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Full Length Research Paper

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

K. Abirami*, J. Rema, P. A. Mathew, V. Srinivasan and S. Hamza

Indian Institute of Spices Research, Calicut-673012, Kerala, India.

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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,

*Corresponding author. E mail: abirami78@gmail.com.

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 T_1-Soil: Sand: FYM 3:1:1, T_2-Soil: Sand: FYM 2:1:1 (control), T_3-Soil: Sand: FYM 1:1:1, T_4-Soil: granite: FYM 3:1:1, T_5-Soil: granite: FYM 2:1:1, T_6-Soil: granite: FYM 1:1:1, T_7-Soil: Sand: vermicompost 3:1:1, T_8-Soil: Sand: vermicompost 2:1:1, T_9-Soil: Sand: vermicompost 1:1:1, T_{10}-Soil: granite: vermicompost 3:1:1, T_{11}-Soil: granite: vermicompost 2:1:1, T_{12}-Soil: granite: vermicompost 1:1:1, T_{13}-Soil: coir dust: Sand: FYM 1:1:1:1, T_{14}-Soil: coir dust: granite: FYM 1:1:1:1, T_{15}-Soil: coir dust: granite: vermicompost 1:1:1:1, T_{16}-Soil: coir dust: sand: vermicompost 1:1:1:1, T_{17}-Coir dust :granite: FYM 2:1:1, T_{18}-Coir dust :Sand: FYM 2:1:1, T_{19}-Soil alone, T_{20}-granite alone, T_{21}-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 T_{16} (42.10 days) which was on par with T_{13} (44.32 days) (Table 2). The germination percentage was highest in T_{16} (86.67%) which was on par with T_{13} (80.32%) and T_{15} (80.24%) and significantly different from all other treatments. The earliness index (0.96) and germination index (1.53) were highest in T_{16} which was at par with T_{13} (0.923 and 1.326 respectively). However, the rate of germination was high in T_{13} (0.022) which was at par with T_{16} (0.021) and significantly different from all other treatments.

Significant differences were observed among the different treatments with regard to seedling growth characters and maximum seedling height was observed in T_{16} (29.84 cm) which was on par with T_{15} (28.79 cm) (Table 3). Maximum seedling girth was observed in T_{16} (0.63 cm) which was on par with T_{13} (0.60 cm) and T_{15} (0.57 cm). Similarly number of leaves and root length were higher in T_{16} (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 T_{16} (30.15 cm) followed by T_{15} (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 T_{16} which was significantly different from all other treatments.

DISCUSSION

The treatment T_{16} was found to be best followed by T_{13} 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 Daverede, 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 T_{16}. Combined application of vermicompost and coir dust in the treatment T_{16} 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 T_{16} (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.

Treatments	Bulk density (g/cc)	Particle density (g/cc)	Water holding capacity (%)	pH	Organic carbon (%)	P (mg/kg)	K (mg/kg)	Ca (mg/kg)	Mg (mg/kg)	Fe (mg/kg)	Mn (mg/kg)	Zn (mg/kg)	Cu (mg/kg)
T1	0.97	1.05	51.0	5.38	1.37	52.5	350.0	757.7	298.7	39.67	18.67	1.467	4.067
T_2	1.01	0.98	52.0	5.58	0.88	65.5	353.7	694.7	298.0	39.00	11.67	1.367	2.724
T_3	1.02	1.09	51.5	5.95	1.30	153.0	374.0	1013.0	387.7	38.67	13.67	1.567	4.100
T_4	1.01	1.04	52.5	5.26	1.31	63.0	284.7	789.0	320.0	40.67	15.67	1.667	6.033
T_5	1.09	1.08	50.0	5.30	1.55	182.0	295.0	953.7	335.7	41.67	11.67	2.967	3.900
T_6	1.17	1.20	53.5	6.12	1.55	260.5	441.7	1148.0	393.7	40.67	23.67	2.800	2.467
T_7	0.93	0.99	53.0	5.23	1.21	150.7	326.7	748.7	299.0	41.67	14.67	2.167	3.067
T_8	0.99	1.05	52.5	5.39	1.39	188.7	319.0	833.0	308.7	42.00	19.67	2.967	4.100
T_9	1.01	1.04	54.0	5.49	1.31	271.0	329.0	955.0	338.0	40.67	10.67	4.367	4.300
T_{10}	1.00	1.01	53.5	5.23	1.33	106.7	312.7	808.0	301.7	41.67	10.67	1.500	3.500
T_{11}	1.01	1.07	44.5	5.28	1.12	174.0	306.0	941.0	325.0	41.67	13.67	1.400	2.800
T_{12}	1.02	1.04	41.5	4.84	1.27	223.7	278.7	924.7	294.7	42.00	10.67	1.167	2.200
T_{13}	0.82	0.82	59.5	5.33	3.20	209.7	440.0	1071.0	442.0	40.67	16.67	1.867	1.467
T_{14}	0.85	0.89	54.7	5.35	3.11	211.7	354.7	1008.0	395.0	40.67	14.67	1.800	5.367
T_{15}	0.85	0.90	56.5	5.01	2.42	307.7	313.0	1070.0	379.7	41.67	7.67	1.667	1.300
T_{16}	0.73	0.80	64.0	5.52	3.13	340.0	525.7	1451.0	428.7	42.67	24.67	1.800	5.000
T_{17}	0.94	0.91	50.5	5.23	2.24	208.7	436.7	1338.0	456.0	40.67	11.67	2.700	2.067
T_{18}	0.95	0.95	38.0	5.11	2.19	264.7	495.7	1239.0	452.7	40.67	10.00	5.267	2.100
T_{19}	0.97	1.05	53.5	4.91	1.61	309.2	189.7	469.0	128.7	39.67	2.67	0.620	2.500
T_{20}	1.55	1.55	23.5	6.27	0.12	9.900	100.7	424.7	72.67	23.00	1.40	0.590	0.490
T_{21}	1.39	1.40	30.5	5.93	0.12	65.67	136.7	425.7	78.0	28.00	1.55	0.430	0.857

