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# Effect of growing media on seed germination and seedling growth of papaya cv. 'Red lady'

**R. L. Bhardwaj**

Krishi Vigyan Kendra, Sirohi, Agriculture University Jodhpur-342304, Rajasthan, India.

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**This study was carried out to explore the effect of growing media on seed germination and seedling growth of papaya (*Carrica papaya*). The research was conducted at the model nursery of Krishi Vigyan Kendra, Sirohi during two successive seasons from July to August 2008-2009 and 2009-2010. This research was arranged in a complete randomized design with nine treatment combinations and three replications. The treatments were combination between types of media with level of cocopeat. Each treatment has 100 poly bags. The results showed that the medium of vermicompost + sand + pond soil (1:1:1) with 2 cm cocopeat in top of the poly bags ($T_9$) gave maximum speed of emergence (277.6 and 709.09), highest germination percent (95.27 and 90.15%), highest seed vigour (91.97 and 86.69), maximum germination index (7.15 and 7.22), germination value (17.33 and 33.83) and least time required for imbibition (9.45 and 9.30 days) and minimum germination period (3.70 and 2.75 days), respectively in both years of experimentation. This medium was also found to be the best medium for the growth of papaya seedlings as it gave the highest parameters in term of seedling height (23.43 and 22.67 cm), leaf area (349.33 and 329.20 $cm^2$), number of leaves (10.02 and 9.67), stem girth (3.16 and 3.48 mm), number of roots (17.20 and 16.17), root length (10.20 and 9.67 cm), production of total biomass (5.02 and 4.77 g/plant) and least root/shoot ratio (0.22 and 0.20). This treatment also significantly reduces the seedling mortality and produce maximum healthy seedlings (92.23 and 93.15%) in minimum days (35.33 and 35.15) with highest net profit (Rs. 3493.30/1000 seedling and Rs. 3448.00/ 1000 seedling) and B:C ratio (1.85 and 1.84) of seedlings, in both years (2008-09 and 2009-10), respectively.**

**Key words:** Seedling, plant growth, cocopeat, pond soil, vermicompost, B:C ratio.

## INTRODUCTION

Use of suitable growing media or substrates is essential for production of quality horticultural crops. It directly affects the development and later maintenance of the extensive functional rooting system. A good growing medium would provides sufficient anchorage or support to the plant, serves as reservoir for nutrients and water, allow oxygen diffusion to the roots and permit gaseous exchange between the roots and atmosphere outside the root substrate (Abad et al., 2002). Nursery potting media influence quality of seedlings produced (Agbo and

E-mail: rajubhardwaj3@gmail.com

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). Papaya is an important fruit crop which is propagated by seeds only. Seed germination is affected by many factors, which include type of substrate used, environ-mental factors such as oxygen, water, temperature and for some plant species, light (Hartmann et al., 2001). The germination of seed of papaya (*Carrica papaya*) is frequently reported to be slow, erratic and is incomplete (Chako and Lange, 1966). Red lady is choicest variety of papaya grower due to hermaphrodite nature and prolonged self life of fruits. But the seed cost of this variety is very high (Rs. 2.0 lakh $kg^{-1}$) so, increasing germination percent and producing more healthy seedling is a challenge for papaya growers. The germination of papaya (*C. papaya*) cv. Red lady seeds faces certain problems in germination and has high seedling mortality due to damping off disease in nursery stage. Initial mortality and incomplete germination is also one of the causes of reduced survival percent of papaya plants. In heavy soil without enough drainage, the development of root system is suppressed and plants are more susceptible to soil borne diseases (Beattie and White, 1992). The papaya seed is endosed within a gelatinous sarcotesta (aril or outer seed coat which is formed from the outer integument). Growing media also plays important role for seed germination. Growing medium not only acts as a growing place but also as a source of nutrient for plant growth. Media composition used influences the quality of seedling (Wilson et al., 2001). Generally, media for fruit crop seedling are composed of soil, organic matter, pond soil and sand. The pond soil is usually used as a basic medium because it is cheapest and easy to procure. Supplementing of the sand is aimed to make media more porous while the organic matter (FYM and vermicompost) is added so as to enrich adequate nutrients for the seedling. There is better relationship between the manure and rooting rather than conventional soil mix and less susceptibility of the seedling to soil borne pests and diseases (Akanbi et al., 2002). Several studies on growth media had been conducted on the various fruit commodities by previous researchers. The best growth of mangosteen seedling was reached on soil medium as compared to the other media (Jawal et al., 1998). Baiyeri (2003) mentioned that the best seedling qualities of African breadfruit (*Treculia africana* Decne) were obtained when grown in medium formulated with top soil + poultry manure + river sand in 1:2:3 (v/v/v) ratios. Humic acids (vermicompost) applied in the medium increased plant height, leaf area and dry weight of peppers, tomatoes and marigold (Arancon et al., 2004). Ratna et al. (2006) working on banana cv. Raja Serai proved that soil and sand medium was the most suitable medium for shoot and leaf growth of this banana. *Uapaca kirkiana* Müell Arg. planted on the medium comprising 75% forest soil and 25% sawdust produced the tallest seedlings, larger root collar diameter and higher survival at 10 months after planting (Mhango et al., 2008).

