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Acacia auriculiformis: an annotated bibliography

K. Pinyopusarerk

The Winrock International Institute for Agricultural Development is a private, non-profit U.S. organisation working in agricultural development around the world. It was established in 1985 through the meeting of the Agricultural Development Council (A/D/C), the International Agricultural Development Service (IADS), and the Winrock International Livestock Research and Training Center. Winrock International's mission is to help increase the agricultural productivity, improve the nutrition, and advance the well-being of men, women, and children throughout the world. Its main areas of emphasis are human resources, renewable resources, food policy, animal agriculture and farming systems, and agricultural research and extension. Winrock International's headquarters are located in Morrilton, Arkansas, with regional offices in Arlington, Verginia and Bangkok, Thailand.

The Australian Centre for International Agricultural Research (ACIAR) was established in June 1982 by an Act of the Australian Parliament. Its mandate is to help identify agricultural problems in developing countries and to commission collaborative research between Australian and developing country researchers in fields where Australia has a special research competence.

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PREFACE

Acacia auriculiformis is a species native to Australia, Indonesia and Papua New Guinea. It has been an important exotic in many tropical countries for more than half a century. The species is currently planted for fuelwood, erosion control, shade and ornamental purposes.

Although *A. auriculiformis* has been planted successfully outside its native range very little is known of its pattern of natural variation. In recent years seed collections have been undertaken from a wide range of locations, providing the basis for detailed genetic studies of the species. Consequently, a collaborative research project was initiated involving the United States Agency for International Development (USAID)-funded Forestry/Fuelwood Research and Development (F/FRED) Project, the Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Australian Centre for International Agricultural Research (ACIAR). This bibliography is one of several joint activities aimed at gathering information on *A. auriculiformis*. Other collaborative activities are a study of geographic variation in seedling morphology under glasshouse conditions and the establishment of field provenance trials on more than ten sites in Asia and Africa.

This bibliography seeks to summarise all important information on *A. auriculiformis* available up until January 1990. Most research reports are in English but Thai, Indonesian and Dutch language reports are important sources of non-English information. The compiler's unique contribution has been his translation of many important Thai language research reports. Dr Sheikh Ali Abod of the Faculty of Forestry, Universiti Pertanian Malaysia provided valuable back-up support in the translation of Indonesian language references.

The kind of international collaboration demonstrated in the compilation of this bibliography is important to future research activities in world forestry. It is hoped that the international collaborative model developed between F/FRED and CSIRO will lead to further bibliographies on other important tree species.

Bibliographies of this kind form a readily available and valuable source of information to foresters located in isolated field stations. This bibliography,

in no small way, seeks to ameliorate the professional isolation of these foresters and to bring them quickly up to date with recent research results from around the world. In summary, Mr Pinyopusarerk has made a very important contribution in this area and we commend the book to all potential readers.

G.H.L. Rothschild
Director
ACIAR

R. Havener
President
Winrock International

ACRONYMS AND ABBREVIATIONS

a	annum
ACIAR	Australian Centre for International Agricultural Research
AIDAB	Australian International Development Assistance Bureau
asl	above sea level
CAI	current annual increment
cm	centimetre
CSIRO	Commonwealth Scientific and Industrial Research Organisation (Australia)
dbh	diameter at breast height
FAO	Food and Agriculture Organisation of United Nations
F/FRED	Forestry/Fuelwood Research and Development Project
ft	foot
g	gram
h	hour
ha	hectare
ht	height
in	inch
IUFRO	International Union of Forestry Research Organisations
kg	kilogram
m	metre
MAI	mean annual increment
mg	milligram
mm	millimetre
MPTS	multipurpose tree species
NFT	nitrogen fixing tree(s)
t	tonne
y	year

RESEARCH CONTACTS

The organisations listed below are known to be currently actively involved in research activities involving *A. auriculiformis*.

AUSTRALIA

CSIRO
Division of Forestry and Forest Products
P.O. Box 4008
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A.C.T. 2600

INDIA

Biomass Research Centre
National Botanical Research Institute
Lucknow (U.P.)

Forest Research Institute and College
P.O. New Forest
Dehra Dun (U.P.)

Forest Department
Bangalore, Karnataka

Forest Research Institute
Peechi, Kerala

State Forest Research Laboratory
Kanpur (U.P.)

State Forest Research Institute
Polipather, Jabalpur
Madhya Pradesh

INDONESIA

Forest Research and Development Centre
Agency for Forestry Research and Development
Bogor

MALAYSIA

Forest Research Institute Malaysia
Kepong, Kuala Lumpur

Forest Research Centre
90008 Sandakan, Sabah

Universiti Pertanian Malaysia
43400 Serdang, Selangor

PEOPLE'S REPUBLIC OF CHINA

Research Institute of Tropical Forestry
Chinese Academy of Forestry
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REPUBLIC OF CHINA

Taiwan Forestry Research Institute
Taipei, Taiwan

THAILAND

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Dr Sheikh Ali Abod of the Universiti Pertanian Malaysia helped locate some references from Bogor, Indonesia. He also provided English translation of many Indonesian language references, and assisted in the subject indexing. Dr Abod undertook a trip to Bogor, Indonesia and Canberra, Australia, in relation to work on this bibliography. These two trips were sponsored by the F/FRED Project.

I would like to thank two Australian-based colleagues; Mr Kron Aken, Australian Tree Seed Centre, CSIRO and Mr Anto Rimbawanto, Department of Forestry, Australian National University, for their help in English translation of many additional Indonesian-language articles. Mr J. Holtzapffel, CSIRO Division of Forestry and Forest Products helped in the Dutch language references.

Many colleagues in the CSIRO Division of Forestry and Forest Products have assisted in the preparation of this bibliography. I especially wish to thank Mr D.J. Boland for his support and advice in many ways. Dr C.E. Harwood gave generous assistance, particularly in the organisation of this bibliography. Mr D.J. Boland, Dr C.E. Harwood, Dr A.P.N. House, Mr S.J. Midgley, Dr L.A.J. Thomson and Dr J.W. Turnbull kindly read the manuscript and gave valuable comments. Mr M.P. Crowe helped in the preparation of the camera-ready

copy for publication. Mr V. Mosmondor designed the cover.

I would also like to thank Mr P.G. von Carlowitz, International Council for Research in Agroforestry and Mr K.G. MacDicken, F/FRED Project for their comments on the draft manuscript.

The library staff at the CSIRO Division of Forestry and Forest Products helped to obtain copies of the text of many references. Ms E. Leslie provided valuable advice on the subject indexing.

My sincere thanks are extended to Mr K.G. MacDicken, F/FRED Project for his substantial support without which this project would not have been possible. He also provided the cover photograph.

Abstracts of the references have been prepared to summarise relevant information on *A. auriculiformis*. Any errors of fact or interpretation contained in this bibliography are solely my responsibility.

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CSIRO Division of Forestry and Forest Products
Canberra, Australia

SCOPE AND ORGANISATION OF THE BIBLIOGRAPHY

The aim of this bibliography is to provide access to information on *Acacia auriculiformis* for foresters and scientists engaged in agroforestry and in management or research in the species. It is compiled from literature in scientific journals, proceedings, books, abstracting journals as well as unpublished papers for conferences and other reports. Foreign-language reports and publications are a special feature of this bibliography.

More than 450 references in total were located but only 368 have been included. An abstract is given for each of the listed references. Other references were not included because they did not contain significant information or the information was not original. Copies of some references could not be obtained, and these references were not included.

Though every attempt was made to obtain all important published information on the species, it is unlikely that a full coverage has been achieved for this bibliography. Communication with some organisations has been difficult, thus, some important information may have been overlooked.

A summary of current knowledge or information on the species is provided in an introductory section. This is followed by a brief account of current research directions.

The arrangement of reference entries is in alphabetical order according to the name of the senior author. The references are numbered from 1 through to 368, and these numbers are referred to in the subject indexing. Many of the references deal with more than one subject, and are therefore indexed more than one heading. The format of each entry is as follow:

(1) Serial number of the reference.

(2) Author(s) and year of publication.

(3) Title.

(4) Citation. The original languages of the references other than English are indicated at the end of the citation. The following codes are used throughout to indicate the languages of the references: Ch=Chinese, De=German, Nl=Dutch, In=Indonesian, Fr=French, Pt=Portuguese, Es=Spanish, Th=Thai. Foreign language references which also provide an English summary are indicated with 'en' following their language codes.

(5) Abstract of the reference. In most cases, I have prepared the abstract myself, unless otherwise indicated, to reflect relevant information on *A. auriculiformis* contained in the reference. In preparing these abstracts, however, I have used as far as possible the authors' own words, although summarising and paraphrasing where necessary. Interpolations identified by square brackets ([]) are used to provide conversion to metric units, to update names of species or countries, or to provide a few words of explanation.

(6) Comments on some references. I have made comments on some of the references which appear after the abstract in smaller typeface. My comments are to draw attention to related references, to highlight points of interest or to query the authors' interpretations where appropriate.

The species' name is spelt '*Acacia auriculiformis*' throughout the bibliography although the previous spelling '*Acacia auriculaeformis*' is used by some authors. Only in the titles have all original spellings remained unchanged.

SUMMARY OF INFORMATION AND RESEARCH DIRECTION

INTRODUCTION

Acacia auriculiformis A. Cunn. ex Benth. is a leguminous, nitrogen-fixing tree of the subfamily Mimosoideae. It is perhaps better known outside its natural range of distribution as a most adaptable species for all kinds of tree planting programs in tropical humid and subhumid lowland regions. *A. auriculiformis* has been cultivated as an exotic in Asia, Africa and South America for more than half a century, and is being increasingly used for reforestation in new areas.

In a re-classification of the genus *Acacia*, the majority of Australian acacias including *A. auriculiformis* have been placed in a new genus called *Racosperma* (Pedley, 1986). In this bibliography however the name *Acacia* has been maintained to avoid confusion.

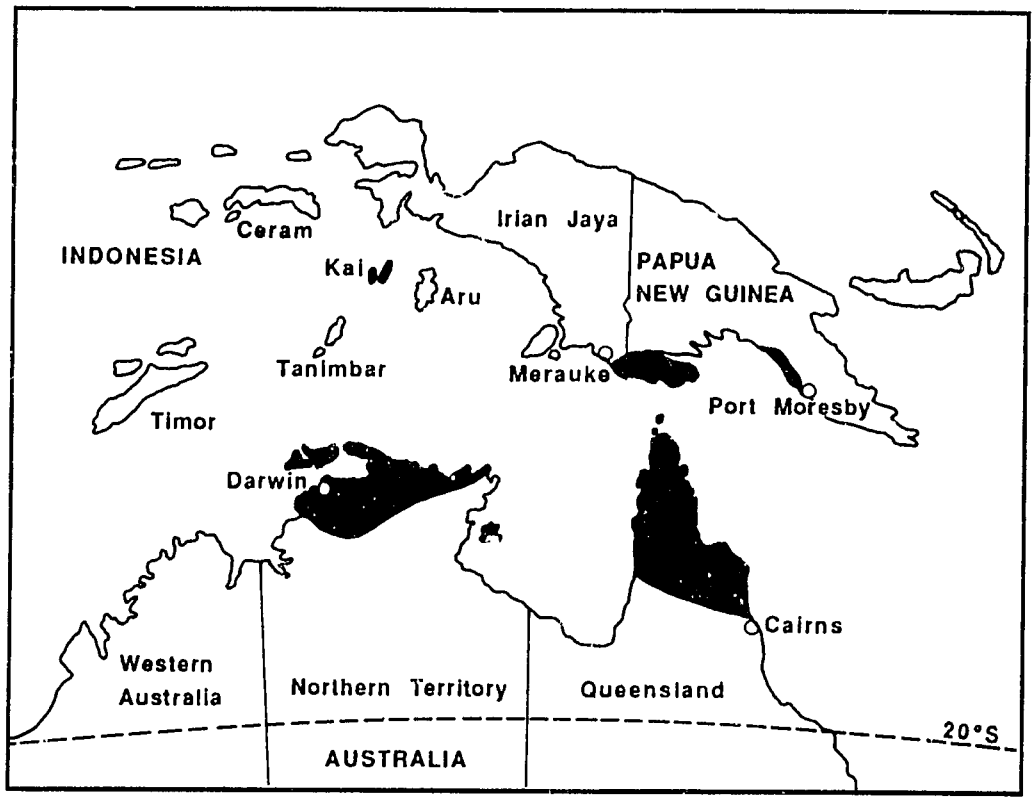
TAXONOMY

A. auriculiformis is normally a small to medium-sized tree, 8-20 m tall, heavily branched with a short, crooked stem, but on some favourable sites it can grow to 30 m tall and 80 cm diameter with a straight, single stem. Young trees have more or less smooth bark, grey in colour but becoming rough, fissured and dark brown with age. Newly-germinated seedlings produce bipinnate leaves but soon develop phyllodes, generally at leaf node number 3 or 4. Phyllodes are 1.5-2.5 cm wide and 4-9 times as long as wide. There are 3 prominent longitudinal nerves (the third one less prominent than the other two) running together towards lower margin or in the middle near the base with many fine crowded somewhat anastomosing secondary nerves. There is a distinct gland (extra-floral nectary) at the base of the phyllode. Flowers are in spikes to 8 cm long in pairs (seldom three) in the upper axils of the phyllode. Pods are flat, rather woody, glaucous, transversely veined with undulate margins, about 1.5 cm wide and 6.5 cm long. The pods are initially straight but become very twisted with irregular spirals on maturity. Seeds are held transversely in the pod, 4-6 mm long and 3-4 mm wide, and each is encircled by a long orange (yellow to red) funicle. Ripe pods dehisce along a single margin, and the mature seeds can be seen hanging out on their funicles.

A. auriculiformis is closely related to *A. aulacocarpa*. It is sometimes confused with *A. leptocarpa* and *A. polystachya*. Pod characteristics and phyllode nervature can be used to distinguish these species. *A. auriculiformis* may have been suspected to have a close relationship to *A. mangium* in view of the occurrence of hybrids both in natural stands and in exotic situations. Suspected hybrids of *A. auriculiformis* x *A. leptocarpa* have also been observed. There are, however, no records of hybridisation between *A. auriculiformis* and *A. aulacocarpa*.

NATURAL DISTRIBUTION AND ECOLOGY

A. auriculiformis occurs naturally in Australia, Papua New Guinea and Indonesia (see map). In Australia, it is found in the north of the Northern Territory (between latitudes 11-14°S and longitudes 130-135°E), Cape York Peninsula, Queensland and on islands in Torres Strait (between latitudes 10-16°S and longitudes 142-145°E). In Papua New Guinea, the main occurrences are in Western Province extending from 9°S, 141°E (the Irian Jaya border) to 9°S, 143°E (Oriomo River). The occurrence of *A. auriculiformis* in Indonesia is not well documented. It is known to



Natural distribution of *A. auriculiformis* in Australia, Papua New Guinea and Indonesia

occur in Irian Jaya near the Papua New Guinea border and on the Kai Islands. It is believed to also occur on the Aru Island, a close neighbour to the Kai group, but no herbarium records are available.

Altitudinal range of the species' natural occurrence is from sea level to about 400 m. In the Northern Territory, it extends from sea level at Danger Point on Melville Island to 150 m on the Reynolds River. The altitudinal range in northern Queensland is from 10 m (Silver Plains) to 380 m (Rifle Creek). In Papua New Guinea, the altitudinal range is generally within 5-20 m.

Climatically, the occurrence of *A. auriculiformis* is in the hot humid and subhumid zones. The mean maximum temperature of warmest month is 32-38°C and the mean minimum temperature of coldest month is 12-20°C. Frosts do not occur in the natural range. Annual rainfall varies from 760 mm in the Northern Territory, Australia to 2000 mm in Papua New Guinea and probably also in Indonesia. However, the species has been reportedly found near Kerema, 240 km northwest of Port Moresby, Papua New Guinea where annual rainfall reaches 3000 mm.

A. auriculiformis grows in a wide range of soils. In Papua New Guinea it grows on well-drained acid soils to waterlogged heavy-clay soils with a pH range from 4.0 to 6.0 In Queensland the soils are frequently yellow earths but vary from dune sands to sandy loams to alluvials with a high clay content (or fraction), pH 6.0-7.0.

The soils in the Northern Territory vary from dune sands to black cracking clays (pH 5.0) to alluvia derived from sandstone and/or laterite (pH 4.5-6.5). At Smith Point, Cobourg Peninsula in Northern Territory it grows on beach sands, pH 8-9.

A. auriculiformis normally grows in narrow strips along river banks but is also found on a variety of landforms such as foredunes, tidal flats, saline lagoons and deltaic floodplains in the Northern Territory. In Papua New Guinea individual trees are widely scattered in savanna woodland. It also grows in swamp forests dominated by tall melaleucas such as *Melaleuca cajuputi* and *M. leucadendra*.

FLOWERING AND SEED PRODUCTION

A. auriculiformis starts flowering at about age 18 months from germination, and will produce large quantities of seed after 4-5 years of age. The age of first flowering of *A. auriculiformis*, however, varies considerably with locality and seed source. A seedlot from Iokwa, Papua New Guinea was planted at two locations in Thailand, and it flowered at only one location but not until after 46 months. Other seedlots from Australia as well as Papua New Guinea planted over 6 locations at more or less the same time flowered from age 18 to 30 months.

Flowering period is also found to vary considerably with locality. It appears that trees in the southern latitudes tend to flower before those in the northern latitudes. It is not uncommon for *A. auriculiformis* to produce two seed crops per year. The second flowering starts soon after the first seed crop matures. Seeds mature about 4 to 5 months after flowering. There are approximately 30,000-60,000 seeds/kg.

In natural stands, insect damage to seeds is frequently observed. Early parasitism of the immature green seeds appears to be a major cause to the damage but fully developed green seeds are also eaten by insects.

SILVICULTURAL FEATURES

Adaptability

There are very few tree species that are as adaptable as *A. auriculiformis*. It is a fast-growing, nitrogen-fixing tree and has shown wide adaptability to a wide range of environmental conditions. It has proved to be especially suitable for rehabilitating and revegetating difficult sites such as tin tailings in Malaysia, *Imperata* grassland and eroded land in Indonesia, and wasteland and overburden mining areas in India. In areas polluted by industrial gases in south China and India it survives and grows successfully. Other special features of *A. auriculiformis* are its ability to tolerate seasonal waterlogging and competition from *Imperata cylindrica*.

The ability of *A. auriculiformis* to fix atmospheric nitrogen and grow on impoverished soils are important attributes for sites currently available for reforestation in the tropics. It is especially suitable for growing on acidic soils but it also thrives well on alkaline soils. Its ability to grow on acidic soils is a good reason for widespread introduction of the species to the tropics. In recent research *A. auriculiformis* has been found to be a highly salt-tolerant species and this will increase its role in reforestation in saline areas.

A. auriculiformis is often grown with successful results under environmental conditions which are quite different from its natural range of occurrence. It has survived and grown well in areas having a prolonged dry season and annual rainfall as low as 650 mm but satisfactory growth has also been reported in areas receiving annual rainfall as high as 6000 mm. *A. auriculiformis* can

tolerate summer temperature in excess of 40°C and light frosts.

Although the altitudinal range in the natural occurrence of *A. auriculiformis* is limited to about 400 m above sea level it has been grown widely at higher altitudes in exotic situations. Two species trials in Zimbabwe where *A. auriculiformis* has shown rapid early growth are located at 1100-1200 m above sea level. However there have been reports of failure of the species at high altitudes i.e. 1150-1570 m in Uganda. This failure may have been caused by prolonged low temperatures at high altitudes.

Seed pretreatment and seedling care

Like most acacias, pre-germination treatment is required to improve seed germination. Pouring boiling water (10-20 times the volume of seed) onto the seed and soaking the seed overnight in the gradually cooling water is a satisfactory pretreatment method. It is a simple but effective treatment, and suitable for large-scale plantings. Immersion of seed in boiling water for 1-2 minutes followed by overnight-soaking in cool water has also been found to be effective. Nicking of the seed coat and acid treatments also improve seed germination but these methods are more suited for research purposes when only small numbers of seeds are involved.

Nursery establishment is generally by sowing the pretreated seeds onto germination beds. Germinated seedlings are transplanted into polythene bags when they reach the second leaf-pair stage. Seeds can also be sown directly into potting containers, 1-2 seeds per pot. Surplus seedlings can be pricked out and transplanted in pots where seeds fail to germinate. Seedlings in the nursery require little attention and there are no serious pests or diseases. Newly-germinated seedlings should receive 50% shade. Once established, 70% full sunlight is ideal. Excess shading often results in attack by leaf fungi (mildews) and damping off. The seedlings should be exposed to full sunlight 2-3 weeks prior to planting. In general, 3-4 months are needed to raise seedlings to plantable size i.e. 25 cm in height. Inoculation by ready-to-apply inoculants or by pure cultures of effective *Rhizobium* is not usually necessary but in sterilised soils inoculation is an insurance.

Establishment and management

Plantations can be established using containerised seedlings or by direct sowing. Containerised seedlings generally give higher survival especially in areas of heavy weed. Aerial seeding has sometimes been successful but site preparation prior to sowing is required.

The optimum spacing for *A. auriculiformis* is not clearly demonstrated. Most current plantings employ spacings of 2x2 m to 4x4 m. Closer spacing is more suitable for fuelwood plantations.

A. auriculiformis has the ability to coppice, which is an important characteristic for a potential firewood species. Stump height has been shown to be an important factor in sprouting; better results are obtained when stumps are cut at high level (i.e. 1 m) from ground. Age or stump diameter as well as seasonal effects on coppicing ability are not clearly understood, and warrant detailed investigation. The species also responds well to pollarding.

A. auriculiformis is normally known for its poor stem form and frequently possesses multiple stems. Removal of lower branches of young plants has been suggested as a means of improving stem form.

Four-year-old trees cut at 1 m above ground coppice vigorously at Chanthaburi, Thailand.

Vegetative propagation

Only in recent years has research into vegetative propagation of *A. auriculiformis* been carried out, and results to date are still preliminary. Grafting and marcotting are possible but they are not suitable for large-scale production of clonal material. Rooted cuttings from young shoots are being developed in Thailand and Taiwan; better results are achieved when rooting hormone is applied.

Micro propagation of *A. auriculiformis* has been successful. Multiple shoots could be obtained from explants such as axillary buds, tip and root collar excised from seedlings grown in vitro. Rooting of these shoots could be induced with the application of indole acetic acid (IAA) and naphthaleneacetic acid (NAA).

Growth and yield

A. auriculiformis has shown excellent growth under plantation conditions and an increment in height of 2-3 m per year is common even on soil of low fertility. A mean annual increment of 15-20 m^3/ha at 10-12 years can be expected from *A. auriculiformis* plantations in favourable situations but production is less on infertile soils and is further reduced on areas with a prolonged dry season.

Selection of suitable provenances can increase plantation productivity. There have been reports from many countries of superior growth, and also tree form, of newly-introduced provenances especially those from Papua New Guinea compared to the performance of local seed sources. On a well-drained site receiving approximately 1500 mm annual rainfall in Thailand, a provenance from Balamuk, Papua New Guinea produced a total above-ground

A 20-year-old plantation of *A. auriculiformis* in south Thailand. This typical form of the species is generally seen in plantations and most natural populations.

biomass (dry) of 135 t/ha in 3 years while another provenance from Springvale, Queensland produced only 60 t/ha at the same age.

There have been reports of increased growth in *A. auriculiformis* when intercropping with some agricultural crops such as peanut, rice and kenaf in Thailand. However, an agroforestry experiment in Cameroon showed that height growth was reduced when the trees were intercropped with maize.

Pests and diseases

There appear to be no serious insect pests and diseases of *A. auriculiformis*. Seedlings in the nursery are reportedly infested by powdery mildew and rust disease but these usually do not cause significant damage. A beetle, *Sinoxylon* sp., can girdle young stems or branches, and causes the stems or branches to break at the point of attack. This insect is of major concern because the broken-stemmed tree will develop into multiple leaders and thus reduce the length of clear bole.

In a species trial in Sri Lanka, *A. auriculiformis* has been shown to be less susceptible to termite attack than *Eucalyptus camaldulensis* and *E. tereticornis*. Similarly in Zimbabwe *A. auriculiformis* is among the fastest growing species in a species trial where *E. camaldulensis* failed due primarily to termite attack. These suggest that *A. auriculiformis* may be resistant to termites to some extent.

WOOD PROPERTIES

A. auriculiformis possesses wood properties which are very suitable for a wide range of utilisation. The wood is heavy with more than 70% of wood volume being heartwood which is quite durable. The heartwood is light brown to dark red in colour, and straight-grained. The texture is fine to medium and specific gravity is between 0.5-0.8. Its basic density, 500-650 kg/m^3, makes pulp production practical. The fibre is relatively short, about 0.85 mm in length and 0.2 micron in width. The physical and mechanical properties of wood compared to teak as standard are considered to be high in quality. The wood of *A. auriculiformis* is easy to work, takes a good polish and finishes well with sharp tools. The boards however tends to split when sawn.

With regard to chemical compositions, its wood consists of 59% cellulose, 24% lignin, 19% pentosan and 0.4% ash. Flavinoid substances are also found in the wood. Barks contain about 12-13% tannins.

USES

Available information on the current uses and potential uses of *A. auriculiformis* as an exotic species is summarised as follows:

Fuelwood: Fuelwood appears to be the primary use of *A. auriculiformis*. Dense wood and high calorific value (4800-4900 kcal/kg) make it a popular fuelwood species. It makes very good charcoal because it glows well with little smoke and does not spark. Firewood plantations have long been established in Southeast Asia and have now been extended to Africa (e.g. Zaire and Sierra Leone).

Wood: The wood of *A. auriculiformis* makes very attractive furniture. It is also suitable for construction work (e.g. framing, flooring), and wood turning and carving. Its sapwood is yellow, and is not suitable for uses that have direct contact with soil. Its crooked and multiple stems largely restrict its use as a pole or other form of timber that require reasonable length.

Pulp: Plantation-grown trees have been found to be very promising for the production of unbleached kraft pulp (for bags, wrapping paper, linerboard) and high quality neutral sulphite semichemical pulp (for corrugating medium and higher-grade products). The sulphate process with 13% alkali yields up to 55% of screened pulp. Large-scale plantations have already been established in Karnataka, India for the production of paper pulp.

Fodder: Although it is not recognised as a fodder species, there is evidence of the species being browsed by cattle. Preliminary study of fodder values has shown that *A. auriculiformis* meets the minimum requirements for certain nutrients and warrants further investigation.

Green manure: Green manure is made from leaves (phyllodes). It is also mixed-planted with non-nitrogen-fixing tree species to maintain or improve soil fertility. Leaves (phyllodes) are very good for soil mulching.

Other forest products: The bark has sufficient tannins for possible commercial exploitation. A natural dye, used in the batik textile industry in Indonesia, is also extracted from the bark. Lac insects were found on trees of *A. auriculiformis* in India, and thus lac culture using the species as host plants is possible. An edible mushroom, *Tylopilus felleus*, is common under plantations of *A. auriculiformis* in Thailand.

Agroforestry: Though not widely used in agroforestry systems, intercropping *A. auriculiformis* with peanut, rice and kenaf has proved to be successful. It has been used satisfactorily as nurse tree in tea plantations.

Erosion control: Its root system is superficial, and densely matted, making the species suitable for stabilising eroded land. It has been used widely in revegetation and rehabilitation of degraded land and grassland in Indonesia and India.

Aesthetic values: It is a popular ornamental tree, and its bright yellow flowers make it especially attractive. Its dense foliage which remains throughout the dry season also makes it an excellent shade tree.

CURRENT RESEARCH DIRECTIONS

At the International Union of Forestry Research Organisations (IUFRO) Planning Workshop for Asia held in Kandy, Sri Lanka in 1984, *A. auriculiformis* was one of the top priority species (other species were *Eucalyptus camaldulensis*, *Leucaena leucocephala*, *Acacia mangium* and bamboos) recommended for intensive development in the humid tropical lowlands. The meeting also recommended several priority research activities for *A. auriculiformis*. These were:

(1) Spacing, thinning and rotation; foliage manipulating; tree species mixtures
(2) Tree breeding
(3) Improve nursery stock production
(4) Vegetative propagation
(5) Culture & inoculation methods; effects on soil productivity

The above recommendations have been taken up by the United States Agency for International Development (USAID) through Winrock International in the development of the F/FRED Project in Asia in 1987. The F/FRED Project involves *A. auriculiformis* in growth and management trials established in six countries in Asia and Southeast Asia. The project has also collaborated with CSIRO in range-wide provenance seed collections from natural populations in Papua New Guinea and Australia in 1987 and 1988. It further involves co-operative studies with ACIAR/CSIRO in field provenance trials and geographic variation of seedling morphology, and the preparation of this bibliography. The field provenance trials cover an almost complete range of the species' natural distribution.

The poor stem form of *A. auriculiformis* is a major drawback limiting wider utilisation of the species. Several countries have genetic improvement programs which aim to improve this characteristic. Collection of seed from phenotypically superior trees has been an important activity. Field progeny trials cum seedling seed orchards have been established to enable production of better quality seed for future planting programs. Results of these trials are very promising.

Investigation into genetic variability of the natural populations of *A. auriculiformis* using the technique of isozyme analysis is underway and should provide better understanding of the pattern of variation in the species.

Natural hybridisation of *A. auriculiformis* and *A. mangium* has been observed in both natural stands and plantations. The hybrid has shown desirable characters e.g. vigour, fine branching and tendency for a strong apical dominance which will eventually lead to a tree with single stem and a good length of clear bole. Production and propagation of the hybrid will be of considerable importance; the subject is currently being studied in an ACIAR collaborative research project between CSIRO, University of Adelaide, the Forest Research Institute Malaysia and several organisations in Sabah.

Seed has been collected from phenotypically superior trees for genetic improvement programs. This excellent tree at North of Mibini Swamp in Western province, Papua New Guinea is 32 m tall and 58 cm dbh. (B.V. Gunn)

Micropropagation of *A. auriculiformis* has been underway in a few countries but results to date are still preliminary. Current development includes multiplication of shoots and induction of roots on these shoots.

The potential use of *A. auriculiformis* in agroforestry practice has not been fully investigated despite its ability to fix atmospheric nitrogen. This may be due to the high frequency of multistemmed trees and heavy branching which restricts intercropping to a great extent. Provenances which have demonstrated light branching and single stemmed form, for example the Springvale provenance from Queensland, Australia should be considered for further investigation. Another possible problem limiting the use of *A. auriculiformis* in agroforestry is its superficial root system which will provide competition for crop plants.

There have been very few studies on symbiotic relationships in *A. auriculiformis*. Nevertheless, the species is found to form both ectomycorrhiza and VA mycorrhiza. Nursery studies also show certain strains of VA mycorrhiza and *Rhizobium* to be effective for *A. auriculiformis*. Inoculation in nurseries to increase plantation productivity should be studied in more detail.

Investigation into wood properties of *A. auriculiformis* reveals it can offer a wide range of utilisation. The wood has proved to be suitable for making furniture, construction timber, plywood and pulp apart from its primary use as fuelwood. The wood can be preserved with simple impregnation methods. There appears to be a high tendency of the wood to split when sawn. Thus research on sawing wood of *A. auriculiformis* is needed.

REFERENCES

1

Abdoel Djalal, R. (1979).
Rehabilitating denuded lands in Madura with *Acacia auriculiformis*.
Unpublished report, Madura Forest District, Indonesia, 41 pp. (In)

Madura district [in Indonesia] has large areas of denuded lands resulting from excessive logging and past agricultural practices. Current efforts of rehabilitating these areas involved reforestation with *Acacia auriculiformis*. The species has been proven to be very easily established and can ameliorate denuded sites. Over 4,500 ha of this acacia were planted during 1955 to 1978. Some rehabilitation efforts in Madura involved planting *A. auriculiformis* with tree species of family Glerisideae. Wood from the acacia trees is targeted for firewood and charcoal production for the rural population.

2

Abdul Aziz Bidin and Hardjosuwano, S. (1977).
Effect of *Iridiomyrmex* ants on the growth of branches from *Acacia auriculiformis* A. Cunn. and *Acacia farnesiana* L.
Paper, Seminar Biologi IV, Yogyakarta, Indonesia. (In)

The presence of *Iridiomyrmex* ants on the branches of *Acacia auriculiformis* doubled their growth within 4 months compared to trees where the ants were absent due to the application of insecticide. The effect was less pronounced for *A. farnesiana*. Estimations of sugar (exuded from extrafloral nectaries) from the stems, petioles and leaves of the former species were markedly greater than the latter. The higher population and greater frequency of ants found on the branches of *A. auriculiformis* suggested a cause and effect relationship with the sugar. Both species produced maximum amount of sugar in the morning (7-8 am), lower in the afternoon (12-1 pm) and least in the evening (4-5 pm) which correlated well with the population of ants in these periods. No cause and effect relationship was apparent between the estimations of protein in the various plant parts and the ant infestation. It is suggested that the relationship between the acacias and the ants is symbiotic, i.e. the host provides sugar for the ants which in turn deter attacks by phytophagous insects.

3

Abdul Razak, M.A., Low, C.K. and Abu Said, A. (1981).
Determination of relative tannin contents of the barks of some Malaysian plants.
Malaysian Forester 44(1), 87-9

Relative tannin contents of the barks of 50 plant species from 23 families grown in West Malaysia were determined quantitatively. Tannin-formaldehyde contents were found to range from 1 to 28% by weight of dry materials, with the highest value being recorded for *Acacia auriculiformis* of family Leguminosae. The barks of 9 species belonging to the families of Rhizophoraceae, Euphorbiaceae, Leguminosae and Guttiferae were found to have sufficient tannins for possible commercial exploitation.

4

Adappa, B.S. (1986).
Waste land development for bio-energy need for forestry grant schemes and incentive policies.
Myforest 22(4), 227-231.

Discusses a project to produce pulp on 14,000 ha in Karnataka [in India] with financial assistance from the UK [United Kingdom] Overseas Development Administration during 1983-1988. *Acacia auriculiformis* is one of the main species being planted. A provenance trial of *A. auriculiformis* is also under way.

5

Addison, G.H. and Henderson, M.R. (1953).
Notes on the planting of ornamental and shade trees in Malaya.
Malayan Forester 16, 131-46.

Outlines planting and tending techniques for numerous ornamental and shade trees in Malaya [Malaysia]. *Acacia auriculiformis* is described as a suitable tree for avenues or as single shade trees. Growth is reportedly slow between 6 in [15 cm] and 3 ft [90 cm] but will grow faster, reaching 25 ft [7.5 m] in 3 years. Care is needed when young to prevent poor shape. Strong staking is recommended at first as the main shoot is thin and weak. Removal of lower branches of young trees are also recommended. The species is said to be native to Thursday Island [north of Cape York Peninsula in north Queensland].

6

Ali, R. (1986).
Revegetating barren land: the Auroville experience.
Tigerpaper 13(1), 14-21.

The paper reports results of a revegetation program on degraded lands at Auroville, Tamil Nadu. About 300 ha have been planted in the last 10 years. The species considered to be productive are *Acacia auriculiformis* (annual yield 34.4 t/ha, dry), *Albizia lebbek* (17 t/ha) and *Cassia siamea* (12 t/ha).

7

Alphen de veer, E.J. van. (1949).
Forest regeneration in Bangka and Belitung - travel report.
Unpublished, 44 pp. (NI)

It is suggested in the report that only small mixed plantations of valuable native or introduced tree species should be established in Bangka and Belitung, Indonesia. *Acacia auriculiformis* is recommended as suitable green manure for sandy soils.

