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Effect of different propagation media on seed germination, seedling growth and vigour of nutmeg (*Myristica fragrans* Houtt.)

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Experiment conducted on the seed germination, seedling growth and vigour of nutmeg (*Myristica fragrans*) revealed that there were significant differences in germination and seedling growth behaviour of nutmeg seeds sown in twenty one different combination of growth media. The results showed germination characters like early germination, germination percentage, germination index and earliness index were maximum in the treatment T16 containing soil: coir dust: sand: vermicompost in 1:1:1:1: as the media followed by T13 soil: coir dust: sand: FYM 1:1:1:1. Similarly the seedling growth characters like seedling height, girth, number of leaves, shoot length, root length and plant biomass were highest in the treatment media of T16 (soil: coir dust: sand: vermicompost 1:1:1:1) which reflected on higher vigour index in the same treatment.

Key words: FYM, nutmeg, germination, seedling growth, vermicompost, coir dust.

INTRODUCTION

Nutmeg, (*Myristica fragrans*) is one of the important tree spices of the world. The tree yields two products of commercial value namely nutmeg seed and the mace which is the aril covering the seed. Both nutmeg seed and mace are used in the pharmaceutical industries for its medicinal properties. The seeds are carminative, stomachic, astringent, deodorant, narcotic, aphrodisiac and useful in flatulence, nausea and vomiting. The antioxidant properties of nutmeg have been augmented by various researchers (Madsen and Bertelsen, 1995; Lagouri and Boskou, 1995). Oil of nutmeg is also useful in the treatment of inflammation of the bladder and urinary tract, halitosis, dyspepsia, flatulence, impotence, insomnia and skin diseases. It is also used externally as a stimulant and the ointment as a counterirritant (Krishnamoorthy and Rema, 2001). Since nutmeg and mace have huge value in international markets, the area under cultivation is in an increasing trend especially in the southern region of India. Seed is the common propagating material in nutmeg; however, the serious problems in the cultivation are dioecious nature, unpredictability of the sex at seedling stage and high cross pollination. All these factors favour the vegetative propagation than sexual propagation in nutmeg. Nonetheless, saplings raised from seeds are important for rootstock purposes. The seeds after extraction are sown either immediately or not later than 3 to 4 days (Khandekar, 2006). The seeds of nutmeg loose viability soon after harvest (Sangakkara, 1993). Further the seeds take minimum two months for germination (Mathew, 1992). Seeds treated with 200 ppm of Gibberellic acid gave the maximum seed germination (75%) (Mathew, 1992). Khandekar (2006) suggested that rice bran, sand and sand + rice bran were the best media for maximum germination and seedling growth in nutmeg under coastal conditions of Maharashtra, India. Keeping the influence of media in germination and seedling growth of nutmeg, the present investigation was carried out to study the effect of different media on seed germination, seedling growth and vigour of nutmeg with the help of locally available media under Kerala conditions of India.

MATERIALS AND METHODS

The experiment was conducted during 2007 - 2008 at Indian Institute of Spices Research (IISR, Calicut) experimental farm,
Peruvannamuzhi, Kerala, India in a completely randomized block
design with three replications. The experiment consisted of 21
 treatments with different combination of growth media namely T1-
Soil: Sand: FYM 3:1:1, T2-Soil: Sand: FYM 2:1:1 (control), T3-Soil:
1:1:1, T10-Soil: granite: vermicompost 3:1:1, T11-Soil: granite:
vermicompost 2:1:1, T12-Soil: granite: vermicompost 1:1:1, T13-
Soil: coir dust: Sand: FYM 1:1:1:1, T14-Soil: coir dust: granite:
FYM 1:1:1:1, T15-Soil: coir dust: granite: vermicompost 1:1:1:1, T16-
Soil: coir dust: sand: vermicompost 1:1:1:1, T17-Coir dust: granite:
FYM 2:1:1, T18-Coir dust: Sand: FYM 2:1:1, T19-Soil alone, T20-
granite alone, T21-Sand alone.

