A METHOD FOR VEGETATIVE PROPAGATION OF 
DROBALANOPS LANCEOLATA (DIPTEROCARPACEAE) BY 
CUTTINGS

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Received December 1992

MOURA-COSTA, P.H. & LUNDOH, L. 1994. A method for vegetative propagation of Dryobalanops lanceolata (Dipterocarpaceae) by cuttings. Two-node cuttings were prepared from the apices of juvenile seedlings of D. lanceolata. Leaves were trimmed reducing leaf area to approximately 30 cm² and the basal end of each cutting was treated with a fungicide solution (0.1 % w/v Benlate) followed by 3 % NAA powder. Cuttings were rooted in a closed chamber mist propagator. After roots formed, cuttings were potted in 7 X 21 cm polybags and weaned for two weeks in high humidity chambers. Percentage rooting after 12 weeks was 80 %. Mortality in the weaning-off stage was around 6 %.

Key words: Vegetative propagation - cuttings - dipterocarps - Dryobalanops lanceolata

MOURA-COSTA, P.H. & LUNDOH, L. 1994. Satu kaedah bagi pembiakan tampang Dryobalanops lanceolata (Dipterocarpaceae) secara pemotongan. Keratan dua-nod disediakan dari apeks anak benih muda D. lanceolata. Daunnya diperhambat sehingga tertinggal keluasan daun yang berukuran kira-kira 30 cm². Hujung pangkal setiap keratan dirawat dengan larutan fuguised (0.1% berat/isipadu Benlate) diikuti dengan 3% serbuk NAA. Keratan-keratan ini dibiarakan berakar di dalam kebuk penyembur air yang tertutup. Setelah berakar, keratan-keratan tersebut dilekatkan di dalam beg poli berukuran 7 × 21 cm dan dibiarakan di dalam kebuk yang mempunyai kelembapan yang tinggi. Peratus akar setelah 12 minggu ialah 80%. Peratus kematian apabila keratan-keratan tersebut dikeluarkan daripada kebuk yang mempunyai kelembapan tinggi lebih kurang 6%.

Introduction

Dipterocarps are the most abundant timber trees of the Malaysian rain forests, in some areas accounting for 80% of the canopy trees (Ashton 1982). Dryobalanops lanceolata Burck (kapur, Dipterocarpaceae) is an important hardwood tree species common in the dipterocarp rain forests of Malaysia, particularly the East coast of Sabah (Meijer & Wood 1964). It reaches heights of up to 77 m, with clear boles of 38 m or more, and timber volume of 64 m³ (Burgess 1966). In some areas these trees represent up to 20% of the total timber volume extracted from the forest (Silam Forest Products Sdn. Bhd., timber extraction tables for the Ulu Segama Region, Sabah, Malaysia, 1978-1981).

To our knowledge, there is no report on vegetative propagation of *Dryobalanops lanceolata* in the literature. This paper describes a successful method for vegetative propagation of *D. lanceolata* by cuttings and the procedure for weaning-off in the nursery.

**Materials and methods**

*Origin of stockplants*

Stockplants were wild seedlings of *D. lanceolata* collected from the forest at the Ulu Segama region (Sabah, Malaysia) and potted in 7X21 cm poly-bags containing 79 cm³ forest top-soil. The age of wildings at the time of collection was approximately three months. Plants were grown in the Danum Valley Field Centre nursery for four months before cuttings were taken for these experiments.

*Preparation of cuttings*

Two-node cuttings, ca. 7 to 10 cm length, were prepared according to the method used by Smits (1983, 1986). The main stems of stockplants were cut across the third node down the apex, using pruning scissors. Leaves were trimmed, reducing the leaf area to ca. 50 cm², approximately 1/3 of the original area (Figure 1), based on the methods of Leakey et al. (1982), Smits (1983) and Aminah Hamzah (1990 c). The basal end of cuttings were dipped briefly in a fungicide solution (0.1% w/v Benlate) and treated with a commercial formulation of naphthalene acetic acid (NAA) powder (Trihormone, 3 % w/w NAA). To minimise stress, cuttings were inserted into the mist chamber immediately after they were prepared. Two batches of cuttings were prepared, containing 396 and 648 cuttings respectively, on two different occasions. Cuttings were grouped in blocks of 18 and blocks were randomly distributed around the rooting beds.