8

Anon. (N/A).
Trip to the Janlappa forest reserve (Banten).
Unpublished report, 9 pp. (NI)

A report on a trip to the Janlappa forest reserve which was selected for establishment of a production forest for fuelwood for Jakarta. The area was virtually an unproductive barren land and covered by alang-alang grass (*Imperata cylindrica*) as a result from shifting cultivation. *Acacia auriculiformis* was recommended for planting in that area

along with *Schima wallichii, Swietenia macrophylla, Fagraea fragrans* and *Albizzia* [*Albizia*] *falcataria.*

9

Anon. (N/A).
Excursion to the Janlappa forest reserve (Banten).
Unpublished report, 9 pp. (Nl)

Another trip report to the Janlappa forest reserve. The area had been planted with the species as recommended in the previous report. *Schima wallichii* and *Fagraea fragrans* were planted in the first year, and *Acacia auriculiformis* and *Albizia falcataria* in the second year. Although *Acacia auriculiformis* was performing well on the poor soil areas, it was thought that its short rotation might have increasingly deteriorated the soil. *Albizia falcataria* was therefore considered for planting on these poor soil areas.

10

Anon. (1939).
The tree species trial plots in Java.
Report of the Forest Research Institute, Indonesia, 26 pp. (Nl)

Discusses species trials planted by the Forest Research Institute in Pasirawi, Cikampek, Pasirhandap and Sumberwringin involving 95 tree species. *Acacia auriculiformis* and a dense undergrowth of kemlandingan [*Leucaena* sp] are suggested for use to prevent the danger of fire.

11

Anon. (1949).
Reafforestation of poor lands in the teak region.

Report of the Forest Research Institute, Indonesia 12 pp. (Nl)

There are areas (in Java) where soil is too poor for teak, and reforestation with other species is recommended. Species recommended for the most difficult soils are *Acacia auriculiformis, Swietenia macrophylla* and *Eucalyptus platyphylla* [*E. alba*].

12

Anon. (1950a).
1950 Working Plan.
Report of the Forest Research Institute, Indonesia, 12 pp. (Nl)

Outlines activities planned for the Forest Research Institute for 1950. For the Silviculture Section, work plan includes planting of *Eucalyptus alba* and *Acacia auriculiformis* in parts of teak areas of West and Central Java not suitable for teak.

13

Anon. (1950b).
Phenology.
Rep. For. Admin. Malaya 1950(7).

Acacia auriculiformis is reported to produce two seed crops per year in Malaya [Malaysia]. Trees flower soon after each crop of fruit matures.

14

Anon. (1952).
Afforestation of semi-wanda areas.
Report, Department of Agriculture, Zanzibar, Tanzania.

Trial plots were established in 1947 to examine the possibility of afforestation of bush country consisting mainly of *Heteropogon contortus* sward on coral soils. Seedlings were planted in holes prepared in the coral rock and filled with soil. Best results were obtained for several species including *Acacia auriculiformis*, *Casuarina equisetifolia*, *Terminalia catappa*, *Cassia siamea*, *Calophyllum inophyllum* and *Eucalyptus* species. Species poorly adapted included *Prosopis juliflora*, *Mangifera indica* and *Eugenia jambolanda*.

15

Anon. (1974).
Guide-lines for selection of suitable tree species for revegetation.
Department of Agriculture, Division of Revegetation and Rehabilitation, Bulletin No. 88, p 259-260. (In)

Information is given on *Acacia auriculiformis* in the following aspects: natural occurrence, habitat, seed pretreatment and germination, planting and tending, pests and diseases, and yield.

16

Anon. (1977).
List of tree species in Jawa-Madura, Jawa-Tengah (Central Java).
Report No. 244, Forest Research Institute, Bogor, Indonesia. (In)

Acacia auriculiformis is one of the numerous species planted by the Forest Service in Central Java. Brief notes on the morphology and origin of the species are given.

17

Anon. (1977).
List of tree species in Jawa-Madura, Jawa-Timur (East Java).
Report No. 253, Forest Research Institute, Bogor, Indonesia. (In)

Acacia auriculiformis is also reportedly found planted in East Java.

18

Anon. (1979).
Production measurements in a young *Acacia auriculiformis* plantation at Ubrag, Jatiluhur.
Internal report No. 9, Project Vegetation and Erosion, Institute of Ecology, Bandung, Indonesia.

Observations were made during 1977 to 1978 on standing biomass and litter production in a plantation of *Acacia auriculiformis* established in 1973 at Ubrug, Jatiluhur. During the 1 year period, total above-ground living biomass increased by 28% , from 59 t/ha to 75 t/ha, while stem-wood volume only increased from 73 to 96 m^3/ha. Litter production over 1-year period was 10.7 t/ha of which 60% consisted of leaf component. It is estimated that 95% of litter would have decomposed in 16 months.

19

Anon. (1983).
Choice of suitable tree species for greenery purposes.
Department of Agriculture, Mataram NTB, Indonesia, 8 pp. (In)

Acacia auriculiformis trees have been identified as one of the species which could be used for successful rehabilitation and greening of difficult sites. It has been found to grow well in marginal sites reaching 10 m in height and 6.6 cm diameter in 4 years. Both plant production and establishment are easy and cheap. The wood is very suitable for firewood and the production of charcoal.

20

Anon. (1989).
Village forestry begins in Sierra Leone.
International Society of Tropical Forestry News, Vol. 10, No. 2, June 1989, p 6.

Fuelwood is the most important source of income for villagers of Grima village in Sierra Leone. *Acacia auriculiformis* planted in demonstration plots shows rapid growth. Subsequently the species has been planted along farm boundaries. Village forest nurseries are planned for all regions of the country.

21

Anuar Mohamad. (1987).
Growth of acacias on a logged-over forest in Sabah.
P 167-169 *in* Australian acacias in developing countries: proceedings of an international workshop held at the Forestry Training Centre, Gympie, Queensland, Australia, 4-7 August 1986 (ed Turnbull, J.W.), ACIAR Proceedings No. 16.

A small trial of 3 *Acacia* species (*mangium*, *cincinnata* and *auriculiformis*) was established in 1982 by the Sabah Forest Department, Malaysia. Latitude 5° 5'N, longitude 117° 42' E, altitude 15 m, annual rainfall 2600-3400 mm, mean temperature 27°C. The experimental area was formerly dominated by secondary vegetation, mostly *Octomeles sumatrana*. Four years after planting, two locally collected seedlots of *A. mangium* from Brumas seedstand, Tawau and Jalan Madu, Ulu Kukut recorded the best height (17.3 and 16.9 m respectively) and diameter growth (14.9 and 14.1 cm respectively). This was followed by *A. cincinnata* (seed from Mossman, Queensland, Australia) 16.4 m in height and 12.0 cm in diameter, and *A. auriculiformis* (Darwin, Northern Territory, Australia) 11.4 m and 8.7 cm. *A. cincinnata* was the poorest in survival with 23% mortality whilst *A. mangium* and *A. auriculiformis* had mortality between 3 and 9%.

22

Anupam Agrawal, Dureja, S.M. and Garg, S.C. (1985).
Some observations on growth characteristics and pulping qualities of *Leucaena leucocephala* in Nepanagar.
Journal of Tropical Forestry 1(4), 295-303.

In a species trial at Nepanagar in Khandwa district [Madhya Pradesh, India] which is a semi-arid site (annual rainfall 750-880 mm, maximum temperature in summer 43-48°C), *Leucaena leucocephala* is the fastest growing among twelve species being tested. Height and diameter (breast height) at 18 months old of *Acacia auriculiformis* are 1.5 m and 1.3 cm

respectively compared to 5.4 m and 4.4 cm respectively of *Leucaena leucocephala.*

23

Anupam Agrawal, Neema, C.S., Saxena, K.A. and Chhaya, J.C. (1986).
Effects of industrial gases on forest vegetation.
Journal of Tropical Forestry 2(2), 170-171.

A brief discussion of mortality in plantations around newsprint mills in Madhya Pradesh [India] which emit the pollutant, chlorine and hydrochloric acid. Four years after planting, the most badly affected species were *Eucalyptus* [*E. tereticornis*], *Albizia procera* and *Parkinsonia aculeata.* Less affected species included *Acacia auriculiformis*, *Cassia siamea* and *Leucaena leucocephala.* Plantations were irrigated monthly for the first 3 years and trees grew satisfactorily, but mortality was observed soon after irrigation was discontinued. No mortality was found in areas away from the factory site. It is suggested that plants were more susceptible to pollutants when they experienced drought.

24

Appelman, F.J. (1941).
Annual report of the Inspector of the Forest Service of the Great East for the year 1940.
Unpublished, 118 pp. (Nl)

Reports on forestry activities of the Great East (Sulawesi, Bali, Lombok, Timor and Maluku) in Indonesia covering forest management, exploitation and plantation. Plantations of several tree species were established. Two hectares of *Acacia auriculiformis* were planted at the Muna teak area in Sulawesi.

25

Ardikusuma, R.I. (1954).
Planting experiment with exotic tree species in the garden of the Forest Research Institute.
Rimba Indonesia 3, 437-484. (In & En)

This paper reports the performance of numerous species including *Acacia auriculiformis*, a species exotic to Java, being planted in the gardens of the Forest Research Institute in various parts of the island.

A. auriculiformis is said in this paper to be native to the Flores Island of Indonesia. This is quite far from the presently-known distribution of the species in Indonesia which extends westward to the Kai islands.

26

Aswathappa, N., Marcar, N.E. and Thomson, L.A.J. (1987).
Salt tolerance of Australian tropical and subtropical acacias.
P 70-73 *in* Australian acacias in developing countries: proceedings of an international workshop held at the Forestry Training Centre, Gympie, Queensland, Australia, 4-7 August 1986 (ed Turnbull, J.W.), ACIAR Proceedings No. 16.

Thirty-seven tropical and subtropical *Acacia* species/provenances were tested for salt tolerance under glasshouse conditions maintained at a day/night temperature of 25-30/20-25 ^{o}C. The salt solution comprised a mixture of NaCl, Na_2SO_4, $CaCl_2$ and $MgSO_4$ dissolved in the molar ratio of 65:18:8.5:8.5 in 1/4 strength Hoagland No. 2 solution. Two-

month old potted seedlings were subjected to salt treatments in step-wise increments of 25 mol m^{-3} every 2 days until 50% mortality was reached. Seedlings were considered dead when their foliage had permanently wilted. The salt concentration level at which 50% of the seedlings died was defined as the level of tolerance of that species or provenance. These were classified as : highly tolerant (>1375 mol m^{-3}), moderately tolerant (975-1375 mol m^{-3}), less tolerant (500-975 mol m^{-3}) and least tolerant (<500 mol m^{-3}).

Acacia auriculiformis was regarded as a highly tolerant species. It grew rapidly and survived up to 1600 mol m^{-3}. Other highly tolerant species included *A. maconochieana*, *A. stenophylla*, *A. leptocarpa*, *A. oraria* and *A. ampliceps*. *A. plectocarpa*, *A. ligulata*, *A. victoriae* and *A. holosericea* were amongst moderately tolerant species whilst *A. mangium*, *A. difficilis*, *A. crassicarpa* and *A. cincinnata* were amongst less tolerant species. *A. torulosa* was the only species in the least tolerant category in the study.

27

Bandara, M.M.S.P.K., Gunasena, H.P.M. and Banasinghe, M.A.S.K. (1986).
Insect attacks on some introduced nitrogen fixing trees grown in Sri Lanka.
Nitrogen Fixing Tree Research Reports 4, 36-39.

Acacia auriculiformis is among the 17 nitrogen fixing tree species planted in trial at the International Winged Bean Institute, Pallekelle, Sri Lanka in 1985. Two species were attacked by caterpillars, *Cassia siamea* by *Eurema blanda*, and *Albizia falcataria* by *Catopsila pomona*. There was no report of insect attack on other species.

28

Bandara, M.M.S.P.K. and Gunasena, H.P.M. (1989).
Performance of some introduced nitrogen fixing trees in Sri Lanka.
Nitrogen Fixing Tree Research Reports 7, 30-31.

A species trial of 16 nitrogen fixing trees planted at Kundasale in Sri Lanka reveals that *Acacia auriculiformis* grew slowly during the initial stage but its rate of growth increased with age. The species produces 6.7 t(dry)/ha of above-ground biomass at 21 months old. Foliage analysis shows that nitrogen content in leaves is 2.3%, and in litter 2.0%. Fifty per cent of *A. auriculiformis* trees were found to coppice but no detail is given on how the trees were cut.

29

Banerjee, A.K. (1973).
Plantations of *Acacia auriculaeformis* (Benth.) A. Cunn. in West Bengal.
Indian Forester 99(9), 533-540.

A review of silvicultural practices for *Acacia auriculiformis* in West Bengal [India]. The species has been cultivated successfully on a variety of soil types in this state, and from 1973, 50% of the annual planting in the lateritic areas has been planned for this species. Growth of *A. auriculiformis* varies considerably with planting site. On deep red soil it attained 8.5 m in height and 8.9 cm in diameter at age 10 years but on shallow lateritic soil it took 20 years to attain a similar size. MAI of wood volume (pulpwood plus solid fuelwood) varies from 2.0 to 5.7 m^3/ha. Fertilisation with N, P and K improves growth on poor soil

areas. *A. auriculiformis* has been recommended as a substitute for *Eucalyptus* hybrid in some specific semi-arid sites.

30

Banerjee, A.K. (1973).
Nutritional experiment in sand culture of *Acacia auriculiformis* (Benth.) A. Cunn.
Indian Forester 99(12), 691-697.

A sand culture experiment was conducted to examine the response of *Acacia auriculiformis* seedlings to fertilisation. The seedlings received NPK fertilisers in the form of NH_4NO_3, H_3PO_4 and K_2SO_4 respectively. It was found that seedling height and total dry matter production responded significantly to NH_4NO_3 and K_2SO_4 applications but not to H_3PO_4. Root nodules developed in most seedlings not receiving N fertiliser. The seedlings had stunted growth of leaves and shortened internode length where potassium was absent, and had yellowish green leaves with the absence of nitrogen.

31

Baqui, S.A. and Shah, J.J. (1985).
Histoenzymatic studies on wood of *Acacia auriculiformis* Cunn. during heartwood formation.
Holzforschung 39(6), 311-320.

The article describes a study on visual distributional pattern of enzymes and pattern of starch localisation of *Acacia auriculiformis*. It is shown that starch content in the cells of wood varies during different seasons of the year but there is no marked variation in the content of lipids and phenolics. Examining the localisation patterns of 7 different hydrolysing, oxidising and respiratory enzymes throughout a year at 2-month intervals indicates acid phosphatase localisation in sapwood in July and September suggesting its involvement in the breakdown of starch during flowering and fruiting in this period. Moderate localisation of succinate dehydrogenase in outer sapwood indicates provision of sufficient energy for physiological needs. Peroxidase localisation observed in sapwood in July and September suggests high oxidative activity in the wood. In March, localisation of acid phosphatase and adenosine triphosphatase in outer sapwood and lipase activity in the sapwood and heartwood boundary suggest the contribution of starch and lipids to the formation of heartwood extractives. It is concluded that heartwood formation occurs throughout the year.

32

Barnard, R.C. (1954).
The control of Lalang (*Imperata arundinacea* var. major) by fire and plantings.
Malayan Forester 17, 152-156.

Experimental plots of tree species were established in 1949 and 1950 at the Forest Research Institute and at the Rubber Research Institute's Experimental Station of Malaya (Malaysia) to investigate their ability to suppress lalang. Planting was done using either stumps or seedlings or direct seeding. None of the species sown or planted can be regarded as directly responsible for the eradication of lalang when it has died out. Direct sowing in lalang is a failure and a waste of seed except for few species, e.g. *Albizzia falcata* [*Albizia falcataria*], *Acacia auriculiformis*, *Anacardium occidentale*

and *Styrax benzoin* which had scattered plants developed from the sowings. *Albizia falcataria* and *Acacia auriculiformis* have been suggested for further trial but they should be established with stumps for the former and seedlings for the latter.

33

Basappa, B. (1983).
Afforestation of degraded grass land.
Myforest 19 (1), 57-61.

A species trial comprising 11 species was established on degraded land at Kogilemane in Belur Taluk, Karnataka, India. Soil was alkaline with no humus, litter or topsoil. 4-6-month-old seedlings were planted in pits in 1981 without fertilizer application. *Acacia auriculiformis* was the most successful species after the first growing season.

A second trial was established but with only 3 species (*A. auriculiformis*, *Leucaena leucocephala* and *Casuarina equisetifolia*). *C. equisetifolia* did not perform well in the first trial but was included because the species is generally suited to alkaline soil. All 3 species developed satisfactorily.

34

Basu, P.K. and Kabi, M.C. (1987).
Effect of application of biofertilizers on the growth and nodulation of seven forest species.
Indian Forester 113(4), 249-57.

Inoculation with either *Rhizobium* or *Rhizobium* + *Azotobacter* combined, has significantly increased nodulation, height growth and dry matter production of seedlings of seven leguminous tree species including *Acacia auriculiformis*. Pelleting the inoculated seed with lime generally did not significantly increase the effect of the inoculants. Species response to inoculation, however, varied substantially possibly due to specific requirement of *Rhizobium* strain for each species. Uninoculated plants of all species were also found to form small number of root nodules with the exception of *Leucaena leucocephala* for which the number of nodules was negligible.

35

Belen, R.E. (1987).
The effects of varying levels of nitrogen and phosphorus on the macro- and micronutrient and uptake by *Acacia auriculiformis* seedlings.
M.Sc thesis, College of Forestry, University of the Philippines at Los Banos.

From author's abstract: *Acacia auriculiformis* A. Cunn. ex Benth. seedlings planted in pots containing Carranglan soil were treated with factorial combination of 0, 30, 60, and 120 kg per hectare of N and P fertilisers. Fertiliser application of 120 kg N per hectare and 30 kg P per hectare increased root dry matter yield of seedlings after six months. Other growth parameters were not significantly affected by the N and P fertiliser treatments. Application of N and P fertilisers increased pH of the soil making Fe, Mn, and Zn, unavailable to the plant. Nitrogen fertilisation increased Mn content, reduced Cu and Zn content, and reduced Zn and N uptake of seedlings. Phosphorus fertilisation increased the total P, Mg content, P uptake and decreased Fe, Mn, Cu content, Fe and Zn uptake.

36

Bell, T.I.W. (1982).
Energy plantation in the Fiji dry zone.
Fiji Pine Research Paper, Fiji Pine Commission/Fiji Forestry Department (No. 10), 7 pp.

Report on energy plantation trials established at the Lololo Forest near Lautoka in 1981. Data are given on height and dbh at 1-year-old of 10 eucalypts, *Casuarina equisetifolia*, *Leucaena leucocephala*, *Acacia auriculiformis* and *Pinus caribaea*. Best height growth was recorded for *Eucalyptus camaldulensis* and *E. tereticornis*, and growth was better if weeding was done by hoeing rather than slashing. *A. auriculiformis* grew vigorously with dense foliage that had completely closed canopy at the end of the year, and is recommended for areas where cultivation is not practicable. The species requires very little maintenance compared to eucalypts.

37

Bell, T.I.W. and Evo, T. (1983).
Fuelwood plantations and the Fijian village community.
Fiji Pine Research Paper, Fiji Pine Commission/Fiji Forestry Department (No. 12), 6 pp.

A further report on the energy plantation trials in Fiji giving 2-year-old data. *Eucalyptus camaldulensis* and *E. tereticornis* were still the two fastest growing species (7.9 and 7.7 m respectively) where weeding was done by hoeing. *Acacia auriculiformis* was also performing well (5 m tall) and was ranked third in the trial. Two new trials were established which also included *Acacia mangium* and results obtained at age 1 year showed that *A. mangium* was also promising.

38

Bhakar, V. and Dasappa. (1986).
Ground flora in *Eucalyptus* plantations of different ages.
P 213-214 *in* Eucalypts in India. Past, present and future: proceedings of the national seminar held at Kerala State Forest Research Institute, Peechi, Kerala, India, January 30-31, 1984, (eds Sharma, J.K., Nair, C.T.S., Kedharnath, S., and Kondas, S.).

Ground vegetation was sampled below 1- to 10-year-old plantations of *Eucalyptus tereticornis*, 4- and 7-year-old *Casuarina equisetifolia*, 7-year-old *Acacia auriculiformis* and *Grevillea robusta* and on open ground in Karnataka. Results showed that there were fewer ground species and fewer plants per square metre below plantations of *A. auriculiformis*, *C. equisetifolia* and >6 years old *E. tereticornis* than below plantations of *G. robusta*. It was suggested that *A. auriculiformis*, *E. tereticornis* and *C. equisetifolia* had profusely branched superficial root system which restricted the development of ground vegetation.

It is also possible that shading and heavy litter fall of *A. auriculiformis* could have contributed to weed suppression, and restricted the number of ground species.

39

Bhumibhamon, S. (1985).
The status of genetic research in tree farming in Thailand.
P 553-556 *in* Increasing productivity of multipurpose species: proceedings of the

IUFRO Planning Workshop for Asia on forest research and technology transfer held in Kandy, Sri Lanka, 16-28 July 1984, (eds Burley, J. and Stewart, J.L.).

Describes the reforestation and tree improvement programs operated by the Thai Plywood Company in cooperation with the Faculty of Forestry, Kasetsart University. Work on *Acacia auriculiformis* has involved selection of 50 plus trees and establishment of a seedling seed orchard based on 25 selected families.

40

Bloem, J.W. (1948).
***Eucalyptus* in connection with the cultivation problem on poor soils.**
Tectona 38, 125-159. (Nl, en)

Acacia auriculiformis and other hardwood species (e.g. *Swietenia macrophylla*, *Dalbergia sissoo*, *Melaleuca leucadendron*, *Casuarina equisetifolia* and *Eucalyptus platyphylla* [*E. alba*]) were found to be suitable for planting on poor soil and drier areas in Java and the Sunda Islands of Indonesia where teak was not successful. In contrast to *S. macrophylla* and *D. sissoo*, *A. auriculiformis* appeared not to have commercial value. *Eucalyptus* species have been trialed for afforestation but most of the trial plots were located outside the arid areas.

41

Boboye, F. Ade. (1982).
The effect of potting media on the germination, survival and growth of *Acacia auriculiformis* seedlings.
Research report, College of Forestry, University of the Philippines at Los Banos.

It is concluded that germination of *Acacia auriculiformis* seeds was not affected by different media (i.e. sand, sawdust, peat, and top soil), and that the seeds could be germinated in any of the media used with relatively good results.

Survival of the germinated seedlings of both direct sowing and potted seedlings was generally high, and was not significantly affected by the media although the rate tended to be higher in sawdust and top soil than in peat and sand. Seedlings were taller and bigger in peat medium.

Peat medium would probably have better water-holding characteristics which resulted in increased number and size of leaves and accelerated rate of photosynthesis.

42

Boland, D.J. (ed.) (1989).
Trees for the tropics - growing Australian multipurpose trees and shrubs in developing countries.
Australian Centre for International Agricultural Research Monograph No. 10, 247 pp.

This book consists of a series of papers summarising collaborative efforts between research organisations in Australia and overseas countries to evaluate, domesticate and utilise a wide range of lesser-known Australian tropical and subtropical tree species. Performance of *Acacia auriculiformis* in field trials in Australia, China, Kenya, Thailand and Zimbabwe is reported. The species is also evaluated in several aspects including its potential for vegetative propagation, coppicing ability, drying and burning properties and fodder

value. Individual chapters providing information on *A. auriculiformis* are listed separately in this bibliography.

43

Boland, D.J. and Turnbull, J.W. (1981).
Selection of Australian trees other than eucalypts for trials as fuelwood species in developing countries.
Australian Forestry 44, 235-246.

The article discusses ecological, botanical and management criteria that could be used in the selection of Australian tree species, other than eucalypts, with potential for fuelwood production. A short list of species with potential for fuelwood and multiple uses is presented. *Acacia auriculiformis* is recommended for the humid tropics.

44

Boland, D.J., Brooker, M.I.H., Chippendale, G.M., Hall, N., Hyland, B.P.M., Johnston, R.D., Kleinig, D.A. and Turner, J.D. (1984).
Forest Trees of Australia.
Commonwealth Scientific and Industrial Research Organisation, Melbourne, Australia.

The ecology and silvicultural characteristics of *Acacia auriculiformis* are described together with a map showing the natural occurrence of the species in northern Australia. Also provided is a set of photographs showing adult trees, bark, seedling, phyllodes, flower spikes, pods and seed.

45

Boland, D.J. and Pinyopusarerk, K. (1987).
Early growth and survival of some *Eucalyptus* and Australian tree species planted at Tung Kula Ronghai Development Project in northeastern Thailand.
Thai Journal of Forestry 6(3), 250-267.

Early results of selected Australian tree species planted in a trial on a salt-affected area in northeastern Thailand. Height, diameter at ground level and survival were recorded at 6 and 12 months after planting. *Acacia auriculiformis* was among several species showing most promise at the early stages.

46

Boland, D.J. and Pinyopusarerk, K. (1988).
***Acacia auriculiformis* international provenance trials - a guide for research cooperators.**
CSIRO Division of Forestry and Forest Products, Canberra, 13 pp.

A field manual providing guidelines for research collaborators participating in an international provenance trial of *Acacia auriculiformis* jointly funded by F/FRED Project and ACIAR. It outlines procedures to follow dealing with selection of trial sites, trial design, seedling production, site preparation, planting and maintenance of trials.

47

Boland, D.J., Pinyopusarerk, K., McDonald, M.W., Jovanovic, T. and Booth, T.H. (1990).
The natural habitat of *Acacia auriculiformis* and factors associated with its distribution.

To be submitted to Journal of Tropical Forest Science.

This paper describes the natural distribution of *Acacia auriculiformis* in Australia (Northern Territory and Queensland), Papua New Guinea and Indonesia. Details are given of past geological and climatic events that may have been important in moulding the distribution. The species is fairly primitive and may have evolved on rainforest fringes sympatrically with *A. aulacocarpa* and *A. crassicarpa* and in recent times it appears to have expanded from monsoon vine forests and gallery rainforests when conditions were favourable and retreated during unfavourable times. The species is opportunistic and very mobile. Rising sea levels and periods of aridity were probably the major factors in determining its current distribution. Implications for seed collection programs and for the interpretation of results from future biosystematic studies are discussed.

48

Boontawee, B. and Kuwalairat, P. (1987).
Introduction of *Acacia mangium* to Thailand.
P 149-150 *in* Australian acacias in developing countries: proceedings of an international workshop held at the Forestry Training Centre, Gympie, Queensland, Australia, 4-7 August 1986 (ed Turnbull, J.W.), ACIAR Proceedings No. 16.

In an arboretum trial plot at Sakaerat, Nakhon Ratchasima, northeast Thailand, *Acacia auriculiformis* grew faster than *Acacia mangium* in the first year, but it was outgrown by *A. mangium* in the second year. The result has generated more planting of *A. mangium* at Sakaerat.

49

Booth, T.H. (1987).
Selecting *Acacia* species for testing outside Australia.
P 74-76 *in* Australian acacias in developing countries: proceedings of an international workshop held at the Forestry Training Centre, Gympie, Queensland, Australia, 4-7 August 1986 (ed Turnbull, J.W.), ACIAR Proceedings No. 16.

Describes two new methods of climatic analysis which can assist identifying species worth evaluating in field trials outside their natural distributions in Australia.

The first method is demonstrated by analysing climatic conditions at an ACIAR trial at Ratchaburi, Thailand. From 36 monthly values, 18 climatic indices (e.g. annual mean temperature, coldest month minimum temperature and driest month mean precipitation) were calculated. The same indices were also calculated for each of 2795 points in a half degree grid across Australia so a climatic similarity computer program (CLIMSIM) can calculate the similarity between the Ratchaburi trial site and the locations in the regular grid across Australia. Data from this program is then used to produce a map which shows those areas of Australia most climatically similar to Ratchaburi. Such areas are likely to confirm species that will do well at Ratchaburi.

The second method determines climatic requirements for *Acacia auriculiformis*. The Bioclimate Prediction System (BIOCLIM) program was used to analyse climatic conditions within the species' natural distribution. Locations in Africa which satisfied three main climatic characteristics (annual mean temperature, annual mean precipitation and driest quarter precipitation) were

then mapped. The paper describes how analysis of the natural distribution can provide a provisional indication of climatic requirements, which can be improved as results from trials become available.

50

Booth T.H. and Jovanovic, T. (1988). **Assaying natural climatic variability in some Australian species with fuelwood and agroforestry potential.** Commonwealth Forestry Review 67(1), 27-34.

Data from over 600 sites in Australia were used to determine the bioclimatic profiles of nine Australian tree species including *Acacia auriculiformis*. It was concluded that these profiles would be useful when establishing trials outside Australia as they would provide a preliminary indication of climatic requirements and assist the selection of provenances for particular climatic conditions.

Twelve important climatic factors used to determine a climatic profile for *Acacia auriculiformis* are as follows:

	Minimum	Maximum
Annual mean temperature(°C)	25.7	27.9
Coldest month minimum temperature (°C)	12.6	20.5
Hottest month maximum temperature (°C)	32.3	38.4
Annual temperature range (°C)	11.8	25.1
Wettest quarter mean temperature (°C)	27.0	29.9
Driest quarter mean temperature (°C)	22.7	25.8
Annual mean precipitation (mm)	763	1667
Wettest month mean precipitation (mm)	185	432
Driest month mean precipitation (mm)	0	4
Annual precipitation range (mm)	184	431
Wettest quarter mean precipitation (mm)	519	1152
Driest quarter mean precipitation (mm)	0	18

The above climatic profile for *A. auriculiformis* was generated from 65 sites in Australia and thus wetter sites in Papua New Guinea were not included e.g. at Dani, annual precipitation is 2000 mm, and the driest quarter mean precipitation is 200 mm.

51

Bowen, M.R. (1981).
***Acacia mangium* - A note on seed collection, handling and storage techniques including some experimental data and information on *A. auriculiformis* and probable *A. mangium* x *A. auriculiformis* hybrid.**
Occasional Technical and Scientific Notes. Seed Series No. 3. FAO/UNDP-MAL/78/009 January 1981.

This report compares, qualitatively and quantitatively, flower, fruit and seed of *Acacia mangium* (AM), *A. auriculiformis* (AA) and suspected hybrid *A. mangium* x *A. auriculiformis* (AM x AA). In general, the hybrid possesses characteristics intermediate between those of the two parent species. Some results from the observations (averaged values) are shown below:

52

Bowen, M.R. and Eusebio, T.V. (1982).
Possible *Acacia* species for use in Sabah plantations (other than *A. mangium*).
Working Paper No. 6, FAO/UNDP-MAL/78/009 April, 1982.

Principal features of *Acacia auriculiformis*, *A. crassicarpa* and *A. cincinnata* are described together with preliminary results of germination tests. These three acacias are recommended for trial in Sabah as a result of a visit to Queensland, Australia and Papua New Guinea by the senior author.

53

Brewbaker, J.L. (1987).
Performance of Australian acacias in Hawaiian nitrogen-fixing tree trials.
P 180-184 *in* Australian acacias in developing countries: proceedings of an international workshop held at the Forestry Training Centre, Gympie, Queensland, Australia, 4-7 August 1986 (ed Turnbull, J.W.), ACIAR Proceedings No. 16.

	AM	AM x AA	AA
No. spikes/node	2.5	1.7	1.5
No. spikes/branch	28.3	19.9	18.5
Length of flowering spikes (mm)	74	63	72
Width of flowering spikes (mm)	10	10	9
No. florets/cm of spike	53	45	32
No. florets/spike	11,080	5,639	4,251
Funicle length (mm)	21.8	33.9	46.1
Seed length (mm)	3.9	4.8	5.4
Seed width (mm)	2.5	3.2	3.9
Seed thickness (mm)	1.4	1.5	1.4

Reports on seven replicated field trials (five in Hawaii, U.S.A. and one each in Indonesia and Philippines) initiated in 1981 to compare 23 fast-growing nitrogen-fixing tree species. Trial sites in Hawaii and Southeast Asia range from latitude 3°S to 21°N and altitude from 20 to 610 m, mean annual temperatures range from 19 to 29°C. Data are presented for three acacias included in these trials; *Acacia auriculiformis*, *A. mangium* and *A. mearnsii*, together with two leucaenas; *Leucaena leucocephala* and *L. diversifolia*.

Results obtained at 1.7-to 3.0-year old show that *A. auriculiformis* and *A. mangium* grew slower than the other three species at most sites. Only at Nakau, Indonesia [North Sumatra] which is a hot and humid lowland site that *A. auriculiformis* and *A. mangium* were superior to leucaenas.

Specific gravity (dry matter/displacement volume) and percent moisture content (fresh weight basis) of these species at age 2 years are compared.

Species	Specific gravity	% moisture content
A. auriculiformis	0.51	45
A. mangium	0.53	44
A. mearnsii	0.47	57
L. leucocephala	0.55	39
L. diversifolia	0.49	47

54

Brewbaker, J., Halliday, J. and Lyman, J. (1983).
Economically important nitrogen fixing tree species.
Nitrogen Fixing Tree Research Reports 1, 35-40

Gives a list of 44 nitrogen-fixing trees of high fuelwood value. The same format is used for each species covering the following details :

Species (Family)
1. origin; height, shape
2. uses and characteristics
3. adaptation (including minimum rainfall)
4. comments, chromosome number

Acacia auriculiformis is one of the species with wide adaptability, suitable for planting on acid soils having minimum mean annual rainfall of 750 mm. Chromosome number is 2n=26.

55

Brewbaker, J.L., Van Den Beldt, R. and MacDicken, K. (1984).
Fuelwood uses and properties of nitrogen-fixing trees.
Pesquisa Agropecuaria Brasileira 19(special), 193-204.

Some results of a network of trials of nitrogen-fixing trees suitable for fuelwood and charcoal being supported financially from the U.S. Academy of Sciences and the Nitrogen Fixing Tree Association are discussed. The trials are conducted at high population densities (spacing 1 x 1 or 1 x 2 m) and with small plots on well-managed experimental areas at high elevation and acid soil locations. No simple generalisation can be made of outstanding species at all locations but there are one or more species which yield as much or more than the control (best locally adapted eucalypt). The following species are most outstanding in the humid tropics :

Acacia auriculiformis (acid soils)
A. mangium (acid soils)
A. mearnsii (highlands)
Albizia falcataria
Casuarina equisetifolia (saline soil)
Gliricidia sepium
Leucaena leucocephala (non-acid soils)
L. diversifolia

56

Brock, J. (1988).
Top End native plants.
John Brock, Darwin, Northern Territory, Australia.

The book provides detailed descriptions of trees and shrubs of the Top End of Northern Territory. A map showing natural distribution is provided for each species together with photos of the tree, flowers and fruits or pods etc. The flowering period of *Acacia auriculiformis* is during April to June, and fruiting period from July to October.

57

Bruijnzeel, L.A. and Wiersum, K.F. (1987).
Rainfall interception by a young *Acacia auriculiformis* (A. Cunn.) plantation forest in West Java, Indonesia: application of Gash's analytical model.
Hydrological Processes 1(4), 309-319.

From Forestry Abstracts: Data are presented for rainfall, throughfall, stemflow and derived interception losses on a daily basis for 2 consecutive rainy seasons in a 4-5-year-old rapidly growing plantation. Although similar results have been reported from other South-east Asian sites, the model suggests that the Java results are anomalous, probably because of difficulty in obtaining a reliable estimate of evaporation rate from a saturated canopy in the humid tropics.

58

Bunyavejchewin, S., Puriyakorn, B. and Boontawee, B. (1986).
Above-ground biomass, firewood and charcoal production, nutrient and energy of five tree species.
Silvicultural Research Report 1984-85, Royal Forest Department, Thailand, p 367-80. (Th)

Data obtained at 18 months after planting are presented for above-ground biomass (dry), firewood and charcoal production, nutrient concentration and calorific values of five fast-growing tree species planted at 1x2 m spacing at Ratchaburi province, Thailand. Soils are generally lateritic.