Tree ripe harvested nutmeg seeds collected and about 30 seeds
were sown on 4th July, 2007 in polythene bags of 20 x 15 cm size
under each treatment. The sowing was done by keeping the seed
in vertical position about 1 inch deep in different media as per
 treatments. The bags were irrigated immediately after sowing and
repeated every day till the final emergence. Observations on
germination (%), no of seeds germinated per day and time taken
for initial and final emergence (days) were recorded. Germination
observations like rate of germination, earliness index and
germination index were done using the method suggested by
Bewley and Black (1982); Bavappa et al. (1964) and Heydecker
(1969) respectively. After the completion of germination, the bags
were irrigated once in 4 days and various growth characters of
seedlings were recorded eight months after sowing the seeds from
five randomly selected plants in each replication of a treatment.
Stem girth was measured 1 cm from the base of the stem using
vernier calipers. The growth characters like seedling height (cm),
girth (cm), number of leaves, shoot length (cm), root length (cm),
fresh and dry weight of shoot and root system (g) were observed.
The vigour index of the seedlings was calculated in two ways as
suggested by Abdul Baki and Anderson, (1970) considering both
length of the seedlings (vigour Index I) and dry weight of the
seedlings (vigour index II) along with the percent germination.
The data recorded were statistically analyzed as per standard
procedures (Panse and Sukhatme, 1995). The physico-chemical
properties of the different media were estimated before sowing the
seeds using standard procedures (Jackson, 1973) (Table 1).

RESULTS

There was a significant difference observed in the days
taken for initiation of germination among all the
treatments and the earliest germination was recorded in
T16 (42.10 days) which was on par with T13 (44.32 days)
(Table 2). The germination percentage was highest in T16
(86.67%) which was on par with T13 (80.32%) and T15
(80.24%) and significantly different from all other
treatments. The earliness index (0.96) and germination
index (1.53) were highest in T16 which was at par with T13
(0.923 and 1.326 respectively). However, the rate of
germination was high in T13 (0.022) which was at par with
T16 (0.021) and significantly different from all other
treatments.

Significant differences were observed among the
different treatments with regard to seedling growth
growth characters and maximum seedling height was observed
in T16 (29.84 cm) which was on par with T15 (28.79 cm)
(Table 3). Maximum seedling girth was observed in T16
(0.63 cm) which was on par with T13 (0.60 cm) and T15
(0.57 cm). Similarly number of leaves and root length
were higher in T16 (21.14 and 18.14 cm, respectively)
which were on par with T13 (20.36 and 127.91 cm,
respectively). Shoot length was highest in T16 (30.15 cm)
followed by T15 (29.86 cm). The total plant biomass was
maximum in T16 (Table 3). With regard to the seedling
vigour index I and II on length and weight basis (Figure
1), maximum value (4185.29 cm and 1122.38 g,
respectively) was noticed in T16 which was significantly
different from all other treatments.

DISCUSSION

The treatment T16 was found to be best followed by T13
with regard to germination behaviour as these media
have suitable physical properties and good water holding
capacity that supports the germination of nutmeg seeds
(Table 1). Coir dust when amended with organic manure
suits as the best media as coir dust has good physical
characteristics (Garcia and Davere, 1994) and also
successfully tested as a growing medium in ornamentals
(Van Holm, 1993). 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, increased biomass, enhanced
growth and development (Bachman and Metzger, 2008)
and also balanced composition of nutrients (Zaller, 2007).