Cocopeat is an agricultural by-product obtained after the extraction of fiber from the coconut husk (Abad et al., 2002). As a growing medium, cocopeat can be used to produce a number of crop species with acceptable quality in the tropics (Yahya and Mohklas, 1999; Yau and Murphy, 2000). Cocopeat is considered as a good growing media component with acceptable pH, electrical conductivity and other chemical attributes (Abad et al., 2002). Cocopeat has good physical properties, high total pore space, high water content, low shrinkage, low bulk density and slow biodegradation (Evans et al., 1996; Prasad, 1997). The results of many experiments revealed that cocopeat used alone, or as a component of soil medium, is suitable for roses (Blom 1999), gerbera (Labeke and Dambre, 1998), many potted plants (De Kreij and Leeuven, 2001; Treder and Nowak, 2002) and also for vegetables. Due to usually high initial level of potassium and sodium in cocopeat, the fertilization program should be adjusted carefully to plant requirements.

Keeping in view the influence of media in germination and seedling growth of papaya, the present investigation was carried out to study the effect of different media viz. sand, pond soil, FYM, vermicompost and cocopeat on seed germination, seedling growth and vigour of papaya seedlings.

## MATERIALS AND METHODS

### Seed material and treatment

Seed germination and seedling growth experiments of papaya were carried out at NHM Model nursery of Krishi Vigyan Kendra-Sirohi (Rajasthan) during two successive season from July to August, 2008-09 and 2009-10. Experimental treatments comprised of nine treatment combinations consisting of different combination of growth media and cocopeat filling at the top of seedling poly bags (10 x 12 cm) namely, $T_1$ – Sand + pond soil (1:1) without cocopeat, $T_2$- Sand + pond soil (1:1) with 1 cm cocopeat, $T_3$- Sand + pond soil (1:1) with 2 cm cocopeat, $T_4$- FYM + Sand + pond soil (1:1:1) without cocopeat, $T_5$- FYM + Sand + pond soil (1:1:1) with 1 cm cocopeat, $T_6$- FYM + Sand + pond soil (1:1:1) with 2 cm cocopeat, $T_7$- Vermicompost + sand + pond soil (1:1:1) without cocopeat, $T_8$- Vermicompost + sand + pond soil (1:1:1) with 1 cm cocopeat, $T_9$- Vermicompost + sand + pond soil (1:1:1) with 2 cm cocopeat. The seed sowing was done in month of July about 1 cm deep in different media as per treatments. The poly bags were irrigated immediately after seed sowing and repeated every day till the final emergence. After the completion of germination, the bags were irrigated once in 2 days.

