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EFFECT OF DIFFERENT GROWING MEDIA ON GROWTH OF SEEDLINGS OF PAPAYA (*CARICA PAPAYA* L.) CV. MADHU BINDU UNDER NET HOUSE CONDITIONS

SANJAY KUMAR NAGAR*, N. J. VIHOL, SADDAM HUSAIN AND PAWAN K. NAGAR
Department of Horticulture,
B. A. College of Agriculture, Anand Agricultural University, Anand - 388 110
e-mail: nagar.sanjay1991@gmail.com

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***Corresponding author**

ABSTRACT
The experimental result showed that significantly maximum number of leaves (6.92), relative growth rate (0.163 g g-^{1}day-^{1}) at 30 DAS, length of seedlings (12.09 cm and 23.73 cm), length of tap root (4.65cm and 8.28 cm), fresh weight (0.17 g and 1.42 g) as well as dry weight of seedling (0.0125 g and 0.1630 g) at 15 and 30 DAS , respectively was recorded in the treatment T_{11} ($M_2 + M_4$)- vermiculite + cocopeat (3:1). Whereas, the treatment T_{13} ($M_3 + M_4$)- sphagnum moss + cocopeat (3:1) recorded significantly maximum seedling length (50.06 cm), number of leaves (11.50), fresh weight of seedling (9.10 g), dry weight of seedling (1.10 g), length of tap root (19.40 cm), RGR (1.09 g g-^{1}day-^{1}), at 45 DAS and number of roots (6.62, 8.67 and 13.70) at 15, 30 and 45 DAS, respectively. The treatmentT_8 ($M_1 + M_4$)-control + cocopeat (3:1) recorded significantly maximum root:shoot ratio (weight basis) (0.15 and 0.19) at 30 and 45 DAS, respectively. From the foregoing discussion it can be concluded that the treatment containing cocopeat as an ingredient of growing media found to be most suitable for raising the papaya seedlings as it gives quality seedling growth.

INTRODUCTION

Papaya (*Carica papaya* L.) belongs to family Caricaceae is an important tropical commercial fruit crop of India. It is 7th important fruit crop of the country after mango, citrus, banana, apple, guava and sapota. The fruit is extensively grown in various states of India, mainly in Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, West Bengal, Chhattisgarh, Tamil Nadu, Assam and Kerala. Papaya occupies 1.9 per cent of total fruit crop area and 6.6 per cent of total fruit production in India. It occupies a cultivated area of 132 thousand hectares with 5382 thousand MT of production with an average productivity of 40.7 MT/ha (Anon., 2013). Among the various varieties of papaya, Pusa Dwarf, Taiwan, Pusa Delicious and Madhu Bindu (Honey Dew) have attained the commercial status throughout the country. Papaya is propagated by seed only. Seed germination is affected by many factors, which include type of substrate used, environmental factors such as oxygen, water, temperature and for some plant species, light (Hartmann *et al*., 2001). The germination of seeds of papaya (*Carica papaya*) is frequently reported to be slow, erratic and incomplete (Chako and Singh, 1966; Lange 1961). Growing medium is a substrate that provides the required elements and physical support to the growing plants. All soils used for media are not always perfect for the germination of seeds and subsequent growth of seedling therefore use of suitable growing media or substrate is essential for production of quality horticultural crops. Vermicompost provides sufficient levels of oxygen to roots, adequate storage of water and nutrient for the plants; humic substances significantly increase nutrients availability and consequently affect growth, yield and quality of plant. FYM is having good water holding capacity as well as sufficient porosity, thus permitting adequate moisture and exchange of gases between the germination growth media and the embryo (Anjanawe *et al*., 2013). Cocopeat is considered as a good growing media component with acceptable pH, electrical conductivity and other chemical attributes (Abad *et al*., 2002). Sphagnum moss is the dehydrated remains of acid hog plants and has three genera, growing naturally in damp humid forest lands. It is relatively sterile, light in weight and has a very high water holding capacity. Normally, it absorbs and holds water 20 times to its weight. It is acidic in nature having pH about 3.5. It also contains a fungistatic substance which is useful to inhibit damping off. Moss is soaked in solution containing fungicide and is impregnated with nutrient solution before being used for propagation. Vermiculite is the micaceous mineral which expands significantly when heated. Chemically it is hydrated magnesium, aluminium, iron, silicate. When expanded it is very light in weight. It is neutral in reaction and has good buffering properties. It is insoluble in water. Vermiculite is available in 4 Grades, out of which the Horticultural Grade No. 2 should be used for rooting and No. 4 for seed germination. It directly affects the development and later maintenance of the extensive root system. A good growing medium would provide sufficient anchorage or support to the plant, serves as reservoir for the nutrient and water, allow oxygen diffusion to the roots and permit gaseous exchange