*Design of propagator and environmental conditions during the rooting phase*

Cuttings were rooted in a closed chamber mist propagator unit. Misting frequency was controlled by an electronic leaf controller connected to a control unit (MacPenny, UK). In order to increase air humidity around cuttings, beds were covered with transparent plastic supported by a wooden frame, forming a closed
chamber 60 cm high (Figure 2). The whole mist unit was covered by 30 % shade netting. Rooting medium was river sand (particle size $313 \pm 32 \mu m$) boiled for 20 min to eliminate possible pathogens. Sand was placed on a layer of gravel (1.0 to 3.0 cm diameter), in order to allow free drainage. Mist was generated from rain water, with pH 6.5. Relative humidity inside the misting chamber, measured with a hygrometer, was about 94 %. Light intensity inside the chambers was measured using a portable infra-red gas analyzer connected to a Parkinson leaf chamber (ADC LCA-3, Hoddeston, UK), giving values around $290 \mu mol m^{-2} s^{-1}$, 26 % of full direct radiation. Air temperature inside the chamber ranged from 22 to 36°C and temperature of the rooting medium from 24 to 34°C.

**Weaning of rooted cuttings**

After forming roots at least 0.5 cm long, cuttings were potted in $7 \times 21$ cm polybags containing $79 cm^3$ forest top-soil and transferred to the shade house. About ca. 2 $cm^3$ of mycorrhizal inoculum was mixed with the soil in each bag. Inoculum consisted of soil from bags containing wildings of *D.lanceolata* in which mycorrhizal associations were identified (Willie Smits, Tropenbos/Kalimantan Forestry Research Project). Plants were watered twice daily using a hose pipe. The shade house was covered by two layers of shade netting, and radiation at ground level was around $190 \mu mol m^{-2} s^{-1}$, 18 % of full direct radiation. In order to increase air humidity around plants and reduce the stress caused by potting and transfer of plants from the misting unit, beds were covered with transparent plastic
supported by a wooden frame, forming closed chambers 30 cm high (Figure 3). Plants were kept inside these closed chambers for two weeks when the plastic covers were removed. Radiation inside the chambers was 180 \( \mu \text{mol m}^{-2} \text{s}^{-1} \), 16% of full direct radiation. Minimum relative humidity inside chambers was 64% and outside 50%, at 14:00h. Photoperiod was 12 h. Air temperature inside chambers ranged between 24 and 40°C and outside between 22 and 34°C.

![Figure 2](image2.png)

**Figure 2.** Design of the closed chamber mist propagator used in Danum Valley Field Centre

![Figure 3](image3.png)

**Figure 3.** Design of the weaning-off chambers used in Danum Valley Field Centre
Assessments

Assessments of rooting were carried out after cuttings had been in the mist unit for 4, 8 and 12 weeks. Cuttings were scored as rooted if roots at least 0.5 cm long were formed. Assessments of mortality during the weaning stage were carried out four weeks after transfer of cuttings out from the mist unit. Plants were considered dead if they had shed their leaves and their stems were either dry or blackened.

Results and discussion

A high percentage of cuttings rooted after 12 weeks in the misting unit (73.09 to 88.25 % of cuttings, Table 1). It appeared that 12 weeks was the minimum time necessary for reaching a high percentage of rooting, since a much lower percentage was observed after 8 weeks. However, cuttings not rooted after 12 weeks in the mist unit were either dead or had not form root initials. It appeared more advantageous to replace them by new cuttings than to maintain them in the mist unit for a longer time. Approximately 6 % of rooted cuttings died during the weaning phase, reducing the percentage of plants recovered from cuttings to ca. 76%.

<table>
<thead>
<tr>
<th>Table 1. Percentages of rooting, mortality and recovery of plants from rooted cuttings of Dryobalanops lanceolata. Means are followed by standard errors</th>
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<tr>
<td>1st batch (396 cuttings)</td>
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<tr>
<td>Cumulative percentage of rooted cuttings after:</td>
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<td>4 weeks</td>
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<td>8 weeks</td>
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<td>12 weeks</td>
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<td>Percentage death during weaning off</td>
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<td>Percentage of plants recovered from cuttings initially prepared</td>
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<td>na = not available.</td>
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The rooting percentages of dipterocarps achieved using this method were considerably higher than results from previous reports. In work with Shorea tabura, Vatica wallichii and Anisoptera scaphula, Momose (1978) obtained an overall rooting percentage below 50%. Rooting of six dipterocarp species exposed to different types and concentrations of auxins was negligible, except for Vatica pauciflora treated with 0.2 or 0.3% w/v indole-3-butyric acid (IBA) solutions (Hallé & Hanif-
Srivastava and Penguang Manggil (1981) reported rooting percentages between 8 and 56% for Anisoptera scaphula, Shorea leprosula and Dipterocarpus chartaceus raised in different propagator beds and exposed to a range of concentrations of IBA (0 to 2000 ppm). They reported high percentages of rooting of Shorea bracteolata (91.2%) after 3 to 5 months, but the number of replicates used (between 2 and 4) was not large enough to allow substantiated conclusions.