### Experimental design and measured parameters

For seed germination and seedling growth experiments, treatments of the experiment were conducted in complete randomized design with three replications. Each treatment was composed of 100 polybags seedlings. All the observation on germination parameters were recorded at the time of germination and growth parameter at the time of transplanting (45 days after seed sowing) from 100 seeds for germination parameter and randomly selected 10 seedling for growth parameters. Data on germination was recorded from the first germination until no further germination at two days interval. The imbibition period, number of days from sowing to commencement of germination, was recorded for all studied treatments. The rate of emergence (RE) was calculated according to Islam et al. (2009) using the following formula:

$$\text{Rate of emergence} = \frac{\text{No. of seedlings emerged 5 days after sowing}}{\text{No. of seedlings emerged 15 days after sowing}} \times 100$$

The germination percentage was calculated as the percent of germinating seeds starting from the first germination to no further germination. Germination percentage was calculated by number of germinated seedling divided by the total number of seeds sown in poly bags and multiplied by 100. The germination period was calculated as the difference between initial and final emergence (number of days) recorded. Seed vigour was calculated by total number of healthy seedling divided by the number of total seedlings and multiplied by 100. The germination index was calculated as described in the Association of Official Seed Analysis (1983) by the following formula:

$$\text{Germination index} = \frac{\text{No. of germinating seeds}}{\text{Days of first count}} + \frac{\text{No. of germinating seeds}}{\text{Days of final or last count}}$$

The germination value (GV) was calculated according to Hossain et al. (2005) by the following formula: Germination value = (Σ DGs/N) X GP/10. Where (GP) is the germination percentage at the end of experiment, (DG) is the daily germination speed obtained by dividing the cumulative germination percentage by the number of days since sowing, (Σ DGs) is the total germination obtained by adding every DGs value obtained from the daily counts, (N) is the total number of daily counts starting from the first germination and (10) is constant. Counting of number of leaves was done at the end of experiment (45 days after seed sowing) when the true leaves have emerged. Stem girth was measured 1 cm from the base of the stem using vernier caliper. Plant height was measured from poly bag top soil surface upto the highest leaf tip by straightening all leaves. Leaf area was calculated by the leaves traced on a graph paper. Number of roots, root length was measured by destructive method of uprooting the plants and taking measurement by standard method. Stem and root were weighed to record stem, root fresh weight, root/shoot ratio, and total weight per plant (g) was recorded at time of transplanting. Survival percent (after transplanting in main field) was recorded by following formula:

$$\text{Survival percent} = \frac{\text{Total survival transplanted plants}}{\text{Total transplanted plants}} \times 100$$

The net return was calculated by subtracting cost of each treatment from the gross return and benefit: cost ratio = Gross income/cost of seedling production. All data was subjected to analysis of variance (ANOVA) to determine significant differences and comparison of means at significant level of 5%.

## RESULTS AND DISCUSSION

The results showed that growing media and cocopeat had beneficial effect on seed germination and growth of papaya seedling.

### Seed germination parameters

Seed germination parameters of papaya (*C. papaya*) as affected by growing media and use of cocopeat are presented in Table 1. The treatment $T_9$ was found to be best followed by $T_8$ with regard to germination behaviour as these media have suitable physical properties and good water holding capacity that supports the germination of papaya seeds (Table 1). Coir dust when mixed with organic manure is the best media as coir dust has good physical characteristics (Garcia and Daverede, 1994) and also successfully tested as a growing medium in ornamentals (Van Holm, 1993). Germination started at the 9.45 and 9.30 days after sowing on vermicompost medium with 2 cm cocopeat ($T_9$) for both year of experimentation, respectively. Germination continued until the 25.72 and 22.03 days from sowing where no further germination was noticed in both year of experimentation, respectively. For both year of experimentation, the maximum speed of emergence (277.6 and 709.0), highest germination percent (95.27 and 90.15%), highest seed vigour (91.97 and 86.69), maximum germination index (7.15 and 7.22), germination value (17.33 and 33.83) and least time required for imbibition (9.45 and 9.30 days) and minimum germination period (3.70 and 2.75 days) were obtained in vermicompost + sand + pond soil (1:1:1) with 2 cm filling with cocopeat of seedling poly bags ($T_9$) in both years of experimentation, respectively. The sand + pond soil (1:1) without cocopeat showed the least results in most cases. The vermicompost medium with 2 cm cocopeat allowed increased germination parameters from the beginning to the end of experiment as compared to other media