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

Treatments	Days taken for germination initiation	Germination (%)	Rate of germination	Earliness index	Germination index
T1	49.33	40.13	0.017	0.811	0.673
T_2	47.81	40.28	0.015	0.789	0.935
T_3	48.60	40.26	0.017	0.836	0.912
T_4	56.75	40.16	0.020	0.844	0.485
T_5	55.16	46.67	0.020	0.719	0.512
T_6	56.62	40.37	0.020	0.844	0.682

Table 2. Contd.

T_7	48.67	73.33	0.018	0.786	0.536
T_8	45.78	60.32	0.018	0.818	0.856
T_9	48.12	53.33	0.014	0.823	0.762
T_{10}	46.14	51.16	0.017	0.828	0.569
T_{11}	46.76	53.33	0.018	0.709	0.428
T_{12}	48.86	26.67	0.018	0.822	0.678
T_{13}	44.32	80.32	0.022	0.923	1.326
T_{14}	45.78	73.33	0.019	0.902	1.108
T_{15}	45.33	80.24	0.019	0.911	1.236
T_{16}	42.10	86.67	0.019	0.955	1.533
T_{17}	52.50	33.67	0.021	0.712	0.390
T_{18}	53.15	20.21	0.018	0.849	0.412
T_{19}	50.83	26.67	0.013	0.833	0.526
T_{20}	53.75	33.33	0.014	0.809	0.736
T_{21}	50.47	33.33	0.018	0.837	0.517
CD at 5%	2.74	2.96	0.016	0.041	0.215

* Treatment details are as mentioned in text

Table 3. Effect of different media on seedling growth characters and biomass of nutmeg.

Treatments	Seedling height (cm)	Seedling girth (cm)	No of leaves	Shoot length (cm)	Root length (cm)	Shoot fresh wt (g)	Shoot dry wt (g)	Root fresh wt (g)	Root dry wt (g)
T_1	24.42	0.52	14.72	25.13	14.68	16.02	7.12	11.07	2.55
T_2	24.38	0.51	13.67	24.98	14.04	15.68	6.49	10.29	2.29
T_3	20.80	0.49	11.22	21.62	11.14	14.45	6.13	8.73	1.26
T_4	15.61	0.44	9.89	16.76	10.64	13.14	5.97	7.67	0.98
T_5	15.29	0.48	8.83	16.14	9.51	12.38	5.81	7.15	0.89
T_6	15.05	0.40	9.75	16.08	9.29	10.72	5.50	5.77	0.82
T_7	22.21	0.48	12.58	24.01	14.32	14.82	6.58	9.58	1.58
T_8	18.30	0.50	14.39	19.65	10.97	12.62	5.97	7.27	0.92
T_9	19.54	0.47	13.08	20.95	11.03	13.34	6.13	8.06	1.13
T_{10}	21.22	0.46	13.70	22.96	11.76	13.71	6.26	8.41	1.01
T_{11}	19.80	0.40	12.14	21.10	10.73	12.14	5.35	6.89	0.88
T_{12}	14.34	0.44	10.92	15.98	8.85	12.08	4.92	6.69	0.82
T_{13}	25.36	0.60	20.36	26.98	17.91	17.36	8.63	12.41	3.91
T_{14}	25.12	0.55	17.89	26.13	14.73	16.24	7.96	11.29	2.79
T_{15}	28.79	0.57	20.11	29.86	15.86	17.06	8.15	11.34	2.86
T_{16}	29.84	0.63	21.14	30.15	18.14	17.70	8.72	12.73	4.23
T_{17}	14.78	0.32	9.33	15.98	8.81	10.43	2.81	5.46	0.79
T_{18}	14.16	0.33	9.72	16.09	9.13	11.86	3.19	6.54	0.87
T_{19}	21.28	0.41	11.39	22.43	11.56	13.02	5.44	7.42	0.96
T_{20}	20.83	0.54	15.75	21.68	11.07	15.23	6.22	9.86	1.86
T_{21}	14.83	0.43	6.42	15.78	8.85	11.78	3.13	6.48	0.83
CD at 5%	2.30	0.08	1.37	2.90	1.36	2.23	0.31	0.50	0.28