The high percentages of rooting achieved in our study may have been due to a combination of factors, but we attribute special importance to the use of juvenile material (see review by Hackett 1985). Mature tissues of woody plants tend to have lower levels of endogenous auxins, are more differentiated (and therefore less prone to dedifferentiation), and may have thicker layers of lignin which creates a physical barrier to root development (Hartmann et al. 1990). Higher levels of rooting inhibitors may also explain lower rooting ability of mature tissues (Paton et al. 1970). It was postulated that phenols can act as auxin cofactors or synergists in root initiation (Haissig 1974), and the concentration of phenols in mature tissues of certain plants tends to be lower than their juvenile forms (Girouard 1967). The use of mature material might have been the reason for an overall low percentage of rooting achieved in the experiments described by Momose (1978), and Hallé and Hanif-Kamil (1981). All cuttings Momose prepared from mature tissues failed to root. On the other hand, high percentages of rooting were observed when juvenile material was used by Smits (1983) and Aminah Hamzah (1990a).

Other important factors contributing to the high percentages of rooting in this experiment were the design of the propagation unit and the concern for preventing water loss from cuttings. The rationale behind any strategy for vegetative propagation by cuttings is to minimize evapotranspiration rates until a root system forms. Water loss occurs when there is a negative water vapour gradient from leaves ($V_{LEAF}$) to the atmosphere ($V_{AIR}$) (Hartmann et al. 1990). It is necessary to reduce this gradient by either decreasing $V_{LEAF}$ or by increasing $V_{AIR}$. The closed chamber mist propagator used in this study addresses both these processes simultaneously. The mist causes a reduction in leaf temperature, reducing $V_{LEAF}$, while $V_{AIR}$ is much increased by using a closed chamber. Using this system, relative humidity inside the mist chamber was maintained above 90%. The low rooting percentages achieved by Srivastava and Penguang Manggil (1981) may have been due to the low relative humidity inside their propagation chambers, which ranged from 66 to 68%. Water loss was also reduced by reducing leaf area and thus potential evapotranspiration. Further studies showed that percentage rooting of D. lanceolata cuttings was significantly higher when leaf area was reduced to ca. 30 cm², compared to cuttings with intact leaves (Moura-Costa & Lundoh, in preparation). Cuttings were taken in the morning between 7:30 and 10:00, before temperatures become too high and evapotranspiration rates increase. Cuttings were inserted into the mist unit immediately after preparation, and the stockplants were located in a shade house located a few meters from the mist unit. In this way the time between excision of plant material from stockplants until insertion into the misting unit was less than 10 min, reducing the period of potential water loss. Stock
plants were healthy and well watered, not suffering from any apparent stress.

Although cuttings were treated with NAA, further studies showed that exogenous auxins did not improve rooting of juvenile cuttings of *D. lanceolata* (Moura-Costa & Lundoh, submitted).

The plant mortality observed during the weaning-off stage (6 %) may have been caused by the relatively low humidity inside the weaning-off chambers (64%), since the plastic covers were not air-tight. It may also have been due to damage to the small young roots during potting.

The method described in this paper provides an alternative to seed propagation for multiplying planting stock of *D. lanceolata* and is being tested for the propagation of other dipterocarp species. Tissue culture techniques for *in vitro* propagation of dipterocarps are also being investigated (Moura-Costa, in press). Vegetative propagation can also be used for cloning selected genotypes of dipterocarps, a subject under study in Danum Valley Field Centre (Moura-Costa, in press). We are attempting to reduce the number of operations required for the production of rooted cuttings, thus reducing costs. Associated with the use of stockplants managed for continuous production of orthotropic shoots (Leakey 1983, Leppe & Smits 1988, Kantarli 1993 a), this method may be used for the large scale production of planting stock at a low cost.

Acknowledgements

This work was possible through the support of Innoprise Corporation Sdn. Bhd., Malaysia, and The Royal Society, London. The authors are grateful to the Forestry Department of Sabah for providing the propagation facilities at DVFC, and the Danum Valley Research and Training Programme. We would also like to thank Albert Ganing for providing the stockplants for this study, Willie Smits for the mycorrhyzae identifications, Martin Barker for advice on light measurements and Ruth Nussbaum for comments on an early version of the manuscript.

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