**Table 1.** Effect of seedling growing media and cocopeat on the germination parameters of papaya (*C. papaya*).

| Treatment | Imbibition period | | Speed of emergence | | Germination (%) | | Germination period | | Seed vigour | | Germination index | | Germination value | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2008-2009 | 2009-2010 | 2008-2009 | 2009-2010 | 2008-2009 | 2009-2010 | 2008-2009 | 2009-2010 | 2008-2009 | 2009-2010 | 2008-2009 | 2009-2010 | 2008-2009 | 2009-2010 |
| $T_1$ | 16.67 | 14.67 | 129.51 | 125.22 | 61.70 | 57.67 | 9.05 | 7.35 | 52.80 | 57.67 | 2.00 | 2.73 | 1.66 | 2.21 |
| $T_2$ | 14.60 | 12.60 | 133.12 | 205.99 | 69.14 | 66.50 | 7.35 | 6.60 | 62.72 | 65.60 | 2.81 | 3.46 | 3.20 | 3.79 |
| $T_3$ | 12.35 | 11.75 | 166.74 | 285.68 | 79.36 | 81.30 | 6.50 | 5.25 | 73.78 | 77.69 | 3.70 | 4.97 | 5.64 | 8.02 |
| $T_4$ | 16.45 | 14.25 | 152.02 | 156.21 | 69.45 | 72.13 | 7.90 | 6.65 | 62.08 | 67.30 | 2.94 | 3.53 | 2.53 | 4.20 |
| $T_5$ | 13.55 | 13.62 | 188.06 | 366.19 | 79.70 | 83.40 | 5.65 | 4.10 | 73.18 | 80.33 | 4.23 | 4.78 | 5.59 | 9.84 |
| $T_6$ | 11.75 | 11.42 | 206.08 | 445.04 | 84.65 | 86.65 | 4.72 | 3.17 | 80.22 | 85.39 | 5.30 | 5.60 | 9.01 | 15.92 |
| $T_7$ | 14.30 | 13.38 | 231.47 | 273.54 | 80.33 | 74.90 | 6.95 | 5.35 | 73.92 | 73.60 | 3.86 | 3.51 | 4.44 | 5.59 |
| $T_8$ | 11.13 | 12.12 | 257.91 | 603.16 | 90.13 | 85.00 | 4.55 | 3.60 | 84.90 | 81.62 | 5.69 | 6.29 | 10.35 | 18.64 |
| $T_9$ | 9.45 | 9.30 | 277.65 | 709.09 | 95.27 | 90.15 | 3.70 | 2.75 | 91.97 | 86.69 | 7.15 | 7.22 | 17.33 | 33.83 |
| SEM± | 0.377 | 0.618 | 5.874 | 12.833 | 1.830 | 2.173 | 0.264 | 0.265 | 1.804 | 1.853 | 0.224 | 0.136 | 0.278 | 0.278 |
| CD at 5% | 1.117 | 1.829 | 17.385 | 37.979 | 5.416 | 6.432 | 0.783 | 0.786 | 5.338 | 5.484 | 0.665 | 0.404 | 0.822 | 0.834 |

combination in both years of experimentation. The reason for the best performance of pond soil and vermicompost are high organic matter content which increases the water and nutrient holding capacity of the medium, which improve the water utilization capacity of plant. Joiner and Nell (1982) found similar results in peat + perlite mixture for Aglaonema and Dieffenbachia. Vermicompost is reported to have bioactive principles which are considered to be beneficial for root growth and this has been hypothesized to result in greater root initiation, higher germination, increased biomass, enhanced growth and development (Bachman and Metzger, 2008) and also balanced composition of nutrients (Zaller, 2007). The higher available well decomposed organic matter (vermicompost) may preserve soil humidity, increase nutrient content and improve soil structure which increase water absorption and maintains the cell turgidity, cell elongation and increase respiration at optimum level, leading to favourable seed sprouting. Vermicompost mixed with pond soil affects properties of soil physics, chemistry and biology, since organic matter acts as glue for soil aggregate and source of soil nutrient (Soepardi, 1983). Vermicompost granules may develop soil aggregate and it's granulating. Soil aggregation will improve permeability and airflow in the polybags. Vermicompost and pond soil (due to high organic matter) may decrease fluctuation of soil temperature. Further, seed germination and root growth becomes easier to the particular depth so that plant grows well and may absorb more water and nutrient (Jo, 1990). Organic matter may also improve nutrient availability and improve phosphorus absorption (Karama and Manwan, 1990). All these factors are favourable for seed germination and ultimate by increase seed germination percent, speed of emergence, seed vigour, germination index, germination value and reduce imbibition period. Combined application of vermicompost and cocopeat in the treatment $T_9$ showed significant effect on germination, seedling growth and plant biomass probably due to the synergistic combination of both factors in improving physical condition of the media and nutritional factors (Sahni et al., 2008).

