CLONAL PROPAGATION AND GENETIC IMPROVEMENT OF DIPTEROCARPS

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ABSTRACT

A system for vegetative propagation of *Dryobalanops lanceolata* (kapur, Dipterocarpaceae) by cuttings was developed. Two- or three node cuttings were prepared from the apex of juvenile shoots from managed stockplants. In order to reduce evapotranspiration of cuttings, leaves were trimmed to *ca.* 30 cm^2, 1/3 of the original leaf area. Cuttings were rooted in a closed chamber mist propagator, using sand as the rooting medium. Eighty percent of cuttings rooted after 12 weeks in the propagator. Successful weaning-off was achieved by keeping rooted cuttings in closed chambers for two weeks after potting, before exposure to normal shade-house conditions. Adaptations of the system to allow large-scale production of cuttings have been tested. Other designs of propagators were used and results are discussed. Tissue culture techniques for in vitro propagation of dipterocarps are also being investigated.

A programme for genetic improvement of D.lanceolata was initiated, based on the selection and clonal propagation of fast growing genotypes. Large populations of seedlings were screened to identify genotypes with high degrees of apical dominance. Trials have been conducted to test the hypothesis that strong apical dominance in seedlings is correlated to fast growth of trees, as suggested by R. Leakey for work with *Triplochiton scleroxylon*. If this hypothesis is confirmed, this method would be useful for selecting superior genotypes of trees at the nursery stage. The methods used are described and preliminary results discussed.

INTRODUCTION

Dipterocarps are the most abundant timber trees of 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 m^3 (Burgess, 1966). In some areas these trees represent up to 20 % of the total timber volume extracted from the forest.

A cooperative project between Rakyat Berjaya Sdn Bhd (a subsidiary of Innoprise, Yayasan Sabah) and the Face Foundation (Forests Absorbing Carbon-dioxide Emission, Netherlands) was initiated in Danum Valley (Sabah, Malaysia) with the objective of promoting the rehabilitation of forests to absorb CO_2 from the atmosphere. The project involves large scale enrichment planting of logged forests using seedlings of dipterocarp trees.

A problem that needs to be addressed regards availability of good quality planting material. Dipterocarps exhibit erratic fruit setting, taking 1 to 10 years between seeding years (Ashton *et al.*, 1988), and their seeds have brief viability preventing long term storage (Sasaki, 1976, 1980; Boontawee & Nutivijarn, 1989; Tompsett, 1989). To our knowledge, no work has ever been done on genetic improvement of dipterocarps and substantial gains are expected by selection and cloning of superior genotypes. An example of benefits of using selection and cloning in forestry is the 3-fold increases in biomass production of *Eucalyptus* achieved in Aracruz Cellulose, Brasil (Campinhos and Ikemori, 1983).

This paper describes a successful method for vegetative propagation of *D.lanceolata* by cuttings and the work on genetic improvement of these trees being carried out at Danum Valley Field Centre (DVFC).

VEGETATIVE PROPAGATION

Stockplants used for making cuttings were young wildings (3 to 8 months old) of *Dryobalanops lanceolata* Burck collected from the forest. Two-node cuttings were prepared according to the method used by Smits (1983, 1986). The main stem of stockplants were cut across the third node down from the apex. Leaves were trimmed, reducing the leaf area to *ca.* 30 cm^2, approximately 1/3 of the original area (Figure 1), following the methods of Leakey *et al.* (1982), Smits (1983) and Hamzah (1990). The basal end of cuttings were dipped briefly in a fungicide solution (0.1 % w/v Benlate). Cuttings were rooted in a closed chamber mist propagator unit (Figure 2). After roots formed, cuttings were potted and kept in plastic covered chambers (Figure 3) in the shade house for two weeks during the acclimatization stage, before exposure to normal nursery conditions.