Acacia auriculiformis produced the smallest above-ground biomass (9.0 t/ha) and *Leucaena leucocephala* the greatest (32.5 t/ha). The values recorded for *Eucalyptus camaldulensis*, *Cassia siamea* and *Azadirachta indica* were 23.5, 23.3 and 14.8 t/ha respectively. Production of firewood and charcoal were also lowest for *A. auriculiformis*.

59

Bunyavejchewin, S. and Visetsiri, K. (1986).
Studies into the growth, above-ground dry matter, and firewood production of a 3-year-old sample plot of *Acacia auriculaeformis* A. Cunn. and *Peltophorum pterocarpum* Back. ex Heyne at Dong Larn, Khon Kaen.
Silvicultural Research Report 1984-85, Royal Forest Department, Thailand, p 323-41. (Th, en)

Reports results from an energy plantation trial established to study growth, biomass and firewood production under different spacing (1x1, 1x2 and 2x2 m) in 3-year-old sample plots of *Acacia auriculiformis* and *Peltophorum pterocarpum* at Dong Lam, Khon Kaen, northeast Thailand. Latitude 16°35'N, longitude 102°10'E, altitude 500 m, annual rainfall 1250-1300 mm. *A. auriculiformis* generally grew faster and produced greater biomass and firewood than *P. pterocarpum*.

For *A. auriculiformis* greatest height was obtained from 1x2 m spacing (8.3 m) and greatest dbh from 1x1 m spacing (7.8 cm). Total above ground biomass production (oven dry) was greatest under 1x1 m spacing 64 t/ha) followed by the values recorded under 2x2 and 1x2 (30 and 12 t/ha respectively). Firewood production followed a trend similar to that obtained for biomass production.

The data of above-ground biomass and firewood recorded for *A. auriculiformis* at 1x1 m spacing were somewhat higher than they should have been. It was suggested that the plant mortality was very high under 1x1 spacing, and most of the surviving trees were quite large and heavy branching resulting in an abnormally high biomass production per unit area.

60

Catinot, R. (1984).
In French-speaking Africa, the future of the tropical forest will depend on the rural communities. The forest cannot be disassociated from its natural environment and its inhabitants.
Bois et Forets des Tropiques (No. 203), 7-43. (Fr, en)

Large-scale reforestation programs are recommended to alleviate the rapid decline in forest land as a result of forest clearance forest to provide agricultural land, firewood and timber. Great emphasis is given on social forestry aspects in order to involve local people because it is felt that the local people feel no responsibility for maintenance of the forests since all forests are entirely state-owned. *Acacia mangium*, *A. auriculiformis* and *Calliandra calothyrsus* are suggested as species especially suitable for planting as forest fallow between agricultural crops, as these species combine high productivity with the ability to improve soil fertility.

61

Cen, B.Z., Hwang, L.F. and Zheng, H.Q. (1986).
A comparison study on the activities of three enzymes in the leaves of *Acacia auriculiformis* susceptible and resistant to *Oidium* sp.
Journal of the South China Agricultural University 7(2), 66-75. (Ch, en)

Young leaves (phyllodes) of *Acacia auriculiformis* are more susceptible to powdery mildew (*Oidium* sp) than old phyllodes. Apparently, activities of ascorbic acid oxidase and peroxidase isoenzyme are higher in old phyllodes. Application of ascorbic acid to infected phyllodes promotes greening and stops the lesions spreading. Activity of ascorbic acid oxidase in young, susceptible phyllodes is increased markedly within 24 hours of the application.

62

Chakraborty, R.N. and Chakraborty, D. (1989).
Changes in soil properties under *Acacia auriculiformis* plantations in Tripura.
Indian Forester 115 (4), 272-273.

Acacia auriculiformis was introduced to Tripura [a State in the east of India] during 1950s but the species did not receive much attention at that time. With deforestation and deterioration of soil, it was found later that *A. auriculiformis* is especially suitable for planting on these degraded lands.

A study on changes in chemical properties of the soils under 2- to 4-year-old plantations of *A. auriculiformis* shows a remarkable improvement in the soil properties. Soil colour changed from light yellowish brown to brown. Soil pH was increased from acidic (5.9) in control area to slightly alkaline (7.6). Electrical conductivity of the soil was increased from 27.9 to 48.4 m mhos/cm. Water holding capacity was also increased from 22.9% to 32.7%. Organic carbon, nitrogen and potassium contents also show an increasing trend. It is concluded that the improvement of the soil is attributed to the fast growing characteristic where even the 3-year-old plantation can provide a good soil coverage and accumulation of leaf litter.

63

Chalermpongse, A. (1988).
Introduction to forest pathology in Thailand.
Paper, IUFRO Workshop on Pests and Diseases of Forest Plantations held in Bangkok, Thailand, 5-11 June 1988.

A comprehensive review of potentially dangerous forest tree diseases identified and reported in Thailand. Control measures are recommended based on the results of laboratory and field studies. Research on biology and ecology of the serious diseases is emphasised.

Foliage diseases of *Acacia auriculiformis* are reported. Sooty mould (*Meliola* sp) is reported to attack phyllodes of *A. auriculiformis* and a few other acacias in an ACIAR trial in Prachuap Khiri Khan. Infection of this mould is found to reduce after the wet season commences. No control measures have been developed.

A. auriculiformis seedlings in the nursery are reportedly attacked by powdery mildew (*Oidium* sp.). There is no report of mortality.

64

Chandhar, S.K. (1985).
Irrigated plantations on Bhata land of Chattisgarh and their prospects.
Vaniki Sandesh 9(3), 7-9.

Early results of an irrigated plantation experiment on Bhata land which is characterised by hard lateritic soil comprising hydrated aluminium and iron oxides, and hard pan at 1 m depth. Plantations of 15 species were established in July 1984, and received flood irrigation once a month in January, March and April 1985. Compared with the non-irrigated plantations, most species including *Acacia auriculiformis* increased their growth rate by 100%. The irrigation did not improve growth of trees in some species e.g. *Azadirachta indica* and *Emblica officinalis*.

The results obtained for survival are rather confusing: irrigated trees of some species had lower survival rates than non-irrigated trees.

65

Chandra Babu, R., Natarajarathnam, N., Padmanabhan, G. and Dharmaraj, G. (1987).
An analysis of drought adaptive characters in certain species of *Acacia*.
Indian Journal of Forestry 10 (4), 276-278.

Five species of *Acacia* were studied for their variation in drought adaptive characteristics. There were significant differences between species in relative bark moisture content, leaf temperature, stomatal resistance, transpiration rate, stem water potential and proline content. Among the species tested, *Acacia auriculiformis* appeared to have better adaptive mechanisms to withstand arid conditions. The other acacias included in the study were *A. albida*, *A. nilotica*, *A. tortilis* and *A. suma*.

A. auriculiformis is normally known to be less well adapted to moisture stress than the other four *Acacia* species included in this study. In the study reported here, the transpiration rate of *A. nilotica* (35.1 mg H_2O $S^{-1}cm^{-2}$) is almost triple than that of *A. auriculiformis* (12.7).

66

Chang, K.P., Hu, H.T. and Kao, P.C. (1986).
Effect of endomycorrhizal fungi and *Rhizobium* inoculation on growth of *Acacia auriculiformis* A. Cunn. ex Benth.
Nitrogen Fixing Tree Research Reports 4, 40-41.

Acacia auriculiformis seedlings were grown for 8 months in sterilised soil that was uninoculated (control) or inoculated with *Rhizobium* and/or VA-mycorrhiza (*Glomus fasciculatum*). Seedlings inoculated with only *Rhizobium* had greater root and shoot dry weight and N uptake than control seedlings, but very few nodules were formed and no C_2H_4 production could be measured by the acetylene reduction method. Inoculation with *G. fasciculatum* alone assisted natural formation of effective nodules (89/plant). Inoculation with both *Rhizobium* and *G. fasciculatum* resulted in the greatest number of nodules, seedling weight, and uptake of N and P.

67

Chantrasiri, S. (1988).
Fast-growing nitrogen fixing trees as MPTS for fuelwood and charcoal on small farms.
P 272 *in* Multipurpose tree species for small-farm use: proceedings of an international workshop held in Pattaya, Thailand, 2-5 November 1987, (eds Withington, D., MacDicken, K.G., Sastry, C.B. and Adams, N.R.).

A brief account of calorific values and coppicing ability of some multipurpose tree species in Thailand. Calorific value of wood of *Acacia auriculiformis* is shown to be 4690 kcal/kg for fuelwood and 7410 kcal/kg for charcoal. Its coppicing ability is, however, poorer than many other fuelwood species e.g. *Eucalyptus camaldulensis* and *Leucaena leucocephala*.

The ability to coppice is an important characteristic when selecting tree species for fuelwood plantation establishment. Coppicing ability of *A. auriculiformis* is not well-understood and needs research.

68

Chaturvedi, A.N. (1985).
Biomass production on saline-alkaline soils.
Nitrogen Fixing Tree Research Reports 3, 7-8.

A brief account of the need to establish firewood plantations in degraded and unproductive, saline-alkaline lands (soil pH 7.8-9.7) which cover about 7.1 million ha in India. Several experiments have been established in these areas to determine suitable species. Data from one experiment are presented on above-ground biomass production. The most productive species is *Prosopis juliflora* while *Acacia auriculiformis* is about average of those species studied. *Leucaena leucocephala* completely failed after showing rapid growth for about 6 months.

69

Chaturvedi, A.N., Sharma, S.C. and Srivastava, R. (1984).
Water consumption and biomass production of some forest trees.
Commonwealth Forestry Review 63(3), 217-223.

Results are presented from lysimeter studies at Kanpur, Uttar Pradesh, India, of seedlings of *Albizzia* [*Albizia*] *lebbek*, *Acacia auriculiformis*, *Dulbergia sissoo*, *Pongamia pinnata*, *Syzygium cuminii* and *Eucalyptus* hybrid [*E. tereticornis*].

After one year, *A. auriculiformis* consumed 1,475 litres of water and produced 1,713 g of dry biomass. This represents an average consumption of water per gram of biomass of 0.86 litre. In regard to volume production, the species produces 1,354 cm^3 volume or an average consumption of water per cm^3 of 1.09 litre. Compared with other species tested *A. auriculiformis* is regarded as intermediate based on its productivity per litre of water consumed.

In this study, *E. tereticornis* consumed the most water (2,662 litres) but it also produced the most biomass (5,209 g) and volume (4,031 cm^3). It is most productive based on the quantity of water consumption (i.e. 0.51 litre per g biomass or 0.56 litre per cm^3 volume). On the contrary, *Pongamia pinnata* consumed the least water (679 litre) but it also produced the least biomass 502 g and volume (251 cm^3), and it is considered to be the least productive (i.e. 1.3 litre per g biomass or 2.7 litre per cm^3 volume).

70

Chaturvedi, A.N., Bhatt, D.N., Singh, U.N. and Gupta, N.N. (1984).
Response of certain forest tree species to varying pH levels under pot culture.
Van Vigyan 23 (3-4), 79-84.

From Forestry Abstracts: Pot culture trials were carried out to determine the response of 5 species (*Azadirachta indica*, *Pongamia pinnata*, *Terminalia arjuna*, *Acacia auriculiformis* and *Eucalyptus tereticornis*) to alkaline soil. All species grew fairly well in soils with a pH up to 10, but growth of *E. tereticornis* was good only up to pH 9.

71

Chaturvedi, A.N., Bhatt, D.N., Mishra, C.M. and Singh, S.L. (1986).
Root development in some tree species on usar soils.
Journal of Tropical Forestry 2(2), 119-130.

Root development of healthy and poorly grown trees of 15 tree species including *Acacia auriculiformis* aged 17 years old were examined. It is noted that vigorous trees generally have healthier lateral root systems. Tree species developing a superficial root system also grow better than those having a pronounced tap-root. *A. auriculiformis* is one of the species which grow well on these saline-alkaline soils.

72

Cheng, T.Y., Yang, J.C. and Chen, Z.Z. (1983).
The early growth of two exotic *Acacia* species in the middle-south of Taiwan.
Nitrogen Fixing Tree Research Reports 1, 23.

Reports growth performance of two exotic acacias, i.e. *Acacia auriculiformis* and *A. mangium*, in comparison with *A. confusa* a species native to Taiwan. Results up to 4 years after planting show that both exotic acacias grow much faster than the local species in height, diameter and thus woody biomass production. *A. auriculiformis*, though taller, produces less wood than *A. mangium* due to its smaller diameter.

73

Chinsukjaiprasert, T. Chayamarit, C. and Ruaysoongnern, S. (1989).
Above-ground biomass and firewood production of *Leucaena leucocephala*, *Acacia auriculiformis* and *Docynia indica* at 5 years old at Watershed Development No. 32 (Doi Musoe), Tak.
Watershed Management Division, Royal Forest Department, Thailand. (Th)

Five-year-old plantations of *Acacia auriculiformis*, *Leucaena leucocephala* and *Docynia indica* at Doi Musoe Watershed Development Unit were sampled for biomass and firewood assessments. The study site is steep in slope (35%), average altitude 800 m, annual rainfall 1700 mm and red-yellow podzolic soil. *A. auriculiformis* produced least above-ground dry biomass (46 t/ha) as compared to *L. leucocephala* (48 t/ha) and *D. indica* (90 t/ha). Firewood production followed a similar trend, i.e. least for *A. auriculiformis* (180 m^3/ha) as compared to *L. leucocephala* (208 m^3/ha) and *D. indica* (227 m^3/ha).

74

Chomcharn, A., Visuthidepakul, S. and Hortrakul, P. (1986).
Wood properties and potential uses of 14 fast-growing tree species.
Report, Division of Forest Products Research, Royal Forest Department, Thailand. (Th)

Thirteen-year-old plantation grown trees of *Acacia auriculiformis* were tested for physical properties and potential use. The results are summarised below:

Physical property

Defect in lumber	
Bow	2.6 mm/m
Spring	2.8 mm/m
Split	17.5 mm/m
Collapse	none
Knot	
-average diameter	1.07 cm
-number/sq ft	0.9
Sapwood	28%
Heartwood	72%
Texture	medium coarse
Grain	straight
Colour	light brown
Shrinkage (oven-dried)	
Tangential	2.6%
Radial	1.3%
Air-dry density	0.798 g/cm^3
Ease of machining	easy-moderate

Potential uses

Pole	not suitable
Light construction	not suitable
Furniture	very good
Frame	good
Flooring	very good
Parquetry	very good
Turning & carving	very good

75

Chong, L. (1986).
Occurrence of mycorrhizae in seedlings of some tree species in Sarawak.
Paper, The 9th Malaysian Forestry Conference, Kuching, Sarawak, Malaysia, 13-20 October 1986, 12 pp.

Roots of 25 species of nursery-raised seedlings were examined for mycorrhizal infections. *Acacia auriculiformis* and *A. mangium* developed both vesicular-arbuscular mycorrhizas and ectomycorrhizas. Endomycorrhizal fungi were observed on all species.

76

Chujit, N. (1982).
Application of ammonium sulphate as a fire retardant to *Acacia auriculaeformis* A. Cunn. ex Benth. seedlings.
M.Sc. thesis, Kasetsart University, Thailand. (Th, en)

Application of ammonium sulphate on young plants of *Acacia auriculiformis* at the amount of 0, 1, 1.5 and 2 litre/plant prior to prescribed burning showed that highest survival was achieved for the plants being sprayed at a rate of 1 litre/plant while best height growth was achieved for the plants being sprayed at 2 litre/plant. This significant effect was obtained when spraying and burning were done in January 1980 in Tak Province, Thailand. A duplicate experiment carried out in February 1980 showed no significant effect of ammonium sulphate application probably due to high air temperature at the experimental site.

77

Chunkao, K. (1968).
A preliminary study of throughfall distribution under *Acacia auriculaeformis* A. Cunn.
Forest Research Bulletin, Faculty of Forestry, Kasetsart University, Thailand, (No 3), 17 pp. (Th, en)

Three transects were set out in different directions from an isolated tree of *Acacia auriculiformis*, and rain-gauges placed at 3 points along each transect. Meteorological data, including rainfall, were recorded throughout the experimental period. Throughfall was found to increase with increasing distance from the tree. With its dense foliage and the ability to grow well on any site conditions especially on wet area

and shallow water table, it is suggested that the species is better suited for soil conservation than for water conservation.

78

Corvanich, A. (1982).
Fast-growing trees and plantation forestry in Thailand.
The Forestry Association of Thailand. Bangkok, 228 pp. (Th)

Includes a literature review on *Acacia auriculiformis* giving information on its introduction to Thailand, natural distribution, and potential use as a plantation species in Thailand.

The species was introduced to Thailand from Australia as an ornamental tree in 1935, but there was no record of the seed origin. It has since been planted almost all over the country because of its wide adaptability to a variety of site conditions.

Information in regard to species' distribution, growth characteristics and uses generally referred to those appearing in National Academy of Science (1979, 1980).

79

Coster, C. (1933).
Travel report No. 21, September/October 1933.
Unpublished report, 31 pp. (Nl)

The author reports on his visit to several field experiments dealing with land stabilisation in East Java. *Acacia auriculiformis* is among many other species (*Eucalyptus alba, Cassia siamea, Acacia leucophloea, Peltophorum pterocarpum* and *Casuarina equisetifolia*) grown successfully to control erosion in Penaggaron area.

80

Coster, C. (1934).
The significance of forestry of some Java imported *Acacia* species.
Tectona 27, 101-141. (Nl, en)

Acacia auriculiformis is described in the article, along with 12 other *Acacia* species, with particular reference to silvicultural aspects. Propagation of *Acacia* species is normally by seed but pretreatment is necessary to improve the germination of the hard shelled seed. Three methods used in seed pretreatments are nicking, soaking in hot water, and sulphuric acid treatment.

Number of seeds per kg is given for some of *Acacia* species, e.g. 54,000 per kg for *A. auriculiformis*. *Acacia* species are considered to be economically important. They are suitable as green manure and their bark is a source of tannin extract.

81

Coster, C. (1937a).
Travel report No. 24, August/September 1937.
Unpublished report, 10 pp. (Nl)

At Indramayu in West Java *Acacia auriculiformis* shows moderate growth rate, whereas at East Ponorogo in East Java the species grows well on poor soils.

82

Coster, C. (1937b).
Travel report No. 25, December 1937.
Unpublished report, 7 pp. (NI)

At Sidayulawas (Tuban) [East Java], trial plantations established in 1930 indicate that *Acacia auriculiformis*, *Swietenia macrophylla* and *Peltophorum pterocarpum* can be planted on a larger scale. These species are suggested for planting in the poorest soil areas at Kemlagi, Mojokerto.

83

Coster, C. and Blink, G C. van den. (1939).
Travel report No. 1, January 1939.
Unpublished report, 19 pp. (NI)

Mentions that at Ponorogo *Acacia auriculiformis* is grown on soil too poor for teak.

84

Cromer, R.N. (1989).
Response of Australian tree species to nitrogen and phosphorus in Thailand.
P 139-143 *in* Trees for the tropics - growing Australian multipurpose trees and shrubs in developing countries (ed Boland, D.J.), ACIAR Monograph No. 10.

A fertiliser experiment was conducted at two sites in Thailand i.e. at Ratchaburi; low in available P but high in cation exchange capacity, and at Huai Bong, Chiang Mai; high in available P but low in cation exchange capacity. *Acacia auriculiformis* and *Casuarina equisetifolia* responded to application of P fertiliser at Huai Bong but not at Ratchaburi while *Eucalyptus camaldulensis* showed a small response at Huai Bong. Growth was generally better at Ratchaburi compared with Huai Bong. No response to N fertiliser was evident at either site.

Growth responses to phosphorus occurred at Huai Bong, despite high level of available soil phosphorus and lack of a general increase in foliar concentration of phosphorus following fertiliser application. On the contrary, there were substantial increases in foliar phosphorus concentration in all species despite lack of a growth response at Ratchaburi. The results suggest that soil characteristics of potential plantation sites in Thailand vary considerably, resulting in variable growth rates and response to fertiliser. More nutritional research is recommended.

85

Date, G.P. (1986).
Plantation and nursery technique series.
Vaniki Sandesh 10(2), 20-21.

Nursery, field planting techniques and some silvicultural aspects of *Acacia auriculiformis* in Madhya Pradesh, India are given as follows.

Adaptability:	raised successfully at all elevations and climate; grows on wide range of soils but growth is poorer on rocky soils and frosty locations
Flowering:	October
Seed collection:	December
Number of clean seeds:	38000-42000 per kg
Storage:	up to 18 months in air-tight conditions at room temperature
Germination:	best germination within 2 months after seed ripening
Planting:	containerised seedlings 25-30 cm in height
Spacing:	3x3 m
Yield:	MAI about 20 m^3/ha at 10-12 years old
Coppicing ability:	poor but responds to pollarding

86

David, C.A. (1980).
***Albizia* and *Acacia* species trials on white sands : three years after planting.**
Guyana Forestry Commission, Georgetown, Guyana.

Reports 3-year-results of two trials planted in March 1977 on white sand areas in Yarowkabra, Guyana; altitude 100 ft [30.5 m], annual rainfall 100 inches [1640 mm], mean temperature 80°F [26.7°C], soil pH 4.7 and low fertility.

The first trial compared growth and survival of *Albizia falcataria* (seed from Dami Forestry Station, Papua New Guinea), and *Acacia auriculiformis* (Waigani, Papua New Guinea). *A. auriculiformis* totally outperformed *A. falcataria* in survival and growth. Survival of *A. auriculiformis* was 96.9% compared with only 6.2% of *A. falcataria*. Height of *A. auriculiformis* was 26.3 ft [8 m] while that of *A. falcataria* averaged only 6.3 ft [1.9 m].

The second trial compared *A. auriculiformis* (same seedlot) with *A. aulacocarpa* var. *aulacocarpa* (Danbulla, Queensland, Australia). Both species had 100% survival but *A. aulacocarpa* grew faster than *A. auriculiformis*. *A. aulacocarpa* attained height and girth of 41.1 ft [12.5 m] and 16.8 in [42.7 cm] respectively compared with 25.6 ft [7.8 m] and 8.7 in [22.1 cm] respectively of *A. auriculiformis*. *A. aulacocarpa* also possessed better tree form than *A. auriculiformis*.

Both *Acacia* species have shown reforestation potential for rehabilitation of the exploited white sand areas in Guyana. Possible utilisation of these species is discussed in detail. Further studies are recommended for the two species in respects of pilot plantings, insect pests and diseases and agroforestry techniques.

Acacia aulacocarpa has been reported to grow faster than *A. auriculiformis* in locations where annual rainfall is higher than 1600 mm. The performance of *A. aulacocarpa* has also been superior in Sabah, Malaysia under annual rainfall ranging from 2000-3200 mm. The two species have been compared in RFD/ACIAR trials over six sites across Thailand where annual rainfall ranges from 800-1500 mm, and *A. auriculiformis* is found to have better growth rate than *A. aulacocarpa* at all sites.

87

Davidson, J. (1987).
Seeds of Australian trees for Bangladesh.
Consultant report prepared under ADAB contract No. 2329.

The paper provides information regarding introduction of *Acacia auriculiformis* into Bangladesh as well as performance and planting program of the species in this country.

Acacia auriculiformis is reported to have been introduced from Asia rather than from Australia or other parts of its natural range. It is a very common tree in Dhaka and several other centres in Bangladesh and has been grown as a shade tree in the tea gardens located in the north-east of the country. Early plantings of *A. auriculiformis* are known for their poor stem form and multi-leaders. It was not until 1981 that introductions were made from potentially better form seed sources. Superior provenances of *A. auriculiformis* have been identified i.e. Balamuk and Bula (both from Papua New Guinea), Darwin (Northern Territory), and Croll Creek, North Iron Range (north Queensland). The Croll Creek provenance is a seed source producing trees which are very straight, and is recommended for seed stands in Bangladesh.

Over 60,000 ha of trees of mostly Australian origin are expected to be planted between 1986 and 1995. The planting areas recommended for *A. auriculiformis* over this ten-year-period are 11,178 ha for fuelwood (6 years rotation) and 2010 ha for pulpwood (12 years rotation).

88

Dela Cruz, R.E., Manalo, M.Q., Aggangan, N.S. and Tambalo, J.D. (1988).
Growth of three legume trees inoculated with VA mycorrhizal fungi and Rhizobium.
Plant and Soil 108, 111-15.

Dual inoculation with either one of the three VA mycorrhizal fungi i.e. *Glomus fasciculatus*, *Glomus marginata* and *Scutellospora persica* with *Rhizobium* are found to be equally effective in promoting height growth of *Acacia auriculiformis* seedlings. In addition, N and P concentration, and total N and P contents are also higher in the seedlings treated with the same inoculations. Only the first two VA mycorrhizal fungi are effective for *Acacia mangium* and *Albizia falcataria*.

89

Delwaulle, J.C. (1979).
Forest plantations in dry-tropical Africa. Techniques and species (continued).
Bois et Forets des Tropiques No. 187, September-October 1979, p 3-30. (Fr)

The article reports results of nursery establishment and field trials of some Australian acacias in Niger which were introduced in 1973 through Centre Technique Forestier Tropical (CTFT). In the nursery, seeds of *Acacia auriculiformis* treated with boiling water germinated 80% compared to 4% and 12% of the seeds soaked in cool water (room temperature) for 24 hours and the untreated seeds respectively.

Forty five seedling were outplanted in November 1974. Survival reduced from 100% down to 53% and 48%

respectively in November 1975 and 1976. Average height as in November 1986 (2 years old) was 2.7 m.

90

Devasahayam, S., Premkumar, T. and Koya, K.M.A. (1987).
Record of *Sahyadrassus malabaricus* (Moore) damaging *Gliricidia maculata*, a standard of black pepper *Piper nigrum* in Kerala.
Entomon 12(4), 391-392.

From Forestry Abstracts: The hepialid *Sahyadrassus malabaricus* was recorded as a pest of *Gliricidia maculata* [*G. sepium*], a standard for black pepper (*Piper nigrum*), for the first time in September-October 1985 in Kerala, India. The damage caused by the larvae, which were also found on *Cajanus cajan*, *Acacia auriculiformis* and *Ailanthus malabaricus* [*A. triphysa*] is described.

91

Dichoso, M.O. (1984).
Drought tolerance of some reforestation species.
Sylvatrop 9(3-4), 197-209.

Acacia auriculiformis and *Gmelina arborea* are found to be more drought tolerant than *Swietenia macrophylla*, *Albizia falcataria* and *Pterocarpus indicus*. The ability of *A. auriculiformis* to tolerate drought is believed to be due to the thick cuticular leaf coatings which greatly reduced water loss and resulted in the delay of the onset of wilting. A possible reason attributed to the delay of the onset of wilting of *A. auriculiformis* seedlings was its higher contents of younger tissues being the youngest among seedlings used. Younger tissues have been shown to be more drought tolerant than older tissues.

92

Ding, M.M., Yi, W.M. and Liao, L.Y. (1986).
A survey on the N_2ase activities of nodules of tree legumes, including *Tamarindus indica*, a species not widely known to nodulate, in artificial forests in Dainbai, Guangdong, China.
Nitrogen Fixing Tree Research Reports 4, 9-10.

Nodulation of 19 leguminous trees in plantations was examined. Soil was lateritic red earth with pH 3.8-5.4. The investigated plants were not inoculated.

Most nodules are found on fibrous roots in the top 0-15 cm of soil, but nodules of *Acacia auriculiformis* are also found on the soil surface covered with damp litter. Shape and size of nodules vary with stages of formation, growth and maturity. For *A. auriculiformis*, nodules were circular at an early stage but later changed into cylindrical or branched form.

N_2ase activities of nodules are reported to depend on the growth and age of plant, and environmental factors such as temperature, sunlight, oxygen, water and soil types.

93

Dixit, P.A. (1985).
Multipurpose species research in Nepal.
P 544-547 *in* Increasing productivity of multipurpose species: proceedings of the IUFRO Planning Workshop for Asia on

forest research and technology transfer held in Kandy, Sri Lanka, 16-28 July 1984, (eds Burley, J. and Stewart, J.L.).

A wide range of multipurpose tree species is being studied in Nepal in several aspects. *Acacia auriculiformis* is being trialed for planting on farmland.

94

Djuwadi, Fanani, Z. and Durbani, M. (1981).
Determination of volume increments of *Acacia auriculiformis* stands on marginal lands of Imogiri using growth rings as indicator.
Research report No. 46, Gadjah Mada University, Yogyakarta, Indonesia, 23 p. (In)

Acacia auriculiformis was planted on marginal lands at Imogiri, Indonesia in 1962 and currently covers an area of 26 ha. Mortality appeared to set in at age 18 years. An attempt was made to determine the optimum rotation for maximum volume production. Sample trees were chosen and the boles cut into one metre lengths, and annual rings were marked. Current annual increment (CAI) and mean annual increment (MAI) for volume were estimated from height x basal area of relevant annual rings. CAI was estimated to equal MAI at year 14, and was zero at year 18. Thus it is recommended that the trees be felled between 14-18 years old for maximum volume production at Imogiri.

95

Draaisma, C.L.M. (1941).
1940 annual report of the Bojonegoro forest district.
Unpublished report, 16 pp. (Nl)

It is mentioned in the report that 82.1 ha non-teak plantations were established in the Bojonegoro forest district [Indonesia] in 1940. The species planted were *Swietenia macrophylla*, *Acacia auriculiformis*, *Acacia leucophloea*, *Dalbergia latifolia* and *Eucalyptus*. *Schleichera oleosa* was interplanted with those species.

96

Drees, M. (1941).
Germination trials and seedlings. I - *Acacia*.
Tectona 34, 1-45. (Nl, en)

Reports on germination experiments with 11 *Acacia* species at the Forest Research Institute at Buitenzorg [Bogor]. Recommended techniques for each species are presented. Seed of *Acacia auriculiformis* can be stored in air-tight containers for at least 18 months. Pouring boiling water over the seed and soaking for 24 hours prior to sowing is recommended for this species.

Line drawings are also presented for *A. auriculiformis* and other species showing the pattern of seedling development from seed.

97

Drewes, S.E. and Roux, D.G. (1966).
A new flaven-3,4-diol from *Acacia auriculiformis* by paper ionophoresis.
Biochemical Journal 98(2), 493-500.

The article reports results of chemical analyses of heartwood and bark of *Acacia auriculiformis*. The authors' summary is presented verbatim.

1. The heartwood of *Acacia auriculiformis* contains a typical mixture of analogues consisting of three isomeric-3,4-diols, a dihydroflavonol, flavanone, flavonol and chalcone based on the 4',7,8-trihydroxyl pattern. These were resolved by preparative paper chromatography and preparative paper ionophoresis.

2. Crystaline (-)-teracacidin [(2R,3R,4R)-4',7,8-trihydroxy-2,3-cis-flavan-3,4-cis-diol] was obtained in high (10%) yield, and a new crystaline derivative of(-) -isoteracacidin [(-)-2,3-cis-3,4-trans isomer] was isolated.

3. The absolute configurations of (-)-isoteracacidin (2R,3R,4S) and of the (+)-2,3-trans-3,4-cis isomer (2R,3S,4S) were tentatively assigned on the basis of nuclear-magnetic-resonance spectroscopy, paper ionophoresis and paper-chromatographic comparison with the epimerization products of (-)-teracacidin.

4. Possible reasons for the absence of polymeric leuco-anthocyanidin tannins are discussed.

5. (±)-4',7,8-trihydroxyflavanone were isolated for the first time.

6. The bark polyphenols consist mainly of polymeric leuco-delphinidins and leuco-cyanidins which redden exceptionally rapidly [when exposed] to light. The mechanism of this phenomenon is discussed.

98

Endert, F.H. (1940).
Quarterly report of the Inspector of the Forest Service of the Indonesia Bagian Timur, first quarter of 1940.
Unpublished report, 42 pp. (NI)

Report of the Forest Service of Indonesia Bagian Timur [Eastern part of Indonesia]. Observations and results of plantation trials are mentioned in this report. The trials included teak, pine, sandalwood, *Anthocephalus* sp and *Acacia auriculiformis*.

99

Endert, F.H. (1941).
Quarterly report of the Inspector of the Forest Service of the Indonesia Bagian Timur, third quarter 1940.
Unpublished report, 38 pp. (NI)

Another report of the Forest Service of Indonesia Bagian Timur. In East Sulawesi, trial plantations of *Acacia auriculiformis* on a grass area were very successful.

100

FAO. (1988).
Nitrogen fixing trees for wastelands.
FAO Regional Office for Asia and the Pacific Publication 1988/1989. Bangkok. 104 pp.

Acacia auriculiformis is included in a list of nitrogen fixing tree species for use on

wastelands in the humid and sub-humid tropics. A general description of the species is presented together with information on its environmental requirements, production and utilisation.

101

Fenton, R., Roper, R.E. and Watt, G.R. (1977).
Lowland tropical hardwoods. An annotated bibliography of selected species with plantation potential.
Ministry of Foreign Affairs, Wellington, New Zealand, vi+456 pp.

Acacia auriculiformis is among 23 tropical species included in the bibliography. Available information on the species is summarised from 34 references (up to 1976) covering almost all aspects, e.g., taxonomy, distribution in natural habitat, seed and regeneration, silviculture, yield and utilisation.

102

Foenander, H. van S. (1955).
Interim note on planting trials on tin tailings.
Malayan Forester 18, 93.

A brief account of species trials on tin tailings at the Forest Research Institute of Malaya [Malaysia] planted in late 1953. The soil varied from pure sand over a major part of the area to small patches of heavy clay. Most of the species tested were exotics including several eucalypts, *Acacia auriculiformis* (one block in pure sand and one block in clay region), pines and *Gmelina arborea*. Most species showed good survival in the first few months but after one year variation in growth amongst the species was remarkable. Species showing good growth and survival were *A. auriculiformis*, *Pinus caribaea*, *Pinus elliottii* var. *elliottii*, *Gmelina arborea* and *Melaleuca leucadendron* (indigenous).

103

Foong, T.W. and Yang, C.N. (1988)
Compound fertiliser requirements for the establishment and early growth of popular ornamental shrubs between road-side trees.
Gardens' Bulletin, Singapore 41(1), 19-28.

Using shade provided by road-side trees of *Acacia auriculiformis* and *Samanea saman*, a fertiliser experiment was conducted under these trees for some ornamental plants. Planting holes were filled with a 3:1 (by volume) mixture of a sandy clay loam soil and treated sludge before the application of a combination of fertiliser treatments. It is concluded that fertiliser requirements for early growth under shade were low and that sufficient nutrients were provided by the sludge at planting.

104

Ganeson, S.K. (1989).
Provenance variation and salt tolerance in *Acacia auriculiformis* A. Cunn. ex Benth.
B.Sc. (Honours) thesis, Department of Forestry, Australian National University, Canberra, 100 pp.

A glasshouse experiment was conducted to examine provenance variation and salt tolerance of 30 provenances of *Acacia auriculiformis*. These provenances came from Papua New Guinea (6),

Queensland, Australia (7), the Northern Territory, Australia (15), and 2 landraces from Thailand. Three-month-old seedlings were subjected to a daily stepwise increase in salt (NaCl) concentrations of 25 m mhos. The concentration was held constant for 3-4 days at 100, 200, etc. The experiment had to be terminated after 7 weeks at which the salt concentration level reached 750 m mhos due to the control plants were getting so large that they were becoming unmanageable (the tallest plant was almost 2 m in pot of 15 cm diameter) and there was evidence of pot bound. Seedling height was measured on the last day of each concentration level, approximately once a week, but diameter was measured at commencement of the treatment, half-way through the experiment, and at final harvest. Height data were subsequently converted to Relative Growth Rate (RGR) Symptom of salinity was noted. At final harvest, shoot dry weight and chloride concentration in the youngest expanded phyllode were determined.

