# SIX PHYLLODINOUS ACACIA SPECIES FOR PLANTING IN THE HUMID TROPICAL LOWLANDS

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ABSTRACT - Brief descriptions are given of the natural distribution, ecology and utilization of six acacia species with potential for planting in the lowland, humid tropics. The mean annual growth increment of *A. auriculiformis* and *A. mangium* over a short rotation on favourable sites is 15-20 $m^3$/ha and 30-40 $m^3$/ha, respectively. Four other acacia species, *A. aulacocarpa, A. crassicarpa, A. cincinnata* and *A. polystachya,* are recommended for trials on the basis of very limited field testing and/or the ecological conditions in their natural area of occurrence.

Index terms: biomass yield, legume trees, nitrogen fixation.

## SEIS ESPÉCIES DE ACÁCIA PARA REGIÕES DO TRÓPICO ÚMIDO

RESUMO - São apresentadas descrições resumidas da distribuição natural, ecologia e uso de seis espécies de acácia, com potencial para plantio em várzeas no trópico úmido. A média anual de crescimento de *A. auriculiformis* e *A. mangium,* em áreas favoráveis, foi de 15-20 $m^3$/ha e 30-40 $m^3$/ha, respectivamente. Quatro outras espécies, *A. aulacocarpa, A. crassicarpa, A. cincinnata* e *A. polystachya,* são recomendadas para ensaios, já que foram pouco testadas no campo e nas condições ecológicas de ocorrência natural.

Termos para indexação: produção de biomassa, leguminosas florestais, fixação de nitrogênio.

## INTRODUCTION

The destruction of tropical forest by over-exploitation followed by over-grazing or repeated burning amounts annually to several million hectares (Lanly 1982). In many areas the end-point of this deforestation is eroded bare soil or grasslands dominated by *Imperata cylindrica.* Much of this degraded land is below 1,000 m latitude available for reforestation provided species can be found to tolerate the inhospitable site conditions.

Traditional plantation species have frequently failed due to a combination of infertile soil, grass competition and the incidence of fire. The bipinnate-leaved *A. decurrens* and *A. mearnsii* are planted commonly in the cooler tropical highlands but several acacia species, which bear phyllodes (flattened and enlarged leaf stalks which look like and function as leaves), will grow on degraded sites in the lowland tropics. Their nitrogen-fixing ability contributes to satisfactory establishment and subsequent growth.

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This paper summarises the ecology, growth and utilization of selected phyllodinous acacias from tropical Australia, Indonesia and Papua New Guinea and suggests potentially useful species for planting in the humid tropical lowlands.

## GROWTH OF ACACIAS IN THE HUMID TROPICAL LOWLANDS

The only acacias grown in plantations in the humid tropical lowlands are the phyllodinous *A. auriculiformis* and *A. mangium.*

*A. auriculiformis:* The natural range of *A. auriculiformis* extends through northern Australia and southern Papua New Guinea, with a restricted occurrence in eastern Indonesia, from near sea level to *ca* 500 m. The climate is tropical hot and humid or subhumid with a mean annual rainfall of 1,000-2,000 mm and a distinct dry season of 4-5 months. This acacia is found on a variety of soil types, including laterites and heavy clays, and tolerates a wide range of soil pH and seasonally-waterlogged soils. On a few favourable sites in its natural habitat it grows into a tree 25-30 m tall with a straight stem dominant for a greater part of tree height. More commonly it is a short, heavily-branched tree with a crooked stem.

Most plantations of *A. auriculiformis* are in India or Southeast Asia where its ability to thrive on impoverished, often poorly-drained sites (including laterites) has been demonstrated (e.g. Lamb 1975, Ghosh 1977). It has been successful on *Imperata* grasslands but growth rate and survival are significantly improved by intensive site preparation and cultivation in the early establishment phase (Luton 1980). On relatively fertile soils in Java a mean annual increment of 15-20 $m^3$/ha is possible but on infertile or highly eroded sites the increment is reduced to 8-12 $m^3$/ha. Yield is further reduced on sites where low rainfall is a limiting factor (Wiersum & Ramlan 1982). Its superior early growth rate relative to many other species on an acidic (pH 4.5) latosol dominated by *Imperata* grass in Sumatra is shown in Fig. 1.

