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Seed and seedling attributes of *Melocanna baccifera* and *Ochlandra travancorica*

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Abstract: *Melocanna baccifera* and *Ochlandra travancorica* are thin-walled bamboo species found in North-Eastern India and Southern India, respectively. Both are commercially important as raw material for traditional and modern industries. Flowering and seeding of *M. baccifera* and *O. travancorica* occurred at the same time at their natural habitats during 2004. Seed and seedling attributes of both the species were recorded for a period of 180 days. In *M. baccifera* seeds were on an average seven times larger than that of *O. travancorica*. Growth and biomass accumulation of *M. baccifera* was higher than that of *O. travancorica*. Both the species contained high moisture at seedling stage. There was no significant difference in the relative growth rate (RGR) of the two species, while net assimilation rate (NAR) was different and *M. baccifera* had higher NAR.

Key words: *Melocanna baccifera*, *Ochlandra travancorica*, seed, seedling attributes, biomass.

INTRODUCTION

Melocanna baccifera (Roxb.) Kurz. known as Muli or Berry bamboo is a thin-walled species, naturally growing in hilly areas in Bangladesh, Myanmar and India and cultivated in Nepal and Bhutan. In India, it occurs in North-Eastern region (Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Sikkim, Tripura) and West Bengal. It has been introduced in many Botanical gardens all over the world (Biswas *et al.*, 1991; Tewari, 1992; Seethalakshmi and Kumar, 1998). *Ochlandra travancorica* Benth. commonly known as reed bamboo, is also a thin-walled species, endemic to the Western Ghats. It occurs widely as an under growth in low level evergreen and semi-evergreen forests in Southern Kerala. Both the species are used for roofing, basketry, mat weaving, musical instruments like flute, and in pulp and paper industry. Young shoots and the tender inner part of the seeds of *M. baccifera* are edible and leaves are used for preparing liquor (Rao *et al.*, 1998). Bamboo ply is manufactured from the mats of *M. baccifera* and *O. travancorica*. Both the species are of high demand and hence included under the priority species selected at national level in India for establishment of large-scale

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plantations. To evaluate the growth performances, a nursery was established in Kerala and seed and seedling attributes were studied.

MATERIALS AND METHODS

Seed source and attributes

Seeds of *M. baccifera* were collected from Tripura through Centre for Indian Bamboo and Rattan Technology (CIBART) and air lifted to Cochin during May 2004. Seeds of *O. travancorica* were collected from Neriamangalam, Kerala during the same period. The collected seeds were cleaned and mixed thoroughly to improve the homogeneity of the samples. Hundred seed weight and the moisture content (on fresh weight basis) of the seeds were determined for each species. From each seed lot, 25 seeds were collected at random to determine the individual seed characters like seed weight, width, length and total seed length.

Seedling production and seedling attributes

The seeds were germinated in the standard nursery beds at the Kerala Forest Research Institute Field Research Centre, Veluppadam, Kerala. The germinated ones were transplanted to polythene bags (18 x 22 cm of gauge 250 mm) filled with forest soil. The seedlings were maintained in the nursery for six months and irrigated daily except on rainy days. At the end of 60, 120 and 180 days after poly-potting, 25 seedlings were randomly collected to record the seedling characters.

The height of the seedling was measured from the tip of growing point to collar region. The number of tillers and leaves of the seedlings was counted. The leaves were detached from the plants and its area was recorded using a leaf area meter (Model LI 3100 LI-Cor, Nebraska, USA). The moisture content of the seedlings was determined by oven dry method and was expressed as a percentage of dry weight. The leaves, shoots, roots and rhizomes were separately dried in hot air oven maintained at 75°C ± 2°C to a constant weight and the dry weight was determined using an electronic balance. From this, the total dry weight was calculated.

Specific leaf area of the seedlings was calculated by dividing total leaf area by leaf dry weight per plant and the average value was expressed in cm^2/g. Root: shoot ratio of the seedlings was calculated by dividing the average value of root weight by shoot weight of each plant (Hunt, 1990).

