of black pepper production. The recent developments like, use of growth regulators, media, rapid multiplication techniques are found helpful in solving this problem to an extent. For productions of quality planting materials serpentine layering method have greater advantages over traditional methods because serpentine layering technique is simple, cheap and produce more number of planting materials. Keeping this in view, the present investigation has been outlined to study the effect of growing media of serpentine layering on production of quality planting material.

MATERIALS AND METHODS

The present investigations were carried out at Instructional Farm, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal to study the effect of growing media of serpentine layering on production of quality planting material under Terai zone of West Bengal in the year 2016-17 and 2017-18. Cooch Behar has a moderate climate characterized by heavy rainfall during the monsoons and slight rainfall from October to March. The atmosphere is highly humid. Experiment was carried out in a CRD (Complete Randomized Design) with three replications. The experiment had ten treatments *viz*. T_1 (top soil), T_2 (top soil + sand @ 1:1), T_3 (top soil + coir pith @ 1: 1), T_4 (top soil + FYM @ 1: 2), T_5 (top soil + FYM @ 1: 1), T_6 (top soil + coir pith + FYM @ 1: 1: 1), T_7 (top soil + vermicompost @ 1:2), T_8 (top soil + sand + FYM @ 1:1:1), T_9 (top soil + sand + vermicompost @ 1:1:1), T_{10} (top soil + coir pith + vermicompost @ 1:1:1). In this experiment, growing media containing top soil + sand + FYM @ 1:1:1 (i.e.

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T_8) was utilized as control media. Plastic packets filled with potting mix were placed near to the mother plant. Each node was pushed and pegged into the potting mix with the help of bamboo sticks and this process was repeated continuously as the vine elongated. When the plant consisted of 10-15 rooted nodes then single node cuttings were taken and planted in a poly bags comprising 10 different potting mixtures (each bag holding one specific potting mixture). This process was continuously repeated as the vine elongated. Observation regarding shoot length, root length, number of roots, number of leaves, crop growth rate, survival percentage and numbers of planting material production at 30 days and 90 days after cutting of layers were recorded. Mean data on all the recorded parameters were statistically analyzed. Crop growth rate was calculated as per method adopted by Fisher (1921) using the formula ($CGR = w_2 - w_1 / t_2 - t_1$ where, w_2 and w_1 are dry weight of whole plant at time t_1 and t_2 respectively). Data were analyzed statistically using the procedure of Gomez and Gomez (1984).

RESULTS AND DISCUSSION

All the parameters mentioned above were observed at two stages *i.e.,* at 30 days and 90 days after cutting of layers and number of planting material production was recorded by counting number of layers obtained throughout the year (Table 1, 2, 3 and 4). Significant variations were recorded with respect to all the observed parameters among the different treatments.

Shoot parameters

Maximum shoot length of layer (18.65 cm and 32.72 cm, respectively) was observed in T_{10} (top soil + coir pith + vermicompost @ 1:1:1) followed by T_9 (top soil + sand + vermicompost @ 1:1:1) with a value of 16.48 cm and 28.62 cm at 30 and 90 days after cutting of layers, respectively. Similarly, T_2 (top soil + sand @ 1:1) showed less influence on the shoot length with a minimum value of 12.17 cm and 18.22 cm followed by T_1 (Top soil) with 12.51 cm and 19.30 cm at 30 and 90 days after cutting of layers, respectively. Number of leaves increased with increase in the length of the layer irrespective of the treatments. Highest number of leaves (5.35 and 9.73) was observed in T_{10} (top soil + coir pith + vermicompost @ 1:1:1) followed by T_9 (top soil + sand + vermicompost @ 1:1:1) (5.02 and 8.85) at 30 days and 90 days after cutting of layers, respectively. Similarly, T_2 (top soil + sand @ 1:1) recorded the lowest result with respect to number of leaves (3.77 and 6.58) after cutting of layers followed by T_1 (Top soil) (4.03 and 7.10) at 30 days and 90 days after cutting of layers, respectively. Among different growing media, the highest shoot length and number of leaves was recorded in treatment T_{10} (top soil + coir pith + vermicompost @ 1:1:1) followed by T_9 (top soil + sand + vermicompost @ 1:1:1) might be due to the presence of a perceivable quantity of nutrients and growth-promoting substances in vermicompost as well as good aeration and good water holding ability provided by incorporation of well decomposed coir pith in a potting mixture which also helped in better utilization of stored carbohydrate, nitrogen and other factors. A more or less similar result was also reported by Akshay *et al.* (2014). Thankamani *et al.* (1996) also reported that black pepper cuttings raised in a mixture of well decomposed coir pith and vermicompost were significantly taller and had more number of leaves than cutting raised in the conventional mixture. Prasath *et al.* (2014) also reported that maximum numbers of leaves were reported in a potting, mixture comprising of coir pith and vermicompost.