EXPERIMENTS WITH PROPAGATION

A series of experiments was carried out to test the influence of different factors on rooting of cuttings of *D.lanceolata*. Among these:

1) Effects of types and concentrations of auxins

Cuttings were treated with powdered formulations of either IBA, NAA or 2,4-D at either 0.2, 0.8 or 3.0 %, and compared with control treatments (powder without auxin, no powder). Assessments of rooting were carried after 12 weeks in the mist propagator. Results showed that the control treatment was the most effective in promoting rooting of cuttings (83 %), showing that application of exogenous auxins is not required in this system.

2) Effects of leaf area and number of nodes of cuttings

One-, two-, three- or four-node cuttings were prepared. Half of the cuttings had all but the uppermost leaf removed, half had their leaves trimmed to approximately 1/3 of the original area. In addition, 10 four-node cuttings were prepared keeping all their leaves intact. Results showed that cuttings with 2 or 3 nodes with trimmed leaves root better than the other combinations tested.

Other experiments are investigating the position on the seedling stem from which cuttings were taken from, use of plant material at different stages of maturity, effects of light and nitrogen fertilisation on stockplant pretreatments, and effects of carbon:nitrogen ratios of tissues.

The system described here provides an alternative method for multiplying planting stock of *Dryobalanops lanceolata*, and is being tested for the propagation of other species of dipterocarps. This system is being adapted to allow the production of cuttings on a large scale.

MICROPROPAGATION OF DIPTEROCARPS

Tissue culture techniques for in vitro propagation of dipterocarps are also being investigated in collaboration with the Forest Research Centre, Sepilok, Sandakan, Malaysia. Successful tissue culture systems enable the large scale rapid multiplication of clonal genotypes (for examples see Evans *et al.*, 1983), with enormous advantages for commercial forestry (Bonga and Durzan, 1987). The methods used for shoot multiplication of dipterocarps are those of Linington (1991). Experiments for rooting micropropagated dipterocarp plants have been carried out in DVFC, using plants from cultures provided by I.Linington (Kew Gardens, U.K.). Up to 25 % rooting has been achieved by dipping the basal end of plantlets in a powder formulation of IBA before rooting in a mist spray unit.

GENETIC IMPROVEMENT

A programme for genetic improvement of *D.lanceolata* was initiated in DVFC, based on the selection and clonal propagation of fast growing genotypes. Selection has been carried out using the "Predictive Test" devised by Ladipo, Leakey and Grace (1991 a,b) for *Triplochiton scleroxylon*. This method is based on the hypothesis that strong apical dominance in seedlings is correlated to fast growth of trees. Trials have been conducted using seedlings of *D.lanceolata* and if this hypothesis is confirmed, this method will be useful for selecting superior genotypes of trees at the nursery stage. Trees can then be clonally propagated using the methods described.

Methods

Plant material used was 7 month-old seedlings of *D.lanceolata* raised in the nursery. Seedlings of *D.lanceolata* usually have four leaves arising from the first basal stem nodes, and in the axile of each leaf there is a bud able to regenerate a new shoot (Ng, 1981). Seedlings were cut just above the four-leaf groups (decapitation), in order to break apical dominance and allow dormant buds to form shoots. The number and length of new shoots formed were measured three months after decapitation (Figure 4). A degree of apical dominance (AD) was calculated using the following formula:

$$AD = \frac{\text{Length of the longest shoot}}{\text{Length of the second longest shoot}}$$

Three hundred and fifty seedings were used for these initial experiments. Trials are being conducted in order to test if there is a correlation between AD at the seedling stage and height increment of trees grown in the field.

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Figure 1: Method used for preparation of cuttings of dipterocarps.

Figure 2. Design of the misting unit used for rooting cuttings in the research nursery at Danum Valley Field Centre.

Figure 3. Design of chambers for acclimatization of rooted chambers.

Figure 4. Method used for inducing the expression of apical dominance in seedlings of *Dryobalanops lanceolata*.