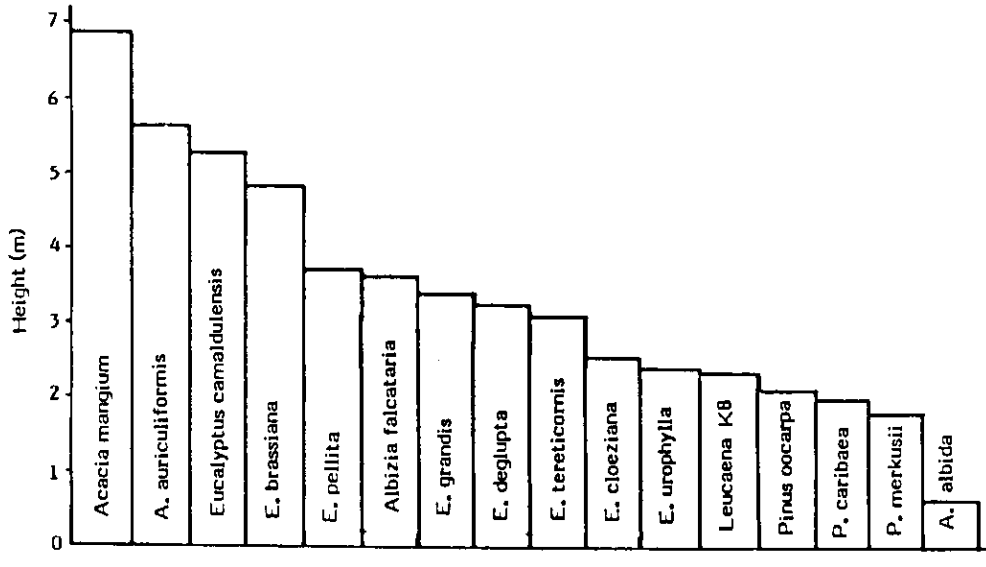


FIG. 1. Height growth at 2 years of a species trial at Subanjeriji, Sumatra.

*A. auriculiformis* wood is hard and heavy and is mainly used for fuel. High chemical pulp yields have been obtained from young plantation-grown wood (Logan & Balodis 1982). The crooked stem form and tendency to multiple leaders of the trees in plantations currently limit their utilization for poles and heavy construction timber. Careful selection and introduction of tall, straight provenances should improve the situation. Other limitations of this species are its sensitivity to fire and weak coppicing ability.

*A. mangium:* In its natural habitat this is a tall tree 25-30 m but with a diameter rarely over 50 cm. The natural distribution is from northeastern Australia through southern Papua New Guinea into the Indonesian provinces of Irian Jaya and Maluku. It usually occurs at an altitude below 300 m in the humid climatic zone with a mean annual rainfall over 1,500 mm. The natural occurrences are on acidic soils, often of low fertility and sometimes with impeded drainage.

*A. mangium* was unknown as an exotic until 1966 when it was introduced into Sabah as an alternative firebreak species around pine plantations on *Imperata* grasslands (Tham 1979). By 1973 it was evident that *A. mangium* had potential as a plantation species for wood production and subsequently about 10,000 ha have been established.

In Sabah *A. mangium* has grown rapidly on infertile sites and controlled *Imperata* grass competition. On favourable sites a mean annual increment of 30-40 $m^3$/ha is achieved and on the best site it has produced 44 $m^3$/ha/annum over 10 years (Tham 1979). At Kemasul, West Malaysia, it reached 6.2 m in 22 months on a lowland cut-over dipterocarp forest site and outgrew eucalypts. A similar result was obtained in Indonesia on *Imperata* grassland at Subanjeriji, Sumatra, where it was 6.7 m tall at 2 years (see Fig. 1). On this site the diameter of *A. mangium* was 8.3 cm, more than double that of the largest eucalypts (*E. deglupta* 4.0 cm and *E. pellita* 3.8 cm).

In Fiji, *Eucalyptus camaldulensis, E. tereticornis* and some other eucalypts have grown faster than *A. mangium* and *A. auriculiformis* when weed competition has been eliminated during the first year of growth. Where this treatment was not possible, due to labour shortage or the possibility of erosion, both acacias show promise. *A. mangium* is preferred because of its better stem form, superior coppicing ability and greater stability during storms (Bell & Evo 1983). Early growth data from Taiwan, comparing the performance of *A. mangium, A. auriculiformis* and the local species *A. confusa* at 4 years old, show the mean annual increments to be respectively 23.4 $m^3$/ha, 18.8 $m^3$/ha and 8.7 $m^3$/ha (Cheng et al. 1983). *A. mangium* has the potential to grow faster than *A. auriculiformis* on suitable sites but appears to lack its very wide adaptability.