Root parameters

Different treatment responded significantly to the root parameters of black pepper layers. Maximum root length (13.89 cm and 24.73 cm) was recorded in T_{10} (top soil + coir pith + vermicompost @ 1:1:1) at 30 and 90 days after cuttings of layers, respectively. Whereas, T_2 (top soil + sand @ 1:1) recorded minimum root length of 6.58 cm and 17.01 cm at 30 and 90 days after cutting of layers, respectively. Highest root length was observed in layers under the treatment T_{10} comprising of top soil + coir pith + vermicompost @ 1:1:1 which might be due to the incorporation of coir pith which provided better texture and porosity to the media that later facilitated easy dispersion of roots. Adding coir pith in mixture also contributes high specific surface due to its low particle density and high water holding capacity (Akshay *et al.,* 2014). Vermicompost is a rich source of minerals and plant nutrients and its addition to media boosts the quality of media by escalating microbial activity and microbial biomass which is a vital factor in the nutrition chain (Norman and Edwards, 2005). Results with respect to number of roots revealed that maximum numbers of roots (7.03 and 8.93) were recorded in T_{10} (top soil + coir pith + vermicompost @ 1:1:1) followed by T_9 (top soil + sand + vermicompost @ 1:1:1) (6.65 and 8.21, respectively) at 30 days and 90 days after cutting of layers, respectively. Similarly, like other root related parameters, T_2 (top soil + sand @ 1:1) recorded the lowest result with respect to number of roots also with 4.80 at 30 days and 5.78 at 90 days after cutting of layers. The maximum number of the roots was observed in a media of soil mixed with vermicompost and coir pith, it might be due to the better texture and porosity of coir pith (Singh *et al.,* 2002), presence of growth promoting substances in vermicompost and sufficient amount of organic matter supply from the soil for better growth and development of layered plants.

Table 1: Effect of different growing media on shoot parameters of layers

Treatment	Shoot length of layers (cm)						Number of leaves per layer					
	30 days after cutting			90 days after cutting			30 days after cutting			90 days after cutting		
	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled
T_1	12.13	12.88	12.51	17.97	20.63	19.30	3.73	4.32	4.03	6.52	7.68	7.10
T_2	11.87	12.47	12.17	17.43	19.00	18.22	3.27	4.27	3.77	6.00	7.15	6.58
T_3	11.65	13.90	12.78	19.62	23.62	21.62	3.62	4.98	4.30	6.83	7.48	7.16
T_4	11.70	14.47	13.08	20.93	24.48	22.71	3.80	5.00	4.40	6.82	7.92	7.37
T_5	12.83	14.33	13.58	20.83	23.62	22.23	3.87	5.03	4.45	6.98	7.60	7.29
T_6	14.43	15.47	14.95	23.83	26.27	25.05	4.00	5.57	4.78	7.60	8.45	8.03
T_7	15.11	16.02	15.56	25.17	27.70	26.43	4.57	5.33	4.95	7.87	8.92	8.39
T_8	13.02	15.00	14.01	22.92	25.52	24.22	4.07	5.20	4.63	7.08	8.45	7.77
T_9	15.93	17.02	16.48	26.70	30.53	28.62	4.22	5.82	5.02	8.30	9.40	8.85
T_{10}	17.70	19.60	18.65	32.64	32.80	32.72	4.78	5.92	5.35	9.17	10.28	9.73
SE(m) ±	**0.62**	**0.77**	**0.70**	**1.27**	**0.90**	**1.08**	**0.28**	**0.38**	**0.37**	**0.32**	**0.45**	**0.39**
LSD. (0.05)	**1.83**	**2.27**	**2.01**	**3.76**	**2.67**	**3.09**	**0.82**	**1.11**	**1.05**	**0.95**	**1.35**	**1.11**

T_1: top soil, T_2: top soil + sand (1:1), T_3: top soil+ coir pith (1:1), T_4: top soil + FYM (1:2), T_5: top Soil + FYM (1:1), T_6: top soil + coir pith + FYM (1:1:1), T_7: top soil + vermicompost (1: 2), T_8: top soil + sand + FYM (1:1:1), T_9: top soil + sand + vermicompost (1:1:1), T_{10}: top soil + coir pith + vermicompost (1:1:1)