### Seedling growth and development parameters

Data presented in Tables 2 and 3 show growth and development of papaya seedling as significantly affected by growing media and cocopeat. Significant differences were observed among the different treatments with regard to seedling growth characters and maximum number of leaves was observed in $T_9$ treatment (10.02 and 9.67) which was at par with $T_6$ treatment (9.20 and 9.00), respectively, in both years (Table 2). Maximum seedling girth (3.16 and 3.48 mm), highest seedling height (23.43 and 22.67 cm), largest leaf area (349.33 and 329.20 $cm^2$), longest root length (10.20 and 9.67 cm) and highest fresh weight of plants (5.02 and 4.77 g) were recorded in $T_9$ treatment in both years of experimentation, respectively. Similarly maximum number of roots per plant was also higher in $T_9$ treatment (17.20 and

**Table 2.** Effect of seedling growing media and cocopeat on the growth parameters of papaya (*C. papaya*) at 45 days after seed sowing.

| Treatment | Number of leaves | | Stem girth (mm) | | Seedling height (cm) | | Leaf area ($cm^2$) | | Number of roots | | Root length (cm) | | Fresh weight of plants (g) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2008-2009 | 2009-2010 | 2008-09 | 2009-2010 | 2008-2009 | 2009-2010 | 2008-2009 | 2009-10 | 2008-2009 | 2009-10 | 2008-2009 | 2009-2010 | 2008-2009 | 2009-2010 |
| $T_1$ | 4.00 | 3.07 | 0.96 | 1.28 | 7.20 | 9.33 | 18.30 | 15.14 | 5.00 | 6.60 | 3.01 | 3.90 | 0.60 | 0.63 |
| $T_2$ | 6.05 | 5.13 | 1.28 | 1.60 | 8.45 | 10.33 | 33.35 | 30.30 | 9.45 | 10.35 | 3.55 | 4.21 | 0.80 | 0.79 |
| $T_3$ | 7.11 | 8.25 | 1.92 | 2.24 | 10.45 | 12.33 | 51.23 | 50.37 | 12.03 | 12.30 | 6.02 | 5.45 | 1.00 | 1.02 |
| $T_4$ | 7.23 | 6.00 | 1.28 | 1.80 | 9.05 | 9.17 | 41.25 | 59.45 | 7.10 | 7.83 | 5.25 | 4.90 | 0.72 | 0.65 |
| $T_5$ | 8.25 | 8.15 | 2.24 | 2.44 | 12.20 | 12.17 | 84.31 | 99.00 | 11.13 | 9.69 | 7.37 | 6.47 | 1.20 | 0.80 |
| $T_6$ | 9.20 | 9.00 | 2.87 | 2.76 | 17.45 | 17.17 | 134.00 | 134.30 | 12.17 | 12.35 | 7.60 | 6.94 | 1.65 | 1.23 |
| $T_7$ | 8.13 | 6.63 | 1.89 | 2.21 | 16.43 | 11.67 | 126.17 | 149.12 | 13.80 | 12.00 | 8.15 | 7.19 | 2.67 | 2.17 |
| $T_8$ | 9.02 | 7.60 | 2.53 | 2.84 | 20.18 | 19.67 | 216.25 | 249.25 | 16.83 | 15.20 | 9.45 | 8.58 | 3.82 | 3.30 |
| $T_9$ | 10.02 | 9.67 | 3.16 | 3.48 | 23.43 | 22.67 | 349.17 | 329.20 | 17.20 | 16.17 | 10.20 | 9.67 | 5.02 | 4.77 |
| SEm± | 0.318 | 0.386 | 0.083 | 0.119 | 0.422 | 0.448 | 3.457 | 3.457 | 0.581 | 0.536 | 0.218 | 0.196 | 0.046 | 0.051 |
| CD at 5% | 0.941 | 1.142 | 0.245 | 0.353 | 1.251 | 1.326 | 10.232 | 10.232 | 1.721 | 1.587 | 0.647 | 0.580 | 0.137 | 0.152 |