Vigour index and dry weight of seedlings indicated the
overall performance of the seeds and seedlings. These
observations varied significantly in all the treatments
and the highest observation was recorded in T16. Combined
application of vermicompost and coir dust in the
treatment T16 showed significant effect on germination,
seedling growth and plant biomass probably due to the
synergistic combination of both the factors in improving
the physical conditions of the media and nutritional
factors (Sahni et al., 2008). Thus based on the results
of this study, it can be concluded that the treatment T16
(Soil: Sand: Coir dust: Vermicompost 1:1:1:1) showed
better water holding capacity, favourable pH, increased
accumulation of P, K, Ca, Mn and Fe (Tables 1 and 2)
which helped in better nutrient availability to the growing
plants and hence supporting enhanced seed germination
and seedling growth compared to the other treatments.
This result is akin to the findings of Priyadarshani et al.
(2006) and Campos Mota et al. (2009) 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 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
coir dust is more suitable than vermicompost alone
because of the better physical properties and enhanced
nutrient level. However further study is required to
standardize the proper proportion mixture of coir dust and
Table 1. Physical properties, organic carbon and nutrient content of different media used for germination and growth of nutmeg.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Bulk density (g/cc)</th>
<th>Particle density (g/cc)</th>
<th>Water holding capacity (%)</th>
<th>pH</th>
<th>Organic carbon (%)</th>
<th>P (mg/kg)</th>
<th>K (mg/kg)</th>
<th>Ca (mg/kg)</th>
<th>Mg (mg/kg)</th>
<th>Fe (mg/kg)</th>
<th>Mn (mg/kg)</th>
<th>Zn (mg/kg)</th>
<th>Cu (mg/kg)</th>
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<tbody>
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<td>T1</td>
<td>0.97</td>
<td>1.05</td>
<td>51.0</td>
<td>5.38</td>
<td>1.37</td>
<td>52.5</td>
<td>350.0</td>
<td>757.7</td>
<td>298.7</td>
<td>39.67</td>
<td>18.67</td>
<td>1.467</td>
<td>4.067</td>
</tr>
<tr>
<td>T2</td>
<td>1.01</td>
<td>0.98</td>
<td>52.0</td>
<td>5.58</td>
<td>0.88</td>
<td>65.5</td>
<td>353.7</td>
<td>694.7</td>
<td>298.0</td>
<td>39.00</td>
<td>11.67</td>
<td>1.367</td>
<td>2.724</td>
</tr>
<tr>
<td>T3</td>
<td>1.02</td>
<td>1.09</td>
<td>51.5</td>
<td>5.95</td>
<td>1.30</td>
<td>153.0</td>
<td>374.0</td>
<td>1013.0</td>
<td>387.7</td>
<td>38.67</td>
<td>13.67</td>
<td>1.567</td>
<td>4.100</td>
</tr>
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<td>1.01</td>
<td>1.04</td>
<td>52.5</td>
<td>5.26</td>
<td>1.31</td>
<td>63.0</td>
<td>284.7</td>
<td>789.0</td>
<td>320.0</td>
<td>40.67</td>
<td>15.67</td>
<td>1.667</td>
<td>6.033</td>
</tr>
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<td>T5</td>
<td>1.09</td>
<td>1.08</td>
<td>50.0</td>
<td>5.30</td>
<td>1.55</td>
<td>182.0</td>
<td>295.0</td>
<td>953.7</td>
<td>335.7</td>
<td>41.67</td>
<td>11.67</td>
<td>2.967</td>
<td>3.900</td>
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<tr>
<td>T6</td>
<td>1.17</td>
<td>1.20</td>
<td>53.5</td>
<td>6.12</td>
<td>1.55</td>
<td>260.5</td>
<td>441.7</td>
<td>1148.0</td>
<td>393.7</td>
<td>40.67</td>
<td>23.67</td>
<td>2.800</td>
<td>2.467</td>
</tr>
<tr>
<td>T7</td>
<td>0.93</td>
<td>0.99</td>
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<td>5.23</td>
<td>1.21</td>