Relative growth rate and net assimilation rate

Relative growth rate (RGR) was calculated from the formula given below (Hunt, 1990).

$$RGR = \frac{Log_e W_2 - Log_e W_1}{t_2 - t_1}$$

W_1 = dry weight estimate at time t_1
W_2 = dry weight estimate at time t_2 and it was expressed in g g^{-1} $month^{-1}$

Net assimilation rate (NAR) is an index of the productive efficiency of plant calculated in relation to the total leaf area. NAR was calculated from the formula given below (Hunt 1990):

$$NAR = \frac{(W_2 - W_1)(\log_e LA_2 - \log_e LA_1)}{(LA_2 - LA_1)(t_2 - t_1)}$$

where, W_2 = dry weight at time t_2
W_1 = dry weight at time t_1
LA_2 = leaf area at time t_2
LA_1 = leaf area at time t_1 and it was expressed in g cm^{-2} $month^{-1}$

Statistical analysis

Data collected for each variable were analyzed for comparing between species and between growth stages. Univariate repeated ANOVA was used for analyzing each variable. Least significant difference (LSD) was used for pair-wise comparison whenever necessary. Transformations were done wherever necessary.

RESULTS AND DISCUSSION

Seed attributes

The seeds of *M. baccifera* were large and green in colour. Seeds of *O. travancorica* were also green in colour but smaller in size compared to *M. baccifera* seeds (Fig 1.). The apex of the seeds of both the species was terminating in a curved beak. The beak length of *O. travancorica* seeds was larger, slender and more pointed compared to *M. baccifera*. Moisture contents in seeds of *M. baccifera* and *O. travancorica* were 60.79 per cent and 69.22 per cent respectively. Weight of individual seeds in seed lot of *M. baccifera* and *O. travancorica* was found to be highly variable. Significant variation was observed in seed weight, seed length, seed width and hundred seed weight between the species (Table 1).

Variation in seed weight and shape was reported during the previous collections also and to minimize the variation, grouping of the seeds as per the weight (heavy, medium and light) has been recommended (Banik, 1994).

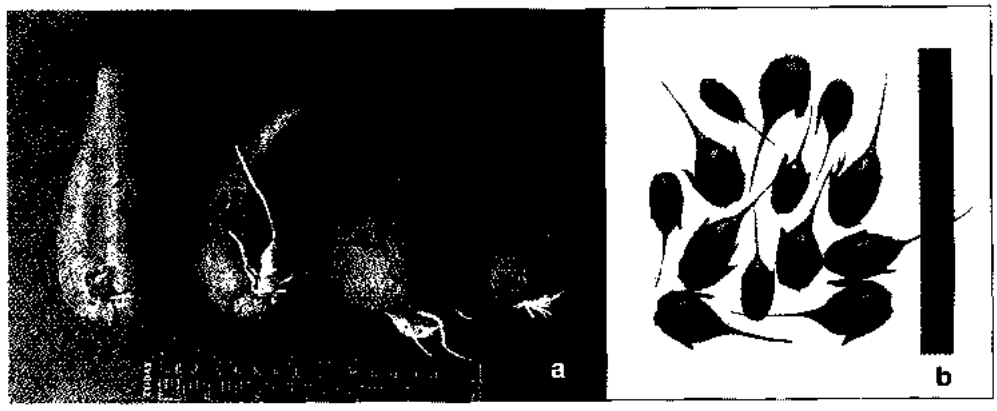


Figure 1. a: Seeds of *M. baccifera*; b: *O. travancorica*

Table 1. Seed attributes of the *M. baccifera* and *O. travancorica*

Species	Seed weight(g)**	Total length (cm)ns	Seed length(cm)	Seed width(cm)**	Moisture content (%)	100 seed weight (kg)**
M. baccifera	119.67[b]	7.10	5.69[b]	4.56[b]	60.79	11.38[b]
O. travancorica	12.61[a]	8.27	4.24[a]	1.15[a]	69.22	*1.70*[a]

** significant at 1 per cent level; ns: not significant

Seedling attributes

Seedlings of *M. baccifera* reached a height of 2.54 m within 180 days, while *O. travancorica* seedling attained only 0.81 m. Tillering capacity of both the species appeared similar reaching a mean of 2.2 in the former and 2.4 in the latter. Number of leaves and leaf area of both the species also differed considerably. *M. baccifera* had a leaf area of 407 cm^2 while *O. travancorica* had only 82 cm^2 (Table 2).