between root and atmosphere outside the root substrate (Abad *et al*., 2002). Nursery potting media influence quality of seedling produced (Agbo and Omaliko, 2006). The quality of seedling obtained from a nursery influences re-establishment in the field and the eventual productivity of an orchard (Baiyeri, 2006). Net house structure, provides totally or partially controlled environmental condition suitable for better seed germination and subsequent seedling growth. However, no information is available as to what kind of media should be used to obtain optimum germination and growth of the seedlings. Therefore, the present study was initiated to find out the suitable media for subsequent seedling growth of papaya cv. Madhu Bindu.

MATERIALS AND METHODS

The present investigation "Effect of different growing media on growth of seedlings of papaya (*Carica papaya* L.) cv. Madhu Bindu under net house conditions" was carried out at Horticultural Research Farm, Department of Horticulture, B. A. College of Agriculture, Anand during the year 2014.For germination, five types of media were studied. The experiment was laid out in Completely Randomized Design with fifteen treatment combination replicated thrice. The treatments comprised of fifteen levels of growing media *viz*., T_1 (M_1)- soil + FYM (1:1) (Control), T_2 (M_2)- vermiculite, T_3 (M_3)- sphagnum moss, T_4 (M_4)- cocopeat, T_5 (M_5)– vermicompost, T_6 (M_1+M_2)- control + vermiculite (3:1), T_7 (M_1+M_3)- control + sphagnum moss (3:1), T_8 (M_1+M_4)- control + Cocopeat (3:1), T_9 (M_1+M_5)- control + vermicompost (3:1), T_{10} (M_2+M_3)- vermiculite + sphagnum moss (3:1), T_{11} (M_2+M_4)- vermiculite + cocopeat (3:1), T_{12} (M_2+M_5)- vermiculite + vermicompost (3:1), T_{13} (M_3+M_4)- sphagnum moss + cocopeat (3:1), T_{14} (M_3+M_5)- sphagnum moss + vermicompost (3:1), T_{15} (M_4+M_5)- cocopeat + vermicompost (3:1) filled in black polythene bags of (4"× 6") size. Each treatment has 40 polybags. Two seeds of the papaya were dibbled at about 2 to 3 cm depth in each polythene bag in the month of August. The experiment was conducted under 75 % shade net house. The bags were watered by water cane at a regular interval. The data on growth parameters like length of seedling (cm), length of longest tap root (cm), number of roots per seedling, fresh and dry weight (g) were recorded at 15, 30 and 45 DAS. The remaining growth parameters *viz*., number of leaves per seedling, root : shoot ratio (weight and length basis) and relative growth rate (RGR) were recorded at 30 and 45 DAS. The length of seedlings was measured by metric scale from the top of the shoot to the tip of primary root of the seedling. Number of roots and length of tap root was measured by destructive method of uprooting the plant and taking measurement by standard method. The root : shoot ratio was calculated by dividing dry weight of roots by dry weight of shoots (weight wise) and total length of root by length of shoot (length wise). The fresh weight of four seedlings was weighed on digital weighing balance and average value was calculated. The dry weight of four seedlings was calculated by drying up rooted seedlings under shade for two days and then oven dried at 60ºC till the constant weight and the average value was calculated. In classical growth analysis, relative growth rate (RGR) is calculated as $RGR = (\ln W_2 - \ln W_1)/(t_2 - t_1)$, where W_1 and W_2 are plant dry weights at times t_1 and t_2 and in is denoted as log. Since RGR is usually calculated using destructive harvests of several individuals, an obvious approach is to substitute W_1 and W_2 with sample means $_1$ and $_2$ (Evans, 1972). The experiment was laid out in a Completely Randomized Design. The recorded data were analyzed statistically using various techniques as described by Panse and Sukhatme (1985). The treatment means were compared with C.D. at 5 per cent level.