Table 2: Effect of growing media on root parameters of layers

Treatment	Root length of layers (cm)						Number of roots per layer					
	30 days after cutting			90 days after cutting			30 days after cutting			90 days after cutting		
	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled
T_1	8.47	10.23	9.35	15.60	18.42	17.01	4.50	6.42	5.46	5.58	6.67	6.13
T_2	8.20	9.22	8.71	14.13	17.20	15.67	4.23	5.37	4.80	5.32	6.25	5.78
T_3	9.23	10.81	10.02	17.17	19.63	18.40	4.90	6.97	5.93	5.90	7.63	6.77
T_4	9.57	10.91	10.24	17.73	20.45	19.09	4.30	6.32	5.31	5.65	6.67	6.16
T_5	10.33	11.20	10.77	16.70	19.70	18.20	4.63	6.60	5.62	5.38	8.05	6.72
T_6	9.40	10.84	10.12	19.90	21.85	20.88	5.23	7.17	6.20	6.45	7.70	7.08
T_7	11.35	12.40	11.88	21.27	22.30	21.78	4.50	6.38	5.44	6.65	7.58	7.12
T_8	11.20	12.13	11.67	19.75	20.80	20.28	5.57	6.75	6.16	6.12	7.47	6.79
T_9	12.43	12.89	12.66	22.93	24.00	23.47	6.00	7.30	6.65	7.20	9.22	8.21
T_{10}	13.27	14.51	13.89	23.77	25.70	24.73	6.63	7.43	7.03	8.27	9.60	8.93
SEm(±)	**0.56**	**0.75**	**0.59**	**0.81**	**0.80**	**0.80**	**0.27**	**0.34**	**0.31**	**0.29**	**0.42**	**0.36**
LSD(0.05)	**1.65**	**2.22**	**1.70**	**2.41**	**2.37**	**2.30**	**0.82**	**1.01**	**0.92**	**0.87**	**1.24**	**1.06**

T_1: top soil, T_2: top soil + sand (1:1), T_3: top soil+ coir pith (1:1), T_4: top soil + FYM (1:2), T_5: top Soil + FYM (1:1), T_6: topsoil + coir pith + FYM (1:1:1), T_7: top soil + vermicompost (1:2), T_8: top soil + sand + FYM (1:1:1), T_9: top soil + sand + vermicompost (1:1:1), T_{10}: top soil + coir pith + vermicompost (1:1:1).

Table 3: Effect of rooting media on dry weight of layers

Treatment	Dry weight of layers (g)								
	30 days after cutting			60 days after cutting			90 days after cutting		
	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled
T_1	1.55	1.56	1.56	2.47	2.33	2.40	3.85	3.46	3.66
T_2	1.44	1.51	1.48	2.27	2.22	2.25	3.42	3.31	3.37
T_3	1.71	1.71	1.71	2.90	3.50	3.20	4.76	4.52	4.64
T_4	1.91	2.41	2.16	3.32	3.36	3.34	4.92	5.08	5.00
T_5	1.87	1.83	1.85	3.04	3.48	3.26	4.72	4.87	4.80
T_6	2.11	2.11	2.11	3.72	3.61	3.67	5.51	5.35	5.43
T_7	2.25	2.11	2.18	3.92	3.61	3.77	5.61	5.48	5.55
T_8	2.02	1.94	1.98	3.51	3.44	3.48	5.14	5.28	5.21
T_9	2.48	2.43	2.46	3.96	3.68	3.82	5.64	5.63	5.64
T_{10}	2.36	2.69	2.53	4.01	4.17	4.09	6.09	6.01	6.05
SEm(±)	**0.12**	**0.14**	**0.12**	**0.15**	**0.23**	**0.19**	**0.26**	**0.24**	**0.24**
LSD (0.05)	**0.35**	**0.41**	**0.35**	**0.44**	**0.67**	**0.54**	**0.76**	**0.70**	**0.68**

T_1: top soil, T_2: top soil + sand (1:1), T_3: top soil+ coir pith (1:1), T_4: top soil + FYM (1:2), T_5: top soil + FYM (1:1), T_6: topsoil + coir pith + FYM (1:1:1), T_7: top soil + vermicompost (1:2), T_8: top soil + sand + FYM (1:1:1), T_9: top soil + sand + vermicompost (1:1:1), T_{10}: top soil + coir pith + vermicompost (1:1:1).