**Table 3.** Effect of seedling growing media and cocopeat on the growth parameters, survival percent, net return and B : C ratio of papaya (*C. papaya*).

| Treatment | Fresh weight of shoot (g) | | Fresh weight of root (g) | | Survival per cent | | Root /Shoot ratio | | Days required for gaining transplanting size of seedling | | Net return (Rs./1000 seedlings) | | B : C ratio | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2008-2009 | 2009-2010 | 2008-2009 | 2009-2010 | 2008-09 | 2009-2010 | 2008-2009 | 2009-2010 | 2008-2009 | 2009-2010 | 2008-2009 | 2009-2010 | 2008-2009 | 2009-2010 |
| $T_1$ | 0.39 | 0.39 | 0.21 | 0.23 | 77.30 | 78.12 | 0.55 | 0.59 | 47.35 | 45.30 | 805.00 | 755.0 | 1.17 | 1.15 |
| $T_2$ | 0.53 | 0.51 | 0.27 | 0.27 | 80.37 | 82.14 | 0.50 | 0.54 | 45.30 | 42.35 | 1005.0 | 955.0 | 1.19 | 1.18 |
| $T_3$ | 0.69 | 0.68 | 0.31 | 0.34 | 84.35 | 86.00 | 0.45 | 0.50 | 42.50 | 41.20 | 1905.0 | 1855.0 | 1.35 | 1.34 |
| $T_4$ | 0.54 | 0.47 | 0.18 | 0.18 | 81.80 | 82.60 | 0.33 | 0.37 | 43.60 | 40.60 | 1093.0 | 1043.0 | 1.20 | 1.19 |
| $T_5$ | 0.95 | 0.61 | 0.27 | 0.19 | 84.88 | 86.65 | 0.28 | 0.31 | 40.50 | 39.50 | 1893.0 | 1843.0 | 1.34 | 1.33 |
| $T_6$ | 1.27 | 0.96 | 0.35 | 0.27 | 86.86 | 90.61 | 0.27 | 0.28 | 38.58 | 37.62 | 2393.0 | 2343.0 | 1.41 | 1.40 |
| $T_7$ | 2.12 | 1.74 | 0.50 | 0.43 | 87.20 | 84.30 | 0.24 | 0.25 | 40.25 | 40.30 | 2193.3 | 2148.0 | 1.65 | 1.64 |
| $T_8$ | 3.11 | 2.77 | 0.71 | 0.60 | 90.25 | 89.35 | 0.23 | 0.22 | 38.30 | 38.35 | 2993.3 | 2948.0 | 1.78 | 1.77 |
| $T_9$ | 4.12 | 3.98 | 0.89 | 0.78 | 92.23 | 93.15 | 0.22 | 0.20 | 35.33 | 35.15 | 3493.3 | 3448.0 | 1.85 | 1.84 |
| SEm± | 0.057 | 0.057 | 0.016 | 0.016 | 1.633 | 1.570 | 0.009 | 0.009 | 1.006 | 1.006 | 60.324 | 45.057 | 0.066 | 0.066 |
| CD at 5% | 0.170 | 1.170 | 0.048 | 0.048 | 4.835 | 4.649 | 0.029 | 0.028 | 2.979 | 2.979 | 178.53 | 133.34 | 0.198 | 0.198 |