RESULTS AND DISCUSSION

The results showed that growing media had beneficial effect on growth of seedlings of papaya. Among different growing media treatment the treatment T_{11} (M_2+M_4)- vermiculite + cocopeat (3:1)significantly recorded the highest length of seedling (12.09 cm and 23.73 cm) at 15 and 30 DAS, respectively. It might be due to the beneficial effect of this media mixture on water holding capacity, porosity and soil aeration which is good for root and shoot growth over media

Table 1: Effect of different growing media on seedling length, length of longest tap root, number of roots and number of leaves per seedling of papaya

Treatments	Length of seedling (cm)			Length of tap root (cm)			Number of roots/seedling			Number of leaves / seedling	
	At 15 DAS	At 30 DAS	At 45 DAS	At 15 DAS	At 30 DAS	At 45 DAS	At 15 DAS	At 30 DAS	At 45 DAS	At 30 DAS	At 45 DAS
T1	9.39	18.29	40.35	3.08	6.13	14.61	4.83	5.67	9.10	5.00	9.83
T2	11.10	20.00	42.48	3.65	7.29	16.25	4.93	5.93	9.17	5.08	10.00
T3	9.97	18.56	41.05	3.32	6.39	15.50	6.08	8.50	11.17	5.92	10.33
T4	11.36	20.90	46.16	4.28	7.93	17.45	5.33	7.80	10.67	6.00	10.92
T5	9.98	18.50	42.00	3.39	6.23	16.06	5.00	7.25	10.00	5.33	10.33
T6	11.17	20.07	45.00	3.64	7.33	17.01	5.17	7.10	10.33	5.58	10.75
T7	10.54	19.75	43.24	3.59	7.10	16.55	5.33	7.92	10.58	5.25	10.58
T8	11.77	22.65	49.86	4.48	7.96	18.74	5.42	7.83	12.10	6.33	11.25
T9	10.28	19.60	42.43	3.52	7.17	16.07	5.25	7.83	10.83	5.08	10.17
T10	11.67	22.50	48.08	4.23	8.18	18.01	5.50	8.17	10.92	6.25	11.08
T11	12.09	23.73	49.89	4.65	8.28	18.65	5.42	8.08	10.92	6.92	11.25
T12	10.53	19.73	42.88	3.48	7.26	16.18	5.33	7.67	10.50	5.17	10.00
T13	12.03	22.78	50.06	4.55	8.13	19.40	6.62	8.67	13.70	6.42	11.50
T14	10.50	19.77	43.47	3.60	7.29	16.48	6.17	8.58	12.50	5.25	10.17
T15	11.07	21.67	47.33	4.16	8.01	17.96	5.58	8.33	11.17	6.08	11.17
S. Em±	0.41	0.32	0.50	0.14	0.21	0.29	0.17	0.20	0.33	0.23	0.29
C. D. at 5 %	1.18	0.93	1.43	0.41	0.61	0.83	0.48	0.58	0.95	0.66	0.84

Table 2: Effect of different growing media on fresh weight, dry weight, root : shoot ratio (weight and length basis) and relative growth rate (RGR) of seedling of papaya