Preliminary wood testing of *A. mangium* indicates that the pale brown timber is easily sawn, planed and polished, and suitable for general construction, furniture, particle board, veneer and paper pulp.

The initial results of recent trials suggest that *A. mangium* will realize its potential on many humid tropical lowland sites. FAO/CSIRO coordinated international provenance trials to be planted at over 100 locations in many countries; in 1983/1984 will test the species more thoroughly and define the range of conditions under which it can be a productive crop.

## OTHER POTENTIALLY PRODUCTIVE ACACIAS

Several tree-form acacias occurring in similar ecological conditions to *A. auriculiformis* and *A. mangium* have potential for planting in the humid tropics.

*A. aulacocarpa:* One of the largest acacias, this species can reach a heigh of 35 m and a diameter of about 100 cm. It has a wide natural distribution between latitudes 6°-30°S in the humid and subhumid tropical zones of Australia and Papua New Guinea. The altitudinal range is from near sea level to 1,000 m. It is commonly found along watercourses and rainforest margins but extends into open eucalypt forest. It is a useful timber species in Australia and Papua New Guinea (Eddowes 1978, Hall et al. 1980) and as an exotic it could be grown for fuel, timber, pulp, erosion control or as an ornamental species. Its adaptability and rapid growth is illustrated by its growth in Guyana where it was tested on a lowland site with a deep excessively freely-drained white quartz sand, pH 4.7 and low nutrient status. Rainfall at the site was *ca* 2,400 mm. *Pinus caribaea* and *Albizia falcataria* failed on this site, but 3 years after planting *A. auriculiformis* was 7.8 m tall and *A. aulacocarpa* was 12.5 m. It was concluded by David (1980) that "the growth potential for *A. aulacocarpa* on poor white sand sites in Guyana is tremendous".

With its extensive natural distribution, genetic variation in *A. aulacocarpa* is likely to be substantial so that provenance testing will be essential to determine optimum seed sources.

*A. crassicarpa:* Closely related to *A. aulacocarpa* this species occurs along the east coast of Queensland, often close to the sea, and is widespread in Western Province of Papua New Guinea. Its principal occurrence is below 200 m. Most trees are 10-20 m tall but occasionally reach 30 m. The stem is frequently straight and in open situations the crown is strongly branched and casts a moderate shade. It is often found on sandy soils but will grow on clays and soils with impeded drainage. It appears to be fire resistant. In Papua New Guinea the wood has been used for heavy construction, furniture, boatbuilding and panelling (Eddowes 1978). It is used for building posts in villages and despite its susceptibility to *Lyctus* borer it has a reputation for durability. It could also be a useful fuelwood species and for rehabilitating impoverished sites in coastal areas. In one of its rare trials outside its native habitat it was reported as growing 'reasonably well' in grasslands near Jayapura in Irian Jaya, Indonesia (Sijde 1957).

*A. cincinnata:* Confined to the east coast of Queensland in two main areas, in the north between 16°S and 18°S and in the south from 25°S to 28°S. The northern occurrences have an altitudinal range of 150-750 m, they are on rainforest margins in the hot humid to subhumid zones with a mean annual rainfall over 2,000 mm. Under these conditions *A. cincinnata* forms a tall, straight, slender tree up to 25 m tall and 40 cm diameter. Southern populations occur at lower altitudes on drier sites and the tree rarely exceeds 10 m in height.

This species is untested in plantations but has potential for agroforestry purposes, casting a light shade but producing posts, poles and fuelwood.

*A. polystachya:* Occurs as a relatively small-crowned tree up to 25 m tall in rainforest but may be reduced to a bushy shrub in open situations near the coast. It is restricted to northern Queensland with the main distribution from 11°S to 17°S, from near sea level to 250 m, within the hot humid climatic zone. The mean annual rainfall range is 1,100-2,200 mm with a monsoonal pattern. *A. polystachya* grows on acidic soils of variable depth and fertility and although occurring in rainforest it is found more commonly in open forest and in woodlands on stabilized sand dunes close to the sea.

*A. polystachya* has not been tested as an exotic. It is closely related to *A. auriculiformis* and their utilization will probably be similar.

## SEED AVAILABILITY

Seeds from a range of populations of the acacias referred to are available from the Tree Seed Centre, CSIRO Division of Forest Research, Canberra, Australia. Details of the seed collections can be found in Turnbull et al. (1983).

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