The results revealed no provenance differences in terms of salt tolerance but the Papua New Guinea provenances were the most vigorous especially under control conditions and were suggested as most promising for planting on salt affected lands. It was concluded that the non-siginificant differences between provenances in response to salt could have been due to the high relative humidity in the glass house (>80%).

105

Gavina, L.D. and Garcia, M.U. (1987).
Growth and nodulation of four species of *Acacia* (*auriculiformis*, *mangium*, *aulacocarpa* and *mearnsii*) in grassland soil.
Nitrogen Fixing Tree Research Reports 5, 14-15.

Examines growth and nodulation of *Acacia auriculiformis*, *A. mangium*, *A. aulacocarpa* and *A. mearnsii* in grassland (*Imperata cylindrica*) soil with and without soil amendments under nursery conditions. Adding 5 g/pot of ash resulted in a marked increase in seedling height and number of root nodules of all species as compared to soil without ash. *Acacia auriculiformis* however had the least response among the four species studied.

106

Gerkens, M. and Kasali, L. (1988).
Productivity of *Acacia auriculiformis* plantation on the Bateke plateau in Zaire.
Tropicultura 6(4), 171-175. (Fr, en)

The paper presents results obtained from large-scale reforestation of *Acacia auriculiformis* on the Bateke Plateau in Zaire. The species can grow on very poor and very acid soil and produce a mean annual increment of 12 m^3/ha/a of first class fuelwood. The productivity can be improved by a better management and by using better quality seed. It is anticipated that 15 m^3/ha/a can be obtained over a 5-year period.

107

Ghosh, R.C. (1985).
Planting techniques in relation to site and type of planting stock.
P 257-271 *in* Increasing productivity of multipurpose species: proceedings of the IUFRO Planning Workshop for Asia on forest research and technology transfer held in Kandy, Sri Lanka, 16-28 July 1984, (eds Burley, J. and Stewart, J.L.).

The paper gives an overview of plantation activities in Asia and Southeast Asia. *Acacia auriculiformis* is mostly planted in the dry tropical to moist tropical climatic zones. Direct seeding and containerised seedlings are normally used. The species has been planted especially in difficult sites i.e. saline and alkaline areas, wetlands and laterite wastelands.

108

Glover, N. and Heuvelop, J. (1985).
Multipurpose tree species in Acosta-Puriscal, Costa Rica.
Nitrogen Fixing Tree Research Reports 3, 4-6.

Multipurpose tree species trials at Tabarcia and Grifo-Alto in Acosta-Puriscal, Costa Rica, altitude 1000 m, rainfall 2500 mm, average temperature 21°C. Soil is high in clay content with pH 4.6; low in available P, Zn, and K with high Al level. *Acacia auriculiformis* grew well in comparison to the other species tested, e.g. *Acacia mangium*, *Calliandra calothyrsus* and *Gliricidia sepium*. It was noted that *A. auriculiformis* was the only species which had a notably less growth rate during the dry season.

109

Goel, V.L. (1987).
Performance of some hardwood species in nursery of alkaline wastelands.
Indian Forester 113(12), 792-98.

A nursery experiment to investigate seedling performance of six tree species is reported. *Acacia auriculiformis* seedlings had the highest survival percentage (62.5) but slowest growth rate (47 cm height) after one year.

110

Goel, V.L. (1987).
Radio-sensitivity of some firewood trees.
Indian Journal of Forestry 10(3), 167-172.

Seeds of *Acacia auriculiformis* were subjected to different dosages of gamma rays varying from 5-60 krad. Germination and survival of seedlings during early growth were improved at almost all levels of gamma rays. However, survival, height and diameter of irradiated plants were reduced substantially after 4 months compared with untreated plants.

111

Goi, S.R., Faria, S.M. de and Neves, M.C.P. (1984).
Nitrogen fixation, nodule type and occurrence of ureides in legume trees.
Pesquisa Agropecuaria Brasileira 19 (special), 185-190. (Pt, en)

A study on nitrogen fixation, morphology of nodules and utilisation of ureides in nitrogen transport of 36 legume trees. Nodulation and acetylene reduction activity were detected in 35 species and ureides in all 36 with the greatest concentration of ureides (up to 700 µg/g) being observed in certain species of the family Dalbergieae which produce nodules of the globular type. Nodules of *Acacia auriculiformis* are of elongate type.

112

Gough, D.K., Bell, R.E., Ryan, P.A. and Bragg, C.T. (1989).
Drying and burning properties of the wood of some Australian tree species.
P 177-186 *in* Trees for the tropics - growing Australian multipurpose trees and shrubs in developing countries (ed Boland, D.J.), ACIAR Monograph No. 10.

2.5-year-old wood samples of 15 Australian tree species including *Acacia auriculiformis* from a trial plot in southeast Queensland were tested for drying and burning properties. Data are presented on the initial moisture content, green density, basic density and computed drying times to 24% moisture content for the drying study. For the burning study, rate of energy utilisation, time taken to boil 20 litres of water, and residue are shown. The test revealed that all the species should be acceptable as fuelwood.

General characteristics of the tested species as fuelwood are described. The wood of *Acacia auriculiformis* is easy to split, crackles and sparks at ignition, with plenty of fly ash throughout the flaming phase with occasional sparks and some smoke.

113

Griffin, A.R. (1988).
Producing and propagating tropical acacia hybrids.
Forestry Newsletter No 6, Australian Centre for International Agricultural Research, Canberra.

A brief account of an ACIAR project 'Hybridisation and vegetative propagation of Australian tropical acacias' involving collaboration between scientists in Australia and Malaysia. The project aims at producing seed of hybrid *Acacia auriculiformis* x *Acacia mangium* as well as propagating vegetatively hybrids selected in the field or produced by manipulated crosses of select parents of the two species. Reliable techniques for hybrid seed production and the vegetative mass propagation of the resulting plants are being developed.

114

Guha, S.R.D. and Pant, P.C. (1966).
Pulping of *Acacia auriculiformis* A. Cunn.
Indian Forester 92(1), 51-55.

Acacia auriculiformis has a short fibre length (average 0.84 mm) like most other hardwood species. Under Neutral Sulphite Semichemical Process, unbleached pulp yields (65-73%) are higher than bleached pulp yields (48-53%). Higher yields of unbleached pulp than bleached pulp are also obtained when using Conventional Sulphate Process, i.e 42-48% for unbleached pulp as compared to 37-41% for bleached pulp. In all processes strength properties are more or less the same for the unbleached and bleached pulps.

115

Gunn, B., McDonald, M. and Moriarty, J. (1987).
1987 seed collections of *Acacia auriculiformis* from natural populations in Papua New Guinea and Northern Australia.
Australian Tree Seed Centre, CSIRO Division of Forestry and Forest Products, Canberra.

Report on seed collection by Australian Tree Seed Centre of *Acacia auriculiformis* from natural populations

in Papua New Guinea and north Queensland and the Northern Territory, Australia in 1987. A total of 54.7 kg of seed was collected from 340 trees representing 32 provenances. Some of the trees in Papua New Guinea and the Northern Territory display excellent growth and stem form. Collection details for each seedlot are recorded. Insect damage to seed was quite severe in the Bensbach area, Papua New Guinea. It appeared that early parasitism of immature green seeds caused the damage.

Natural hybrids of *A. auriculiformis* and two other species i.e. *A. mangium* and *A. leptocarpa* were observed in the Balamuk and Old Tonda areas, Papua New Guinea. Seed was also collected from a suspected hybrid *A. auriculiformis* x *A. leptocarpa* tree near Elizabeth River (40 km south of Darwin) in the Northern Territory.

This collection was an almost complete range-wide provenance collection of *Acacia auriculiformis*. The current international provenance trial of this species is one of many research projects made possible by this collection.

116

Gunn, B., McDonald, M. and Gardiner, C. (1988).
1988 seed collections of tropical acacias in Papua New Guinea and North Queensland.
Australian Tree Seed Centre, CSIRO Division of Forestry and Forest Products, Canberra.

This is a report of another joint funded seed collection of tropical acacias in Papua New Guinea and north Queensland, Australia. *Acacia mangium* was the main species for this collection but seed was also collected from other tall acacias i.e. *A. auriculiformis*, *A. crassicarpa* and *A. aulacocarpa*.

Five provenances comprising 59 individual trees were sampled for *A. auriculiformis* in Papua New Guinea. Single-stemmed trees in excess of 30 m are common in the Morehead River and Mibini Swamp areas. Seeds were also collected from Mai Kussa River where the species occurs as an emergent behind the mangrove zone. Soil pH varies from 4.5-8.0. The differences in pH are probably due to periodic waterlogging.

Natural hybrids of *A. auriculiformis* x *A. mangium* were observed along the Mai Kussa River. The hybrid trees were morphologically intermediate between the two parents.

117

Gupta, G.N., Prasad, K.G., Mohan, S. and Manivachakam, P. (1986).
Salt tolerance of some tree species at seedling stage.
Indian Forester 112(2), 101-113.

In a pot culture experiment varying levels of salinity were simulated in clay, loam and sand textured soils. Based on survival, height and dry matter production, *Acacia auriculiformis* was found to be a highly sensitive species to salinity and did not survive salinity above 2.5 m mhos/cm.

The sensitivity of *Acacia auriculiformis* to such a low level of salinity in this study is surprising. In another study (Aswathappa *et al.*, 1987), *A. auriculiformis* was classified as highly salt tolerant perhaps indicating intraspecific variation in salt tolerance.

118

Gupta, G.N., Prasad, K.G., Mohan, S., Subramaniam, V. and Manivachakam, P. (1988).
Effect of alkalinity on survival and growth of tree seedlings.
Journal of the Indian Society of Soil Science 36 (3), 537-542.

From Forestry Abstracts: In a pot culture experiment, *Acacia nilotica* and *Eucalyptus camaldulensis* were found to be alkali-resistant tree species. *A. nilotica* could be grown up to pH 9.7 on sandy soil, 9.2 on clay soil and 8.8 on loam soil, while *E. camaldulensis* could be grown at pH values of 11 on sand, 9.2 on clay and 8.6 on loam soil. *Ceiba pentandra* was slightly tolerant to alkalinity; *Casuarina equisetifolia* and *Acacia auriculiformis* were sensitive to alkalinity.

Chaturvedi *et al.* (1985) found potted seedlings of *A. auriculiformis* grew well in soil pH up to 10.

119

Gwaze, D.P. (1989).
Growth and survival of Australian tree species in field trials in Zimbabwe.
P 129-138 *in* Trees for the tropics - growing Australian multipurpose trees and shrubs in developing countries (ed Boland, D.J.), ACIAR Monograph No. 10.

Three of the ACIAR trial sites in Zimbabwe are located at Kadoma (latitude 18°18'S, longitude 29°55'E, altitude 1100 m, annual rainfall 780 mm), Makoholi (19°45'S, 30°46'E, 1200 m, 600 mm) and Middle Sabi (20°21'S, 32°18'E, 440 m, 400 mm). *Eucalyptus camaldulensis* was planted as the check species at all sites. At 18 months after planting, *Acacia auriculiformis* was the fastest growing at Kadoma and Makoholi. At Middle Sabi which is the driest site, it was ranked in the top ten while *E. camaldulensis* failed at this site due mainly to termite attack.

The good performance of *A. auriculiformis* in Zimbabwe is further evidence of the wide adaptability of the species to various site conditions. The low annual rainfall of the trial sites in Zimbabwe is much lower than those across the range of the species' natural distribution or at locations reported for successful growth of the species elsewhere. However, the results reported here are obtained at age 18 months only, and whether the species can maintain the rapid early growth remains to be seen.

120

Gwaze, D.P. and Stewart, H.T.L. (1989).
Biomass equations for eight exotic tree species in Zimbabwe.
Forest Research Centre, Harare, Zimbabwe. (unpublished report)

Twelve *Acacia auriculiformis* trees aged 16 months old from Makoholi, Zimbabwe were harvested to estimate biomass production. The followings are the distribution of dry weight components of sample trees (kg/tree):

	Biomass (kg)	**% above -ground biomass**
Stem	0.190	23.1
Branches/twigs	0.331	40.3
Leaves	0.301	36.6
Total	0.822	100.0

121

Hadipoernomo. (1979).
Critical land rehabilitation with air seeding.
Duta Rimba 5(31), 9-12. (In, en)

Satisfactory success was achieved from air-seeding on lalang (*Imperata cylindrica*) grassland in the Forest District Balapulang, Brebes District in Central Java which receives annual rainfall of 2400 mm. Species used were *Leucaena glauca*, *Dalbergia* sp, *Calliandra calothyrsus*, *Sesbania grandiflora*, *Acacia auriculiformis* and *Pinus merkusii*. The study area (370 ha) was prepared by tractor-ploughing, burning, and left untreated.

210 kg of *Acacia auriculiformis* seed were broadcast over the study area; sowing density was approximately 8500 seeds/ha. About 4600 seeds/ha were found with most of them being seen in the valley possibly washed away by rain-water. Average 1200 trees/ha accounting for 26% of the seeds found were estimated to have germinated in the first year but the number decreased so substantially that only 248 trees/ha or 2.6% remained after seven years. Better results were obtained for *Leucaena glauca* (9964 trees/ha or 8.3%) and *Calliandra calothyrsus* (1742 trees/ha or 10.4%). No success was achieved on the area without site preparation.

These figures in terms of percentage may be very low compared to those obtained from ordinary plantations (60-80%). Nevertheless, the number of surviving trees per unit area is relatively high. After 7 years, the study area was covered with vegetation, erosion had stopped, and a humus layer had formed.

122

Hall, N., Turnbull, J.W. and Martensz, P.N. (1980).
***Acacia auriculiformis* A. Cunn. ex Benth.**
Australian Acacia Series Leaflet no. 8, CSIRO Division of Forest Research, Canberra.

Describes the botanical features, distribution and ecology, and utilisation of *Acacia auriculiformis*. A map showing the species' natural distribution in Australia is provided.

123

Halliday, J. and Nakao, P. (1984).
Technical note on the germination of leguminous tree seeds.
Pesquisa Agropecuaria Brasileira 19 (special issue), 231-234.

Germination percentages of seeds of 33 leguminous trees following mechanical and chemical treatments are tabulated. The results obtained for *Acacia auriculiformis* are as follows :

Snipping (nicking)	0%
Immersion in H_2SO_4 30 minutes	58%
Immersion in hot (80°C) water	21%
No treatment	0%

The low germination of seed treated by immersion in hot water treatment appears to due to the low temperature of hot water (i.e. 80°C). Immersion in boiling water for 1-2 minutes has been recommended by Australian Tree Seed Centre, CSIRO for some hard-seed-coat acacias.

Nicking is, in general, the best or near best method for many acacias, and is highly recommended for pretreating *Acacia* seed before germination test or for small and valuable research seedlots.

124

Harrington, R. (1989).
Modeling to improve prediction of growth and allocation of MPTS.
Farm Forestry News Vol. 3, No. 1. Forestry/Fuelwood Research and Development (F/FRED) Project.

A computer simulation model is being developed by the Global Research Unit of the F/FRED Project to help transfer improved technologies from research sites to small farms. The model will predict growth and biomass allocation of tropical MPTS under various management practices and environmental conditions. It will also provide a framework for integrating data from empirical tree growth trials and generate hypotheses on important interactions between MPTS and their environments.

Data from field trials established under the F/FRED Project network will be used to incorporate effects of environment on tree growth. In addition, the model can also be used to match species characteristics with physical site factors and to predict the optimal planting design for the desired harvest regime.

Field experiments have already been established in Hawaii by the Global Research Unit to calibrate the model for three priority species under the F/FRED Project Network i.e. *Acacia auriculiformis*, *Gliricidia sepium* and *Leucaena diversifolia*. Results are to be reported in future issues of Farm Forestry News.

125

Hawkins, T. (1987).
Biomass and volume tables for *Eucalyptus camaldulensis*, *Dalbergia sissoo*, *Acacia auriculiformis* and *Cassia siamea* in the Central Bhabar-Terai of Nepal.
Occasional Paper No. 33, Oxford Forestry Institute, Department of Plant Science, University of Oxford.

Single entry biomass tables of oven dry and fresh weight, based on the equation Ln Weight = a + b Ln DBH (diameter at breast height) or Ln Weight = a + b Ln BD (basal diameter, taken at 10 cm above ground level) are presented for *Acacia auriculiformis*. It is suggested that for very young trees or trees of poor form, basal diameter is better suited than diameter at breast height in predicting biomass production. These biomass regression are based on trees less than 3 years old and are suggested to be adequate for approximate estimates of the early yield of fuelwood from short rotation plantations. Larger trees are recommended to be included when they become available in the future.

126

Hearne, D.A. (1975).
Trees for Darwin and Northern Australia.
Canberra: Australian Government Publishing Service.

Silvicultural features of *Acacia auriculiformis* are described. The species is listed as having potential uses for flowering tree, coastal and foreshore planting, windbreaks or shelterbelts, and avenue tree. Its local name is Darwin black wattle.

127

Hellinga, G. (1950).
Forest tree species for planting on a large scale.
Meded. B.P.S. 31; Tectona 40, 179-229. (Nl, en)

Forest tree species used in the Indonesian Forest Service's large-scale plantations are mentioned. Taking soil conditions, altitude and rainfall into account, 22 species including *Acacia auriculiformis* showing promise for large scale plantations are recommended. Data on silviculture for each species are provided.

128

Hildebrand, F.H. (1951).
Revised list of tree species of Java-Madura with notes on their distribution and dimensions, etc.
Report of the Forest Research Institute, Bogor, Indonesia, No 50. (In, en)

Briefly mentions that *Acacia auriculiformis* is a tree reaching 15 m in height and 45 cm diameter. The species is said to be native to Irian Jaya [Indonesia] and Australia but being planted by the Forest Service in Java-Madura.

129

Hu, H.T. and Chang, K.P. (1983).
Pure culture synthesis of nodules by *Rhizobium* sp. on *Acacia auriculaeformis* Cunn. ex Benth. and its morphology.
Technical Bulletin, Experimental Forest, National Taiwan University, No. 145. (Ch, en)

From Forestry Abstracts: *Rhizobium* sp. isolated from nodules of *Acacia auriculiformis* successfully formed nodules of similar morphology to those occurring naturally, on host seedlings growing in yeast extract mannitol agar medium in sterilised test tubes. The internal morphology of the nodules is shown using scanning electron microscope.

130

Hu, T.W., Chen, W.E. and Shen, T.A. (1983).
Growth of the seedlings of four leguminous tree species in relation to soil pH in a pot test.
Nitrogen Fixing Tree Research Reports 1, 24-25.

In a pot trial conducted to determine the effect of soil pH on growth of four leguminous tree species, *Acacia auriculiformis* is shown to have a high adaptability to a wide range of soil pH from 4.3-8, and to grow equally well in acidic, neutral and alkaline soils.

131

Hu, T.W., Juang, T.C. and Young, C.C. (1985).
The role of nitrogen-fixing trees in soil biology.
P 307-316 *in* Increasing productivity of multipurpose species: proceedings of the IUFRO Planning Workshop for Asia on forest research and technology transfer held in Kandy, Sri Lanka, 16-28 July 1984, (eds Burley, J. and Stewart, J.L.).

The trend for future forest cultivation will be most likely emphasised on short-rotation tree species which in turn requires replacement of nitrogen reserves at a considerable rate. Nitrogen input to the soil from both biological and non-biological sources is thus essential to

maintain the sustained productivity of the forest lands. There are large number of trees which fix atmospheric nitrogen. An integrated approach to determine the most favourable plant/micro-organism can lead to improving and maintaining the productivity of forest lands.

There are three classes of symbiotic N fixation namely *Rhizobium* symbiosis, actinomycete symbiosis, and mycorrhiza/nodule/host symbiosis. *Acacia auriculiformis* is classified in the *Rhizobium* symbiosis category.

132

Hu, T.W. and Shen, T.A. (1986).
Vegetative propagation of *Acacia auriculiformis* by leafy cuttings under mist spray.
Nitrogen Fixing Tree Research Reports 4, 44-45.

Leafy cutting experiments conducted at Taiwan Forest Research Institute show that 20 cm long leafy twigs of tip shoot are the ideal material for rooted cuttings of *Acacia auriculiformis* when treated with either IBA or NAA at 250 ppm concentration. Using dibble tubes made transplanting much easier and also reduced transplanting shock.

133

Huang Shineng and Zheng Haishui (1989).
Comparative studies on the productivity of some nitrogen fixing tree species grown in latosol.
Nitrogen Fixing Tree Research Reports 7, 21-24.

Report on the productivity of some introduced fast growing trees on Hainan Island (latitude 19°14'N, longitude 110°28'E, altitude 20 m, mean annual rainfall 1770 mm). The planting site was ploughed and 1 kg farm manure and 50 g phosphate fertiliser were applied to each planting hole (35x35x30 cm). At three years old, *Acacia auriculiformis* recorded the highest survival (92%), and *Casuarina junghuhniana* the lowest (62%). *Acacia mangium* appeared to have poorest form with 65% of the trees being multistemmed or forking while *C. junghuhniana* had the best form. In terms of dry biomass production, *A. mangium* produced the greatest above-ground biomass (84.8 t/ha) followed by *A. auriculiformis* (34.6 t/ha), *A. mearnsii* (11.2 t/ha), *Cassia siamea* 8.8 t/ha) and *C. junghuhniana* (7.4 t/ha).

134

Hutacharern, C. (1983).
Pests and diseases in forest plantations.
Proceedings of the 3rd Seminar on Silviculture held at Kasetsart University, Bangkok, Thailand, 24-25 February 1983. (Th)

A comprehensive review of insect pests and diseases found to attack forest plantations in Thailand together with possible control measures. There have been reports of foliar damage in old trees in *Acacia auriculiformis* plantations by unidentified larvae. Young trees of *A. auriculiformis* have also been reportedly attacked by small beetles (3-5 mm in length) in the dry season. Stems and branches break due to girdling. There is no report of fungal damage in the species.

135

Hutacharern, C. (1987).
Pests in a Thai species trial.
Forestry Newsletter No. 4, Australian Centre for International Agricultural Research, Canberra.

A branch and twig borer identified as *Sinoxylon* sp. was found to attack small stems and branches of trees in an ACIAR species trial in Chanthaburi province, Thailand during the dry season in 1987. *Sinoxylon* sp. girdles and breaks the stems or branches at the point of attack. A survey of the insect damage found that the beetle prefers *Acacia auriculiformis*, *A. crassicarpa* and *Casuarina cunninghamiana*. This beetle attacks only young trees up to 2 years old or when stem diameter is less than 3 cm. *Sinoxylon* sp. normally takes refuge in the girdled stems or branches. Collecting and burning the broken branches can reduce the population and inhibit infestation. Chemical spray with 'chlorpyrifos' or 'methanidophos' during the dry season is effective. Increasing tree growth by fertilisation is another method of lowering the risk.

136

Hutacharern, C. and Eungwijarnpanya, S. (1982).
Biology and host preference of *Sinoxylon* sp.
Paper presented to the 8th symposium on Science and Technology for Country Development. The Science Society of Thailand. 8 pp.

The significant effect of an insect, *Sinoxylon* sp., was brought to attention by the considerable damage caused to plantations of *Acacia auriculiformis* in Thailand. Subsequently, woody branches and one year old seedling of 14 economically important tree species were investigated for host preference by this beetle. Apart from *A. auriculiformis*, other species found to be preferred by this beetle include *Casuarina equisetifolia*, *Samanea saman*, *Leucaena leucocephala* and *Cassia siamea*. *Azadirachta indica*, *Pterocarpus macrocarpus* and *Melia azedarach* were not preferred.

137

Hutacharern, C., Choldumrongkul, S., Eungwijarnpanya, S, Choldumrongkul, A. and Pholwicha, P. (1988).
Check lists of forest insects in Thailand.
Royal Forest Department, Thailand, 72 pp.

Acacia auriculiformis is listed to be a host plant of an insect identified as *Adoretus compressus* Weber in the family Scarabaedae. The insect is of a leaf-eating type.

138

Ibnu, Z. and Supriana, N. (1987).
The use of the fungicide copper oxychloride 85% to control powdery mildew diseases on *Acacia auriculiformis* A. Cunn.
Bulletin Penelitian Kehutanan Vol. 3, No. 1, 63-72. (In, en)

An experiment was conducted at a forest research station at Pematang Siantar [North Sumatra, Indonesia] on the use of fungicide copper oxychloride 85% to control powdery mildew infesting *Acacia auriculiformis* seedlings. A weekly spray on seedlings with the fungicide at a concentration of 4 g/l (in water) for 8 weeks was found to be effective in controlling the disease. Infected plants recovered after being treated for eight weeks.

139

International Council for Research in Agroforestry. (1988).
News from the field - humid lowlands of West Africa.
Newsletter and Agroforestry Review No. 24, October 1988.

Report on preliminary results of field trials established under Agroforestry Research Networks for Africa of ICRAF's Collaborative Programs. In one of the trial established at Nkomeyos Station near Yaounde, Cameroon, 10 multipurpose tree species including *Acacia auriculiformis* were tested under agroforestry practices. At one year after planting, height growth of all species was lower when interplanted with maize. Intercropping with maize also reduced biomass production for all species.

Also reported is a hedgerow-intercropping trial which was established in 1987 at Nkomeyos. Six multipurpose tree species including *Acacia auriculiformis* were pruned one year after planting and different amounts of the prunings obtained were applied to the surrounding plots as mulch. Maize was interplanted one week after pruning and mulch application. Results are not yet available.

140

International Union of Forestry Research Organisations. (1984).
Increasing productivity of multipurpose tree species: a blueprint for action.
IUFRO Planning Workshop for Asia, Kandy, Sri Lanka, July 16-28 1984. (compiled by Shea, K.R. and Carlson, L.W.)

This report of IUFRO meeting provides guide-lines for research to be pursued by the participating countries at the meeting in research and development on multipurpose tree species and particularly for the establishment regional, species-oriented networks. *Acacia auriculiformis* was among the top priority species recommended by the meeting for intensive development in the humid lowlands. The most important activities recommended for immediate action for *Acacia auriculiformis* are:

1. Spacing, thinning, and rotation; foliage manipulating; tree species mixtures
2. Tree breeding
3. Improve nursery stock production
4. Vegetative propagation
5. Culture and inoculation methods (N-fixing organism); effects on soil productivity

The recommendation of the IUFRO meeting in Sri Lanka was taken up by USAID (through Winrock International Institute for Agricultural Development) in the development of the F/FRED Project in Asia. The F/FRED Project involves *Acacia auriculiformis* in growth and management network trials, and co-sponsored seed collections in Papua New Guinea and Australia in 1987 and 1988, and co-operative studies with CSIRO/ACIAR in field provenance trials, geographic variation of seedling morphology and the preparation of this bibliography.

141

Jha, M.N. (1987).
Reclamation of mine wasteland by trees.
P 62-66 *in* Amelioration of soil by trees: a review of current concepts and practices (eds Prinsley, R.T. and Swift, M.J.), Commonwealth Science Council, London.

A brief account of the successful reclamation of land mined for bauxite at Armarkantak in Madhya Pradesh, India. Seedlings of 10 species were planted in 1972 in 45 cm^2 pits dug at 2x2 m spacing on land levelled by bulldozing. The pits were filled with soil taken from nearby sal forest and additional compost. Two species, *Moringa* sp. and *Melaleuca leucadendron*, completely failed. Species surviving well (83-96% at 4 years) were *Shorea robusta*, *Pongamia pinnata* (both indigenous), *Acacia auriculiformis*, *Eucalyptus camaldulensis*, *Pinus caribaea*, *P. roxburghii*, *Grevillea robusta* and *G. pteridifolia*. *A. auriculiformis* ranked third in height growth (average 4.1 m). *E. camaldulensis* was the tallest (16.8 m) followed by *G. pteridifolia* (7.3 m).

142

Jones, N. and Tham Chee Keong. (1980).
A report on visit to some of the acacia forests of Papua New Guinea and Queensland.
Working paper No. 2, FAO/UNDP-MAL/78/009 July, 1980.

The report begins with an outline of how *Acacia mangium* was first introduced to Sabah, Malaysia and how the species became one of the most important species in the current reforestation programmes in Malaysia. Natural hybridisation of *A. mangium* x *A. auriculiformis* was noted after the introduction of *A. mangium*. Notes are given on the visit to north Queensland, Australia and Western Province, Papua New Guinea where *A. mangium* and its closely associated species were observed. A number of recommendations were made regarding future plans for *A. mangium* in Sabah.

143

Kapur, A.P. (1954).
On some unrecorded host plants of the lac insect, *Laccifer lacca* (Kerr), (Homoptera : Lacciferidae).
Journal of Bombay Natural History Society 52(2/3), 645-7.

Lac insect (*Laccifer lacca*) was found on a solitary tree of *Acacia auriculiformis* at Ranchi, Chota Nagpur, India. Thin branches of nearly half an inch [1.3 cm] diameter were covered with thick incrustations some of which were about 6 inches [15 cm] long. The resinous secretion was thick and light amber in colour; wax filaments were also relatively long and suggested a healthy state of the lac insects embedded in the incrustation. The females were seen full of developing eggs and the swarming of larvae took place by the end of October. The infestation could have been brought about by accident or by birds which may carry nymphs on their bodies from one tree to another.

144

Kasmudjo. (1979).
"Soga" extract from bark of *Acacia auriculiformis*.
Duta Rimba 5(34), 15-20. (In & En)

Bark of *Acacia auriculiformis* can be used to produce natural soga dye which is used in the batik-textile industry in Indonesia for preparation of yellow and brown colours. The bark contains 6-14% of this natural dye with higher content being extracted from lower part of tree trunk. Older trees tend to produce higher soga content than younger trees.

145

Kaul, R.N. and Ganguli, B.N. (1965).
Trials in the introduction of acacias in the arid zone of Rajasthan. I - seed studies.
Indian Forester 91(8), 554-558.

Seeds of thirty-two *Acacia* species including *A. auriculiformis* were germinated without pretreatment at room temperature approximately 27°C. Commencement of germination varied from 4 days to 47 days after sowing, and total germination period varied from 10 days to as long as 156 days. *A. auriculiformis* started germination 7 days after sowing, and germination period lasted 92 days. The germination of *A. auriculiformis* was very poor i.e. 2.0% and 6.2% for two seedlots. It is concluded that most of the *Acacia* species tested require seed pretreatment to improve their germination.

146

Keating, W.G. and Bolza, E. (1982).
Characteristics, properties and uses of timbers. Volume I South-east Asia, Northern Australia and the Pacific.
Melbourne : Inkata Press.

Wood of *Acacia auriculiformis* is described as follows: Sapwood wide, somewhat paler than heartwood. Timber light brown. Texture fine, grain maybe straight or wavy. When open-grown, tree has deep spreading crown and poor stem form. Timber reported to be relatively tough and hard, considering its density. Easy to work, takes a good polish, finishes well with sharp tools. Liable to marine borer attack but mostly termite-resistant. Attacked by *Ganoderma lucidum*, a root fungus. Sapwood permeable, heartwood moderately permeable. Must be seasoned with care, but very stable. Boards tend to split when sawn. Bark contains 13% cold-water-soluble tannin. Flavonoid substances, which are found in the wood, probably contribute to its durability. Good for firewood and charcoal. Pulping and paper-making properties excellent.

147

Kessy, B.S. (1987).
Growth of Australian acacias in Tanzania.
P 123-125 *in* Australian acacias in developing countries: proceedings of an international workshop held at the Forestry Training Centre, Gympie, Qld., Australia, 4-7 August 1986 (ed Turnbull, J.W.), ACIAR Proceedings No. 16.

Acacia auriculiformis was planted on an experimental scale in Tanzania in the early 1950s along the coast on infertile sandy soils. There are no records of further plantations being established with this species in Tanzania except in Zanzibar. In Zanzibar, it attained 10.6 m in height and 12.7 cm in diameter at 8 years when planted on shallow coral soil, and reached 10.6 m in height and 20.6 cm in diameter on deep sandy soils.

148

Khandiya, S.D. (1987).
Short rotation firewood forestry on sodic soils in northern India - research imperatives.
Indian Journal of Forestry 10(2), 75-79.

In northern India there are 2.5 million ha of highly sodic soils in low lying areas which are not suitable for agriculture. Species trials at the Biomass Research Centre of the National Botanical Research Institute showed that 5 of 12

species being tested (*Prosopis juliflora*, *Acacia nilotica*, *Acacia auriculiformis*, *Terminalia arjuna* and *Eucalyptus tereticornis*) have a relatively high tolerance to sodic soils.

149

Khanduja, S.D. and Goel, V.L. (1986).
Pattern of variability in some fuelwood tree species grown on sodic soils.
Indian Forester 112(2), 118-123.

Reports three-year measurement of fuelwood species trial planted in alkali soils at the Biomass Research Centre, Banthra in India. *Acacia auriculiformis* had only rather low survival (57%) but its height (2 m) and diameter (1.7 cm) were around overall average. *Prosopis juliflora* appeared to survive and grow best (94%, 4.3 m and 3.4 cm). *Leucaena leucocephala* failed in the trial.

150

Kietvuttinon, B. (1985).
Yield-density effect of *Acacia auriculaeformis* A. Cunn. ex Benth. plantation.
M.Sc. thesis, Kasetsart University, Thailand. (Th, en)

Four-year-old *Acacia auriculiformis* plantations planted at different densities i.e. 1250 (2x4 m spacing), 625 (4x4), 417 (4x6) and 278 (6x6) stems/ha were assessed for yield production. Biomass of stem, total above-ground wood, stem fuelwood (>2 cm diameter) and stem volume could be estimated from dbh whilst biomass of branches and leaves were better estimated from stem diameter taken at the point immediately below the first living branch. In all cases yield/ha was highest in plantation having the highest planting density (above ground dry biomass 38.6 t/ha), and lowest for the lowest density (19.9 t/ha). By contrast, highest yield/tree was produced at 417 stems/ha (23.8 kg) and lowest by that planted at 1250 stems/ha (12.9 kg).

151

Kinhal, G.A. (1988).
Early planting and critical watering - an effective method of wasteland afforestation.
Advances in Forestry Research in India 1, 125-134.

Six-month-old seedlings of *Acacia auriculiformis* and five other species (*Dalbergia sissoo*, *Pongamia pinnata*, *Albizzia* [*Albizia*] *procera*, *Azadirachta indica* and *Bassia* [*Madhuca*] *latifolia*) were planted in 30x30x30 cm pits at 2x3 m spacing on wasteland in the Katangi Range of South Balaghat Division, Madhya Pradesh in 1986. The experimental area was surrounded by a cattle-proof trench, and one of the gullies was plugged to store winter rainwater. Four plots were laid out. Plots A, B and C were planted early in May, 2 months before the monsoon season, and plot D during the monsoon season. Plots A and B were watered every evening with 1 and 0.5 litre water per seedling; plots C and D were not watered. Height was measured in July 1986 and 1987 and in September 1986. In general, early planting with irrigation (plots A and B) resulted in increased vigour and height of seedlings. The seedlings in plot C, planted early before the monsoonal season, were all dead.

152

Kong Guohui (1988).
The reconstruction of forest vegetation in regions polluted by industrial contaminated gases.
Paper, Regional training seminar on recovery of vegetation in tropical eroded coastal areas held in Guangzhou, China, 13-27 March 1988.

A revegetation programme is being carried out on Gui Ding Hill, 90 km from Guangzhou (latitude 23°05'N, longitude 112°25'E) formerly carrying a dense forest plantation of *Pinus massoniana*. The dense pine forest died gradually as a result of industrial pollutants (fluoride and sulphur dioxide) produced by a nearby phosphate fertilizer plant and ironworks factory, and the area became a shrubby grassland and suffered soil erosion. Four years after planting, only seven out of 65 species planted in the contaminated area could be regarded as successfully adapted, and *Acacia auriculiformis* performed better than the other species. It ranked first in terms of height growth (average 6.5 m) and photosynthetic rate (17.07 mg $CO_2/dm^2/h$).