Table 4: Effect of different growing media on survival percentage and numbers of planting material production

Treatment	Survival percentage (%)						Numbers of planting		
	30 days after cutting			90 days after cutting			material production per year		
	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled
T_1	87.33 (9.42)	89.00 (9.49)	88.17 (9.40)	81.67 (9.09)	82.33 (9.13)	82.00 (9.06)	45.33	45.67	45.50
T_2	85.33 (9.29)	87.67 (9.42)	86.50 (9.30)	80.00 (9.00)	81.33 (9.07)	80.67 (8.98)	43.00	44.00	43.50
T_3	89.00 (9.49)	90.67 (9.57)	89.83 (9.48)	83.00 (9.17)	86.00 (9.33)	84.50 (9.19)	51.00	45.00	48.00
T_4	87.67 (9.42)	88.33 (9.45)	88.00 (9.38)	82.00 (9.11)	83.00 (9.17)	82.50 (9.08)	52.33	47.67	50.00
T_5	89.00 (9.49)	90.00 (9.54)	89.50 (9.46)	84.67 (9.26)	84.67 (9.26)	84.67 (9.20)	50.33	47.00	48.67
T_6	90.00 (9.54)	92.00 (9.64)	91.00 (9.54)	86.00 (9.33)	87.00 (9.38)	86.50 (9.30)	53.67	46.33	50.00
T_7	91.00 (9.59)	92.33 (9.66)	91.67 (9.57)	86.00 (9.33)	89.00 (9.49)	87.50 (9.35)	50.00	51.00	50.50
T_8	89.00 (9.49)	92.33 (9.66)	90.67 (9.52)	85.00 (9.27)	87.00 (9.38)	86.00 (9.27)	47.67	50.00	48.83
T_9	91.00 (9.59)	95.00 (9.80)	93.00 (9.64)	87.00 (9.38)	90.67 (9.57)	88.83 (9.43)	51.67	50.67	51.17
T_{10}	93.00 (9.70)	95.00 (9.80)	94.00 (9.70)	89.00 (9.49)	91.33 (9.61)	90.17 (9.50)	53.33	54.00	53.67
SEm(±)	**0.06**	**0.07**	**0.04**	**0.07**	**0.06**	**0.04**	**1.83**	**1.48**	**1.74**
LSD(0.05)	**0.17**	**0.21**	**0.11**	**0.2**	**0.19**	**0.12**	**5.43**	**4.38**	**4.98**

T_1: top soil, T_2: top soil + sand (1:1), T_3: top soil+ coir pith (1:1), T_4: top soil + FYM (1:2), T_5: top Soil + FYM (1:1), T_6: top soil + coir pith + FYM (1:1:1), T_7:top soil + vermicompost (1:2), T_8: top soil + sand + FYM (1:1:1), T_9: top soil + sand + vermicompost (1:1:1), T_{10}: top soil + coir pith + vermicompost (1:1:1)

*Values in parentheses indicate the square root transformation value (Gomez and Gomez, 1984

Table 5: Effect of different growing media on crop growth rate (CGR)

Treatment	Crop growth rate (gm^{-2} day^{-1})					
	30-60 days after cutting			60-90 days after cutting		
	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled
T_1	0.026	0.031	0.028	0.038	0.046	0.042
T_2	0.024	0.028	0.026	0.036	0.038	0.037
T_3	0.06	0.04	0.05	0.052	0.041	0.047
T_4	0.032	0.047	0.039	0.057	0.053	0.055
T_5	0.055	0.039	0.047	0.046	0.056	0.051
T_6	0.05	0.054	0.052	0.058	0.06	0.059
T_7	0.05	0.056	0.053	0.062	0.056	0.059
T_8	0.05	0.05	0.05	0.061	0.054	0.058
T_9	0.042	0.049	0.046	0.065	0.056	0.061
T_{10}	0.049	0.055	0.052	0.061	0.069	0.065
SEm(±)	**0.005**	**0.004**	**0.004**	**0.006**	**0.007**	**0.007**
LSD(0.05)	**0.016**	**0.019**	**0.018**	**0.022**	**0.019**	**0.021**

T_1: top soil, T_2: top soil + sand (1:1), T_3: top soil+ coir pith (1:1), T_4: top soil + FYM (1:2), T_5: top soil + FYM (1:1), T_6: top soil + coir pith + FYM (1:1:1), T_7: top soil + vermicompost (1:2), T_8: top soil + sand + FYM (1:1:1), T_9: top soil + sand + vermicompost (1:1:1), T_{10}: top soil + coir pith + vermicompost (1:1:1).

