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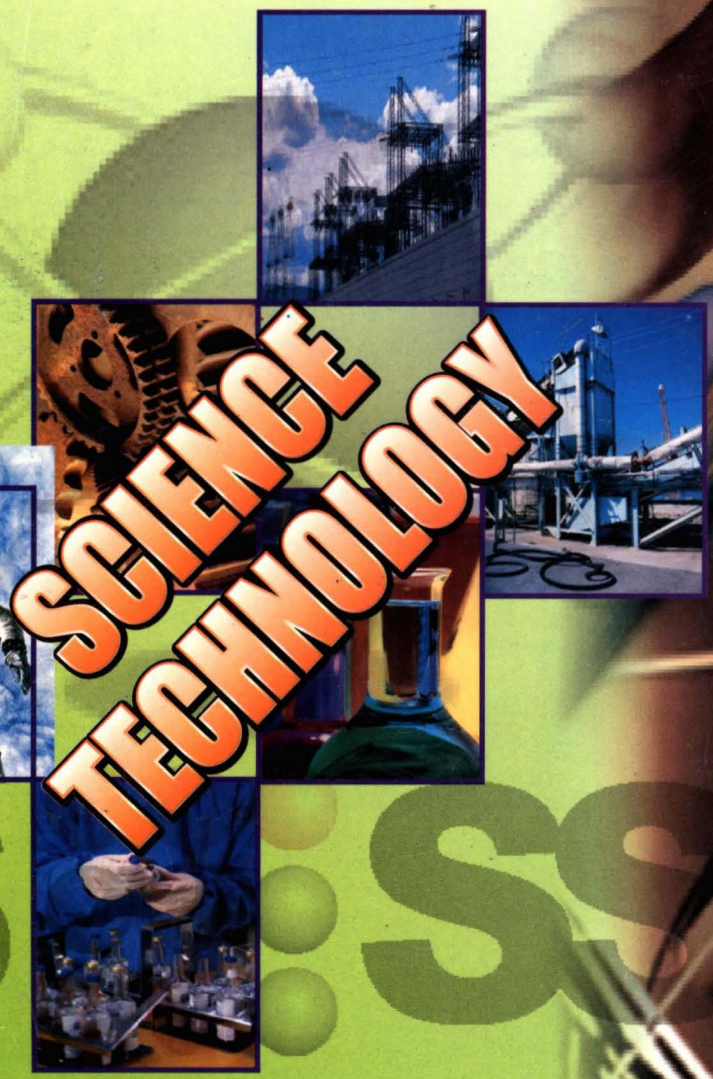

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Application of Biotechnology: Evaluation of Improved-Quality Planting Materials for Forest Plantation Species

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ABSTRACT

Improved planting materials of Dyera costulata, Endospermum malaccense and Acacia hybrid were first introduced and trial-planted by the Silviculture Unit, Forest Research Institute Malaysia in 1998. The growth using improved materials performed well in the open and has an average volume production of 37.58, 50.46 and 95.79 m^3 ha^{-1} respectively. These species is categorized as fast growing hardwood and planned for specific objectives depending on wood quality. This paper highlights the potential of each species for future large-scale plantation.

Keywords: *plantation, growth, increment , rooting.*

Introduction

It is a known fact that timber supply from the natural forest in Malaysia is dwindling and forest plantations timbers which were perceived to act as a complementary and supplementary in sustaining the timber supply are still taking the back stage. In spite the high demand for timbers worldwide and the upsurge in price over the years, yet forest plantations in Malaysia is developing at a very slow phase. The most commonly asked questions, among others are, plantation forestry might require long gestation period before harvest, inappropriate species and low quality planting materials. In dealing with these uncertainties, a long-term research project by the Silviculture Unit, Forest Research Institute Malaysia (FRIM) covering improved quality trees has being undertaken in Bukit Hari, Bukit Lagong Forest Reserve, Selangor. The study has started as early as 1998 using tissue-cultured plantlets developed by the biotechnology laboratory in FRIM. The main objectives of this study were to test the potential of the species for timber production as well as to determine an effective planting material for the establishment of the species on commercial scale. The species are jelutong (*Dyera costulata*), Sesenduk (*Endospermum malaccense*) and *Acacia hybrid* and have been identified as potential candidate for future large planting under the National Forest Plantation Programme under the 9th Malaysian Plan (2006-2010). This paper highlights the current performance of 7-year old tissue-cultured planting materials after out-planting in the field.

General description of the species

Dyera costulata is regarded as one of the promising indigenous species for light construction including pencils, toys and drafting boards. The species has been categorized as one of the selected plantation species (Ab Rasip *et al.* 2004) for future plantation programme under the National Policy on Forest Plantation. It has been found suitable for forest plantations in Peninsular Malaysia and reforestation works will cover a wide spectrum of land areas including flat, undulating and even sloping topography. It is a fast-growing indigenous timber species from the family *Apocynaceae* and can be found in all states of Peninsular Malaysia (except Perlis). It is widely distributed in lowland secondary forests, especially in logged-over forests up to 1000 m (Whitmore 1972). Wyatt-Smith (1952) ranks the tree as an intermediate between the emergent and main canopies. It can attain 40 m in height and 3 m in girth and produces good stem form for sawntimber. The timber is classified as light hardwood timber with an average density of about 435 kg m^{-3} at 15 % moisture content. To date this species has not been planted on a large scale.