Treatments	Fresh weight (g)			Dry weight (g)			Root: Shoot ratio (Weight basis)		Root: Shoot ratio (Length basis)		RGR (g g-1day-1)	
	At 15 DAS	At 30 DAS	At 45 DAS	At 15 DAS	At 30 DAS	At 45 DAS	At 30 DAS	At 45 DAS	At 30 DAS	At 45 DAS	At 30 DAS	At 45 DAS
T1	0.11	0.67	6.07	0.010	0.09	0.56	0.12	0.15	0.51	0.58	0.09	0.55
T2	0.15	0.86	7.73	0.012	0.12	0.79	0.12	0.17	0.57	0.62	0.12	0.78
T3	0.12	0.73	6.20	0.010	0.10	0.60	0.12	0.18	0.52	0.61	0.10	0.60
T4	0.16	1.00	8.40	0.012	0.13	0.89	0.14	0.16	0.58	0.61	0.13	0.89
T5	0.12	0.74	6.67	0.010	0.10	0.67	0.12	0.16	0.51	0.62	0.10	0.66
T6	0.14	0.92	8.11	0.012	0.12	0.83	0.14	0.17	0.58	0.61	0.12	0.82
T7	0.13	0.75	7.36	0.012	0.12	0.77	0.11	0.14	0.56	0.62	0.12	0.76
T8	0.16	1.10	8.80	0.012	0.14	0.90	0.15	0.19	0.54	0.60	0.14	0.89
T9	0.13	0.79	7.43	0.012	0.11	0.69	0.12	0.15	0.58	0.61	0.11	0.68
T10	0.16	1.00	8.27	0.012	0.15	0.99	0.13	0.15	0.57	0.60	0.15	0.98
T11	0.17	1.42	8.90	0.013	0.16	0.93	0.15	0.18	0.54	0.60	0.16	0.92
T12	0.13	0.81	7.57	0.012	0.12	0.76	0.12	0.15	0.58	0.61	0.12	0.75
T13	0.16	1.28	9.10	0.012	0.15	1.10	0.14	0.17	0.56	0.63	0.15	1.09
T14	0.14	0.82	7.80	0.012	0.12	0.80	0.12	0.16	0.59	0.61	0.12	0.79
T15	0.14	1.03	8.87	0.012	0.13	0.92	0.15	0.17	0.59	0.62	0.13	0.91
S. Em±	0.00	0.03	0.15	0.00	0.00	0.02	0.01	0.01	0.03	0.01	0.00	0.02
C. D. at 5 %	0.01	0.10	0.42	0.00	0.01	0.07	0.02	0.02	NS	NS	0.01	0.07

soil alone (Chopde *et al*. 1999). However, T_{13} (M_3+M_4) - sphagnum moss + cocopeat (3:1) produced significantly the highest seedling length (50.06 cm) at 45 DAS. This may be attributed to general improvement in the physical and chemical properties of the rooting medium. (Dileep *et al*. 1994). The similar results were obtained by Hasan *et al*. (2010) in papaya, Abirami *et al*. (2010) in nutmeg, Yadav *et al*. (2012) in acid lime, Bhardwaj (2013a), Bhardwaj (2013b), Kumawat *et al*. (2014),), Ramteke *et al*. (2015) and Arvind *et al*. (2015) in papaya when they used cocopeat as an ingredient of the growing media.

The number of roots per seedling was increased with increase in days. The treatment T_{13} (M_3+M_4)- sphagnum moss + cocopeat significantly recorded maximum number of roots (6.62, 8.67 and 13.70) per seedling at 15, 30 and 45 DAS, respectively as compared to rest of the treatment. It might be due to this combination (sphagnum moss + cocopeat) attributing to proper aeration and high water holding capacity which helped better root initiation (Rymbai *et al*., 2012).

The treatmentT_{11} (M_2+M_4) - vermiculite + cocopeat (3:1) recorded the maximum length of tap root (4.65 cm and 8.28 cm) at 15 and 30 DAS, respectively. This may be attributed to general improvement in the physical and chemical properties of the rooting medium which improved the growth of the roots (Dileep *et al*., 1994).Whereas, T_{13} (M_3+M_4)- sphagnum moss + cocopeat (3:1) recorded the maximum length of tap root (19.40 cm) at 45 DAS as compared to rest of the treatment. It might be due to this combination (sphagnum moss + cocopeat) attributing to proper aeration and high water holding capacity which helped better root growth and development (Rymbai *et al*., 2012).