<td>150.7</td>
<td>326.7</td>
<td>748.7</td>
<td>299.0</td>
<td>41.67</td>
<td>14.67</td>
<td>2.167</td>
<td>3.067</td>
</tr>
<tr>
<td>T8</td>
<td>0.99</td>
<td>1.05</td>
<td>52.5</td>
<td>5.39</td>
<td>1.39</td>
<td>188.7</td>
<td>319.0</td>
<td>833.0</td>
<td>308.7</td>
<td>42.00</td>
<td>19.67</td>
<td>2.967</td>
<td>4.100</td>
</tr>
<tr>
<td>T9</td>
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<td>1.04</td>
<td>54.0</td>
<td>5.49</td>
<td>1.31</td>
<td>271.0</td>
<td>329.0</td>
<td>955.0</td>
<td>338.0</td>
<td>40.67</td>
<td>10.67</td>
<td>4.367</td>
<td>4.300</td>
</tr>
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<td>T10</td>
<td>1.00</td>
<td>1.01</td>
<td>53.5</td>
<td>5.23</td>
<td>1.33</td>
<td>106.7</td>
<td>312.7</td>
<td>808.0</td>
<td>301.7</td>
<td>41.67</td>
<td>10.67</td>
<td>1.500</td>
<td>3.500</td>
</tr>
<tr>
<td>T11</td>
<td>1.01</td>
<td>1.07</td>
<td>44.5</td>
<td>5.28</td>
<td>1.12</td>
<td>174.0</td>
<td>306.0</td>
<td>941.0</td>
<td>325.0</td>
<td>41.67</td>
<td>13.67</td>
<td>1.400</td>
<td>2.800</td>
</tr>
<tr>
<td>T12</td>
<td>1.02</td>
<td>1.04</td>
<td>41.5</td>
<td>4.84</td>
<td>1.27</td>
<td>223.7</td>
<td>278.7</td>
<td>924.7</td>
<td>294.7</td>
<td>42.00</td>
<td>10.67</td>
<td>1.167</td>
<td>2.200</td>
</tr>
<tr>
<td>T13</td>
<td>0.82</td>
<td>0.82</td>
<td>59.5</td>
<td>5.33</td>
<td>3.20</td>
<td>209.7</td>
<td>440.0</td>
<td>1071.0</td>
<td>442.0</td>
<td>40.67</td>
<td>16.67</td>
<td>1.867</td>
<td>1.467</td>
</tr>
<tr>
<td>T14</td>
<td>0.85</td>
<td>0.89</td>
<td>54.7</td>
<td>5.35</td>
<td>3.11</td>
<td>211.7</td>
<td>354.7</td>
<td>1008.0</td>
<td>395.0</td>
<td>40.67</td>
<td>14.67</td>
<td>1.800</td>
<td>5.367</td>
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<tr>
<td>T15</td>
<td>0.85</td>
<td>0.90</td>
<td>56.5</td>
<td>5.01</td>
<td>2.42</td>
<td>307.7</td>
<td>313.0</td>
<td>1070.0</td>
<td>379.7</td>
<td>41.67</td>
<td>7.67</td>
<td>1.667</td>
<td>1.300</td>
</tr>
<tr>
<td>T16</td>
<td>0.73</td>
<td>0.80</td>
<td>64.0</td>
<td>5.52</td>
<td>3.13</td>
<td>340.0</td>
<td>525.7</td>
<td>1451.0</td>
<td>428.7</td>
<td>42.67</td>
<td>24.67</td>
<td>1.800</td>
<td>5.000</td>
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<tr>
<td>T17</td>
<td>0.94</td>
<td>0.91</td>
<td>50.5</td>
<td>5.23</td>
<td>2.24</td>
<td>208.7</td>
<td>436.7</td>
<td>1338.0</td>
<td>456.0</td>
<td>40.67</td>
<td>11.67</td>
<td>2.700</td>
<td>2.067</td>
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<tr>
<td>T18</td>
<td>0.95</td>
<td>0.95</td>
<td>38.0</td>
<td>5.11</td>
<td>2.19</td>
<td>264.7</td>
<td>495.7</td>
<td>1239.0</td>
<td>452.7</td>
<td>40.67</td>
<td>10.00</td>
<td>2.567</td>
<td>2.100</td>
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<tr>
<td>T19</td>
<td>0.97</td>
<td>1.05</td>
<td>53.5</td>
<td>4.91</td>
<td>1.61</td>
<td>309.2</td>
<td>189.7</td>
<td>469.0</td>
<td>128.7</td>
<td>39.67</td>
<td>2.67</td>
<td>0.620</td>
<td>2.500</td>
</tr>
<tr>
<td>T20</td>
<td>1.55</td>
<td>1.55</td>
<td>23.5</td>
<td>6.27</td>
<td>0.12</td>
<td>9.900</td>
<td>100.7</td>
<td>424.7</td>
<td>72.67</td>
<td>23.00</td>
<td>1.40</td>
<td>0.590</td>
<td>0.490</td>
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<tr>
<td>T21</td>
<td>1.39</td>
<td>1.40</td>
<td>30.5</td>
<td>5.93</td>
<td>0.12</td>
<td>65.67</td>
<td>136.7</td>
<td>425.7</td>
<td>78.0</td>
<td>28.00</td>
<td>1.55</td>
<td>0.430</td>
<td>0.857</td>
</tr>
</tbody>
</table>