Endospermum malaccense belongs to the family *Euphorbiaceae,* and commonly found throughout Malaysia, Thailand and Sumatra. It occurs in the lowlands to lower montane forest up 1000 m. An opportunist species and its occurrence are characterized by the presence of strong light mainly in areas after shifting cultivation, gaps or openings. This species has massive, spreading limbs and domed-shaped crowns. Leaf blades are rounded at the base with two prominently raised glands at the junction of the stalk to the leaf blade. The timber is classified as light hardwood timber with an average density of about 400 kg m^{-3} at 15 % moisture content. The timber is suitable for wide range of general utility timber, blockboards, toys and drawing boards.

Acacia hybrid is the natural hybridization between *Acacia mangium* Willd. and *Acacia auriculiformis* A. Cunn ex. Benth trees that differ markedly in growth and stem form. In Peninsular Malaysia, natural hybrids of *A. mangium* and *A. auriculiformis* have been detected in almost all *A. mangium* plantations. Observation in Hulu Sedili

Forest Plantation, Johore, has shown that there are about 10 % hybrid trees in each hectare of *A. mangium* plantations (Darus & Ab Rasip 1989). In Sabah, natural hybrid of *A. mangium* and *A. auriculiformis* has been observed as early as in 1971 (Rufelds 1987; Jaffirin 1988). The hybrid has shown favourable characteristics such as slender branchlets, large phyllode, cream-coloured flowers, faster rate of growth and dominant among the *A. mangium* trees (Jaffirin, 1988). The timber is classified as light hardwood timber with an average density of about 451 kg m^{-3} at 15 % moisture content (Ab Rasip et al. 2004)

Stand growth performance

The growth of *D. costulata*, *E. malaccense* and *A. hybrid* trial-planted in FRIM show outstanding performance (Table 1) and produced good stem form with an average diameter at breast height and clear bole height of 14 cm and 8 m respectively. The calculated average tree volume was 0.1253, 0.1682 and 0.3193 m^3 $tree^{-1}$ respectively. Based on 300 selected trees, the stand achieved an estimated mean annual volume production of 5.37, 7.21 and 15.96 m^3 ha^{-1} $year^{-1}$ after 6 -7 years. Normal planting using seedlings, *D. costulata* only managed to reach 14 cm diameter at breast height and total height of 10.3 m after 17 years (Azman et al. 1990). Similarly with *E. malaccenses*, sample plot measurements in FRIM show the trees reached an average diameter at breast height of 9.3 cm in 7 years (Wyatt-Smith 1963).

Table 1: Summary on the growth performance of *D. costulata*, *E. malaccense* and *A. hybrid*

Species	Age	Av. clear bole height (hc)	Av. Diameter (dg)	Av. vol. $tree^{-1}$	Est. vol ha^{-1} (V)
D. costulata	7	8.5	13.7	0.1253	37.58
E. malaccenses	7	8.8	15.6	0.1682	50.46
A. hybrid	6	8.4	22.0	0.3193	95.79

Note Volume calculation - based on 300 trees ha^{-1}
hc clear bole height (m)
dg diameter at breast height
V volume ha^{-1}

From the results, the growth of *A. hybrid* is distinctly higher as compared with *D. costulata* and *E. malaccense*. The species of *A. hybrid*, is a natural hybrization between *A. mangium* and *A. auriculiformis* is grouped as pioneer trees, having rapid growth and performed well on a wide variety of soil and habitats (Nicholson 1981). The species belongs to the family *Leguminosae* and as nitrogen fixation helped the trees to achieve faster rate of growth as compared to the indigenous with relatively slower rate of growth. Moreover, the timber from *A. hybrid* is grouped under general utility timber and more suitable for industrial wood production including woodchips and medium density fibre-board. For both indigenous species, they are categorized as quality light hardwood timber based on their uses suitable for specialty timber products as compared to *A. hybrid*. Compared to other identified timber species to be grown as plantation crops, the growth performance of these species planted using improved materials is very promising (Table 2).

Table 2: The growth performance of *Dyera costulata*, *E. malaccense* and *A. hybrid* in comparison with some timber species

Species	Age	*dg*	
D. costulata	7	13.7	
E. malaccenses	7	15.6	
A. hybrid	6	22.0	
Peronema canescens (seedling)	7	12.7	Rosdi et al. 2003
Azadirachta excelsa (seedling)	7	12.5	A. Zuhaidi et al. 2001
A. mangium	6	16.5	A. Zuhaidi 1993