The treatment T_{11} (M_2+M_4)- vermiculite + cocopeat (3:1) significantly recorded the maximum number of leaves (6.92) at 30 DAS and treatment T_{13} (M_3+M_4) - sphagnum moss + cocopeat (3:1) significantly recorded the maximum number of leaves (11.50) at 45 DAS. It may be due to better nutrient and moisture availability leading to higher production of photosynthetically functional leaves by growing media. (Borah *et al*., 2008).

The treatment T_{11} (M_2+M_4)- vermiculite + cocopeat (3:1) recorded significantly the maximum fresh weight (0.17 g and 1.42 g) of seedling at 15 and 30 DAS, respectively as compared to rest of the treatment. Similar results were also obtained by Abirami *et al*. (2010) in nutmeg and Hasan *et al*. (2010) in papaya and Yadav *et al*. (2012) in acid lime. Whereas, treatment T_{13} (M_3+M_4)- sphagnum moss + cocopeat (3:1) recorded significantly the maximum fresh weight of seedling (9.10 g) at 45 DAS. This may be attributed to general improvement in the physical and chemical properties of the rooting medium (Dileep *et al*., 1994).

The treatment T_{11} (M_2+M_4)- vermiculite + cocopeat (3:1) registered significantly the maximum dry weight (0.013 g and 0.16 g) of seedling at 15 and 30 DAS, respectively whereas, treatment T_{13} - sphagnum moss + cocopeat (3:1) recorded the maximum dry weight of seedling (1.1 g) at 45 DAS. This may be attributed to the improvement in the physical and chemical properties of the rooting medium (Dileep *et al*., 1994).

The treatment T_8 (M1 + M4)- control + cocopeat (3:1) recorded the significantly maximum root : shoot ratio (weight basis) (0.15) and (0.19) at 30 and 45 DAS, respectively as compared to rest of the treatment. This might be due to the organic media which improved the physical and chemical conditions of the growing media and thus favour in increased in the dry matter of the root similar results were also obtained by Parasana *et al*. (2013).

The root : shoot ratio (length basis) at 30 and 45 DAS was non-significantly influenced by different treatment. However, the treatment T_{15} (M_4+M_5)- cocopeat + vermicompost (3:1) recorded the maximum root : shoot ratio(0.59) at 30 DAS. Whereas, T_{13} (M_3+M_4) - sphagnum moss + cocopeat (3:1) recorded the maximum root : shoot ratio (0.63) at 45 DAS as compared to rest of the treatment.

The treatment T_{11} (M_2+M_4) - vermiculite + cocopeat (3:1) recorded significantly the maximum relative growth rate (0.16 g g-1day-1) at 30 DAS as compared to rest of the treatment. The results of study are in close agreement with the findings of Wong and Lee, (2000) in *Nepenthes ampullaria* as they studied the effect of potting mixes on the growth of plantlets and found

best the combination of cocopeat, vermiculite and sand in 1:1:1. Whereas, T_{13} (M_3+M_4)- sphagnum moss + cocopeat (3:1) registered the significantly the maximum RGR (1.09 g g-^{1}day-^{1}) at 45 DAS as compared to rest of the treatment. Rahimi *et al*. (2013) concluded that moss and cocopeat media were better than other media in relation to high water holding capacity and high keeping capacity of nutrient and air, which help in better crop growth.

From the foregoing discussion it can be concluded that the treatment containing cocopeat as an ingredient of growing media *i*.e. T_8 (M_1+M_4)*i*.e. Control + Cocopeat (3:1), T_{11} (M_2+M_4) *i*.e. Vermiculite + Cocopeat (3:1), T_{13} (M_3+M_4) *i*.e. Sphagnum Moss + Cocopeat (3:1) and T_{15} (M_4+M_5) *i*.e. Cocopeat + Vermicompost(3:1) found to be most suitable for raising the papaya seedlings as it gives better quality seedling growth.

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