153

Kriek, W. (1967).
Report on species and provenance trials in the wooded savanna above 5000 ft altitude.
Uganda Forestry Department, Technical Note 142/67.

Acacia auriculiformis reportedly failed in Uganda. The planting sites are high in altitude, 1150-1570 m, annual rainfall 890-1280 mm. Soils differ from sandy, shallow over quartzite to dark brown clay loam of good depth.

154

Ku, V.C. and Chen, H.T. (1984).
Study on the pulping of fast-growing Acacia species.
Taiwan Forestry Research Institute, Taipei, Taiwan, Republic of China, Bulletin No. 416, 10 pp. (Ch, en)

Pulping and paper-making characteristics of plantation-grown *Acacia auriculiformis* and *Acacia mangium* were determined using kraft and soda-anthraquinone processes. Fibre length and length to width ratios of these two acacias are lower than those of local hardwoods and *Leucaena* wood, but all species are generally similar in fibre width and chemical compositions. At kappa No. 20, the pulp yield and alkali requirement (active alkali as Na_2O) of *Acacia auriculiformis* are about 51.5-53% and 14-16% respectively, and those of *Acacia mangium* are 57% and 12.5-14% respectively indicating that both species are very good raw material for pulping and paper-making. It is concluded that excellent quality kraft and soda-anthraquinone pulps from these acacias are suitable for making good quality printing and writing papers.

155

Kumar, P., Anathanarayana, A.K. and Sharma, S.N. (1987).
Physical and mechanical properties of *Acacia auriculaeformis* from Karnataka.
Indian Forester 113(8), 567-573.

Wood samples of *Acacia auriculiformis* from 14-year-old planted trees in Karnataka were tested for physical and mechanical properties and suitability indices using teak for standard comparison. The results indicate that the species possesses wood properties which are very suitable for a wide range of

utilisation besides its common use as firewood, e.g. turnery, furniture, joinery, flooring, construction timber and tool handles. Its wood is classified as very heavy, extremely strong, moderately tough and extremely hard.

Physical and mechanical properties of *A. auriculiformis* from 14-year-old trees are compared with standard teak as follows :

Properties	*A. auriculiformis*		Teak	
	green	dry	green	dry
Specific gravity	0.747	0.722	0.596	0.604
% moisture content	48	12	77	12
Static bending:				
(a) Modulus of rupture(kg/cm^2)	1081	1473	841	959
(b) Modulus of elasticity ($1000\ kg/cm^2$)	113.5	160.5	109.7	119.6
Compression parallel to grain: Maximum crushing stress(kg/cm^2)	476	736	415	532
Compression perpendicular to grain: Compressive stress at E.L.(kg/cm^2)	109	125	86	101
Hardness:				
(a) Radial (kg)	827	1134	557	502
(b) Tangential (kg)	801	1095	551	524
(c) End (kg)	945	1348	486	488
Shear parallel to grain:				
(a) Radial (kg/cm^2)	92.6	103.5	89.5	96.6
(b) Tangential (kg/cm^2)	104.1	148.5	100.2	108.0
Tension perpendicular to grain:				
(a) Radial (kg/cm^2)	36.2	45.3	68.3	57.6
(b) Tangential (kg/cm^2)	49.2	48.5	79.4	66.4
Nail holding power:				
(a) Side (kg)	218	112	127	-
(b) End (kg)	174	79	91	-
Screw holding power:				
(a) Side (kg)	454	403	331	-
(b) End (kg)	319	214	236	-

Suitability indices of the species in terms of teak taken as 100 are as follows :

Properties	Suitability indices
Strength	132
Stiffness	114
Suitability as post	112
Shock resisting ability	116
Shear	110
Splitting	63
Hardness	160
Nail holding power	138
Screw holding power	116
Weight or heaviness	123

156

Kushalapa, K.A. (1988a).
Comparative biomass of *Acacia auriculiformis* and *Leucaena leucocephala* trees from moist region of Karnataka.
Myforest 24(1), 12-15.

Six-year-old plantations of *Acacia auriculiformis* and *Leucaena leucocephala* were sampled for biomass assessment, and roots of the sampled trees were excavated for calculation of weight and length. Height growth of *A. auriculiformis* was greater than that of *L. leucocephala* but girth was smaller. *L. leucocephala* produced much greater biomass than *A. auriculiformis* but wood percentage of biomass was similar for the two species. Bark percentage, which is a source of tannin extract, was greater in *A. auriculiformis*.

157

Kushalapa, K.A. (1988b).
Comparative productivity of *Acacia auriculiformis* and *Casuarina equisetifolia* in high rainfall areas.

Nitrogen Fixing Tree Research Reports 6, 12.

Reports trial of *Acacia auriculiformis* and *Casuarina equisetifolia* established in 1977 at Hosur near Argumbe of Shimoga district in Karnataka, south India (latitude 14°32'N, longitude 75°6'E, altitude 700 m, annual rainfall 6000 mm, soil pH 5.5). Nine years after planting, *A. auriculiformis* had a survival of 92%, and produced total above-ground dry biomass 152.8 t/ha. *C. equisetifolia* had a survival of 84%, and produced total above-ground biomass 108.3 t/ha. *A. auriculiformis* has also been found to perform better than *C. equisetifolia* in other localities.

The annual rainfall in the study area (6000 mm) is twice that recorded for the highest range of annual rainfall (3000 mm) in the natural range of *A. auriculiformis* in Papua New Guinea.

158

Kushalapa, K.A. (1988c).
Comparative biomass of *Leucaena leucocephala* and *Acacia auriculiformis* trees in six years.
Nitrogen Fixing Tree Research Reports 6, 10-11.

Plantations of *Acacia auriculiformis* and *Leucaena leucocephala* were established on an area formerly carrying a dry deciduous type of forest at altitude 800 m with annual rainfall 1000 mm, and a soil pH of 8. Six-year-old trees were

harvested for biomass production and their roots excavated. Growth of *L. leucocephala* was better than *A. auriculiformis* probably due to deeper penetration and longer spread of roots. In unprotected areas, *A. auriculiformis* has a better chance of surviving because it is not browsed by cattle.

159

Kushalapa, K.A. (1988d).
Silvicultural systems in the tropical rain forests of Karnataka.
Indian Forester 114 (7), 372-378.

Hardy species like *Acacia auriculiformis*, *Grevillea robusta*, *Casuarina equisetifolia*, *Bambusa vulgaris* and *Bixa orellana* were found to be successful in afforestation on grasslands in the tropical rain forests of Karnataka. The planting areas are on the ridges or slopes of the Western Ghats which are completely protected from felling.

160

Lahiri, A.K. (1984).
Note on *Acacia mangium* on a lateritic tract of West Bengal.
Nitrogen Fixing Tree Research Reports 2, 2-4.

A brief account of growth performance of *Acacia mangium* and *A. auriculiformis* in West Bengal between 21-24°N latitude and 85-87°E longitude. The region is hot in summer with temperatures up to 40°C and average rainfall 1000-1500 mm per annum Soils are lateritic with low N and P, high Fe and Al oxides. *A. auriculiformis* has a mean annual height increment of 1.2 m compared to 2.1 m for *A. mangium*. *A. auriculiformis* has naturalised in the area since its introduction in 1946.

161

Lahiri, A.K. (1986).
Trial on intensive cultivation of fuelwood for maximum biomass production.
Indian Agriculturist 30(4), 281-85.

A fuelwood plantation trial of *Leucaena leucocephala*, *Acacia auriculiformis*, *Casuarina equisetifolia*, *Dalbergia sissoo*, *Cassia siamea* and *Albizzia* [*Albizia*] *procera* was established on a grassy area at Mahatpur, in the central alluvial tract of West Bengal having rainfall 1000-1200 mm and sandy loam soil, pH 7.2. Close spacings, 30x30, 45x45, 60x60 and 100x100 cm, were used. Data are tabulated on mean annual and total biomass (dry) production per ha for each species and spacing and on solar energy conversion efficiency for each species at the optimum spacing. *L. leucocephala* recorded highest biomass productivity (63.5 t/ha/y) followed by *A. auriculiformis* (44.5 t/ha/y) at 45x45 cm spacing. In regard to energy conversion efficiency, *L. leucocephala* and *A. auriculiformis* also ranked highest.

162

Lamb, D. (1975).
Kunjingini plantations 1965-1975.
Tropical Forestry Research Note, Papua New Guineas (No. SR. 24), 14 pp.

The report summarises species trials established during 1965-1975 in Kunjingini area of the East Sepik District where soil is infertile and poorly drained thus not suitable for agricultural development. Nineteen tree species have been tested but most have failed. Only

Acacia auriculiformis and *Eucalyptus tereticornis* have grown well and shown promise for reafforestation.

A. auriculiformis is shown to respond to NPK fertilizer but the results are not consistent. Further study is suggested before detailed fertilizer prescription can be devised. However, there is evidence that growth of *A. auriculiformis* is improved by certain site preparation. Mounding following ripping appears to improve tree height over ripping alone. It is believed that mounding not only provides better drainage for the newly-planted seedlings but also increases rate of organic matter mineralisation and reduces weed competition.

163

Langkamp, P. and Plaisted, M. (1987).
Native plant seed usage by the mining industry - a survey.
In Langkamp, P. (ed), Germination of Australian native plant seed. Inkata Press, Melbourne-Sydney.

Provides a list of Australian native plant seed used by the mining industry. For each species authority, collection method, amount, cost, germination treatment, site name, latitude and longitude and vegetation type are given. Two seed sources of *Acacia auriculiformis* are reportedly used, one from Ranger, in the Northern Territory (12°39' S, 132°54'E) another from Weipa, Queensland (12°38'S, 141°53'E). 10 kg of seed from the Northern Territory source were hand-picked; fresh seed germinated without treatment but stored seed required treatment with boiling water. Only 0.01 kg was collected from Queensland.

164

Lantican, C. and Yantasath, K. (1987).
A guide for multipurpose tree species research cooperators.
Forestry/Fuelwood Research and Development (F/FRED) Project Coordinating Unit, Bangkok, Thailand, 11 pp.

A field operational manual prepared for the cooperators in the multipurpose tree species trials in 1987 in the humid tropics under the F/FRED Project. The manual covers standard procedures for field establishment such as seedling production, site preparation, planting and maintenance. Two provenances of each of three species i.e. *Acacia mangium, A. auriculiformis* and *Leucaena leucocephala* were recommended for comparison under three management regimes; control, pollarding and pruning.

165

Lapongan, J. (1988).
Introduction to the acacia hybrid.
P 273 *in* Multipurpose tree species for small-farm use: proceedings of an international workshop held in Pattaya, Thailand, 2-5 November 1987, (eds Withington, D., MacDicken, K.G., Sastry, C.B. and Adams, N.R.).

A brief account of the hybrid of *Acacia auriculiformis* and *A. mangium* which was first observed in 1971 in Sabah. The hybrid possesses intermediate characteristics that belong to the two acacias but its growth is more vigorous. Potential uses for the hybrid are discussed.

166

Latif, M.A., Khan, S.A. and Bhuiyan, M.K. (1985).
Prospects of *Acacia mangium* for afforestation in Bangladesh.
Pakistan Journal of Forestry 35(1), 7-12.

Growth of *Acacia mangium* is compared with other species over 7 sites. Height and diameter increment of *A. mangium* are generally comparable to that of *Eucalyptus camaldulensis* and *E. tereticornis*. Where the soil is sandy clay to clay, *A. mangium* grows much faster than *A. auriculiformis* but growth rate of these two species was more or less the same where the soil is sandy loam to clay loam and the top-soil has been removed.

167

Leelavathi, P., Ramayya, N. and Prabhakar, M. (1980).
Foliar stomatal distribution patterns in Leguminosae and their taxonomic significance.
Phytomorphology 30(2/3), 195-204.

Examines foliar stomatal distribution patterns of 106 species belonging to three subfamilies of Leguminosae. In *Acacia auriculiformis* stomata are found all over on both sides of phyllode except on mid-vein and main lateral veins. They are irregularly arranged and variously oriented.

168

Liese, W. and Martawidjaja, A.A. (1962).
The use of simple impregnation methods for protecting tropical timbers.
Holz Roh und Werkstoff 20(11), 438-443. (De, en)

Carbolineum and a 4% NaF solution were brushed on to air-dried and water-saturated wood specimens of 12 Indonesian species. Application and subsequent investigation of penetration depth were done according to German Standard DIN 52618. Penetration was greatest in *Acacia auriculiformis*, *Pinus merkusii*, and *Agathis loranthifolia*. Penetration of NaF solution into water-saturated specimens was 2-3 times as great as into air-dried specimens.

169

Logan, A.F. (1981).
Pulping of tropical hardwood reforestation species.
Research Review 1981, CSIRO Division of Chemical Technology, Melbourne.

Because of the increasing utilisation of tropical rainforests by pulp and paper and other wood-using industries, the future supply of pulpwood in tropical countries is believed to have to come from plantations or reforested areas. Accordingly, tropical tree species which have shown promise for reforestation are evaluated for their pulping characteristics.

Acacia auriculiformis is reported to be suitable for sulphate and neutral sulphite semichemical (NSSC) pulp production. It has a basic density of 500 kg/m^3 which makes pulp production practical when cost efficiency is taken into consideration. The following table summarises pulping properties of *A. auriculiformis* in comparison with some selected tropical hardwood reforestation species.

Species	Age (y)	Basic density (kg/m^3)	Unbleached sulphate pulps	NSSC pulps	High-yield pulps
A. auriculiformis	10	500	Excellent	Excellent	Fair-poor
A. mangium	10	420	Very good	-	-
Albizia falcataria	7	240	Very good	Very good	Very good
Euc. deglupta	10	360	Very good	Very good	Fair
Euc. tereticornis	5	660	Poor	Fair	Very poor
Gmelina arborea	5	350	Very good	Very good	Very good
Leu. leucocephala	4	470	Very good	Very good	-

170

Logan, A.F. (1987).
Australian acacias for pulpwood.
P 89-94 *in* Australian acacias in developing countries: proceedings of an international workshop held at the Forestry Training Centre, Gympie, Qld., Australia, 4-7 August 1986 (ed. Turnbull, J.W.), ACIAR Proceedings No. 16.

The paper discusses pulping and paper-making attributes of some Australian *Acacia* species by considering some results from kraft and NSSC pulping studies. Several *Acacia* species having good silvicultural characteristics are highly suitable for pulpwood plantations in developing countries. These species include *A. auriculiformis* and *A. mangium* which have shown similar pulping quality to that of *Eucalyptus deglupta*, *E. regnans* and *Gmelina arborea*. Kraft pulping properties of plantation-grown *A. auriculiformis* from different locations are presented.

The paper emphasises the need to improve the poor stem form of *A. auriculiformis* which is the major drawback to its utilisation as a plantation pulpwood. Hybrid *A. auriculiformis x A. mangium* could also be produced with acceptable form and good pulping characteristics.

171

Logan, A.F. and Balodis, V. (1982).
Pulping and paper making characteristics of plantation-grown *Acacia mangium* from Sabah.
Malaysian Forester 45(2), 217-236.

Acacia auriculiformis is said to be a very promising pulpwood plantation species from Papua New Guinea. The sulphate and NSSC pulping properties of *A. mangium* and *A. auriculiformis* are quite similar but *A. auriculiformis* would attract a higher export woodchip price because of the higher wood density and pulp yield.

172

Logan, A.F., Phillips, F.H., Williams, M.D. and Eddowes, P.J. (1984).
Pulpwood potential of some fast growing tropical hardwoods.
Appita 37(5), 391-399.

The article reports pulpwood potential of six fast growing tropical tree species (*Acacia auriculiformis*, *Albizia falcataria*, *Eucalyptus tereticornis*, *E. deglupta*, *Gmelina arborea* and *Terminalia brassii*). It is stressed that since the pulpwood potential of the different species varies within and between processes, there is a need to

carefully plan reforestation regimes in tropical regions to suit the required and end use envisaged for the resource. A range of species could be planted to allow utilisation for various pulping operations, but close consideration needs to be given to both silvicultural characteristics and pulping properties.

173

Luangjame, J. and Bunbhakdee, L. (1987).
Comparing salt tolerance of *Eucalyptus camaldulensis* with other fast-growing trees.
Thai Journal of Forestry 6, 347-361. (Th, en)

Seedlings of *Eucalyptus camaldulensis*, *Acacia auriculiformis*, *Anacardium occidentale*, *Azadirachta indica* and *Leucaena leucocephala* were subjected to NaCl 0, 0.5, 1.0, 1.5 and 2.0% concentration for 3 months. In general, shoot and root growth of seedlings of all species are decreased with the increased salt concentration levels from 0 to 2%. All species except *E. camaldulensis* survived at the highest concentration level.

174

Luangviriyasaeng, V., Puriyakorn, B., Boonnarutee, P. and Pinyopusarerk, K. (1988).
Seed pretreatment for *Acacia auriculiformis*.
Research report, Silvicultural Research Subdivision, Royal Forest Department, Thailand. (Th, en)

Seed of *Acacia auriculiformis* was treated with different amounts of hot-boiling water for different periods of time under laboratory conditions. It is concluded that pouring boiling water (10-20 times the volume of seed) onto the seed and soaking the seed overnight in the gradually cooling water is the most simple and effective method. It is especially suitable in developing countries where plantations are often established in rather remote areas.

175

Lundqvist, E. (1964).
Report to the government of India on the expansion of plantation forestry.
Expanded Program of Technical Assistance, FAO, Rome. FAO Report No. 1874, p vii+56.

In view of the increased demand for wood consumption in India, country-wide reforestation of high yielding species has been initiated to replace the low-yielding natural forests. *Acacia auriculiformis* is included in these planting programs. It is also recommended in the report that research be carried out to study the use of *A. auriculiformis* for pulpwood.

176

Luton, J.R. (1983).
***Acacia auriculiformis* A. Cunn. ex Benth - promising fast-growing species for the tropics.**
Proceedings of the symposium and workshop on breeding and yield of fast growing tree species held in Aguas de Sao Pedro, Sao Paolo, Brazil, 25-30 August 1980. Silvicultura 30, 348-350.

Provides a map showing natural distribution of *Acacia auriculiformis* in Papua New Guinea, Australia and Indonesia. Natural distribution in Papua New Guinea is reported to be on the savannas along the Papuan coast. Poor stem form and the tendency to

multileaders of the trees are normal in Papua New Guinea, but straight specimens with single leader can be seen along the road outside Port Moresby. Collection of seed from straight trees for breeding programs is mentioned.

Seed stored in airtight jars in an airconditioned laboratory is still viable after six years.

Recent seed collection expeditions in Papua New Guinea by CSIRO Australian Tree Seed Centre (see Gunn *et al.* (1987) have found straight stem trees of *A. auriculiformis* in many areas. Field trials have been established with seeds collected from these trees. Early results have shown some individuals of the Papua New Guinea populations to grow vigorously with a strong apical dominance.

177

MacDicken, K.G. and Brewbaker, J.L. (1983).
Wood volume prediction equation for the early growth of selected nitrogen fixing fuelwood species.
Nitrogen Fixing Tree Research Reports 1, 46-47.

Two wood volume equations were derived for four nitrogen fixing tree species using height, basal diameter, diameter breast height (DBH), the square and logarithm of each variable and the height x DBH^2 interaction. For *Acacia auriculiformis* the following two equations are given:

(1) $Y = -378 + 120(BD^2)$
$R^2 = .88$

(2) $Y = -163 + 64(BD^2) + 25(HT(DBH^2))$
$R^2 = .93$

where Y = wood volume in cm^3/tree
BD = basal diameter
DBH = diameter breast height (1.37 m)
HT = Height

The use of these equations is limited to the size classes from which the samples were drawn, i.e. HT 1.5-6.0 m, BD 1.0-7.0 cm and DBH 0.5-5.0 cm. This will cover ages up to 1-2 years after planting.

178

MacDicken, K.G. and Brewbaker, J.L. (1984).
Descriptive summaries of economically important nitrogen fixing trees.
Nitrogen Fixing Tree Research Reports 2, 46-54.

Environmental description and utilisation information are given for 44 nitrogen fixing tree species. The following is information given on *Acacia auriculiformis.*

Descriptive information

Height at maturity	5-25 m
DBH at maturity	60 cm
Tree form	poor
Leaf type	alternate, simple flattened phyllode
Climatic zone	humid-subhumid tropics
Minimum rainfall	1300 mm
Dry season tolerance	4-6 months
Elevation range	0-600 m
Temperature range	20-30 °C
Soil reaction	strongly acid-highly alkaline
Other limitations	low wind tolerance

Product and utilisation information

Wood products	fair timber, excellent pole, good pulp
Forage products	none

Other products	good tannin and ornamental
Specific gravity	0.60-0.75
Heating value	4800-4900 kcal/kg
Wood volume	5-20 m^3/ha/a
Seeds/kg	60,000-63,000

Recent research results have shown the species survives and grows satisfactorily under extreme conditions: average annual rainfall below 800 mm (e.g. in Thailand and Zimbabwe) or high up to 6000 mm (e.g in Karnataka, India), high temperatures up to 40^{o}C (e.g. in West Bengal), long dry periods up to 8 months (e.g in Zimbabwe). It is also found to tolerate waterlogging for up to 6 months (e.g. in Thailand).

Field observations in the species' natural habitats in Australia and Papua New Guinea and several cultivated stands in Thailand have found many straight and single-stemmed trees. Seed has been collected from these trees to establish progeny and provenance trials. Early results from these trials are very encouraging.

Fodder value of *A. auriculiformis* has been investigated (Vercoe, 1989), and has been shown to have the minimum requirements for certain nutrients.

179

MacDicken, K.G. and Brewbaker, J.L. (1988).
Growth rates of five tropical leguminous fuelwood species.
Journal of Tropical Forest Science 1(1), 85-93.

Reports two-year-results of five experiments conducted to compare growth of five tropical leguminous fuelwood species (*Leucaena leucocephala*, *Leucaena diversifolia*, *Acacia auriculiformis*, *Calliandra calothyrsus* and *Sesbania grandiflora*) planted over five different locations in Hawaii and Philippines. Two leucaenas produce the largest wood yields. Results obtained for *A. auriculiformis* at each planting site are as follows:

Location	Height (m)	Basal diameter (cm)	Wood volume (m^3/ha/a)
Waimanalo, Hawaii	5.0	4.9	12.5
Molokai, Hawaii	4.6	3.8	5.8
Waipio, Hawaii	3.2	3.2	3.6
Niulii, Hawaii	2.5	4.7	11.0
Davao, Philippines	6.1	6.6	30.9

Davao site is by far the most productive site for all species due mainly to well-distributed rainfall and fertile soils. The least productive site is Niulii which has the lowest temperature range (15-22^{o}C) suggesting the suitability of the tested species to warmer sites.

180

Madamba, J.C. (1985).
Multipurpose tree species as components of agroforestry system in Asia.
P 413-448 *in* Increasing productivity of multipurpose species: proceedings of the IUFRO Planning Workshop for Asia on forest research and technology transfer held in Kandy, Sri Lanka, 16-28 July 1984, (eds Burley, J. and Stewart, J.L.).

A list of potential multipurpose tree species is given along with their potential uses. *Acacia auriculiformis* is recommended for the humid and semi-arid tropical Asia.

181

Mahato,, S.B., Pal, B.C. and Price, K.R. (1989).
Structure of acaciaside, a triterpenoid trisaccharide from *Acacia auriculiformis*.
Phytochemistry 28(1), 207-210.

From Forestry Abstracts: Acaciaside isolated from the seeds of *Acacia auriculiformis* was shown to be acacic acid lactone-3-0-ß-D-glucopyranosyl (1 6)-[a-L-arabinopyranosyl (1 2)]-ß-D-glucopyranoside, based on its spectral properties and some chemical transformations.

182

Mamit, J.D. (1986).
Specific gravity of two reforestation species in Sarawak.
Malaysian Forester 49(1), 72-78.

Compares specific gravity of *Acacia auriculiformis* and *Paraserianthes falcataria* [formerly *Albizia falcataria*] using wood specimens collected from different locations in Sarawak. Mean specific gravity of *A. auriculiformis* over three locations is 0.61 and is found to decrease upwards along the trunk from 0.63 to 0.58. Mean specific gravity of *P. falcataria* is much lower (0.25), and seems to increase up the stem from 0.25 to 0.27.

Regular applications of boron fertilizer were made in a plot of *A. auriculiformis*, and this plot gave the highest specific gravity. It is concluded that the high specific gravity might have been influenced by the fertilizer.

183

Marcar, N.E. (1988).
Salinity research in Asia.
Forestry Newsletter No. 6, Australian Centre for International Agricultural Research, Canberra.

Describes an ACIAR funded project "Australian Woody Species for Saline Sites in Asia". *Acacia auriculiformis* is included in field trials in northeast Thailand (acid soil) and Pakistan (alkaline soil). The project also includes glasshouse study on intraspecific variation in salt tolerance in *A. auriculiformis*.

184

Marunda, C.T. (1989).
Seedling evaluation and the physiological effects of seed pretreatments on the subsequent development of *Acacia auriculiformis* (A. Cunn. ex Benth.) and *Acacia holosericea* (A. Cunn. ex G. Don) seedlings.
Paper, IUFRO symposium on seed problems of multipurpose trees and other tropical and subtropical species held in Gympie, Queensland, 21-24 August 1989.

Seeds of *Acacia auriculiformis* and *A. holosericea* were nicked, immersed in hot water and soaked in sulphuric acid to improve germination and to determine the effects of the various pretreatments on germination and vigour of subsequent seedling growth. For both species, nicking achieved the highest germination (100% for *A. auriculiformis* and 97% for *A. holosericea*), but the seedlings were less vigorous when compared to other treatments. For *A. auriculiformis*, soaking seeds in acid for 30 minutes and immersing seeds in hot water for 5 minutes gave high germination (95 and 85% respectively) and the resultant

seedlings were most vigorous. For *A. holosericea*, immersion in hot water (1 and 5 minutes) gave high germination (93 and 90% respectively) as well as vigorous resultant seedlings.

It is noted that germinating seeds and seedlings treated in acid and hot water exhibited more surface fungal infection than those nicked. It is suggested the severe treatments could have removed the protection offered by seed coat resulting in metabolites leaking out providing a nutritious medium for fungal growth. The severe treatments could have enhanced the germination of the fungal spores. Sterilisation of nursery soil is recommended in order to reduce the incidence of fungal infection.

The temperature of hot water in the study was not specified. It is likely that the author refers to boiling water.

185

Maun, M.M. (1977).
Survival and growth of four reforestation species with slow-release tablet fertilizer.
Sylvatrop, 2(3), 219-222.

Application of Agriform slow-release tablet fertilizer (18-8-6) had no significant effect on survival of *Acacia auriculiformis*, *Gmelina arborea*, teak (*Tectona grandis*) and *Pinus kesiya* under field conditions at Bugnay, Diadi, Nueva Vizcaya, Philippines over a 3-year period from August 1972-August 1975. However, the fertilizer significantly increased height growth of *A. auriculiformis* and *G. arborea*, but not teak and *P. kesiya*.

186

Mawardi, A.M., Achmad. (1986).
Some NFT species used in mound culture in tidal swamp areas of south Kalimantan, Indonesia.
Nitrogen Fixing Tree Research Reports 4, 24.

Acacia auriculiformis and *Albizia falcataria* are reportedly growing well in tidal swamp areas in South Kalimantan. The areas receive 2000-3000 mm of rain per annum and are subject to flooding during the wet season (October to June). *Leucaena leucocephala* and an unidentified *Sesbania* do not perform as well.

187

Meshram, P.B., Ram Bhajan and Jamaluddin. (1985).
Occurrence of insect *Kerria lacca* Kerr. on *Acacia auriculiformis* A. Cunn. ex Benth.
Journal of Tropical Forestry 1(4), 356.

Roadside plantations of *Acacia auriculiformis* in Madhya Pradesh were reportedly attacked by lac insects (*Kerria lacca*). The evidence thus confirms that trees of *A. auriculiformis* would be suitable as host plants for lac culture.

188

Midgley, S.J. and Weerawardane, N.D.R. (1986).
Termites and their control in eucalypt plantations of the Community Forestry Project.
Sri Lankan Forester 16 (3,4) in press.

Subterranean termites (probably *Odontotermes* and *Nasutitermes* sp) have

been found to cause greatest damage in eucalypt plantations of the Community Forestry Project in Sri Lanka. In a species trial which was also largely destroyed by termites, preliminary results indicated that some species could be less susceptible than the two commonly grown eucalypts (*Eucalyptus camaldulensis* survived 22% and *E. tereticornis* survived 27.3%). Other species all recorded significantly higher survival: *A. auriculiformis* (77.6%), *Acacia mangium* (79.3%), *A. leptocarpa* 75%), *Leucaena leucocephala* (77.6%), *Azadirachta indica* (100%), etc.

189

Midgley, S.J., Turnbull, J.W. and Hartney, V.J. (1986).
Fuelwood species for salt affected sites.
Reclamation and Revegetation Research 5, 285-303.

Fuelwood plantations have been established in all types of degraded land including salt-affected wasteland as one of the measures to overcome fuelwood shortage in many developing countries. Tree species especially suitable for planting in the salt-affected areas are suggested in this article, together with future directions in species selection. Examples of salt tolerant species are *Acacia auriculiformis*, *Eucalyptus camaldulensis*, *Rhizophora* sp, *Prosopis tamarugo*, *Casuarina equisetifolia* and *Melaleuca quinquenervia*.

190

Midgley, S.J. and Vivekanandan, K. (1987).
Australian acacias in Sri Lanka.
P 132-135 *in* Australian acacias in developing countries: proceedings of an international workshop held at the Forestry Training Centre, Gympie, Qld., Australia, 4-7 August 1986 (ed Turnbull, J.W.), ACIAR Proceedings No. 16.

Acacia auriculiformis is among many *Acacia* species being introduced to Sri Lanka. Although the species has only been introduced recently, it has shown rapid early growth on area with prolonged annual drought. It is reported that the trees suffered from a tip dieback when they are 2-2.5 m tall but recovered quickly. The tip dieback has, however, affected the form. It is suggested that *Acacia auriculiformis* is suitable for afforestation of lowland, sub-humid sites.

191

Mijers, W.N. (1941).
Reforestation in Madura.
Tectona 34, 909-39. (Nl)

A reforestation program was planned on the island of Madura [Indonesia] as a result of rapid decline in forest area. The planting program covers a total area of 7550 ha in 10 years and includes *Acacia auriculiformis*.

192

Milimo, P.B. (1989).
Growth and survival of Australian tree species in field trials in Kenya.
P 103-107 *in* Trees for the tropics - growing Australian multipurpose trees and shrubs in developing countries (ed Boland, D.J.), ACIAR Monograph No. 10.

Acacia auriculiformis was planted in semi-humid to semi-arid, and humid areas in Kenya as part of ACIAR species trials. Early results (3 months after planting) are promising with *A. auriculiformis* being the fastest growing

at semi-humid to semi-arid site, and second only to *Acacia crassicarpa* at the humid site. Survival was high.

193

Misra, C.M. (1981).
Eco-silvicultural problems of southern Uttar Pradesh I. (B) Ecology of seed germination.
Van Vigyan 17(1/4), 11-15.

A report on the germination behaviour and relative salt tolerance of *Acacia auriculiformis* and *Leucaena latisiliqua*. Seeds of *A. auriculiformis* were sown at different depths after pre-treated with acid (concentrated H_2SO_4) scarification for different durations. Maximum germination (79%) was obtained for the seeds treated with acid for 10-15 minutes and sown at 2 cm depth.

In regard to salt tolerance, *A. auriculiformis* seeds could germinate in all concentration levels (0-15 E.C. in m mhos/cm), with a peak at 4 E.C. and then a decline with increased concentrations.

194

Misra, C.M. and Singh, S.L. (1987).
Ecological evaluation of certain leguminous trees for agro-forestry.
Nitrogen Fixing Tree Research Reports 5, 5.

Evaluation of root development of some leguminous tree species revealed that most species tended to develop more lateral roots rather than deep tap roots in saline-alkaline soils in the southern/central part of Uttar Pradesh. It is suggested that the lateral spread of roots helps these species survive under the saline-alkaline conditions. Lateral roots of *Acacia auriculiformis* were measured up to 4.6 m in length. It is concluded that the spread of lateral roots greatly improves surface soil conditions for agricultural crops, but also means that tree spacing must be wider in saline-alkaline soils to avoid root overlapping and to reduce competition with crops.

195

Mitchell, B.A. (1957).
Malayan tin tailings - prospects of rehabilitation.
Malayan Forester 20(4), 181-8.

Describes the conditions to be dealt with and research into possible methods of rehabilitation and afforestation in tin-tailings. Species trials planted on very infertile tailings show that *Acacia auriculiformis*, *Eucalyptus deglupta*, *Fagraea fragrans*, and *Pinus merkusii* are very promising. Other species i.e. *Pinus caribaea* and *Casuarina equisetifolia* may also be suitable.

196

Mitchell, B.A. (1963).
Forestry and tanah beris.
Malayan Forester 26, 160-170.

Tanah beris is the result of the accumulation of sand thrown up by the annual north-east monsoon in Malaya [Malaysia]. It occurs as a narrow strip running from north-east coastal Kelantan in the north to south-east coastal Pahang in the south. It is considered to be an infertile site. Natural vegetation is generally poor.

Two tanah beris sites, one at Cherang Rutu, Kelantan and one at Rantau Abang, Trengganu were selected for trial planting with exotic species because indigenous species were not successful. *Acacia auriculiformis*, though not

regarded as a valuable timber species, was selected for its good growth shown on other infertile sites e.g. tin tailings and coastal sites.

At Kelantan, survival is reported to be very good except for some mortalities caused by monsoon and a few death during a prolonged dry season. Mean height after 30 months was approximately 8 ft [2.4 m]. There was evidence of old fructifications of *Thelephora ramariods*, a fungus observed in the rooting zone of healthy plants of *A. auriculiformis*. It is not sure whether this fungus stimulates growth of *A. auriculiformis*.

At Trengganu, growth is better and there is a greater development of *Thelephora*. Although the trees were damaged by monsoon winds, mean height at 30 months was 15 ft [4.6 m].

Height growth of *A. auriculiformis* observed on moderately fertile sites in Malaysia is said to be around 20 ft [6 m] in 2.5 years, and on sandy tin tailings 13 ft [4 m] in the same period. Mortality is generally less than 10%. This acacia is believed to be superior to indigenous species on well-drained areas of tanah beris.

197

Mitchell, B.A. (1964).
Ornamental, roadside and shade trees.
Malayan Forester 27, 96-144.

This is an enlargement and revision of the article by G.H. Addison and M.R. Henderson (1954) with particular emphasis given on species planted in lowland Malaysia.

198

Mittal, A., Agrawal, R. and Gupta, S.C. (1989).
***In vitro* development of plantlets from axillary buds of *Acacia auriculiformis* - a leguminous tree.**
Plant Cell, Tissue and Organ Culture 19, 65-70

The article reports on morphogenic response of *Acacia auriculiformis*. Different explants e.g. seedling leaves, cotyledons, hypocotyl segments and axillary buds were excised from one-month old *in vitro* grown seedlings. Multiple shoots could be obtained only from the axillary buds, in basal medium supplemented with coconut milk (5 or 10%) and benzylaminopurine (10^{-6}M). These shoots produced roots at their base if they were transferred to basal medium augmented with indole-3-acetic acid (10^{-7}M) or naphthaleneacetic acid (10^{-6} or 10^{-7}M)

Semsuntud (1988) reports that multiple shoots could be obtained from tip, axillary bud and root collar excised from *in vitro* grown seedlings.

199

Mohd. Nor, B.M.Y., Khoo, K.C., Lee, T.W. and Peh, T.B. (1986).
Sulphate pulping of *Acacia auriculiformis* from Peninsular Malaysia.
Malaysian Forester 49(1), 23-34.