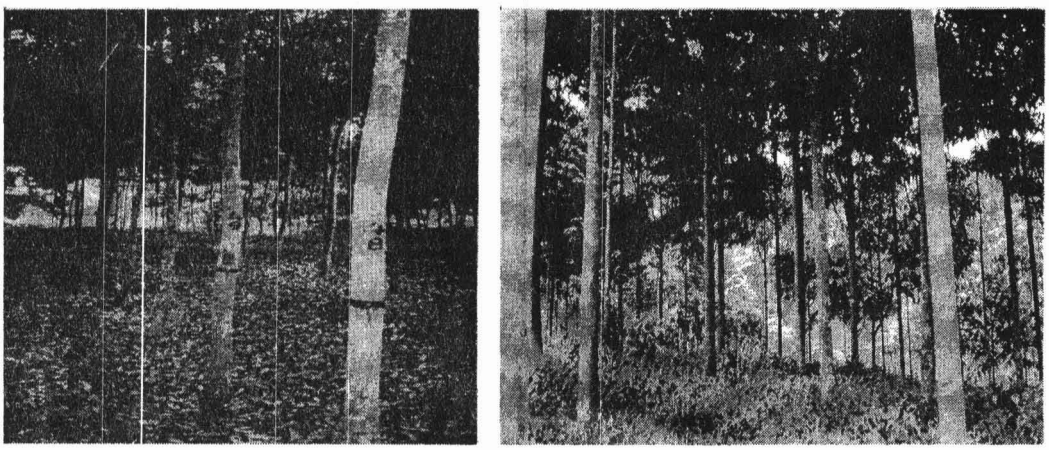

Fig. 1: An overview of planted *Endospermum malaccense, Acacia hybrid* and *Dyera costulata* using improved materials, FRIM, 2005.

In comparing the hybrid, growth results obtained from the monitoring works in Kemasul plantation, Pahang, yielded similar growth pattern. A 6-year old *A. mangium* stand had an estimated volume of 92.81 m^3 ha^{-1} with an achieved mean diameter at breast height and clear bole height of 16.5 cm and 14 m respectively (A. Zuhaidi 1993).

Pest and disease

From our observation, *D. costulata*, *E. malaccense* and *A. hybrid* trees planted in FRIM were relatively free from serious pests and diseases, except for skeletonizers attack on mature leaves of *E. malaccenses*. However, the effect was not serious and localized and generally limited during the dry spell before flushing of new leaves.

Rooting system

The investigation on the rooting pattern of tissue-cultured *D. costulata*, has shown that that the root structures are able to maintain the stability and anchorage of the trees. The extent of the lateral roots reached up to a meter in length. There was no taproot observed, however, the lateral roots or *pseudo* taproot has developed to take the function as the main root for the trees to remain erect (Figure 2).

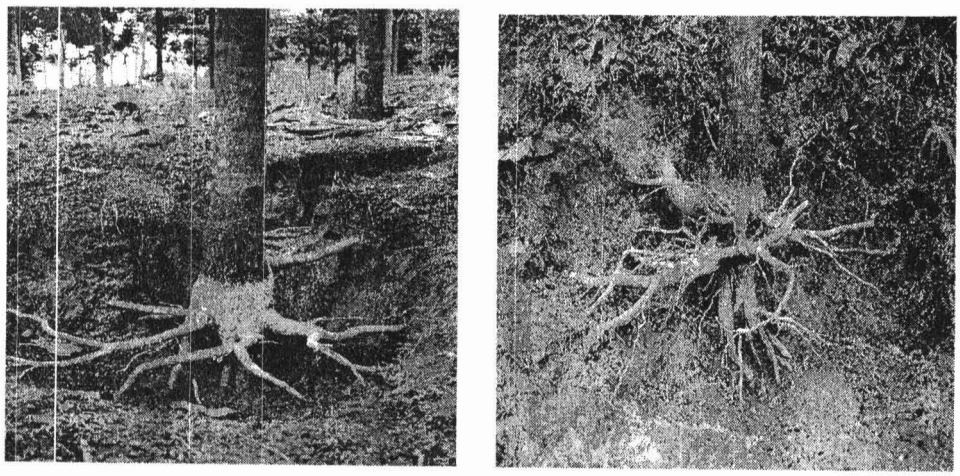

Fig. 2: 6 year old tap root system of tissue-cultured *D. costulata*, Field 44 A, Bukit Lagong Forest Reserve, FRIM.

Future programme

The government through the Ministry of Plantation Industries and Commodities has decided that *D. costulata, E. malaccenses* and *A. hybrid* be selected as the main species for future planting under the National Forest Plantation Programme, 9th Malaysian Plan (2006-2010). The selection of these species is based on its ability to produce wood fibres within 5 to 7 years and timber for furniture and specific end uses after 20-30 years. FRIM (Tree Improvement and Plantation Silviculture) Unit would be responsible in providing the research backup and improvement of the species with the production of new clones. Apart from the potential use of these species, rapid growth and relatively free from major pests and diseases, the technology to produce improved materials in vast quantity is currently being developed for future mass production.

Conclusion

The results from various studies have indicated the potential of using improved planting materials as an alternative besides the conventional method using seedlings. The overall growth on diameter and height seemed to be promising and despite having no tap root system, the trees are developing at the desired phase. The growth results obtained from the trial planting have provided us the direction on the future growth and potential yield of the species. The results may be inconclusive; as such an extended period of observation may be needed to further observe the performance of this species for future planting.

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