EFFECTS OF POTTING MEDIA AND SIZE OF ROOT TRAINERS ON THE GROWTH OF *SHOREA LEPROSULA* SEEDLINGS

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AMINAH, H., AB RASIP, A. G., MOHD ZAKI, A., ABDUL KHALIM, A. S., KASSIM, E. & YUSOF, Y. 2004. Effects of potting media and size of root trainers on the growth of *Shorea leprosula* seedlings. A factorial experiment, consisting of six potting media and two sizes of root trainers, was carried out in the nursery of the Forest Department, District of Lentang, Pahang. Potting media used were 100% coconut husk, peat gro and decomposed oil palm mesocarp fibre. Another three media were prepared, consisting each of the above medium mixed with rice hulls in the ratio of 3:1. These media were filled into two sizes of root trainers (500 and 700 cm^3) and were tested with *Shorea leprosula* seedlings. Measurements taken at six months after potting showed that increments in height and diameter as well as root and shoot dry weights of *S. leprosula* were significantly better in plants raised in medium containing 100% oil palm mesocarp fibre compared with the other media tested. In this medium, height and diameter increments, and root and shoot dry weights were 50.8 cm, 3.8 mm, 1.5 g and 6.8 g respectively. No differences were observed in these parameters when two sizes of root trainers were used. More than 90% survival was obtained in all the media used. The results indicated that decomposed oil palm mesocarp fibre has the potential to be used as a lightweight potting medium for forest seedlings. Being a waste product from oil palm mills, it is easily obtainable and cheap. As a lightweight medium, it will greatly facilitate transportation of seedlings to the planting sites.

Key words: Oil palm mesocarp fibre – lightweight medium – containerised seedlings

AMINAH, H., AB RASIP, A. G., MOHD ZAKI, A., ABDUL KHALIM, A. S., KASSIM, E. & YUSOF, Y. 2004. Kesan medium pasu dan saiz tabung pembentuk akar terhadap pertumbuhan anak benih *Shorea leprosula*. Satu kajian faktorial merangkumi enam media tabung dan dua jenis saiz tabung pembentuk akar telah dijalankan di tapak semaian Jabatan Perhutanan Lentang Pahang. Media tabung yang digunakan ialah 100% sabut kelapa, peat gro dan kompos sabut mesokarpa kelapa sawit. Tiga medium lagi yang disediakan terdiri daripada setiap media di atas bercampur sekam padi dalam nisbah 3:1. Medium yang telah disediakan ini dimasukkan ke dalam dua saiz tabung pembentuk akar (500 cm^3 dan 700 cm^3) dan diuji ke atas anak benih *Shorea leprosula*. Ukuran yang dilakukan selepas enam bulan ditabung menunjukkan

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perbezaan yang bererti dari segi peningkatan ketinggian dan diameter serta berat kering akar dan daun bagi *S. leprosula* yang ditabung dalam 100% kompos sabut mesokarpa kelapa sawit berbanding medium lain. Apabila menggunakan medium ini, peningkatan ketinggian dan diameter serta berat kering akar dan daun ialah masing-masing 50.8 cm dan 3.8 mm, 1.5 g dan 6.8 g. Tidak terdapat perbezaan antara saiz tabung pembentuk akar dalam semua parameter yang diukur. Kemandirian anak benih melebihi 90% dalam semua medium yang digunakan. Keputusan kajian ini menunjukkan bahawa kompos mesokarpa kelapa sawit mempunyai potensi yang tinggi untuk digunakan sebagai medium tabung yang ringan untuk pengeluaran anak benih hutan. Bahan ini senang didapati dan murah kerana ia merupakan bahan buangan kilang kelapa sawit. Medium tabung yang ringan juga akan membantu dari segi pengangkutan anak benih ke lapangan.

Introduction

Like most tropical countries in the world, Malaysia is also facing the problems of forest depletion. In order to decrease the rate of depletion of wood-based resources from the natural forest, the government of Malaysia has taken measures to reduce logging activities and to encourage regeneration of logged-over forests. In addition, planting of indigenous and fast-growing exotic species in forest plantations has been carried out. Among these, dipterocarps have received tremendous interest as suitable species for reforestation (Appanah & Weinland 1993, Salleh & Appanah 1994, Smits 1994).

Most of the nursery operations in this country are familiar with the system of producing planting stock in polybags, using soil as the main ingredient for potting mixture. In the nursery at the Forest Research Institute Malaysia (FRIM), seedlings or rooted cuttings are normally potted in a mixture of sand, soil and rice hulls. This medium is lighter than soil and sand; however, it is still heavy compared with soilless media. Lighter media make transportation of seedlings to the field easier, especially to sites that are difficult to access. Besides, it is now difficult to obtain good quality topsoil for seedling production. In addition, the soil and sand mixture commonly used do not produce good fibrous root systems. Heavy and poorly drained soil media inhibit aeration, drainage and root growth.