The article gives an assessment of pulping and paper-making characteristics of *Acacia auriculiformis* grown in Malaysia. The authors' abstract is presented verbatim.

Two samples of *Acacia auriculiformis*, aged 7 and 20 years, grown in Peninsular Malaysia were examined to assess their

potential as a raw material for pulp and paper. Wood density for both samples exceeded 570 kg/m^3. Fibres were short (less than 1 mm long), slender (about 19 microns wide) and thin-walled. Both samples were found to have an alpha-cellulose content of over 40% and pentosans content of around 15%. Despite a higher lignin content of 27% the younger sample was easier to pulp by the sulphate process, producing stronger pulp than that from older sample. Both gave a pulp yield exceeding 45% at Kappa number of about 20.

200

Mohammad, G. and Singh, S.P. (1988).
Effect of tripartite symbiosis on containerized *Acacia auriculiformis* seedlings.
Vaniki Sandesh 12(1), 10-12.

A poly-pot experiment was conducted to assess the influence of microsymbionts on biomass accumulation and nutrient uptake in *Acacia auriculiformis* seedlings. Five plastic pots (9.5x21.5 cm) filled with soil and sand were inoculated at the rate of 2 g solid base cultures of *Rhizobium*, *Bacillus megaterium*, *Glomus fasciculatum*, separately and in combination. One set of 5 pots was not inoculated to serve as control. Two seeds were sown in each pot and one germinated seedling was retained.

Results after 3 months of growth are summarised in the table.

Maximum biodynamic effects were recorded on all parameters under the influence of triple inoculants followed by double and single inoculants. However, single inoculation with *Rhizobium* was found to be more effective than double inoculants (*B. megaterium* + *G. fasciculatum*) in shoot length, root depth and N uptake. Among dual inoculants, *Rhizobium* + *G. fasciculatum* was more effective than other combinations.

Treatment	Shoot length (cm)	Root depth (cm)	Nodule Nos/pl	Nodule dry wt (g/pl)	Dry mass (g/pl)	N uptake (mg/pl)	P uptake (mg/pl)
Control	36.9	18.2	3.2	0.019	3.1	61.9	1.4
Rhizobium	63.0	30.6	5.9	0.025	6.3	127.7	4.6
B. megaterium	46.8	22.0	2.6	0.003	5.4	92.9	5.0
G. fasciculatum	53.5	26.7	3.1	0.006	6.5	113.0	5.6
R. + B.meg	63.6	31.3	11.8	0.026	7.3	162.0	7.4
R. + G.fas	69.8	36.3	14.2	0.108	8.4	147.1	7.6
B.meg+G.fas	59.1	29.6	8.9	0.066	7.5	116.3	5.7
R.+B.meg+G.fas	74.8	42.8	16.2	0.197	9.9	212.5	8.7
CD at 5%	18.2	13.4	6.2	ns	3.7	13.6	3.7

201

Mohanan, C. and Sharma, J.K. (1989).
Diseases of exotic acacias in India.
Indian Journal of Forestry (submitted).

The following foliar diseases are reportedly observed in the nurseries and young plantations of *Acacia auriculiformis*.

***Exserohilum* foliar spot:** The disease caused by *Exserohilum rostratum* anamorph of *Setosphaeria rostratum* was recorded on 2-year-old plants of *A. auriculiformis* at the Biomass Centre, Madurai Kamaraj University in December 1984. The disease was characterised by the production of amphigenous small dark brown to black elliptical to irregular lesions with an off-white area at the centre. The lesions occasionally coalesced to form large necrotic areas. The lesions were also produced on petioles and tender green branches.

***Colletotrichum* foliar infection:** The disease caused by *Colletotrichum* state of *Glomerella cingulata* was recorded in May/June and November/December 1984 on nursery seedlings and 2-to 3-year-old plants at Peechi (Kerala Forest Research Institute campus) and Chandanathodu, Wynad in June/July 1983. Initial symptom of the disease was the production of amphigenous small dark brown lesions which later coalesced to form large dark brown to black necrotic areas. Severe infection was seen along the margins and tip of phyllodes.

***Phomopsis* foliar spots:** One and a half year old plants at Peechi were seen infected by the disease (*Phomopsis* sp.) in June/July 1983. The infected lamina showed dark brown to black spots lined by yellowish margin.

202

Moran, G.F., Muona, O., and Bell, J.C. (1989).
The breeding systems of and genetic diversity in the tropical forest trees, *Acacia auriculiformis* and *A. crassicarpa*.
Biotropica 21(3), 250-256.

From authors' abstract: The mating system and levels of genetic diversity in populations of the two tropical species, *Acacia crassicarpa* Cunn. ex Benth. and *A. auriculiformis* Cunn. ex Benth. from natural riverine forests and open savannahs in Australia and Papua New Guinea were examined using isozyme markers. Levels of genetic diversity were generally lower than in either conifers or eucalypts, and the degree of population differentiation higher. The findings suggest that these acacias may have smaller effective population sizes than have been found in many other trees. Both species were found to have high levels of outcrossing with little variation in the outcrossing rate between populations.

203

Morton, J.F. (1986).
The earleaf acacia, a fast growing, brittle exotic "weed" tree in Florida.
Proceedings of the Florida State Horticultural Society 1985 98, 309-314.

The article warns against growing *Acacia auriculiformis* for ornamental landscaping in Florida, which is a hurricane-prone area, because it lacks wind resistance. The species is claimed to be now a common weed in Florida.

204

Mullick, S.P. (1957).
Coastal plantations and technique of sand fixation on the coasts of Midnapore district (W. Bengal).
Indian Forester 83(2), 97-100.

Describes the methods employed in stabilising extensive sand-dunes, with some indication of costs. *Casuarina equisetifolia* is the main species being used, and it is sometimes underplanted with *Anacardium occidentale* (cashew nut) and *Acacia auriculiformis*.

205

Namprasert, P. (1982).
Chemi-thermo-chemical pulping for newsprint of wattle.
Report, Division of Forest Products Research, Royal Forest Department, Thailand. (Th, en)

Chemi-thermo-chemical pulp of *Acacia auriculiformis* is found to be suitable for newsprint production and can be used as a substitute for bleached kraft pulp for the production of newsprint and stationery.

206

Namprasert, P., Kobayashi, Y., Nishiyama, M., Matsuo, R., Kubo, T. and Hosokawa, J. (1984).
The chemithermomechanical pulping of *Acacia auriculaeformis* for use as a raw material in newsprint.
Appita 37 (8), 658-660.

Potential use of *Acacia auriculiformis* as a raw material for chemithermomechanical (CTM) pulp for newsprint is reported. Chips were pretreated by mixtures of sodium hydroxide and sodium sulphite, the most effective pretreatment was obtained from a mixture of 2% sodium hydroxide and 1% sodium sulphite. The CTM pulp produced was easy to bleach (an increased brightness of 17% with the use of 1.3% H_2O_2), but it needed some mixture of long fibre to reach newsprint grade. Compared with the CTM pulp produced by *Leucaena leucocephala*, that of *A. auriculiformis* is higher in breaking strength but lower in tear factor. The yield of CTM pulp produced from *A. auriculiformis* is also higher than that from *L. leucocephala*. It is concluded that the quality of CTM pulp produced from *A. auriculiformis* is suitable for newsprint, and that it may be used to replace part of the softwood bleached kraft.

207

Natarajan, N. and Vinaya Rai, R.S. (1988).
Studies on maximisation of germination in *Acacia auriculiformis*.
Indian Journal of Forestry 11(4),304-306.

Seed of *Acacia auriculiformis* was treated in concentrated sulphuric acid (specific gravity 1.84) at different rates, viz. 20, 30, 40, 50, 60 and 70 ml per 100 g of seed, and each at varying durations, viz. 5, 10, 15, 20, 25, 30, 35 and 40 minutes with complete soaking served as control. Of the various combinations, 50 ml per 100 g of seed for 40 minutes recorded the highest germination (85%) and this treatment is recommended by the authors. In general, however, stirring the seed in higher acid rates for longer periods tended to improve seed germination.

208

Nath, S., Das, S.K., Gangopadhyay and Kapoor, K.S. (1989).
Suitability of different forest species for social forestry programme under different soil conditions. Part I - Alluvial Soil.
Indian Forester 115 (8), 536-547.

Seventeen tree species were included in species screening tests established within the alluvial soil zone of Midnapore district, West Bengal, India where the soils have developed on the flood plains of the rivers Rupnarayan and Kangsabati. The areas are 10-25 m asl, receive 1700 mm annual rainfall with a mean annual temperature of 27.5°C. *Acacia auriculiformis* was planted at four sites. Average height growth at 3.5 years was more or less the same (i.e. 6.2, 6.3 and 6.5 m) at three sites, and was 8.0 m at the fourth site. The better height growth at the fourth site was probably due to the trial area was adjacent to irrigated and fertilised rice field.

209

National Academy of Science. (1979).
Tropical legumes - research for the future.
National Academy of Science, Washington, D.C., U.S.A.

Acacia auriculiformis is described as a fast-growing tree which should be tested throughout tropical areas. The wide adaptability to a variety of environmental conditions of the species is emphasised. Performance of the species in cultivation in Australia, Papua New Guinea, Malaysia, Tanzania is demonstrated. In Indonesia, it is recommended for planting in areas too high for *Leucaena leucocephala* to grow satisfactorily.

It is suggested that the full potential of *A. auriculiformis* has not yet been recognised and experience in the species is still limited. Trial plantings on difficult sites in tropical lowlands are warranted. The trial sites should include barren soils, newly cleared building sites or excavations where top soil has been removed, spoil dumps, eroding slopes, laterite, sand, clay, and other soils where texture and properties make silviculture and agriculture difficult.

210

National Academy of Science. (1980).
Firewood crops: shrub and tree species for energy production.
National Academy of Science, Washington, D.C., U.S.A.

Trees and shrubs with potential as fuelwood species are listed and described. *Acacia auriculiformis* is recommended for the humid tropics.

211

National Research Council. (1981).
Sowing forests from the air.
Report of the ad hoc panel of the Advisory Committee on Technology Innovation, Board on Science and Technology for International Development, National Academy Press, Washington D.C.

Aerial seeding is considered to be appropriate when conditions and species are right, and seed supply is sufficient. It is suitable for reforesting large areas that have rough terrain, debris or difficult access. A list of tree species which have been sown successfully from the air is given.

Acacia auriculiformis is reportedly sown successfully from the air in two areas in

Indonesia, at Balapulang (Central Java) and Lawu (West Java). [results are summarised in Hadipoernomo, 1979; Soemana and Sudiono, 1974a,b]

212

National Research Council. (1983).
Mangium and other fast-growing acacias in the humid tropics.
National Academy Press, Washington D.C., U.S.A.

Acacia mangium and nine other *Acacia* species from the humid tropics (including *A. auriculiformis*, *A. aulacocarpa* and *A. crassicarpa*) of northern Australia, Papua New Guinea and eastern Indonesia are described. Only a few of these acacias have been trialed in plantations but all offer promise for tropical forestry. They produce root nodules profusely and often survive on land low in nitrogen and organic matter where most other tree species fail.

213

Neelay, V.R. and Dhoudiyal, L.P. (1985).
Observation on the possibility of using industrial effluent water for raising forest plantations.
Journal of Tropical Forestry 1(2), 132-139.

In Nepanagar (Madhya Pradesh, India), effluent water from a pulp and paper mill is treated by primary clearing and pH correction, and 25% of this treated effluent has been used for irrigation of plantations of 13 species established during 1981-1983. Results up to January 1985 showed that the irrigation increased height and diameter at ground level of *Acacia auriculiformis*, *Eucalyptus camaldulensis*, *Leucaena leucocephala*, *Pongamia pinnata* and *Dendrocalamus strictus* as compared to these trees in non-irrigated plantations.

214

Neil, P.E. (1989a).
Experience with Australian acacias in Nepal.
Nitrogen Fixing Tree Research Reports 7, 57-58.

Fifty acacias have been introduced and tested in Nepal on sites ranging from low altitudes (50-300 m) to high middle mountains (>2500 m). *Acacia auriculiformis* was shown in a number of trials to have great potential for planting at altitudes below 1000 m. The species always proves to be the most vigorous and has high survival. However, provenance variation has been so great and it is recommended that only seed from Queensland, Australia be used rather than seed from India.

215

Neil, P.E. (1989b).
Exotic acacia trials in Vanuatu, Southwest Pacific.
Nitrogen Fixing Tree Research Reports 7, 59-61.

In one of the species trials in Vanuatu at Erromango, latitude 18°47'S, longitude 169°03'E, altitude 250 m, annual rainfall 1500-2000 mm, and low fertility soils, *Acacia auriculiformis* is the slowest growing, though with very good survival, among *Acacia* species introduced in 1983. At 30 months its height growth was only 1.5 m compared to 4.6 m for *A. crassicarpa*, 4.2 m for *A. mangium* and 3.5 m for *A. aulacocarpa*. Seeds of all these acacias were

introduced from north Queensland. *A. auriculiformis* in the trial is generally multileadered.

It is noted that *A. auriculiformis* and a local species *A. spirobis* are very similar, as not only are their phyllode and stems are of similar appearance but *A. auriculiformis* also developed rust galls like that found on *A. spirobis* (caused by *Uromycladium tepperianum*).

216

Ng, F.S.P. and Tang, H.T. (1974).
Comparative growth rates of Malaysian trees.
Malaysian Forester 37(1), 2-23.

Trees of *Acacia auriculiformis* planted in 1931 at the arboretum of the Forest Research Institute at Kepong, Malaysia were measured for girth from age 10 to 40 years old. The largest tree attained girth of 55 in [approximately 140 cm = about 45 cm dbh] at age 40 years.

217

Ngamkhajornwiwat, S. and Luangviriyasaeng, V. (1990).
Flowering development of *Acacia auriculiformis*.
Thai Journal of Forestry. (accepted for publication)

Flowers of *Acacia auriculiformis* are in spikes, generally in pairs, developing from axillary buds on the upper axil of the phyllode. Individual flowers on the spike vary in size with those at the base tending to be larger than those at the tip. It takes approximately 45-50 days for the flowers to become fully open, and if not pollinated they will soon be shed.

218

Ngulube, M.R. (1988).
Survival and growth of seedlings of 14 Australian dry-zone acacias under nursery conditions in Zomba, Malawi.
Forest Ecology and Management 25, 291-297.

Results are presented of a nursery study on survival, growth and biomass production of 14 Australian acacias in Zomba, Malawi. Measurements were made up to 3 months after a 30 day-germination period. *Acacia auriculiformis*, *A. polystachya*, *A. aulacocarpa*, *A. difficilis* are amongst the fastest growing species in the nursery, and a period of 2-3 months in the nursery would be sufficient to achieve good-quality planting stocks (i.e. >20 cm in height). Some species, including *A. auriculiformis*, were found to be susceptible to powdery mildew but generally seedlings recovered fully from the attack by age 3 months.

219

Ngulube, M.R. (1989).
Tropical acacia trials in Malawi.
ACIAR Forestry Newsletter No. 8. Australian Centre For International Agricultural Research.

Australian *Acacia* species trials were established in Malawi in low altitude, dryland zones. In one of the trials at Namiyanga, Liwonde F.R. (15°05'S 35°25'E, 660 m asl, pH 5.5 with a 6-7 month dry season and 800 mm annual rainfall), *Acacia auriculiformis*, provenances from Papua New Guinea and Queensland, was the fastest growing, mean height at 3 years being 5.9 and 5.3 m respectively. This was followed by *A. crassicarpa* (Papua New Guinea) 4.8 m,

A. crassicarpa (Queensland) 4.4 m and *A. leptocarpa* 3.8 m. *A. bidwillii* is only 0.4 m tall.

A. auriculiformis is normally found to grow slower than *A. crassicarpa* in field trials in many countries. The results obtained in Malawi may reflect the ability of *A. auriculiformis* to cope better with the low rainfall and long dry period.

220

Nicholson, D.I. (1965).
A note on *Acacia auriculaeformis* A. Cunn. ex Benth. in Sabah.
Malayan Forester 28(3), 243-244.

A brief account of results from the first plantation trial of *Acacia auriculiformis* in Sabah planted in 1953 at 15x15 ft [4.5x4.5 m] spacing on a red brown tropical soil covered with lalang (*Imperata cylindrica*). At age 10 years, average breast height girth was 30.6 in [77.7 cm = about 26 cm dbh] and basal area 81.8 sq ft/acre [19 m^2/ha]. Other trials planted at later years were not reported but it was suggested that larger seedlings and close spacing might be more suitable in dense lalang areas.

221

Norani Bte Ahmad. (1983).
A preliminary study on nodulation and VA mycorrhiza in legume roots.
Malaysian Forester 46(2), 171-74.

Seedlings of *Acacia auriculiformis* were found to form root nodules. 54.5% of the root segments sampled were infected with VA mycorrhiza.

There is no detail as to how the seedlings were established or the age of the seedlings used in the study.

222

Oey Djoen Seng. (1951).
Specific gravity of Indonesian woods and its significance for practical use.
Report of the Forest Research Institute, Bogor, Indonesia, No. 46. (Nl, en)

Specific gravity of heartwood of *Acacia auriculiformis* based on four samples is between 0.49-0.84 with a mean value 0.69.

Age and size of the wood samples were not given.

223

Paijmans, K., Blake, D.J., Bleeker, P. and McAlpine, J.R. (1971).
Land resources of the Morehead-Kiunga area, Territory of Papua New Guinea.
Land Research Series No. 29. CSIRO, Australia.

Vegetation, forest resources, and ecology of the Morehead-Kiunga area in Papua New Guinea are outlined in details. *Acacia auriculiformis* is a common emergent tree species along with *Melaleuca cajuputi* in littoral forest in which the species composition is very mixed. Other associated species are *Aleurites moluccana*, *Alstonia spectabilis*, *Intsia* sp. *Canarium* sp. and *Dysoxylum* sp. etc.

Littoral forest occurs on the old beach complex of Wunji land system and considerable portions of the area are subject to periodic inundation.

224

Pan Zhigang and Yang Minquan. (1987).
Australian acacias in the People's Republic of China.
P 136-138 *in* Australian acacias in developing countries: proceedings of an international workshop held at the Forestry Training Centre, Gympie, Qld., Australia, 4-7 August 1986 (ed. Turnbull, J.W.), ACIAR Proceedings No. 16

Acacia auriculiformis was first introduced to China (Guangzhou, Guangdong Province) from Southeast Asia in 1961, and grows well south of 23°N latitude in a variety of soils with a pH range of 4-6.5. The species is used for fuelwood and for soil improvement plantings.

225

Pande, M.C., Tandon, V.N. and Mridula Negi. (1986).
Biomass production and its distribution in an age series of plantations of *Eucalyptus* hybrid and *Acacia auriculaeformis* in Bihar.
Indian Forester 112(11), 975-985.

Data are presented for distribution of biomass in various tree components and productivity in 3-, 5-, 7- and 9-year-old plantations of *Acacia auriculiformis*. It is suggested that *Eucalyptus tereticornis* and *A. auriculiformis* should be grown alternately on the same site in order to maintain site productivity to some extent.

226

Pande, M.C., Tandon, V.N. and Shanker, P.P. (1987).
Distribution of nutrients in an age series of *Eucalyptus* and *Acacia auriculiformis* plantations in Bihar.
Indian Forester 113(6), 418-26.

Distribution of nutrients (N, P, K, Ca, Mg) in plants and their losses as a result of harvesting are discussed in an age series of plantations of *Acacia auriculiformis* and *Eucalyptus* sp. [*E. tereticornis*]. Considerable amounts of nutrients are retained in the leaf and twig components which should be left in the field after harvesting to minimise nutrient losses.

227

Pandey, D. (1987).
Yield models of plantations in the tropics.
Unasylva 39(3-4), 74-75.

Data are presented for 19 species on rotation, yield (MAI), stems/ha, altitudinal range, mean annual rainfall and number of dry months. The following is given for *Acacia auriculiformis*:

Rotation age (year)	5-10
Wood yield MAI (m^3/ha)	8-10
No. stems/ha	1000-2500
Altitudinal range (m)	0-500
Mean annual rainfall (mm)	1300-1700
Number of dry months	4-6

A. auriculiformis is generally recommended for humid tropics but it can grow successfully in areas where annual rainfall is as low as 800 mm and its ability to tolerate a long dry season (4-6 months) is far better than other species recommended for the same region, e.g. *Albizia falcataria* (0-2 months), *Casuarina equisetifolia* (3-4 months) and *Eucalyptus tereticornis* (3-4 months). In

fact, its ability to tolerate long dry period is comparable with some species recommended for semi-arid areas, e.g. *Eucalyptus camaldulensis* (4-6 months), *Cassia siamea* (4-6 months) and *Albizia lebbek* (2-6 months).

The productivity given here (8-10 m^3/ha/a) is normally obtained where growing conditions are poor (e.g. very infertile soils or low rainfall areas). Under favourable conditions, 15-20 m^3/ha/a can be expected.

228

Parry, M.S. (1955).
Tree planting practices in tropical Africa.
Forestry Development Paper No. 8, FAO, Rome.

Planting techniques used in tropical Africa are outlined for a number of species. For *Acacia auriculiformis*, it is preferable to use transplants although direct sowing is also found to be suitable. This is due to limited seed supply during that period. The species is said to be very fast growing, reaching a height of 35-40 ft [10.7-12.2 m] in about five years. On poor soil where the species is most useful, growth is slower, but probably at least 5-6 ft [1.5-1.8 m] a year.

229

Pasaribu, R.A. (1983).
The sulphate pulp properties of four wood species from the reforestation area of South Sulawesi.
Report, Forest Products Research and Development Centre, Bogor, Indonesia,(No. 167), 1-11. (In, en)

Sulphate pulps were produced from *Pinus merkusii*, *Eucalyptus deglupta*, *Acacia auriculiformis*, *Acacia decurrens*, and from mixtures of these species. The physical properties of the unbleached pulp were affected by the amount of active alkaline, but the physical properties of bleached pulp were affected only by the species. *P. merkusii* pulp had the highest tear factor, stretch percentage and folding endurance, and *E. deglupta* had the highest burst factor and breaking length. *Acacia auriculiformis* pulp had poor strength properties but high brightness.

230

Patanaprapapan, S. (1980)
Use of *Acacia auriculiformis* in plywood manufacture.
Annual report of the Forest Products Research Division, Royal Forest Department, Thailand, p 60-65. (Th)

Veneer peeled from 10-year-old wood, 30 cm in diameter, of *Acacia auriculiformis* was even in thickness, smooth in surface with little lathe check. The quality of plywood produced from veneer of this species was comparable with that from *Dipterocarpus* species and *Anisoptera costata*, the species used widely in plywood manufacture.

231

Patel, J.D., Bhat, K.V., Rao, K.S. and Sakunthala Davi, G. (1984).
Dimensional analysis of wood elements in sapwood and heartwood of six angiosperm trees.
Indian Journal of Forestry 7(3), 196-201.

Dimensional analysis of elements of wood of *Acacia auriculiformis* is presented together with five other angiosperm species. Average length and width (in microns) of vessel elements, axial parenchyma cells, fibres, procumbent ray cells and ray in sapwood

and heartwood are summarised in the following table:

	Vessel element	Axial parenchyma	Fibres	Procumbent ray cells	Ray
Length					
Sapwood	228.02	76.06	1036.61	85.93	153.70
Heartwood	187.44	77.70	841.04	97.69	126.04
Width					
Sapwood	134.97	27.97	16.71	12.20	20.62
Heartwood	103.38	22.91	19.62	11.70	14.34

232

Pedley, L. (1978).
A revision of *Acacia* Mill, in Queensland.
Austrobaileya 1(2), 75-234.

Acacia auriculiformis is one of 83 members of the genus *Acacia* classified under section *Juliflorae* (Benth.) Maiden & Betche of subgenus *Heterophyllum* Vassal. The following description of *A. auriculiformis* is provided.

Tree to 25 m; branchlets angular, glabrous. Phyllodes similar in texture and shape to those of *A. aulacocarpa*, 10-16 cm long, (12-)15-25(-30) mm wide, 4-9 times as large as wide; 3 prominent longitudinal nerves running together towards lower margin or in the middle near the base, many fine crowded, somewhat anatomosing secondary nerves; gland basal, distinct swelling with small rimmed orifice at distal end. Spikes up to 8 cm long, somewhat interrupted in pairs in upper axis. Flowers 5-merous; calyx glabrous, 0.7-1 mm long, shortly lobed; corolla 1.7-2 mm long, 2-2.5 times as long as the calyx; stamens *ca* 3 mm long; ovary densely pubescent. Pod flat, rather woody, glaucous, transversely veined with undulate margins, *ca* 6.5 cm long, 1.5 cm wide. Seeds transverse, *ca* 5 mm long, 3.5 mm wide; areole large, almost closed; funicle encircling the seed.

233

Pedley, L. (1986).
Derivation and dispersal of *Acacia* (Leguminosae), with particular reference to Australia, and the recognition of *Senegalia* and *Racosperma*.
Botanical Journal of the Linnean Society 92, 219-254.

The author proposes a reclassification of the genus *Acacia* on grounds that the morphology of seedlings, leaves, flowers and inflorescences, anatomy of the pod, the occurrence of extra-floral nectaries, free amino acids of the seeds, flavonoid compounds in heartwoods, cyanogenic compounds and porate and extraporate pollens, and susceptibility to rusts all indicate that three genera namely *Acacia* Miller, *Senegalia* Raf. and *Racosperma* Matius should be recognised. In this reclassification, section *Juliflorae* of subgenus *Heterophyllum* in which *Acacia auriculiformis* belongs has been transferred to genus *Racosperma*.

234

Petmak, P. (1979).
Effects of agricultural intercropping on the early growth of some fast-growing species.
Paper presented to the second seminar on silviculture held at Kasetsart University, Bangkok, Thailand, 9-11 January 1979. (Th)

In an agroforestry experiment in northeast Thailand, four fast-growing species (*Eucalyptus camaldulensis*, *Leucaena leucocephala*, *Acacia auriculiformis* and *Peltophorum dasyrachis*) were intercropped with rice, peanut and mungbean. Five months after planting, mean height growth of these tree species were 154, 80, 78 and 41 cm respectively. There was a tendency for *E. camaldulensis*, *L. leucocephala* and *A. auriculiformis* to grow taller when intercropped with peanut, while *P. dasyrachis* grew better with rice. It is also noted that height growth of non-intercropped trees of all species was poorer than those of intercropped trees.

235

Petmak, P. and Boonyuen, S. (1988).
Species screening test under agroforestry system.
Research report, Division of Silviculture, Royal Forest Department, Thailand. (Th)

Data are given on five-year-results of an agroforestry experiment carried out in northeast Thailand to determine the number of years that agricultural crops can be intercropped with 10 economically important forest tree species planted at an original spacing of 4x8 m. The species can be placed in three groups:

The first group comprises *Eucalyptus camaldulensis* and *Acacia auriculiformis* with which peanut can be intercropped for 3 years, and kenaf up to 4 years.

The second includes *Xylia xylocarpa*, *Azadirachta indica*, *Albizia procera* and *Melia azedarach* with which peanut can be planted for 4 years, and kenaf 5 years.

The third group consists of *Pterocarpus macrocarpus*, *Swietenia macrophylla*, *Dalbergia cochinchinensis* and *Pinus kesiya* with which peanut can be cultivated for 5 years, and kenaf for more than 5 years.

For all tree species, height growth is almost double when intercropped with peanut compared to that with kenaf. This results in at least one-year-shorter period for peanut intercropping.

236

Petmak. P., Kietvuttinon, B. and Boontawee, B. (1987).
Some ecological impacts of planting *Eucalyptus* in agricultural area.
Thai Journal of Forestry 6, 362-374. (Th, en)

A comparative study of ecological impacts of planting *Eucalyptus camaldulensis* and *Acacia auriculiformis* under agroforestry landuse system in northeast Thailand over a period of 8 years. Yield of corn obtained during the first 4 years was higher in the *Eucalyptus* plot than the *Acacia* plot but the reverse is true after 4 to 8 years. On the contrary, yield of peanut was always higher in the *Eucalyptus* plot throughout the 8- year-period. Ground water table was lowered at the rate of 1.5 cm/year in both species. It is concluded that planting eucalypt does not deteriorate soil productivity.

237

Pewloung, C., Pukittayacamee, P. and Liengsiri, C. (1989).
Heat tolerance of *Acacia auriculiformis* seed.
Research Report, ASEAN/Canada Forest Tree Seed Center, Royal Forest Department, Thailand. (Th, en)

Seeds of *Acacia auriculiformis* were oven-heated at 40,50,60,70,80,90 and 105°C, and each temperature for varying period, i.e. 1, 3, 6, 12 and 24 hours. Oven-heated seeds at 70°C tended to have a fairly consistent germination (i.e. 68.5-74%) regardless of heating period although the highest germination (78%) was obtained when the seed was heated at 80°C for 1 hour. Prolonging heating period at 80°C or higher reduced germination. The seeds heated at 105°C for more than 12 hours failed to germinate.

238

Phillips, F.H. (1976).
The pulping of tropical woods.
Research Review 1975, CSIRO Division of Chemical Technology, Melbourne.

A review of the utilisation of mixed tropical species for pulping. Detailed study of Papua New Guinea mixed hardwoods have shown encouraging results and chemical and semichemical pulps suitable for a wide range of paper and paperboard products can be obtained from a run-of-the-forest mixture. Species showing potential include *Acacia auriculiformis*, *Eucalyptus tereticornis*, *Gmelina arborea*, *Terminalia brassii* and *Anthocephalus chinensis*. These species have already been planted extensively in trials in Papua New Guinea.

239

Phillips, F.H. and Logan, A.F. (1976).
Papua New Guinea hardwoods : Future resource of raw material for pulping and paper-making.
Appita 30(1), 29-40.

The mixed tropical hardwoods of Papua New Guinea have emerged as a source of raw material for future pulping and paper-making operations. These raw materials would be suitable for utilisation in a wide variety of paper and paperboard products, either bleached or unbleached.

The properties of young plantation species including *Acacia auriculiformis* were studied and 10-year-old plantation trees of *A. auriculiformis* from Bainyik, East Sepik District, Papua New Guinea showed potential for pulping. With only 13% total alkali, delignification to Kappa number 17.4 was achieved together with very good yield (55%) of screened pulp. This yield was higher than other species studies i.e. 52% at 18.6 Kappa number in *Gmelina arborea*, 53% at 17.9 in *Albizia falcataria*.

240

Phillips, F.H., Logan, A.F. and Balodis, V. (1979).
Suitability of tropical forests for pulpwood : mixed hardwoods, residues and reforestation species.
Tappi 62(3), 77-81.

The article discusses factors considered necessary for achieving improved utilisation of tropical rain forests. Examples are given of pulping studies on mixed hardwood species from the rain forests of Papua New Guinea, on forest and sawmill residues of *Shorea albida* from peat swamp forests in Sarawak,

Malaysia, and on fast-growing hardwood species used in reforestation programs.

Suitability of seven tropical hardwood species for unbleached kraft and NSSC pulp production was assessed. Approximate ranking in order of suitability for pulp and paper products is given on the basis of pulp yield, pulp strength, and basic density. *Acacia auriculiformis* was found to be extremely suitable and is at the top of each list. However, all species listed should be suitable for both kraft and NSSC pulp production, irrespective of ranking.

Unbleached kraft pulp (bag and wrapping papers, linerboard)
Acacia auriculiformis
Gmelina arborea
Eucalyptus deglupta, *Terminalia brassii* and *Albizia falcataria*
Anthocephalus chinensis
Sesbania grandiflora

NSSC pulp (corrugating medium and higher-grade products)
Acacia auriculiformis
Eucalyptus deglupta
Terminalia brassii and *Albizia falcataria*
Gmelina arborea
Anthocephalus chinensis
Sesbania grandiflora (corrugating medium only)

241

Pinyopusarerk, K. (1984). ***Acacia auriculiformis* A. Cunn. ex Benth.** Forestry Review No. 12, Division of Silviculture, Royal Forest Department, Thailand, 14 pp. (Th)

A comprehensive review on *Acacia auriculiformis* with particular reference to plantation establishment and maintenance of the species in Thailand. Growth of the trees from different plantations are presented.

Age (y)	Location	Soil	Annual rainfall (mm)	Mean height (m)
2	Ratchaburi	laterite	800	4.5
2	Chiang Mai	sandy loam	1200	3.5
3	Chanthaburi sandy	loam	1200	9.0
4	Nakhon Ratchasima	red-yellow podzolic	1300	14.9

242

Pinyopusarerk, K. (1986).
Biennial report on the tree improvement program of *Acacia auriculiformis* (1984-85).
Silvicultural Research Report 1984-85, Royal Forest Department, Thailand. p 497-500. (Th)

The first biennial progress report on tree improvement program of *Acacia auriculiformis* in Thailand during 1984-85. Includes selection of plus trees, establishment of seedling seed orchards, establishment of seed production areas and research on vegetative propagation, nursery techniques and method of plantation establishment.

243

Pinyopusarerk, K. (1987).
Improving *Acacia auriculiformis* through selection and breeding in Thailand.
P 147-148 *in* Australian acacias in developing countries: proceedings of an international workshop held at the Forestry Training Centre, Gympie, Qld., Australia, 4-7 August 1986 (ed Turnbull, J.W.), ACIAR Proceedings No. 16.

Acacia auriculiformis is a very important plantation species in Thailand because of its wide adaptability to a variety of soil types and its early rapid growth rate which enables it to compete with weeds. The species has been included in the tree improvement programs of the Royal Forest Department of Thailand since 1984. Progress of the program is discussed.

244

Pinyopusarerk, K. (1988a).
Provenance testing of *Acacia auriculiformis*.
P 55-57 *in* Proceedings of the tenth meeting of Research Working Group No. 1 (Australian Forestry Council), Gympie, Queensland, Australia, 30 October-4 November 1988.

The paper briefly outlines collaborative research activities on *Acacia auriculiformis* after a range-wide provenance seed collection of the species from natural populations in Australia and Papua New Guinea in 1987 by CSIRO Australian Tree Seed Centre.

ACIAR and F/FRED Project are funding international provenance trials planted over 10 sites in several countries in Asia and Africa (Zimbabwe), and a glasshouse trial conducted to investigate variation in the seedling morphology.

Genetic conservation stands and a seed orchard have been established on Melville Island in northern Australia. These plantings involve the Australian Tree Seed Centre, Conservation Commission of the Northern Territory and the Tiwi Land Council.

245

Pinyopusarerk, K. (1988b).
Biennial report on the tree improvement program of *Acacia auriculiformis* (1986-87).
Silvicultural Research Subdivision, Royal Forest Department, Thailand 13 pp. (Th)

Second biennial report on the tree improvement program of *Acacia auriculiformis* in Thailand carried out during 1986-87. 212 plus trees from cultivated stands were selected and seed

collected from each individual. New developments of the program included progeny trials, provenance trials, and controlled pollination.

246

Pinyopusarerk, K. (1989).
Growth and survival of Australian tree species in field trials in Thailand.
P 109-127 *in* Trees for the tropics - growing Australian multipurpose trees and shrubs in developing countries (ed. Boland, D.J.), ACIAR Monograph No. 10.

Acacia auriculiformis is one of the most promising species in the ACIAR species trials in Thailand. It survives and grows well at 8 different trial sites across Thailand.

247

Pinyopusarerk, K. and Puriyakorn, B. (1987).
***Acacia* species and provenance trials in Thailand.**
P 143-146 *in* Australian acacias in developing countries: proceedings of an international workshop held at the Forestry Training Centre, Gympie, Qld., Australia, 4-7 August 1986 (ed Turnbull, J.W.), ACIAR Proceedings No. 16

Reports on 6-month results of *Acacia* species only of the ACIAR species trials planted at 6 sites in Thailand in 1985. *Acacia auriculiformis*, *A. crassicarpa* and *A. leptocarpa* are amongst the fastest growing acacias at age 6 months.