Table 2. Seedling attributes of the *M. baccifera* and *O. travancorica*

Seedling attributes	Species	Days after polypotting			Mean*
		60	120	180	
Height (m)	*M. baccifera*	1.23	2.02	2.54	1.93[B]
	O. travancorica	0.43	0.70	0.81	0.67[A]
	Mean	0.83[c]	1.36[b]	1.68[a]	
Number of tillers	*M. baccifera*	1.13	1.67	2.20	1.67
	O. travancorica	1.33	1.93	2.40	1.89
	Mean	1.23[c]	1.80[b]	2.30[a]	
Number of leaves	*M. baccifera*	7.07	11.60	18.20	12.29[B]
	O. travancorica	4.27	7.27	11.60	7.71[A]
	Mean	5.67[c]	9.43[b]	14.90[a]	
Leaf area (cm^2)	*M. baccifera*	198.13	211.76	407.66	300.47[B]
	O. travancorica	52.38	65.97	82.26	66.87[A]
	Mean	125.26[c]	138.86[b]	244.00[a]	

*Seedling attributes with same superscript do not vary significantly.

Figure 2. Seedlings of *M. baccifera*

One per cent of the seedlings of *M. baccifera* was albinos. Two types, complete white and white with green stripes were observed among albino seedlings (Fig. 2). Some of the latter turned to green within a period of one month. Occurrence of albino seedlings was less than 0.5 per cent in *O. travancorica* (Fig. 3).

Biomass accumulation and moisture content

Both the species showed prominent difference in the accumulation of biomass in roots, shoots, rhizomes and leaves. In all the parameters, *viz.*, total dry weight, shoot dry weight, leaf dry weight, root dry weight and rhizome dry weight, *M. baccifera* showed higher values than *O. travancorica* (Table 3). The ratio of dry weight of *M. baccifera* and *O. travancorica* was 7:1, 21:1, and 10:1 at 60, 120 and 180 days of observations respectively. It is important to note that the rhizome development which is a critical factor for field establishment of the seedlings after transplantation is quicker and more in *M. baccifera*. The difference between, the two species was manifested within 60 days. After 180 days, height o *M. baccifera* seedlings (2.54 m) was three times more than *O. travancorica*. Although *M. baccifera* produced multiple shoots at the time of seed germination, the number of tillers (shoots) produced at different stages of growth of both the species was almost same.

Table 3. Biomass accumulation of *M.baccifera* and *O. travancorica* seedlings

Seedling characters	Species	Days after polypotting		
		60	120	180
Total dry weight (g)**	*M. baccifera*	19.69	84.03	83.20
	O. travancorica	2.90	4.53	8.10
Shoot dry weight (g)**	*M. baccifera*	6.67	36.97	46.87
	O. travancorica	0.62	1.37	2.99
Leaf dry weight (g)**	*M. baccifera*	7.47	21.83	22.27
	O. travancorica	1.29	1.77	2.83
Root dry weight (g)**	*M. baccifera*	4.40	15.73	5.93
	O. travancorica	0.98	1.12	1.98
Rhizome dry weight (g)**	*M. baccifera*	1.15	9.50	8.13
	O. travancorica	0.02	0.25	0.31

** indicates that the interaction between species and growth stages was significant at 1 per cent level

Seedlings of both *M. baccifera* and *O. travancorica* contained high moisture. On an average, at the end of the observation period (180 days) the moisture contents of the leaves, shoot, root and rhizome of the former were 168.25, 253.61, 359.25 and 559.33 per cent respectively and 212.84, 288.27, 283.10 and 440.32 per cent respectively for the latter (Fig. 4).