* Treatment details are as mentioned in text.

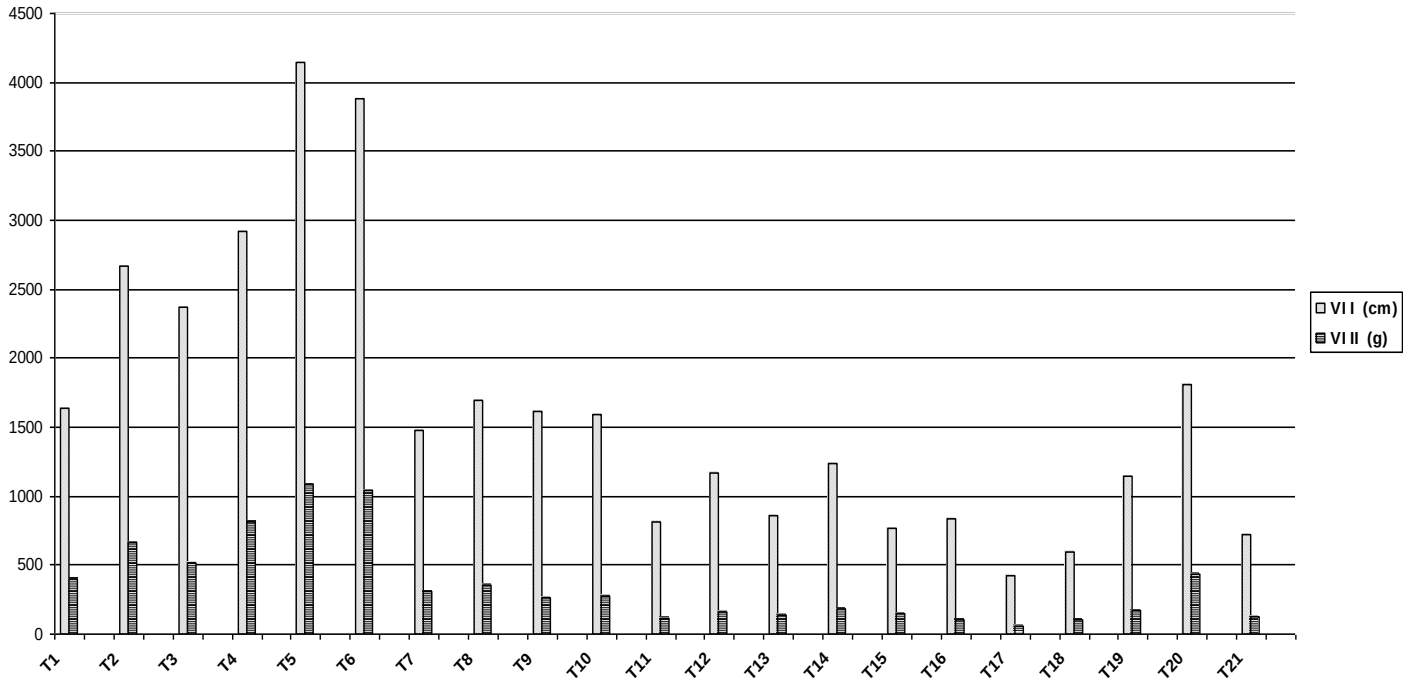

Figure 1. Vigour index on growth (VI 1) and weight (VI II) basis of nutmeg seedlings under different media combinations.

vermicompost.

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