248

Pinyopusarerk, K. and Boland, D.J. (1987).
Early growth of some Australian *Acacia* and *Casuarina* species in field trials in Thailand.
Paper, Symposium on the Contribution of Biological Nitrogen Fixation to Plant Production held in Cisarua, Indonesia, 3-7 August 1987.

Reports results at 12 months after planting of 12 *Acacia* and 3 *Casuarina* species from the same trials described above. Acacias are growing faster than casuarinas. *Acacia auriculiformis*, *A. crassicarpa* and *A. leptocarpa* are still the fastest growing.

249

Pongpanich, K., Chalermpongse, A. and Boonthavikoon, T. (1988).
Seedling diseases in Sakaerat nursery.
Paper, Fourth seminar on silviculture held at Pattaya, Thailand, 18-22 January 1988. (Th)

50-70% of seedlings of *Acacia auriculiformis* in a nursery at Sakaerat, Thailand have been found to be infected by powdery mildew (*Oidium* sp.). Although the disease does not cause plant mortality, it affects seedling development. It is recommended that the seedlings be sprayed with "MANOB" 0.2% every two weeks. Elemental sulphur (dust) is also effective.

250

Prakash, D. and Misra, P. (1987).
Protein and amino acid composition of some wild leguminous seeds.
Qualitas Plantarum Plant Foods for Human Nutrition 37(1), 29-32.

Data are given on the contents of individual amino acids in the seed proteins of 14 tree species including *Acacia auriculiformis*, *A. nilotica*, *Albizia lebbek* and *Erythrina indica*.

251

Prasad, R. (1965).
Afforestation and soil conservation in South Bihar.
Indian Forester 91(1), 33-40.

The main objective of afforestation is to stop soil erosion by preventing quick run-off. In addition the crop would also provide firewood and small timber for local consumption. Among the species being tested are *Tectona grandis*, *Gmelina arborea*, *Albizia lebbek*, *Acacia auriculiformis*, *A. catechu*, *Dalbergia sissoo*, *Melia azedarach* and *Terminalia tomentosa*.

Nursery techniques, field establishment and maintenance as well as cost of establishment are discussed.

252

Prasad, R. (1987).
Performance of Jalshakti, a sorb material in forestry seed germination and plant growth.
Vaniki Sandesh 2(3), 1-7.

'Jalshakti' a material in powder form reported to be capable of absorbing water 50-100 times of its weight was coated on seeds of *Acacia auriculiformis* and seven other species to compare the germination with uncoated seeds under laboratory conditions. It was found that only *A. auriculiformis* and *Albizia procera* showed a clear improvement in germination per cent i.e. 14% for uncoated to 26% for coated seeds in *A. auriculiformis*, and 12% for uncoated to 34% for coated seeds in *A. procera*. Coating with the sorb material was also found to speed up the completion of germination in many species but had no effect on the initiation of germination.

Germination percentage of the coated seed is still very low (26%). An average 80-90% germination can be expected from hot water pretreatment.

253

Prasad, R. and Pandey, R.K. (1985).
Natural plant succession in the rehabilitated bauxite and coal mine overburdens of Madhya Pradesh.
Journal of Tropical Forestry 1(4), 309-320.

Trial plantations of 15 species were established in Shahdol district of Madhya Pradesh, India in 1979-1984 on bauxite overburdens (latitude 22°44'N, longitude 81°45'E, annual rainfall 1490 mm) and in 1982-1983 on coal mine overburdens (latitude 23°12'N, longitude 81°32'E, annual rainfall 1350 mm). Mean annual temperature of the areas is 24.4°C with maximum summer temperature of 40°C and minimum winter temperature falling below 1°C. A survey was made of the ground flora on these plots as well as on unplanted areas in August-September 1985. Coal mine overburdens appeared to provide a better substrate for indigenous species than the bauxite mine overburdens. Plots on coal mine areas established in 1982 had 24,936 plants/ha of 21 species, compared with 14,580 plants/ha of 10 species on bauxite areas established in the same year. Natural regeneration of *Acacia auriculiformis* was observed on coal mine areas.

254

Prasad, R. and Shukla, P.K. (1985a).
Reclamation and revegetation of coal mine overburdens in Madhya Pradesh.
Journal of Tropical Forestry 1(1), 79-84.

Reports on trial plantation on coal mine overburdens at Dhanpuri of Shahdol district, Madhya Pradesh, India (latitude 23°12'N, longitude 81°32'E, annual rainfall 1350 mm). Soil at the upper 30 cm has pH 6.3-6.6, and is deficient in major nutrients. The area was levelled and pits of 60x60 cm dug and then filled with farm young manure plus soil from adjacent sal [*Shorea robusta*] forest plus 5 kg. Measurements at two years after planting revealed high survival rate (85-100%) for most species. The best height growth was recorded for *Eucalyptus* hybrid (5.5 m), *Eucalyptus camaldulensis* (5.2 m) and *Acacia auriculiformis* (4.6 m). Other species performing reasonably well included *Dalbergia sissoo* (2.8 m), *Acacia catechu* (2.5 m) and *Acacia nilotica* (2.2 m).

255

Prasad, R. and Shukla, P.K. (1985b).
Restoration of ecological balance to the bauxite mined areas of Madhya Pradesh.
Journal of Tropical Forestry 1(3), 236-245.

Trial on bauxite mined areas in Karanjia Range of Dindori Forest Division in Mandla District of Madhya Pradesh, India, latitude 22°40'N, longitude 81°45'E, altitude 1000 m, mean annual rainfall 1750 mm. Soils after mining are almost devoid of organic matter, pH 5.5-6.5. The area was levelled and pits 45x45x45 cm dug and filled with surface soil from adjoining sal forest and 500 g cow dung. *Acacia auriculiformis*, though surviving well, grew slowly attaining only 2.1 m in height after five years. The fastest growing species were *Eucalyptus camaldulensis* with 7.7 m, and *Grevillea pteridifolia* 5.0 m.

256

Prasad, R. and Chadhar, S.K. (1987).
Afforestation of dolomite mine overburdens in Madhya Pradesh.
Journal of Tropical Forestry 3(2), 124-131.

Reports on the rehabilitation of dolomite mine overburdens in Bilaspur, Madhya Pradesh, India at latitude 22°N and longitude 82°6'E. The area is 290 m asl and mean annual rainfall varies from 1100-1400 mm. The area was in roughly levelled dumps consisting of a mixture of loose sand, gravel, pebbles and very little soil. Pits were 45x45x45 cm and filled with a mixture of humus-rich soil from paddy fields and cow dung. Six species were planted in 1984 either in blocks of pure crops or mixed with bamboo (*Dendrocalamus strictus*). Results after 28 months showed that mixed planting with bamboo resulted in substantial increase in survival rate in all species. For *Acacia auriculiformis*, survival was 76% for pure crop compared with 98% for mixed planting. Height and diameter growth were also found to be greater when mixed planted with bamboo i.e 4.3 m and 3.3 cm respectively compared with 3.5 m and 2.7 cm respectively of pure crop.

257

Prasad, R. and Pandey, R.K. (1987).
Vegetation damage by frost in natural forests of Madhya Pradesh.
Journal of Tropical Forestry 3(3), 273-278.

Damage caused by unexpected frost to the vegetation in the eastern part of

Satpura Hill of Shahdol district, Madhya Pradesh, India during December 1985 to January 1986 was assessed. Minimum temperature below 1°C has been recorded in this area. A nursery within the area was also damaged by frost and it was found that *Acacia auriculiformis*, *Eucalyptus tereticornis*, *Albizzia* [*Albizia*] *procera*, *Syzygium cumini* and *Pongamia pinnata* in the nursery, were only slightly damaged.

A. auriculiformis is not subject to frost in its natural habitat. The incident occurred in Madhya Pradesh suggests that the species can stand frost to some extent. At Gympie, *ca.* 120 km north of Brisbane, in southeast Queensland, Australia, *A. auriculiformis* planted in 1984-85 has survived annual light frosts.

258

Prasad, R. and Chadhar, S.K. (1988).
Optimum potting mixture for sprouting of root-shoots in some tree species.
Vaniki Sandesh 12(3), 7-11.

An experiment was conducted at the Bilaspur field centre of State Forest Research Institute, Madhya Pradesh, India to examine the effect of potting media on the sprouting and growth of stumps (root-shoots) of ten species including *Acacia auriculiformis*. The potting media consist of various combinations of compost, sand and soil. Stumps were prepared so that the shoot portion length was 2.5 cm and root portion 20 cm. Ten stumps for each species were planted, in the filled-up poly pots keeping the collar of the root-shoot at medium level, for a period of 6 months.

A. auriculiformis started sprouting as early as 17.5 days in 1:2:0 combination of potting mix, but it took 38 days to sprout in 1:2:3 potting mix. It is suggested that potting mix of 0:1:2 is best suited for stumping *A. auriculiformis* judging from survival (80%) and shoot growth (27.5 cm).

259

Prasad, R. and Jamaluddin. (1988).
Effect of effluent water from Nepa mill on different tree species.
Journal of Tropical Forestry 4(1), 90-93

Effluent water from the Nepa paper mill (at Nepanagar, Madhya Pradesh, India) was used to irrigate plantations of several tree species including *Acacia auriculiformis*. There was no significant effect of effluent water on change in the nutrient status of soils. The effluent treated plants did not show sign of abnormality in the form of foliar symptoms or stem damage such as dieback or canker. The development of leaves was normal and no chlorosis was observed. Root nodule development was abundant in plants irrigated with both effluent or fresh water.

260

Prasad, U. (1984).
Experiment of pollarding of *Acacia auriculaeformis* for production of biomass.
Indian Forester 110(4), 419-420.

A brief account of a pollarding experiment of *Acacia auriculiformis* for production of biomass at Gamharia Research Centre, Singhbhum District, Bihar, India. Trees were 4.5 years old at time of cutting; average height 10.1 m and diameter 7.1 cm. Biomass production per tree in terms of branches,

leaves and pods (fruits) is 6.3, 6.3 and 0.8 kg respectively.

The are no details of the height above ground where the pollarding took place.

261

Pryor, L.D. (1989).
Vegetative propagation of *Casuarina* and *Acacia* : potential for success.
P 155-157 *in* Trees for the tropics - growing Australian multipurpose trees and shrubs in developing countries (ed Boland, D.J.), ACIAR Monograph No. 10.

A review of vegetative propagation of Australian species of *Casuarina* and *Acacia*. Work described on *Acacia auriculiformis* is mainly that carried out in Thailand using air layering [macottage], grafting and cutting methods.

More results of vegetative propagation of *A. auriculiformis* have been reported by Simsiri *et al.* (1988)

262

Pukittayacamee, P. (1987).
Seed maturity in *Acacia auriculiformis*.
M.Sc. thesis, The University of Alberta, Canada.

From author's abstract: Seed maturity of *Acacia auriculiformis* A. Cunn. ex Benth. at Muak-Lek, Thailand in 1985 was studied associated with germination, dormancy and seed coat development including some aspects on seed coat treatments. The seeds developed during the rainy season between June and October 1985. Seed began ripening by September 5 (82 days after anthesis). Brown pericarps and black seed coats could be used as a qualitative maturity index. Funiculus colour was not a good indicator because of its fast development. Fruit and seed moisture content decreased with maturation. At maturity, fruit and seed moisture content were about 35% and 27% (fresh weight basis), respectively. Seed fresh weight and dry weight showed maturity when they remained at the constant level of 20-21 and 17 mg, respectively. Seed ripening was also investigated by X-ray radiographs, and seeds reached maturity after September 5 [12 weeks after anthesis]. Loss of seed moisture was an important factor controlling germination and dormancy behaviour during maturation. Germinability decreased while natural dormancy increased after seed moisture content fell below 23%. Furthermore, seeds showed imposed dormancy when they were harvested and dried rapidly before natural seed shedding took place. Seeds collected early tended to be more dormant than those collected late. The structure of immature seed coats differed from that of mature seed coats. The immature seed coats had a macrosclereid layer and parenchymatous layers while the mature seed coats had differentiated more having three more layers; cuticle, hypodermal osteosclereids and inner osteosclereids. Seeds were morphologically fully mature when they showed compressed parenchyma cells, constant thickness of macrosclereid plus cuticular layer. Concentrated sulphuric acid, 95°C water and hand scarification treatments were able to make seed coats permeable to water in *A. auriculiformis*. Seeds soaking in 95°C water for 1 and 3 minutes gave the best total germination while hand scarification and concentrated sulphuric acid gave the best germination rate. Two months after collection, seed maturation still influenced the germination of seeds.

This is one of the most thorough studies of seed development in *A. auriculiformis*.

Moisture content is shown to be a very important factor influencing seed dormancy.

263

Pukittayacamee, P. and Hellum, A.K. (1988).
Seed germination in *Acacia auriculiformis* : developmental aspects.
Canadian Journal of Botany 66(2), 388-393.

From authors' abstract: Germination of *Acacia auriculiformis* A. Cunn. ex Benth. seeds was related to seed development. Full physiological development of seeds, indicated by maximum seed weight, was reached 82 days after anthesis; however, maximum percent germination was not reached before day 89. Later, germination declined gradually as dormancy and mortality increased. Most seeds were capable of germination without pretreatment at the time of collection, indicating that seed coats were not impermeable to water. Germination of seeds with moisture content from 14 to 29% can be achieved. Anatomical studies revealed that seeds reached maturity after compressing the parenchyma cells against the inside of the seed coat. The physical properties of the seed coat, therefore, did not control its permeability to water. After the development period, seed dormancy increased by further drying of seeds during storage.

The study reported here is the same as that reported in the previous reference by the senior author.

264

Puriyakorn, B. and Luangviriyasaeng, V. (1988).
Assessment of some Australian tree species for general health, phenological differences, and insect and pest attack in RFD/ACIAR trial at Ratchaburi, Thailand.
Paper, ACIAR/CAF workshop on "Use of Australian trees in China". Guangzhou, China, 2-11 October 1988.

Reports observations for up to 36 months on health, phenological differences, and insect and pest attack in an ACIAR trial planted in 1985 at Ratchaburi, latitude 13°25'N, longitude 99°50'E, altitude 30 m. Soil is red-yellow lateritic to sandy loam, pH 5.2-5.7. Mean annual rainfall is less than 900 mm. Four provenances of *Acacia auriculiformis* were included in the trial of which two came from Papua New Guinea (Iokwa and Balamuk) and two from Australia (Queensland and the Northern Territory).

It was observed that there are two periods of active shoot elongation in *A. auriculiformis* i.e. during May to June and September to January which account for 7 months in a year. Provenances from Queensland and Balamuk first started flowering at 15 months after planting. Flowering occurs during November to January, and fruit (pod) matures during January to March. Seed shedding is common in March and April. Damage from insects was noted on stem and branches during February to April (first dry season only) by shoot borer, and on phyllodes during January to July. The damage was light to moderate.

265

Rai, S.N. and Shettigar, D. (1979).
Afforestation of grassy blanks in high rainfall zone of Karnataka.
Research Paper, Karnataka Forest Development, (No. KFD-1), 13 pp.

Afforestation experiments on grassy areas were carried out in Karnataka, India in 1976 and 1977 at five locations having rainfall between 1000-6000 mm and altitude range from 600-800 m. Of 36 species tested, five species are recommended for planting in areas which are protected from grazing, and another six species for planting in areas not protected from grazing. *Acacia auriculiformis* is one of the latter six species and grows very well at all sites planted. Potted seedlings survived better than bare-rooted seedlings.

266

Rajan, B.K.C., Kushalapa, K.A. and Khan, K.A.R. (1979).
Wood of *Acacia auriculiformis* for turnery and lacquer coating.
Myforest (June), 83-86.

Trials with the wood of *Acacia auriculiformis* indicate that it is a suitable replacement for *Wrightia tintoria* (hale) wood which is used extensively for carving and lacquer work for toys, but is becoming very scarce in Karnataka, India.

267

Ranjani, K. and Krishnamurthy, K.V. (1987).
A comparative study of root and stem woods of some members of the Mimosoideae (Leguminosae).
Journal of the Arnold Arboretum 678(3), 349-355.

A comparative study was carried out to investigate the structure of root and stem woods using 11 species in the subfamily Mimosoideae including *Acacia auriculiformis*. The only consistent difference between root and stem is the presence of more thin-walled elements in root than in stem wood.

268

Rativanich, T., Abhijatabutr, A., Promchotikool, M., Namprasert, P., Jensuthivejkul, S. and Ruangpornsawat, S. (1980).
Sulphate pulping from *Acacia auriculaeformis* A. Cunn.
Annual report of the Forest Products Research Division, Royal Forest Department, Thailand, p 138-174. (Th)

Sulphate pulping of 7-year-old plantation grown *Acacia auriculiformis* in Thailand has shown that the species can be pulped satisfactorily with 16% active alkali to yield 53% screened pulp with good paper-making properties. Unbleached pulp is very suitable for making wrapping or single-wall bag paper and kraft liner-board. The pulp could be bleached to acceptable brightness levels of bleached grades to make writing and printing papers.

269

Rativanich, T., Caruhapattana, B. and Anantachoke, C. (1981).
The destructive distillation of wattle.
Annual report, Forest Products Research Division, Royal Forest Department, Thailand. (Th)

Wood samples taken from 5-year-old tree of *Acacia auriculiformis* were subjected to a furnace set at 400°C until the moisture content reached 30% of fresh weight. Chemical analysis of sapwood and heartwood revealed the acetic acid and methyl alcohol content of 1.63 and 0.71% respectively. Charcoal made from wood of *A. auriculiformis* had a heating value of 5414 kcal/kg and 70 % of fix carbon.

270

Ratnasabapathy, M. (1974).
***Acacia auriculaeformis* and *Casuarina equisetifolia* - the urban invaders.**
Malayan Nature Journal 28(1), 18-21.

Describes ecology, propagation and pests (relatively few) of *Acacia auriculiformis* and *Casuarina equisetifolia*, the two popular street trees in Petaling Jaya, Malaysia which are also the dominant trees in pioneer vegetation on disturbed sites in the same area. Trees of these two species are found to provide a good home for several kinds of bird.

271

Reddell, P. and Warren, R. (1987).
Inoculation of acacias with mycorrhizal fungi: potential benefits.
P 49-53 *in* Australian acacias in developing countries: proceedings of an international workshop held at the Forestry Training Centre, Gympie, Qld., Australia, 4-7 August 1986 (ed Turnbull, J.W.), ACIAR Proceedings No. 16.

A review on potential for using mycorrhizal fungi to improve the survival, establishment and growth of hardwood species in tropical plantations. Special attention is given to the very limited information available on the mycorrhizal requirements of *Acacia* species and their responses to inoculation with mycorrhizal fungi in both nursery and field. Of the two major types of mycorrhizas, viz. ectomycorrhizas and vesicular-arbuscular (VA) mycorrhizas, the latter is found in *Acacia auriculiformis*.

Chong (1986) reported that *A. auriculiformis* developed both ectomycorrhiza and VA mycorrhiza.

272

Reddy, C.V.K. (1981).
Meeting of the challenge of energy.
Indian Forester 107(12), 813-817.

The article emphasises the need to raise large-scale energy plantations in India to meet the country-wide fuelwood shortage crisis. In Andra Pradesh, about 58,000 ha of energy plantations have been raised under various schemes up to 1978/79. 600 ha of *Acacia auriculiformis* has been planted under the drought-prone areas program.

273

Relwani, L.L., Lahane, B.N. and Gandhe, A.M. (1988).
Performance of nitrogen-fixing MPTS on mountainous wastelands in low rainfall areas.
P 105-113 *in* Multipurpose tree species for small-farm use: proceedings of an international workshop held in Pattaya, Thailand, 2-5 November 1987, (eds Withington, D., MacDicken, K.G., Sastry, C.B. and Adams, N.R.).

The paper discusses results from nitrogen-fixing multipurpose tree species trials on mountainous wastelands of the Deccan Plateau which are characterised

by low and erratic annual rainfall of 300-500 mm received in a short period of 3-4 months. Soils are shallow, deficient in plant nutrients, and poor in moisture-holding capacity. Growth data are tabulated for each of the trials established under dry land, protective irrigation and hand-watering systems.

Under dry land conditions, growth data 5 years after planting were collected from top, middle and bottom sections of a slope. *Acacia auriculiformis* did not survive at the top and middle sections, and had 25% survival and average height of 3.6 m at the bottom of slope. *Leucaena leucocephala* is by far the best species. There is a distinct increase in growth from top through to bottom for all species.

Under protective irrigation system, trees were planted in July 1985, watered twice in 1985 and 1986, and once in 1987. *Acacia auriculiformis* averaged 3.4 m in height, 3.8 cm in basal diameter and 85% in survival at 26 months old. *Leucaena leucocephala* doubled in growth rate and had 100% survival.

274

Rierink, A. (1938).
On the calorific value of 60 Netherland-Indies wood species.
Tectona 31, 400-418. (Nl, en)

Specific gravity and calorific values are tabulated for 60 wood species. Air-dried wood of *Acacia auriculiformis* has a specific gravity value of 0.62. Calorific values of heartwood and sapwood (oven-dry) are 4805 and 4907 calories respectively and these values do not differ much from other species.

275

Rockwood, D.L. (1984).
Genetic improvement potential for biomass quality and quantity.
Biomass 6(1-2), 37-45.

A discussion of desired traits, and selection and evaluation procedures with examples from the southern USA, especially Florida, (including *Pinus elliottii*, *P. clausa*, *Acacia auriculiformis* and *Eucalyptus grandis*).

276

Rosecrance, R.C. (1989).
The relationship between specific gravity and growth of 12 fast growing tree species.
Nitrogen Fixing Tree Research Reports 7, 34-35.

There were no relationships found between plant growth (height and diameter) and specific gravity of 12 fast growing tree species, including *Acacia auriculiformis*, grown for 2 years in Hawaii. It is suggested that the poor relationships, though not surprising, could be improved with increasing ages of the trees.

277

Roughley, R.J. (1987).
Acacias and their root-nodule bacteria.
P 45-49 *in* Australian acacias in developing countries: proceedings of an international workshop held at the Forestry Training Centre, Gympie, Qld., Australia, 4-7 August 1986 (ed Turnbull, J.W.), ACIAR Proceedings No. 16.

Provides a table showing host promiscuity (percentage of *Rhizobium* strains which nodulate individual *Acacia*

species) of 63 *Acacia* species inoculated with 20 strains of *Rhizobium* and 18 of *Bradyrhizobium*. 45 out of 63 *Acacia* species including *A. auriculiformis* could be nodulated by most strains of the bacteria.

278

Ruaysoongnern, S. (1983).
Utilisation of fuelwood on highlands.
Proceedings of the 3rd Seminar on Silviculture held at Kasetsart University, Bangkok, Thailand, 24-25 February 1983. (Th)

A comprehensive review on utilisation of fuelwood on highlands in Thailand giving detailed information on fuelwood consumption by hill tribe peoples and use of fuelwood in tobacco curing and charcoal making. *Acacia auriculiformis* has been planted to supply fuelwood for tobacco curing and charcoal making.

279

Rudjiman. (1981).
Multiple-purpose species for planting on critical soils on Java.
P 76-89 *in* Observations of agroforestry on Java, Indonesia: report on an agroforestry course organized at Forestry Faculty, Gadjah Mada University, Yogyakarta (ed. Wiersum, K.F.).

Provides a list of multipurpose tree species suitable for planting on critical soils on Java. *Acacia auriculiformis* is described in respect of botanical features, natural distribution and its environmental requirements, products and possible use in agroforestry systems.

280

Rufelds, C.W. (1987).
Quantitative comparison of *Acacia mangium* Willd. versus hybrid *A. auriculiformis*.
Forest Research Centre Publication No. 40. Sabah, Malaysia, 22 pp.

A comparative study on quantitative and qualitative traits of *Acacia mangium* and hybrid *A. auriculiformis* [x *A. mangium*] in a plantation in north-western Sabah. The followings were assessed:

Type of assessment	Character assessed
Quantitative	DBH (cm)
	Total height (m)
	Clear bole length (m)
	% *mangium* (hybrid tree)
Qualitative	Straightness
	- lower 1/3
	- lower 2/3
	- whole tree
	Circularity
	- lower 1/3
	- middle 1/3
	Branching
	- persistence
	- size
	- angle (first 15 cm)
	Crown
	- shape
	Health
	- leaf colour
	- leaf density
	- defoliation
	- stem defect

The results indicate a better performance of *A. mangium* than hybrid *A. auriculiformis* in 9 out of 16

characteristics compared. The expected vigour of hybrid trees was not present, but nevertheless, hybrid trees are superior in regard to branching habit and bole circularity which are important attributes to quality of timber. Introduction of good phenotypes of *A. auriculiformis* and initiation of a hybrid breeding program are suggested.

281

Rufelds, C.W. (1988).
***Acacia mangium* and *A. auriculiformis* and hybrid *A. auriculiformis* seedling morphology study.**
Forest Research Centre Publication No. 41, Sabah, Malaysia, 84 pp.

Reports results of three experiments conducted to investigate methods that can be used to make accurate seedling identification of *Acacia auriculiformis*, *A. mangium* and their hybrid based on seedling morphology within eight to ten weeks. Experiment I was undertaken to test for variation between seedlings originating from different provenances and families. Experiment II examined the effect of environmental parameters in the nursery e.g. light, water, and nutrients upon distinguishing features of each taxon. Finally, *A. auriculiformis*, *A. mangium* and their hybrid seedling guide was developed and operationally tested in Experiment III.

Seedling leaf development pattern prior to the emergence of phyllode is distinct for seedlings from each taxon. *A. auriculiformis* clearly develops into full phyllode stage much earlier than *A. mangium* with the hybrid exhibiting intermediacy. Moreover, several taxonomic characteristics, e.g. colour and pubescence on the pinnule margin, are found to be taxon specific.

282

Rufelds, C.W. and Lapongan, J. (1986).
The occurrence of hybrid *Acacia auriculiformis* A. Cunn. ex Benth. in Sabah.
Paper, the 9th Malaysian Forestry Conference, Kuching, Sarawak, Malaysia. 13-20 October 1986.

Describes the occurrence of hybrid *A. auriculiformis* x *A. mangium* in Sabah, Malaysia with a map showing 12 localities where the hybrids are found. Several studies have been developed to provide necessary information that will lead to commercial reforestation with hybrid *A. auriculiformis* in Sabah.

283

Ruswandy, H. and Wibowo, A. (1986).
The growth rate of three firebreak species at Sipiso-piso, North Sumatra.
Forest Research and Development Centre, Bogor, Indonesia, Forest Research Bulletin No. 476, 23-30. (In, en)

Acacia auriculiformis, *Albizia falcataria* and *Macadamia hildebrandii* were planted as firebreak surrounding plantation of *Pinus merkusii* in North Sumatra, Indonesia. The planting area is very high in altitude i.e. 1400 m. After 2 growing seasons, *M. hildebrandii* had significantly better height growth and survival than *A. auriculiformis* and *A. falcataria*.

284

Ryan, P.A., Podberscek, M., Raddtz, C.G. and Taylor D.W. (1987).
***Acacia* species trials in southeast Queensland, Australia.**
P 81-85 *in* Australian acacias in developing countries: proceedings of an international

workshop held at the Forestry Training Centre, Gympie, Qld., Australia, 4-7 August 198[illegible] (ed Turnbull, J.W.), ACIAR Proceedings No. 16.

Reports early results of *Acacia* species only in two ACIAR tree species trials established in 1984 by the Queensland Department of Forestry at Tuan and Wongi State Forests. There are 17 species of *Acacia* among many species from other genera in the trials. *Acacia auriculiformis* is one of the promising species at age 1-2 years after planting. Seeds of this species came from Papua New Guinea, Queensland and Northern Territory. Other *Acacia* species performing well at the same ages include *A. crassicarpa*, *A. aulacocarpa*, *A. cincinnata*, *A. mangium*, *A. holosericea*, and *A. leptocarpa*.

285

Ryan, P.A. and Bell, R.E. (1989).
Growth, coppicing and flowering of Australian tree species in trials in southeast Queensland, Australia.
P 49-68 *in* Trees for the tropics - growing Australian multipurpose trees and shrubs in developing countries (ed Boland, D.J.), ACIAR Monograph No. 10.

Another report on the ACIAR tree species trials established in Gympie, Queensland but covers results from the whole range of species being tested (177 species comprising 306 seedlots of 27 genera) as well as more characters assessed. *Acacia auriculiformis* from Papua New Guinea has been found to grow faster than that from Queensland. Powdery mildew has also been observed on *A. auriculiformis* though to a lesser extent compared with that found on some other species e.g. *A. holosericea*.

Assessment on coppicing ability revealed that *A. auriculiformis* coppiced better when cut at 1 m above ground compared with that cut at 0.1 and 0.5 m above ground.

Flowering was not seen up to 36 months after planting.

Three-year-old trees of *A. auriculiformis* in Thailand were also found to coppice better when cut at higher (1 m) level above ground than cut at lower (0.5 and 0.1 m) levels above ground. Trees cut at 1 m above ground with one live branch remaining coppiced even better and it was observed that all sprouts occurred on the opposite side to the live branch, but these sprouts eventually died off later. The cause is not known but it could be that the surviving original branch re-exerts apical dominance on the stem buds below the original branch.

The late flowering of *A. auriculiformis* at Gympie suggests that site (i.e. environment) may be very important when seed production is the prime objective of the planting.

286

Sahai, R., Agarwal, S.K. and Rastogi, R.P. (1980).
Auriculoside, a new flavan glycoside from *Acacia auriculiformis*.
Phytochemistry 19(7), 1560-62.

The article describes the structural elucidation of auriculoside, a new flavan glycoside from *Acacia auriculiformis*. This flaven glycoside is unsubstituted in the heterocyclic ring.

287

Sahunalu, P., Suwannapinant, W., Kaitpraneet, S. and Tanpibal, V. (1979).
Biomass production of 8-year old *Acacia auriculaeformis* stand planted on the tailing tin-mine soil.
Paper, Second Seminar on Silviculture held in Bangkok, Thailand, 20-28 November 1979. (Th)

Data are presented on growth and biomass production of *Acacia auriculiformis* aged 8 years old planted on a tailing tin-mine area in Pangnga province, south Thailand. The planting area was levelled using bulldozer prior to planting. Soil was clay with pH 5-7. Mean annual rainfall was very high, 4000 mm. Survival after 8 years was very good i.e. about 90%. Most of the trees were heavily branched from ground level but this did not affect the utilisation in terms of firewood and charcoal.

Spacing	5x5 m
Mean height	9.9 m
Mean diameter	16.7 cm
Biomass (dry)	
- stem	32.6 t/ha
- branches	6.6 t/ha
- leaves	2.7 t/ha

288

Salam, S. (1980).
Mixed plant species for forest range Wonogini, Surakarta Forest District.
Duta Rimba 6(40), 17-22. (In & En)

In order to increase income of the Surakarta Forest District [Java, Indonesia], mixed plantations have been proposed for the total area of about 5,391 ha to produce firewood and construction timbers. 225 ha will be planted with *Acacia auriculiformis* for firewood. The species is selected for its short rotation, fast growth rate and good quality firewood and charcoal.

289

Santoso, E. (1987).
Effect of extract alang-alang (*Imperata cylindrica* L. Beauv) to the growth of *Pinus merkusii* and *Acacia auriculiformis* seedlings.
Forest Research Bulletin, Bogor 490, 1-12. (In, en)

Acacia auriculiformis and *Pinus merkusii* are two species identified as important for rehabilitating and greening of marginal sites in Indonesia. One of the major problems for plant production and establishment of these species is the competition for light, water and nutrients and allelopathic effect from *Imperata cylindrica* (alang-alang). This study examined the effect of extracts of leaf, stem and rhizome of alang-alang on the germination and early growth of *A. auriculiformis* and *P. merkusii*. The results show that these extracts had no significant effect on the germination of the trees' seeds. The effect of the leaf extract was, however, found to be significant in inhibiting the growth of the radicle, hypocotyl, cotyledon and dry matter production of both the tree species. Effects of the extracts from the stem and rhizome of the alang-alang were less effective in inhibiting the growth of the germinants. It is postulated that the growth inhibition was due to vanilic acid present in phenolic compounds. The concentration of vanilic acid in the stem of alang-alang has been reported to be lower than in the leaves.

290

Santoso, E. and Suharti, M. (1984).
Morphology and anatomy studies on rust diseases which attacked *Acacia auriculiformis* A. Cunn. plant.
Report No. 441, Forest Research and Development Center, Bogor, Indonesia. (In, en)

Macroscopic and microscopic observations of healthy and infected leaves of *Acacia auriculiformis* seedlings reveals *Uromyces* species to be responsible for rust fungal diseases. Initial symptoms are characterised by chlorosis and spot formation which subsequently develop into galls of varying shapes and sizes.

291

Santoso, W.B. (1982).
The supply of firewood by *Acacia auriculiformis* A. Cunn.
Duta Rimba 8(55), 7-9. (In, en)

The demand for firewood is rapidly increasing and is already at critical levels in many rural areas of Indonesia. One major effort recommended to overcome the problem is the establishment of large-scale plantations of *Acacia auriculiformis* for firewood. The species has a high wood calorific value and can be harvested within 8 years after planting. Detailed descriptions of the nursery and field establishment techniques are outlined.

292

Sapkota, M. (1988).
Multipurpose tree species for small-farm use in Nepal.
P 48-52 *in* Multipurpose tree species for small-farm use: proceedings of an international workshop held in Pattaya, Thailand, 2-5 November 1987, (eds Withington, D., MacDicken, K.G., Sastry, C.B. and Adams, N.R.).

There is a pressing need to improve multipurpose tree species to meet the increasing demand for food, fodder, fuelwood, shade and timber in Nepal. Accordingly multipurpose tree trials have been conducted in various agro-climatic regions as part of the Farm Forestry Project supported by the International Development Research Centre of Canada, and the Nepal Institute of Agriculture and Animal Science and of Forestry. Studies have included intercropping trials, species elimination trials, spacing trials, and feeding studies on goats and buffalo calves. Promising species are cultivated and distributed to farmers. Species mentioned as of particular use include *Leucaena leucocephala*, *Acacia auriculiformis*, *Dalbergia sissoo*, *Cassia siamea* and *Eucalyptus camaldulensis*.

Leaves [phyllode] of *A. auriculiformis* can be used for green manure and mulch, and are reportedly eaten by goats.

293

Saroa, K.M. (1988).
Multipurpose, nitrogen-fixing trees for small-farm use in Papua New Guinea.
P 124 *in* Multipurpose tree species for small-farm use: proceedings of an international workshop held in Pattaya, Thailand, 2-5 November 1987, (eds Withington, D., MacDicken, K.G., Sastry, C.B. and Adams, N.R.).

Nitrogen fixing trees as shade trees for mixed cropping being investigated in Papua New Guinea include *Albizia falcataria*, *Gliricidia sepium*, *Acacia auriculiformis*, *Leucaena leucocephala*,

Calliandra calothyrsus, *Calliandra confusa*, *Casuarina oligodon* and *Casuarina equisetifolia*. Although experimental data are being compiled, the results are encouraging and indicate that subsistence food crops grown with trees can continue to produce well and not be affected by drought or soil fertility problems.

294

Sastroamidjojo, J.S. (1964).
***Acacia auriculiformis* A. Cunn.**
Rimba Indonesia 9(3), 214-225. (In, en)

The article reports on growth characteristics, silviculture and economic importance of *Acacia auriculiformis* in Indonesia. The species is relatively fast growing with a MAI of 16.8 m^3 at 10 years of age recorded in various trial plots in Java. Trees grown at a density of 1968 stems/ha were mainly single-leadered and of good form compared to 1206 stems/ha which were multi-leadered and crooked. A more detailed study on the relationship between stand density and tree form of the species is recommended.