16.17) which was at par with $T_8$ treatment (16.83 and 15.20). Highest fresh weight of shoot (4.12 and 3.98 g), fresh weight of roots (0.89 and 0.78 g) and least root/shoot ratio (0.22 and 0.20) was also reported in $T_9$ treatment in both years of experimentation (2008-09 and 2009-10), respectively. Manure (vermicompost) provides adequate nutrients and enhances both the physical properties and the water holding capacity (Soegiman, 1982). Similar result was also reported by Supriyanto et al. (1990) working on orange seedling where media containing manure produced growth and roots better than those containing sawdust and rice hulk. Purbiati et al. (1994) proved that soil + manure (1:1) was the best medium for the growth components of salacca cv. Pondoh and Bali. Merrow (1995) found similar results in sedge peat medium for *Ravenea rivularis*. Combined application of vermicompost and cocopeat in the treatment $T_9$ showed significant effect on seedling growth parameters and plant biomass probably due to the synergistic combination of both factors in improving the physical conditions of the media and nutritional factors (Sahni et al., 2008). This result is akin to the findings of Campos Mota et al. (2009) and Abirami et al. (2010) who suggested that since coir dust is low in nutrients when mixed with vermicompost, provides a better growth medium for plant establishment. However, the air filled porosity (AFP), easily available water (EAW) and aeration of vermicompost and FYM were not at the recommended level which in turn limit the root growth and lowered the water holding capacity. Therefore, the medium with vermicompost and cocopeat is more suitable than vermicompost alone because of the better physical properties and enhanced nutrient level.

This treatment combination was also helpful in reducing damping off disease in seedling due to proper aeration in root zone of the seedling and produce highest survival percent of seedling (92.23 and 93.15%, respectively) which was at par with $T_8$ treatment (90.25 and 93.15%, respectively). Because of the better physical properties and enhanced nutrient level in $T_9$ treatment, growth of seedling are too fast and minimum days required for gaining transplanting size is 35.33 and 35.15 days which is at par with $T_6$ (37.62 days) in second year (2009-10) of experimentation (Table 3). Vermicompost with cocopeat may improve soil porosity, water content, pore of drainage, soil permeability and water availability, whereas weight of soil may decrease. This may develop soil aggregation, and moreover it improves permeability and air flow in the soil, this type of condition sharply reduce damping off disease in nursery stage and provide support to fast growth of the seedling due to availability of better nutrition with water and air in root zone of the seedling ultimately, the seedling gain transplanting size very soon in this treatment combination than other treatments. It seems that good physical and biological conditions in cocopeat and vermicompost had positive effect on root development, which is helpful in increased survival percent of seedling in main field after transplanting. Beneficial effect of cocopeat on root system was observed on nutmeg seedling by Abirami et al. (2010), *Osteospermum* cuttings by Nowak (2004), salvia, viola by Pickering (1997) and *Impatiens* by Smith (1995).

Application of vermicompost : pond soil : sand (1:1:1) with 2 cm cocopeat media ($T_9$) for preparation of papaya seedling proved profitable and showed maximum net return (Rs. 3493.30/1000 seedlings and Rs. 3448.00/1000 seedlings) and benefit : cost ratio (1.85 and 1.84) for the first and second year of experimentation, respectively due to higher germination percent and survival percent obtained (Tables 1 and 3). This treatment was significantly superior to the rest of the treatments during both year but benefit : cost ratio was *at par* with $T_8$ treatment.

## Conflict of Interests

The author(s) have not declared any conflict of interests.

## Conclusion

In conclusion, presented results showed that vermicompost and cocopeat, due to suitable physical, chemical and biological properties could be used successfully in preparation of papaya seedling. On the basis of results obtained from this study, it is concluded that growing media significantly influenced the germination, growth and development parameters of papaya seedling in which medium of vermicompost + pond soil + sand (1:1:1) with 2 cm cocopeat filling of poly bags was the best media since the germination, seedling growth and development parameters were higher than those on the other media. The overall results revealed that media supplemented with cocopeat gave higher parameters of germination, growth and development of papaya seedling as compared to media without cocopeat. Therefore, this result suggested that vermicompost, pond soil and sand with cocopeat should be used as growing media for higher germination percent quickening of papaya seedling growth and earn more profit by sale of seedlings.

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