Reports from various literature have shown that seedlings grown in polybags produce plants with spiral roots resulting in root strangling, slow growth, poor drought tolerance and lack of wind tolerance after field planting (Wilson 1986, Sharma 1987). Following this, many nurseries in the tropics are now using root trainers instead of polybags (Josiah & Jones 1992). Root trainers are containers usually made of high density polypropylene or polyethylene. There are vertical ribs inside them which direct roots downwards through draining holes to be air pruned, thus avoiding spiraling of roots. There are several types of root trainers, namely, individual tube, book or sleeve container and block container. This experiment was aimed at finding better and lighter potting medium and alternative containers for raising potted planting stock of *Shorea leprosula*, one of the dipterocarp species commonly used for reforestation programmes.

Materials and methods

A factorial experiment consisting of six potting media and two sizes of root trainers was carried out at the nursery of the Forest Department, District of Lentang, Pahang, Peninsular Malaysia. Three of the potting media used were 100% non-composted coconut husk, peat gro (a commercially processed tropical peat), and compost of oil palm mesocarp fibre. The other three media consisted of each of the above media mixed with uncomposted rice hulls at a ratio of 3:1. The oil palm mesocarp fibre was obtained from the local mills and it was left to naturally decompose for six months. The coconut husk was purchased from a commercial plant nursery while peat gro was obtained from Zigas Malaysia Sdn. Bhd. Rice hulls were obtained from local rice mills. The sizes of the root trainers used were 500 and 700 cm^3.

These media were analysed at FRIM for nitrogen (N), carbon (C), available phosphorus (P), potassium (K) and pH. N was extracted using Kjedahl method, available P by Bray and Kurtz No. 2 and K by nitric acid digestion. These elements were then determined colorimetrically using Technicon autoanalyser. Details of the method are described in Wan Rashidah *et al.* (1990). C was analysed by Walkley and Black method (Nelson & Sommers 1982) while pH was measured in water-based solution at a ratio of 1:2.5 (water:sample).

The prepared media were filled into the root trainers. Germinated seedlings of *S. leprosula* from open-pollinated seeds were transplanted into these media. These potted seedlings were then arranged on transplanting beds in four blocks in a randomised complete block design. Each treatment combination consisted of 48 seedlings. Throughout the experiment, the transplanting bed was shaded with black plastic nettings with 50% light intensity. Watering was conducted at field capacity twice a day. Commercially prepared NPK fertiliser ($12N:12P_2O_5:17K_2O:2MgO$ + trace elements) was applied monthly at a rate of 1.0 g $plant^{-1}$, starting one month after potting. Weeding and pesticide applications were performed when necessary.

Initial height and diameter of the seedlings for each treatment were measured one day after the seedlings were potted. The averages for initial height and diameter of seedlings were 15.0 cm and 1.5 mm respectively. The height of seedlings was then measured monthly, but subsequent diameter measurements were made starting from the third month because the diameter growth of seedlings was slow during the initial months. The height was measured from the ground level to the tip of the highest shoot, while diameter was measured at soil level using digimatic callipers (Model CD-6, Mitotoyo Corporation, Japan). The experiment was terminated six months after potting since all the plants were more than 30 cm tall (the recommended height for field planting). After harvesting, shoots and roots from all treatments were separated after which the roots were cleaned from the potting medium. Following this, the shoots and roots were dried at 50 °C in an oven (ULM 500 Memmert, Germany) until constant weight was obtained. Data collected were subjected to analysis of variance using Statistical Analysis System version 6.04 from SAS Institute Incorporation, Cary, North Carolina, USA. This was followed by contrast analysis to determine the significance of the different treatments (Steel & Torrie 1960). The results of the analysis were

considered significant when probability level was equal to or less than 5% ($p \leq 0.05$).

Results and discussion

Chemical properties of the potting media used in this study are given in Table 1. Measurements taken at six months showed that increments in height and diameter as well as root and shoot dry weights of *S. leprosula* were significantly higher in plants raised in media containing oil palm mesocarp fibre, either totally or in a mixture, compared with the other media tested (Table 2). Height and diameter increments, root and shoot dry weights were 50.8 cm and 3.8 mm, 1.5 g and 6.8 g respectively in 100% oil palm mesocarp fibre. This is probably due to the lower carbon nitrogen ratio (C/N) of mesocarp fibre compared with the other media used (Table 1). Generally, plants grown in other potting media performed poorly; plants grown in coconut husks and rice hulls showed the lowest growth (Table 2). Monthly readings for the rate of growth of *S. leprosula* seedlings did not show any differences between the various potting media. No differences were also observed in the height and diameter increments of plants grown in the two sizes of root trainers (results not shown). High survival rates, i.e. more than 90% were obtained in all media.