Figure 3. Seedlings of *O. travancorica*

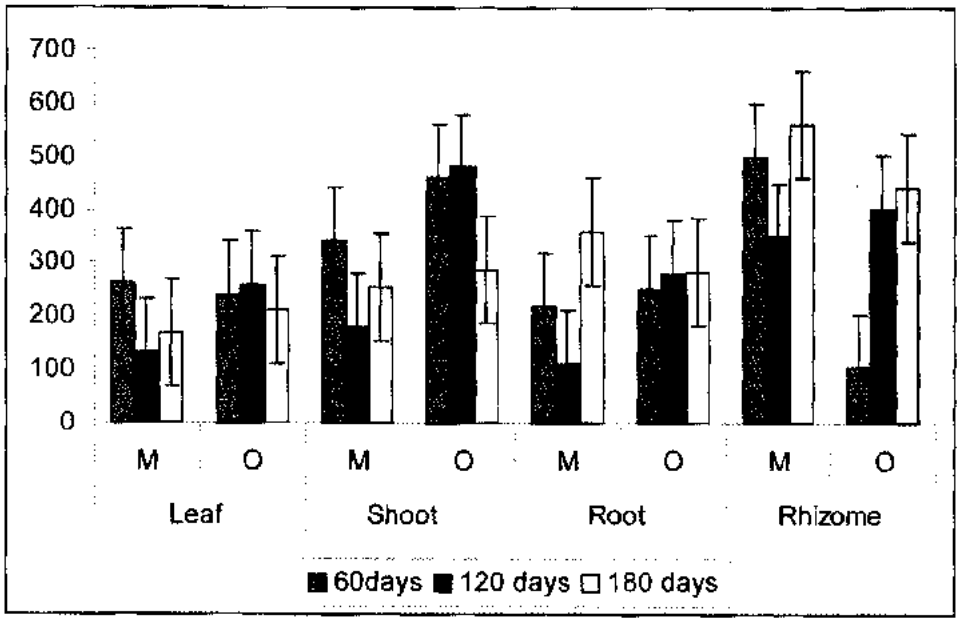
Table 4. Specific leaf area ($cm^2\ g^{-1}$) and root: shoot ratio of *M.baccifera* and *O. travancorica* seedlings

Seedling attributes	Specie	Days after polypotting			Mean
		60	120	180	
Specific leaf area **	*M. baccifera*	27.88	10.13	21.88	
	O. travancorica	41.74	39.97	29.00	
	Mean				
Root: shoot ratio	*M. baccifera*	1.28	1.20	1.54	1.37[A]
	O. travancorica	1.77	1.72	1.81	1.77[B]
	Mean	1.59	1.45	1.68	

** Significant at 1 per cent level.

Specific leaf area and root : shoot ratio

The specific leaf area (the leaf area per unit leaf dry weight) was higher in seedlings of *O. travancorica* than that of *M. baccifera* at all three stages of observations. The variation became less prominent at 180 days (27.88 and 41.74 at 60 days and 21.88 and 29.00 at 180 days). The interaction between species and duration was significant for specific leaf area (Table 4). But significant interaction effect was absent in root: shoot ratio and it varied significantly between the species. Estimation of specific leaf area which is an important parameter in crop growth models, both for calculating leaf photosynthesis and for estimating leaf area development (Boote *et al.*, 1996) was also taken into consideration for both the species. Its value often varies with developmental stages in many crops (Grashoff and d'Antuono, 1997). The same effect was found in these two species also.



Relative growth rate and net assinilation rate

The RGR value of *M. baccifera* for the entire study period was 0.327 g g^{-1} $month^{-1}$ and that of *O. travancorica* was 0.252 g g^{-1} $month^{-1}$, which does not differ significantly. However, NAR differed significantly at one per cent level. NAR of *M. baccifera* was 0.751 g cm^{-2} $month^{-1}$ and that of *O. travancorica* was 0.313 g cm^{-2} $month^{-1}$.

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