Table 2. Effect of different media on germination behaviour of nutmeg seeds.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Days taken for germination initiation</th>
<th>Germination (%)</th>
<th>Rate of germination</th>
<th>Earliness index</th>
<th>Germination index</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>49.33</td>
<td>40.13</td>
<td>0.017</td>
<td>0.811</td>
<td>0.673</td>
</tr>
<tr>
<td>T2</td>
<td>47.81</td>
<td>40.28</td>
<td>0.015</td>
<td>0.789</td>
<td>0.935</td>
</tr>
<tr>
<td>T3</td>
<td>48.60</td>
<td>40.26</td>
<td>0.017</td>
<td>0.836</td>
<td>0.912</td>
</tr>
<tr>
<td>T4</td>
<td>56.75</td>
<td>40.16</td>
<td>0.020</td>
<td>0.844</td>
<td>0.485</td>
</tr>
<tr>
<td>T5</td>
<td>55.16</td>
<td>46.67</td>
<td>0.020</td>
<td>0.719</td>
<td>0.512</td>
</tr>
<tr>
<td>T6</td>
<td>56.62</td>
<td>40.37</td>
<td>0.020</td>
<td>0.844</td>
<td>0.682</td>
</tr>
</tbody>
</table>
Table 2. Effect of different media on seedling growth characters and biomass of nutmeg.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Seedling height (cm)</th>
<th>Seedling girth (cm)</th>
<th>No of leaves</th>
<th>Shoot length (cm)</th>
<th>Root length (cm)</th>
<th>Shoot fresh wt (g)</th>
<th>Shoot dry wt (g)</th>
<th>Root fresh wt (g)</th>
<th>Root dry wt (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>24.42</td>
<td>0.52</td>
<td>14.72</td>
<td>25.13</td>
<td>14.68</td>
<td>16.02</td>
<td>7.12</td>
<td>11.07</td>
<td>2.55</td>
</tr>
<tr>
<td>T2</td>
<td>24.38</td>
<td>0.51</td>
<td>13.67</td>
<td>24.98</td>
<td>14.04</td>
<td>15.68</td>
<td>6.49</td>
<td>10.29</td>
<td>2.29</td>
</tr>
<tr>
<td>T3</td>
<td>20.80</td>
<td>0.49</td>
<td>11.22</td>
<td>21.62</td>
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<td>14.45</td>
<td>6.13</td>
<td>8.73</td>
<td>1.26</td>
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<tr>
<td>T4</td>
<td>15.61</td>
<td>0.44</td>
<td>9.89</td>
<td>16.76</td>
<td>10.64</td>
<td>13.14</td>
<td>5.97</td>
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<tr>
<td>T5</td>
<td>15.29</td>
<td>0.48</td>
<td>8.83</td>
<td>16.14</td>
<td>9.51</td>
<td>12.38</td>
<td>5.81</td>
<td>7.15</td>
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<tr>
<td>T6</td>
<td>15.05</td>
<td>0.40</td>
<td>9.75</td>
<td>16.08</td>
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<td>10.72</td>
<td>5.50</td>
<td>5.77</td>
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<td>22.21</td>
<td>0.48</td>
<td>12.58</td>
<td>24.01</td>
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<td>14.82</td>
<td>6.58</td>
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<td>1.58</td>
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<tr>
<td>T8</td>
<td>18.30</td>
<td>0.50</td>
<td>14.39</td>
<td>19.65</td>
<td>10.97</td>
<td>12.62</td>
<td>5.97</td>
<td>7.27</td>
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<td>T9</td>
<td>19.54</td>
<td>0.47</td>
<td>13.08</td>
<td>20.95</td>
<td>11.03</td>
<td>13.34</td>
<td>6.13</td>
<td>8.06</td>
<td>1.13</td>
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<td>21.22</td>
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* Treatment details are as mentioned in text.
Figure 1. Vigour index on growth (VI I) and weight (VI II) basis of nutmeg seedlings under different media combinations.

REFERENCES