Results of this study suggest that decomposed oil palm mesocarp fibre can be a potential lightweight potting media for forest seedlings. It is easily obtainable and cheap as it is one of the wastes in oil palm mills (Anonymous 1999). Earlier results also indicated that height and diameter growth of *S. leprosula* seedlings

Table 1 Chemical properties of the potting media

Potting media	Nitrogen (N) (%)	Carbon (C) (%)	Available phosphorus (ppm)	Potassium (%)	pH	C:N ratio
100% oil palm mesocarp fibre	0.56	17.1	144.0	0.07	5.01	30.5
Oil palm mesocarp fibre:rice hulls (3:1)	0.48	21.4	181.0	0.08	5.09	44.6
100% peat gro	0.64	34.0	10.0	0.02	4.82	53.1
Peat gro:rice hulls (3:1)	0.33	33.6	19.4	0.05	4.72	101.8
100% coconut husk	0.19	28.8	27.4	0.71	5.91	151.6
Coconut husk:rice hulls (3:1)	0.14	26.1	107.0	0.30	6.09	186.4

Table 2 Height and diameter increments, dry weights of root and shoot of *Shorea leprosula* seedlings grown in different potting media six months after potting (n = 48 per treatment combination)

Potting media	Height increment (cm)	Diameter increment (mm)	Dry weight of roots (g)	Dry weight of shoots (g)
100% oil palm mesocarp fibre	50.8 a	3.8 a	1.50 a	6.8 a
Oil palm mesocarp fibre:rice hulls (3:1)	48.0 a	3.6 a	1.29 b	5.4 b
100% peat gro	29.8 b	2.8 b	0.64 c	3.2 c
Peat gro:rice hulls (3:1)	31.9 b	2.6 c	0.55 c	3.0 c
100% coconut husk	17.7 c	2.0 d	0.53 c	1.6 d
Coconut husk:rice hulls (3:1)	10.9 d	1.3 e	0.35 d	1.0 d

Means followed by the same letter are not significantly different at $p \leq 0.05$.

raised in soilless medium were 40% better than seedlings grown in soil or sand medium (Aminah & Ngaijah 2001). Other studies on *S. selanica* and *S. leprosula* showed significant increases in height, stem diameter and total dry weight when organic material of composted sawdust was used as part of the potting medium (Heriyanto & Masano 1997). Many central nurseries in Indonesia use several types of potting material such as peat, bagasse, cassava waste, pine barks and their mixtures (Valli 1996).

Poor performance of plants grown in potting media containing coconut husk in this experiment may be due to the use of uncomposted coconut husk. For other plant species, such as *Dalbergia cochinchinensis*, it has been shown that the use of uncomposted coconut husk resulted in high seedling mortality (Radjagukguk 1983). This could be due to the high C/N ratio and high content of tannin in uncomposted coconut husk. Composting of coconut husk will lower the C/N ratio and tannin contents; thus seedlings grown in this media are healthier (Miller & Jones 1995). In Thailand, successful results have been obtained using decomposed coconut husks as growing medium for forest seedlings (Kijkar 1991).

Oil palm mesocarp fibre is a lightweight medium and, therefore, will greatly facilitate transportation of seedlings to planting sites. Other advantages in using soilless medium for raising seedlings include higher content of organic matter, which should form the major fraction of container media (Miller & Jones 1995). Organic matter helps resist compaction and retain water while still maintaining porosity for movement of air and root growth. With high organic matter content in potting medium, watering frequency could be reduced. Kijkar (1991) reported that when composted coconut husk is used as potting media, watering is carried out every three days during the dry season. However, another experiment showed that there were no differences in diameter and dry mass of *Dyera costulata* plants watered twice or once a day when using potting media containing high proportions of organic matter (Aminah 2002).

Conclusions

This study indicated that the size of root trainers used in nursing *S. leprosula* seedlings did not show any significant difference after six months. For this reason, smaller root trainers can be used since they require less space and medium. Of the three media tested, the decomposed oil palm mesocarp fibre produced the best result in terms of height and diameter increments as well as root and shoot dry weights. Thus, this medium can be recommended as a potential lightweight potting medium for forest species. In addition, this medium can be easily obtained and is cheap.

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