Dry weight of layers

Different treatments responded significantly to the root parameters of black pepper layers. T_{10} treatment comprising growing media with top soil + coir pith + vermicompost @ 1:1:1 was found superior (2.53 g, 4.09 g and 6.05 g of dry weight of layers at 30 days, 60 days and 90 days after cutting of layers, respectively) than the rest of the growing media which was statistically *at par* with T_9 (Top soil + sand + vermicompost @ 1:1:1). The lowest dry weight of layers (0.93 g, 1.48 g, 2.25 g and 3.37 g at 30 days, 60 days and 90 days after cutting of layers, respectively) was recorded in the plant grown under the growing media of top soil and sand @ 1: 1 (T_2) which was statistically *at par* with T_1 (top soil). Dry weight of layers reflects the vegetative parameters recorded (Akshay *et al.,* 2018). Therefore, the treatments with better vegetative parameters have recorded higher dry weight and treatment with lower vegetative parameters shown lower dry weight of layers.

Survival percentage

The effect of different growing media on the serpentine cutting of layers of black pepper showed significant differences for both the years and pooled data. The experimental findings revealed that highest survivability (94.00 % and 90.17 %, respectively at different time intervals of 30 days and 90 days after cutting of layers) was recorded with the plant grown under treatment T_{10} (top soil + coir pith + vermicompost @ 1:1:1) followed by 93.00 % and 88.83 % at 30 days and 90 days after cutting of layers in T_9 (top soil + sand + vermicompost @ 1:1:1). The lowest survivability was recorded with the plant grown under treatment T_2 comprising of top soil and @1:1 with a minimal value of 86.50 % and 80.67 % at 30 and 90 days after cutting of layers, respectively followed by plants grown under treatment T_1 (top soil only) with 88.17 % and 82.00 % at 30 days and 90 days, respectively after cutting of layers.

Variations among different treatments might be due to the advantage of the balanced mixture and combined effect of the media components like soil, coir pith and vermicompost that improve the porosity of potting mixture along with the best crude amendments important for root and shoot development, survival of saplings and better growth and development of layers for a considerable phase of time. A similar type of findings was also reported by Sharangi *et al.* (2010) who reported that growing media also have a significant influence on the survivability of layers. Potting media comprising of sand, soil, and FYM and coir pith were found to maximize the survivability of saplings.

Total planting material production

Maximum numbers of planting material (53.67) was produced in T_{10} growing media comprising of top soil + coir pith + vermicompost @ 1:1:1 which was statistically *at par* with T_9 (51.17) comprising of growing media of top soil + sand + vermicompost @ 1:1:1 and T_7 (50.50) comprising of growing media of top soil + vermicompost @ 1:2. Treatment T_6 (top soil + coir pith + FYM @ 1:1:1) and T_5 (top soil + FYM @ 1:2) also recorded same number (50.00) of planting material. Among the various

treatments, T_2 (top soil + sand) produced the minimum number of planting material (43.50). The combined effect of the media provided better porosity and allowed good root penetration apart from having good water absorption capacity. Presence of growth promoting substances in vermicompost and sufficient amount of organic matter supply from the soil for better growth and development of layer together was responsible for maximum planting material production of black pepper.

Crop growth rate (CGR)

Among different treatments the highest crop growth rate of 0.052 gm^{-2} day^{-1} and 0.065 gm^{-2} day^{-1} at 30 to 60 days and 60 to 90 days after cutting of layers was observed in plants under treatment T_{10} (top soil + coir pith + vermicompost @ 1:1:1) followed by layers under treatment T_9 (top soil + sand + vermicompost @ 1:2) with a value of 0.046 and 0.061 gm^{-2} day^{-1} at 30 to 60 days and 60 to 90 days after cutting of layers, respectively. Among different growing media, the lowest result with respect to the growth rate of layers (0.026 gm^{-2} day^{-1} and 0.037 gm^{-2} day^{-1}) at 30 to 60 days and 60 to 90 days after cutting of layers was found in black pepper layers grown under the treatment T_2 comprising of top soil + sand @ 1:1 followed by black pepper layers grown under T_1 (top soil) with the values of and 0.028 gm^{-2} day^{-1} at 30 to 60 days and 0.042 gm^{-2} day^{-1} at 60 to 90 days. The crop growth rate is the gain of dry matter production on a unit area and time. It is affected by a series of factors including heat, levels of solar radiation, water supply, crop, cultivar and its age (Reddy 2000). Therefore, the treatment with better dry matter accumulation showed higher crop growth, whereas treatment with least dry matter accumulation showed the least growth rate.

CONCLUSION

From the above studies, it may be concluded that among different treatments, maximum number of planting material was produced by the growing media comprising of top soil + coir pith + vermicompost @ 1:1:1 along with higher survival percentage, number of roots and leaves and shoot length followed by the growing media comprising of top soil + sand + vermicompost @1:1:1 and growing media comprising of top soil + vermicompost @ 1:2 and these may be used over conventional growing media for production of more than fifty healthy planting material.

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