Mature trees flower all year round particularly from July to November and produce abundant seeds. Planting stock is easy and cheap to produce, plant and protect. Newly-transplanted plants cannot compete with wild grass and other growth and may require tending until about 3 years old.

Three methods of regeneration are described. The first is the "tumpangsari" which is an artificial regeneration by people who work for the Forest Service under a contract; the second is the natural regeneration method following clear cutting; and the third is by coppice system with stump height cut not less than 50 cm.

Because of its strength, timber cut from *A. auriculiformis*, if painted or kept from direct contact with moist soil, is suitable for heavy construction but its crooked stem restricts its utilisation. Its high specific gravity offers the best potential for charcoal production or fuelwood.

295

Satjapradja, O. and Susatijo, B. (1983).
The implementation of afforestation and soil conservation at Sampean catchment area, Besuki Residency, East Java.
Report, Forest Research and Development Centre, Bogor, Indonesia, No. 412-414, 27-40. (In, en)

Reforestation and afforestation are considered to be important activities in Indonesia. Research is being conducted to study implementation and operational management of afforestation and soil conservation within Sampean catchment area. Few species have been used in the planting i.e. *Albizia falcataria*, *Acacia auriculiformis*, *Swietenia macrophylla*, *Calliandra calothyrsus* and *Pennisetum purpureum*, but the results are not up to expectation. Possible constraints which contributed to the unsuccessful results were reported to be insufficient budget, condition of planting stock, uncontrolled grazing in the planting area, lack of support from local governmental offices and capability of field manager.

296

Sawintara, S. (1982).
Bilateral return of the third year agri-silviculture practices at Amphur Kantrarom, Si Sa Ket Province.
M.Sc. thesis, Kasetsart University, Thailand. (Th, en)

An investigation into the effect of intercropping sweet potato, cassava and castor bean between rows of 3-year-old *Acacia auriculiformis*, *Leucaena leucocephala*, *Eucalyptus camaldulensis* and *Peltophorum dasyrachis* in Si Sa Ket Province, northeast Thailand. The following results were recorded.

1. Comparison of tree species performance in respect of wood yield showed that *A. auriculiformis* gave the highest yield followed in order of magnitude by *P. dasyrachis*, *E. camaldulensis* and *L. leucocephala.*

2. *Eucalyptus camaldulensis* produced greatest leaf dry weight, followed by *A. auriculiformis*, *P. dasyrachis* and *L. leucocephala.*

3. Interplanting with agricultural crops improved growth of all tree species.

4. Best yield of the agricultural crops was obtained when interplanted with slower growing tree species. In general, therefore, intercropping with *L. leucocephala* gave the highest crop yield.

297

Schedl, K.E. (1959).
A new Solytid species and new host records of some Malayan Scolytidae and Platypodae.
Malayan Forester 22(2), 167-9.

Describes a new insect, *Stephanoderes dimorphus*, found boring into young shoots of *Acacia auriculiformis* at the Forest Research Institute, Kepong, Malaya [Malaysia].

There was no report as to the extent of damage caused by this insect. In Thailand *Sinoxylon* sp, a beetle, is found to girdle young stems or branches of *A. auriculiformis* during the dry season. The stems or branches break at the point of attack.

298

Semsuntud, N. (1988).
Development of tissue culture techniques for *Acacia auriculiformis*.
Progress report, Division of Silviculture, Royal Forest Department, Thailand. (Th)

Multiple shoots were found to develop from explants (tip, axillary bud and root collar) excised from *in vitro* grown seedlings of *Acacia auriculiformis*. The number of shoots varied with the type of explants though there was a tendency for more shoots to develop from root collar. Rooting of these shoots could be induced with the application of indole acetic acid (IAA) and naphthaleneacetic acid (NAA). The best results were obtained in basal medium augmented with either IAA or NAA at 10^{-5}M concentration.

299

Setiadi, D.S. and Samingan, T. (1978).
Allelopathic effects of *Acacia auriculiformis* and *Albizia falcataria* on seedlings of *Tamarindus indica*.
Kehutanan Indonesia 5(6), 6-21. (In)

Tamarindus indica seeds were germinated and grown in an untreated soil and in soil which has been used for germination and growth of *Acacia*

auriculiformis. Germination percentage and growth of *Tamarindus indica* were significantly higher in the untreated soil. Similar test using soil treated with *Albizia falcataria* revealed the allelopathic effects of *Acacia auriculiformis* to be significantly greater than that of *Albizia falcataria*.

300

Sheen, S.C., Chen, M.Y. and Chen, C.Y. (1984).
Photosynthesis and respiration of fast-growing woody legumes.
Quarterly Journal of Chinese Forestry 17(4), 27-36. (Ch, en)

Net photosynthetic rate of *Acacia auriculiformis* was found to be 9-21 mg $CO_2/dm^2/h$ and respiration rate was 1.1-4.5 mg $CO_2/dm^2/h$. Light saturation point was 40-50 klux while light compensation point was 0.4-6.0 klux. Transpiration rate was very high even under low light intensity levels (i.e. 1.4 g $H_2O/dm^2/h$ at 5 klux) suggesting that stomatal opening is rather sensitive to light. Under constant light intensity of 60 klux, net photosynthetic rate of *Acacia auriculiformis* reached a peak within 3 hours.

301

Sijde, H.A. van der. (1957).
Reafforestation trials in the surroundings of Jayapura.
Unpublished, 15 pp. (Nl)

In trial plantations at the Kota-Nica area near Jayapura [capital of Irian Jaya Province, Indonesia], young trees of some species are suppressed by long grasses (*Saccharum* sp.), but *Acacia auriculiformis* is still growing well.

302

Sim Boon Liang and Gan, E. (1987).
Present status of research on *Acacia mangium*, *A. auriculiformis* and hybrid *A. auriculiformis* in Malaysia.
Summary report for the collaborative research project (ACIAR/Malaysia) in acacia hybridisation, Sabah Forest Industries Sdn. Bhd., Sabah, Malaysia.

The paper is a review of all phenology, controlled pollination and vegetative propagation research conducted on *Acacia mangium*, *Acacia auriculiformis* and their hybrid in Malaysia.

There appears to be very little information on the original introduction of *Acacia auriculiformis* to Sabah. Most of the early plantings are believed to have originated from old trees on Labuan Island [western part of Sabah], and thus the genetic base of *Acacia auriculiformis* is believed to be as narrow as that of the original *Acacia mangium* planted in Sabah (i.e. seed was collected from a single tree from Australia.).

Results of controlled pollination of *Acacia auriculiformis* and *Acacia mangium* indicate a high percentage of crossing between the two species i.e. 30% when *Acacia mangium* is mother tree, and 39% when *Acacia auriculiformis* is mother tree.

303

Sim Boon Liang and Gan, E. (1988).
Comparative growth of five tropical acacias on four different sites in Sabah.
Commonwealth Forestry Review 67(2), 149-58.

Reports one-year results of a series of *Acacia* species trials in Sabah, Malaysia. Three provenances of *Acacia*

auriculiformis from Papua New Guinea (Balamuk, Iokwa and Bula) and two landraces (Yigo from Guam, and Sepilok, Sabah) are compared with four other *Acacia* species (i.e. *A. aulacocarpa*, *A. crassicarpa*, *A. mangium* and *A. mearnsii*) at four sites ranging from 100 to 1300 m altitude. Mean annual rainfall at these sites ranges from 2000 to 3200 mm.

Acacia auriculiformis grows satisfactorily at all sites and appears to perform better than *A. mangium*, the current major plantation species in Sabah, particularly at poor sites such as rocky, shallow and sandy soil with heavy lalang (*Imperata cylindrica*). Most of the trees of *A. auriculiformis* are of poor stem form, but the provenances from Papua New Guinea especially the Iokwa provenance produce some fairly straight trees with single leader. In these series of trials *A. crassicarpa* and *A. aulacocarpa* grow faster than *A. auriculiformis* at all sites.

Of all the *Acacia* species tested, *A. aulacocarpa* appears to be the most interesting species in that it shows good stem form, fine branching habit and strong apical dominance while *A. crassicarpa* is the most vigorous of all species on the lowland sites (<650 m).

304

Simsiri, A., Boontawee, B., Vuttivijarn, T., Thai-ngam, R. and Sirilak, S. (1988).
Vegetative propagation of *Acacia auriculiformis*.
Research report, Silvicultural Research Subdivision, Royal Forest Department, Thailand. (Th)

Acacia auriculiformis can be propagated vegetatively using layering, grafting and cutting methods, but better results were obtained when rooting hormone (IBA) was also applied. On average from 26 trees, layering undertaken on branches of 7-year-old trees gave only 12% success and increased to 33% if treated with IBA. Grafting using branches of 7-year-old trees as scion on potted stocks was also successful without IPA treatment i.e. 28%. Cuttings under mist spray showed that those from seedlings gave much better results than those from more mature parts of the crown. Cuttings from plants 1.5 years old or from hedged 2.5-year-old plants gave about 30% success which was more than doubled with the addition of IBA.

305

Singh, P., Jamaluddin and Purohit, M. (1988).
Studies on growth and development of some forest tree species in red mud soil Balco Korba.
Indian Forester 114(5), 285-288.

Chemical waste from an aluminium ore industry deposited on the red mud soil is detrimented tree growth at Balco Korba, Madhya Pradesh. The affected soil (Balco soil) is highly alkaline. An experiment was therefore conducted to determine suitable species for the affected area.

Seedlings of *Acacia auriculiformis*, *Pongamia pinnata* and *Eucalyptus* sp. [*E. tereticornis*] were transplanted from media of pH 6-7 to polythene bags containing soil of different treatments:

Balco soil	13.0 pH
Balco soil + soil mix	7.6 pH
Balco soil + 10% H_2SO_4	7.3 pH
Balco soil + soil mix + H_2SO_4	6.9 pH
Soil mix	6.5 pH

After 4 months, seedlings of all species died in the Balco soil treatment (pH 13) but survived 100% in other treatments except for *A. auriculiformis* in the soil mixed with H_2SO_4 where survival was only 20-40%.

Also reported is a separate experiment of seedlings transplanted in red mud area at Balco for reclamation of the mine waste area. Seedlings were planted in 60x60 cm pits filled with soil and cow dung. After 4 months *A. auriculiformis* survived 100% and was 44 cm in height. *A. nilotica* was slightly taller (i.e. 46 cm) but poorer in survival (85%). The poorest species is *A. catechu*, average survival 42% and height 14 cm.

306

Skelton, D.J. (1987).
Distribution and ecology of Papua New Guinea acacias.
P 38-44 *in* Australian acacias in developing countries: proceedings of an international workshop held at the Forestry Training Centre, Gympie, Queensland, Australia, 4-7 August 1986 (ed Turnbull, J.W.), ACIAR Proceedings No. 16.

Nine acacias have been recorded as indigenous to Papua New Guinea, 4 species of large tree, 2 medium, 1 shrub and 2 climbing species. *Acacia auriculiformis* is one of the large trees up to 30 m. Its distribution is mainly in distinctive drier (subhumid) parts on the Oriomo Plateau where annual rainfall is 2000 mm or less in savanna/woodland/forest complexes often associated with *Melaleuca* species. Species composition and locations where *A. auriculiformis* is seen naturally are described. Additional notes are also given on flowering and fruiting. *A. auriculiformis* flowers in April/May, and fruits from the end of September to early November.

307

Skelton, D.J. and Howcroft, N.H.S. (1987).
Seed production and silvicultural trials of acacias in Papua New Guinea.
P 188-190 *in* Australian acacias in developing countries: proceedings of an international workshop held at the Forestry Training Centre, Gympie, Queensland, Australia, 4-7 August 1986 (ed Turnbull, J.W.), ACIAR Proceedings No. 16.

The Papua New Guinea acacia research program has been established as part of FAO Global Programme for Improved Use of Genetic Resources. Work to date includes seed production areas, form and vigour observation, provenance expansion and improvement and local species and provenance trials for *Acacia mangium*, *A. auriculiformis*, *A. aulacocarpa*, and *A. crassicarpa*.

A range of provenances of *Acacia mangium* and one sample of *A. auriculiformis* were planted in 1982 on three different sites, namely ex-forest imperfectly drained, ex-forest poorly drained and *Imperata* imperfectly drained. Growth after 2.5 years is excellent at both ex-forest site types but is extremely poor at the *Imperata* area. *A. auriculiformis* at the ex-forest sites is susceptible locally to root rot by *Ganoderma* and *Phellinus* species. Additional plantings with *A. auriculiformis*, *A. aulacocarpa*, *A. crassicarpa* and *A. mangium* were carried out in 1986 on ex-forest imperfectly drained and *Imperata* imperfectly drained areas for comparison with the 1982 plantings. No results are reported.

In view of tree improvement work, it is noted that *A. auriculiformis* from Brown River provenance exhibits very poor form and it is believed that poor selection of mother trees during the original collections may have contributed to the poor form. This poor form of the Brown River provenance is also observed in other areas throughout Papua New Guinea.

308

Soedibja, S. (1955).
What is the destination of Janlappa.
Rimba Indonesia 4, 217-222. (In, en)

Trial plantings of *Acacia auriculiformis* at Janlappa [Indonesia] have shown the species to be very suitable for rehabilitating or revegetating abandoned paddy fields and nutrient deficient sites. Plantations of the species at Janlappa can supply both fuel wood and timber for general utilisation to populations near Jakarta where the demand for such products is very high. A system of clear cutting after 10 years rotation followed by natural regeneration is suggested. Weed competition must be reduced at the early stages of rotation.

309

Soedibja, S. and Ardikusumah, I. (1953).
A consideration about the coppice system experiment with *Acacia auriculiformis* A. Cunn. at Maribaja (Djasinga).
Rimba Indonesia 2(6/7), 279-288. (In & En)

A coppicing experiment was conducted in a 5-year-old *Acacia auriculiformis* plantation at Maribaja [West Java, Indonesia] with an effort to find the best cutting methods which would maximise firewood production. A square block of 100x100 m was divided into several small sub-plots for different cutting treatments. Stumps were cut at several height levels from ground (0-30 cm); some plots were clear cut, some plots cut at 50-64%. It was found that stumps in the clear-cut plots were all dead regardless of the height cut because the stumps were dried out and bark peeled off. Stumps in the plot cut at 50% sprouted about 21%, and in the plot cut at 64% sprouted 2%. It is believed that the ability to sprout was due to the shade provided to the cut stumps.

Outside the experimental block was a boundary 10 m wide, and the trees were also cut but with one live branch remained intact. It was found that up to 60% of these stumps sprouted. The live branch is believed to protect the stump from full sunlight as well as help prevent the stumps from drying out.

Visaratana and Puriyakorn (1988) also reported stumps cut at 1 m above ground with one live branch remaining intact had higher coppicing rate. After sprouting however, the sprouts tended to dry out at a higher rate compared to those stumps without live branches. It may be desirable to remove the live branch after the coppice shoots have sprouted. Ryan and Bell (1989) also found stumps cut at 1 m above ground coppiced better than those cut at lower levels (0.1 and 0.5 m).

310

Soekarpi. (1955).
Some notes on *Acacia auriculiformis* A. Cunn.
Report of the Forest Research Institute, Bogor, Indonesia, No. 71. (In)

Trial plantings with various exotic species at many marginal sites in Java have shown *Acacia auriculiformis* to be very promising both for fuelwood production at a rotation of about 10 years

and for site amelioration. Investigations for a suitable regeneration system of the plantation showed that coppice system was the most feasible for fuelwood production. However, stumps needed to be cut not less than 30 cm above ground to protect them from drying out, and with some shade provided by surrounding trees - hence clearcutting is not feasible. The presence of a live branch on the stump was found to improve coppicing.

311

Soemarna, K. and Sudiono, Y. (1974a).
Sampling results in the area of aerial seeding in the Forest District Lawu Ds., East Java.
Forest Research Institute, Bogor, Indonesia, Report No. 180. (In)

A report on results of an aerial seeding experiment over an *Imperata cylindrica* grassland in the Forest District Lawu Ds., Ponorogo, East Java. The study area has an annual rainfall of 1800 mm, and is 800 m in altitude with 35° slope. The area was prepared in three ways: hoeing, burning or left untreated. *Acacia auriculiformis* and *Calliandra calothyrsus* were sown at about 53,000 seeds/ha. The results assessed at 10 months after sowing are as follows.

	Hoed areas	Burned areas	No treatment
Acacia % success	23.9	46.7	50.0
mean height (m) 0.89 0.95	1.02		
Calliandra % success	13.4	18.4	18.5
mean height (m)	1.29	1.69	1.34

The untreated plot appears to have highest establishment. No explanation is given.

312

Soemarna, K. and Sudiono, Y. (1974b).
Sampling results in the area of aerial seeding in the Forest District Balapulang, Middle Java.
Forest Research Institute, Bogor, Indonesia, Report No. 188. (In)

Another report at 10 months after aerial seeding but at Balapulang Forest district in Central Java, annual rainfall 2400 mm and covered with *Imperata cylindrica*. Land preparations include tractor-ploughing, burning and left untreated. No success was obtained for area without preparation. For *Acacia auriculiformis* there were 782 seedlings/ha in the ploughed area; this accounts for 7.4% of the seed sown per hectare. In the burnt area, there were 1469 seedlings/ha or 22.6% of the seeds sown/per hectare.

More detailed results of the aerial sowing at Balapulang have been reported by Hadipoernomo (1979) and National Academy of Science (1981).

313

Soetrisno, T. (1980).
Acacia (*Acacia auriculiformis*) as basic pulp material for paper.
Berita Selulosa 16(3), 61-65. (In)

A study was carried out to investigate the potential of *Acacia auriculiformis* as a raw material for the production of pulp and paper. The findings of the study indicate that the species can be grouped with those with high density and short fibres when compared to other tropical woods. Lignin content is low with a good solubility characteristic. Heating of this acacia wood with 15% sulphuric acid can produce pulps with good physical characteristics suitable for the production of high quality paper.

314

Srinivasan, P.S. and Vinaya Rai, R.S. (1989).
Inter-species variation in growth and a few drought-adaptive attributes in *Acacia*.
Journal of Tropical Forest Science (submitted).

In a 3-year-old experiment conducted at the Forestry Research Station, Mettupalayam, India (latitude 11°19'N, longitude 76°56'E, altitude 300 m, annual rainfall 830 mm and soil pH 7.1), *Acacia auriculiformis* outperformed 14 other *Acacia* species judging from its overall performance. It recorded the highest values in terms of height, bark moisture content, total chlorophyll content and stomatal resistance, and was second to *A. platycarpa* in dbh. In addition, it had the lowest transpiration rate. It is concluded that *A. auriculiformis* is the most drought-adaptive species. Other species which performed next best to *A. auriculiformis* were *A. albida* and *A. platycarpa*. *A. holosericea* grew well but had very low bark moisture content and high transpiration rate.

315

Steup, F.K.M. (1955).
***Acacia auriculiformis*.**
In Sub-Panitya Tehnik Kehutanan, p 2.

This paper contains botanical and silvicultural description of *Acacia auriculiformis* from northern Australia for the following aspects: distribution, habitat, fruiting, sexual reproduction, cultivation, pruning, wood production and possible uses (fuelwood).

316

Streets, R.J. (1962).
Exotic forest trees in the British Commonwealth.
Clarendon Press, Oxford. p 139-140.

Acacia auriculiformis is used as an exotic to check erosion. Utilisation of the wood is mainly for fuel because of its poor form, but the tree suppresses grass quickly and gives a useful leaf-litter. Notes on cultivation of the species in countries in the British Commonwealth is described.

Malaya [Malaysia]. First planted at the Forest Research Institute in 1931, it has grown vigorously on poor soils, and seems particularly promising for soil improvement on tin-tailings (spoil-heaps of tin mines). Trees planted as tubed seedlings, at 6x6 ft [1.8x1.8 m] on clay reached 30-40 ft [9-12 m] height after 3 years, and have shaded out dense *Imperata* grass, survival being 100%. On a poorer site in sandy soil, trees have grown to 20 ft [6 m] in the same time.

Flowering and fruiting is almost continuous, and natural seedlings, transplanted to veneer tubes, are often used because nursery germination of seed is uncertain.

North Borneo [Sabah]. Well established and highly successful, both in plantation and as a shade-tree.

Tanganyika [Tanzania]. It is a promising fuel species for poor sandy soils in coastal areas, but seed supply (ex Zanzibar) is limited.

Zanzibar [Tanzania]. It was first introduced in the 1910s probably for ornamental planting; but has been tried in plantation. It has adapted to a wide range of soils, reaching a height of more than 30 ft [9 m] with a diameter of 5 in [12.5 cm] in 8 years on shallow coral soil, and a height of 35 ft [10.7 m] with a diameter of 8 in [20 cm] in 6 years on a deep sand. The original spacing was 6x6 ft [1.8x1.8 m], and the second plantation was thinned in the 4th years by removing about 50% of the original stems; the canopy had closed again by the 6th year. Flowering is early and profuse, but the seed-pods have been attacked by sap-sucking bugs resulting in short supply of seed. Planting is done with seedlings about 2-2.5 ft [60-75 cm] high, which give better results in sand when buried to a depth of about 0.5 ft [15 cm] above the collar. *A. auriculiformis* is also successful on a small scale, when planted on steep eroding slopes making it suitable for soil conservation purposes. The species has now been planted on poor soils for poles, posts and fuel.

317

Sugur, G.V. (1989a).
Litter production and nutrient cycling of different species under plantation conditions.
Myforest 25, 43-49.

From Forestry Abstracts: Measurements were made of litter production in 10-year-old plantations of 6 species at Devbal, Shimoga District, Karnataka [India], from September 1986 to August 1987; collections were made over 25 m^2-areas at monthly intervals. The litter was divided into leaf and non-leaf litter and weighed. Oven-dry weight and nutrient analyses (organic C, N, P, K, Ca and Mg) were determined on samples. Data are tabulated on production of oven-dry weight (kg/ha) and nutrient content (%) of leaf, non-leaf and total litter over the study period, and on seasonal (June-September, October-January, February-May) production of leaf litter and corresponding N, P and K contents (as %). The highest total litter production over the period was by *Casuarina equisetifolia* (3.16 t/ha) followed (in decreasing order) by *Acacia auriculiformis* (3.04), *Anthocephalus cadamba* [*A. chinensis*] (2.58), *Cassia siamea* (2.21), *Gmelina arborea* (2.18) and *Lagerstroemia lanceolata* (1.73). There were no particular trends in nutrient contents between species, although *L. lanceolata* (which was not suited to the site) returned least nutrients. All species except *A. auriculiformis* shed most leaf litter in October-January; for *A. auriculiformis* maximum shedding was in February-May. Contents of N, P and K were highest in June-September for all species and nutrients, except N in *A. auriculiformis* which was highest in October-January.

318

Sugur, G.V. (1989b).
Biomass production of different density stands of *Acacia auriculiformis* and *Casuarina equisetifolia*.
Myforest 25, 84-88.

The study was made in 4 plantations established in 1981 in the Tirthahali Range, Karnataka at 1x1 and 2x2 m spacings for *Acacia auriculiformis* and 1x1 and 1.5x1.5 m spacings for *Casuarina equisetifolia*. Survival was about 84% in all plantations. *A. auriculiformis* was superior both in total biomass production (15.3 and 39.4 kg/tree at 1x1 and 2x2 m spacings respectively) and MAI (19.9 and 12.7 t/ha respectively). Comparable values for *Casuarina equisetifolia* were 9.8 and 15.8 kg/tree for total biomass and 10.6 and 8.8 t/ha for MAI.

319

Suharti, M. (1980).
Preliminary study on rust disease of *Acacia auriculiformis* A. Cunn.
Report, Forest Research and Development Centre, Bogor, Indonesia, No. 347, 17 pp. (In, en)

A gall rust disease is common in *Acacia auriculiformis* seedlings in nurseries in Java and Madura. Infected plants are chlorotic, stunted in growth and show gall formation on leaves, buds and young stems. Microscopic examination of infected plants showed that pycnial, uredial and telial phases were all found on *A. auriculiformis* seedlings suggesting that the species is the primary host of the disease. A recommended control measure is either to excise the infected parts or destroy the whole plant.

A survey on the occurrence and intensity of infection of the disease in nurseries in Java and Madura revealed no correlation with nursery sites (of different altitudes) or age of the seedlings.

320

Suharti, M. and Santoso, E. (1984).
Control of rust infected *Acacia auriculiformis* A. Cunn. seedlings with Terraclor Super X and Orthocide 50 WP.
Report, Forest Research and Development Centre, Bogor, Indonesia, No. 437, 8 pp. (In, en)

Rust disease infected seedlings of *Acacia auriculiformis* were sprayed with two fungicides namely Terraclor Super X and Orthocide 50 WP at the concentration of 0, 0.20, 0.25, 0.30, and 0.35% respectively. Results revealed both fungicides to be effective in checking the spread of infection within seedlings. Both fungicides were most effective at the highest concentration level (i.e. 0.35%). Orthocide 50 WP was generally more effective than Terraclor Super X. It is hypothesised that the disease is seed borne. Recommended control measures include sprays of seeds and seedlings with these fungicides at a lower concentration than 0.35% more than once.

321

Sun Jisheng. (1987).
Relationship between chlorophyll content, photosynthesis, and biomass production in *Acacia* and *Eucalyptus* seedlings.
P 139-142 *in* Australian acacias in developing countries: proceedings of an international workshop held at the Forestry Training Centre, Gympie, Qld., Australia, 4-7 August 1986 (ed Turnbull, J.W.), ACIAR Proceedings No. 16.

Glasshouse grown seedlings of *Acacia auriculiformis* were found to grow faster than those of *A. confusa*. The net photosynthesis rate of *A. auriculiformis* was about 1.15 times greater than that of *A. confusa*. *A. auriculiformis* apparently had higher chlorophyll content which may be part of the reason why the two species differ in photosynthesis capacity and growth.

322

Tan, S.M. and Chen, B.G. (1984).
Studies on the transpiration rate of several tree species.
Scientia Silvae Sinicae 20(1), 72-79. (Ch, en)

Measurements of transpiration in relation to various environmental factors were made over 1 year (1981-82) on *Acacia auriculiformis*, *Eucalyptus torelliana* and *Cunninghamia lanceolata* growing at 1395 stems/ha in Guangzhou, Guangdong. Annual rates of water transpired were 13,631, 4818 and 9944 t/ha respectively. Variation in the rates was mainly limited by light intensity and temperature. Practical equations derived by multiple regression analysis are given as a simple method of estimating the transpiration rates of the 3 species.

323

Tanpibal, W. and Sahunalu, P. (1981).
Litter production and decomposition of *Acacia auriculaeformis* stand planted on the tailing tin-mine soil.
Research Note No. 2, Faculty of Forestry, Kasetsart University, Thailand. (Th, en)

A sample plot of 50 m x 110 m was laid out to study growth performance and soil amelioration of an 8-year-old plantation of *Acacia auriculiformis* on the tailing tin-mine soil at Takuapa, Pangnga province, south Thailand in 1979. Annual rainfall at the study area is very high with an average of 4000 mm/annum. Monthly litterfall was collected in 1x1 m traps for estimation of decomposition rate. It was found that total litter production (oven dried) was 5.21 t/ha/a with the greatest fall in December being 1.2 t/ha, and least fall in May and June being 0.07 t/ha. Leaf litter was found to be the major component of the litter production (i.e. 3.82 t/ha/a) with the highest monthly fall in December (0.96 t/ha) and the lowest in May and June (0.04 t/ha). Branch litter (diameter > 5 mm) totalled 0.3 t/ha/a, and other components made up 1.09 t/ha/a. Decomposition rate of litter was estimated at 2 t/ha/a. The most rapid decomposition rate was found in August (0.29 t/ha), and the slowest rate in March (0.003 t/ha)

324

Thaiutsa, B., Songpitakchai, M. and Pattaratuma, A. (1974).
Transpiration rates of some fast growing tree species.
Research Note No. 11, Faculty of Forestry, Kasetsart University, Thailand, 9 pp. (Th, en)

Transpiration rate of 18-month-old seedlings of *Acacia auriculiformis* was 0.0315 cm/hr which was higher than other species e.g. *Gmelina arborea* (0.0136) and *Pinus khasya* [*kesiya*] (0.0042). It is concluded that the orientation of phyllodes of *Acacia auriculiformis* make them more exposed to sunlight and wind compared to the other species.

325

Thojib, A. (1981).
Litter production and decomposition of some reforestation species on Java.
P 105-111 *in* Observations of agroforestry on Java, Indonesia: report on an agroforestry course organized at Forestry Faculty, Gadjah Mada University, Yogyakarta (ed Wiersum, K.F.)

A review of studies on litter production and decomposition of some reforestation species in Java. Several factors are said to have an effect on these processes, e.g. species composition, plant age, planting distance and environmental conditions (rainfall, temperature, soil moisture, pH, etc)

An effect of plant age on litter production of *Acacia auriculiformis* was demonstrated. At age 5 years, 10.9 t/ha of fine litter was produced, but increased to 13.0 t/ha at age 6. Both figures were obtained over a 12 months period from the same plantation grown on a regosol over marl at altitude 110 m, annual rainfall 2700 mm, and tree density 1010 stems/ha.

Species with higher N content are shown to have higher rates of litter decomposition. *A. auriculiformis* with a N content 1.63% had a decomposition rate of 33% after 16 weeks while *Leucaena leucocephala* with a N content of 2.51% had a decomposition rate of 76% after the same period. *Swietenia macrophylla* had lower N content, 1.11%, and its decomposition rate was also lower, 26%. These comparisons were made under the same environmental conditions at Ubrug forest, Jatiluhur.

326

Thomson, B.R. (1980).
Firebreaks in grasslands, Vara Creek (X-S/765-771).
Forest Research Note, Forestry Division, Solomon Islands, No. 2/80, 2 p.

Acacia auriculiformis and other broadleaved species (*Gmelina arborea*, *Tectona grandis* etc.) were planted in February 1978 at 2x2 m spacing around the block of *Pinus caribaea* to protect the pine trees from damaging crown fires which occurred in previous seasons. At 2 years growth of all species was poor despite fertilizing with NPK in the first year. There was slight suppression of weed under *A. auriculiformis* and *G. arborea*, and *A. auriculiformis* was recommended for further trials. However, it was believed that controlled burning in the early dry season would be a more effective method for fire control.

327

Tomar, O.S. and Gupta, R.K. (1985).
Performance of some forest tree species in saline soils under shallow and saline water-table conditions.
Plant and Soil, 87, 329-335.

Reports a study on the influence of seasonal variations in salinity and soil moisture profiles due to fluctuating water table on the performance of 16 tree species including *Acacia auriculiformis*. The study area at the experiment station of the Central Soil Salinity Research Institute, Karnal, India has soils of sandy loam in texture which contain excess of chloride and sulphate salts of Ca, Mg and Na. The area has a semi-arid climate with a mean annual rainfall of 650 mm, of which 80% is received during July to September. Mean monthly temperature varies from 21°C in January to 40.5°C in

May. Over a yearly cycle, water table having an EC of 2-46 mmhos/cm fluctuated between 10-140 cm from the surface. In areas where salinity is not associated with high water table conditions, tree species like *A. auriculiformis*, *Terminalia arjuna* and *Leucaena leucocephala* can be grown. *Casuarina equisetifolia* and *Prosopis juliflora* are better adapted to high salinity or high water table conditions occurring separately or simultaneously. If planted on ridges (i.e. reduced salinisation and improved soil aeration) *A. auriculiformis* grows satisfactorily.

328

Totey, N.G., Kulkarni, R., Bhowmik, A.K., Khatri, P.K., Dahia, V.K. and Prasad, A. (1987).
Afforestation of salt affected wasteland. I- Screening of forest tree species of Madhya Pradesh for salt tolerance.
Indian Forester 113(12), 805-815.

Seeds of *Acacia auriculiformis* were germinated on filter paper in petri dishes using different artificially prepared saline solutions of 3, 6, 9, 12 and 18 mmhos/cm electrical conductivity adjusted in Hoagland Solution No. 1 by incorporating a neutral salt, NaCl. Two additional levels were compared i.e. tap water was used as control whose EC was 0.56 mmhos/cm and fresh Hoagland Solution contained 1.76 mmhos/cm EC. Germination per cent was highest at the lowest salinity level (i.e. average 54.4% in tap water) and was decreased with an increased salinity (17.5% under 18 mmhos/cm EC). Commencement of germination was also delayed as the salinity level was increased.

329

Turnbull, J.W. (1982).
Tropical acacias in Australia, Indonesia and Papua New Guinea.
Report of the FAO consultant. CSIRO Division of Forest Research, Canberra, Australia. (unpublished)

A report of tropical acacias in their natural habitats in Australia, Indonesia and Papua New Guinea. Among 12 *Acacia* species examined, *Acacia auriculiformis* has already been cultivated most widely and successfully as an exotic, but provenance testing is recommended to make its use fully effective. The natural occurrence, habit, ecology, potential utilisation and conservation status of the species are described in detail. The report also includes a description of a reconnaissance of seed crops on several species of *Acacia* in Western Province of Papua New Guinea. An FAO-sponsored seed collection expedition for these acacias was recommended.

330

Turnbull, J.W. (1984).
Six phyllodinous *Acacia* species for planting in humid tropical lowlands.
Pesquisa Agropecuaria Brasileira 19(special), 69-73.

A brief account of the natural distribution, ecology and utilisation of six *Acacia* species with potential for planting in the lowland, humid tropics. Growth characteristics of *Acacia auriculiformis* in plantations are described. A figure illustrating height growth of 16 species of *Acacia*, *Eucalyptus* and *Pinus* indicates that *A. auriculiformis* is second only to *A. mangium* after 2 years in a species trial at Subanjerji, Sumatra. It is suggested that

selection and introduction of tall, straight provenances would improve utilisation of *A. auriculiformis* for poles and heavy construction timber.

331

Turnbull, J.W. (ed) (1986).
Multipurpose Australian trees and shrubs : lesser known species for fuelwood and agroforestry.
ACIAR Monograph No. 1, 316 pp.

The main part of this book contains descriptions of the botanical, ecological, silvicultural and utilisation characteristics of 100 selected Australian tree and shrub species suitable for domestic fuel and agroforestry. Most of the species described are generally not known in traditional forestry. *Acacia auriculiformis* is among those species selected based on the following reasons: capable of providing products and services in addition to fuelwood, easily established and maintained, capable of growing in extreme environments including arid and humid tropical zones, infertile soils, saline, alkaline or waterlogged sites. Other characteristics of *A. auriculiformis* are an ability to fix atmospheric nitrogen, a capacity for rapid growth, an ability to coppice and good burning properties.

332

Turnbull, J.W. (1987a).
Recent results of Australian nitrogen fixing trees in the tropics.
Report on Regional Training Course in Nitrogen Fixing Trees. Regional Wood Energy Development Program in Asia, GCP/RAS/111/NET, Bangkok, October 1987, p 108-118.

New provenances of *Acacia auriculiformis* from Australia and Papua New Guinea have been introduced to many countries in Asia and it is found that these newly-introduced provenances are growing significantly faster than local seed sources. Of particular note are the provenances from Papua New Guinea i.e. Balamuk, Iokwa and Bula which have performed exceptionally well in Malaysia, Thailand and China. One-year results of small trials in Sabah show that the new provenances of *A. auriculiformis* from Papua New Guinea are taller than *A. mangium* of local seed source on shallow rocky soils. It is also noted that the Papua New Guinea provenances of *A. auriculiformis* tend to have better stem form than the local land races.

333

Turnbull, J.W. (1987b).
***Acacia auriculiformis* - the adaptable tropical wattle.**
NFT Highlights. Nitrogen Fixing Tree Association, Waimanalo, Hawaii, 2 pp.

Acacia auriculiformis is briefly described in regard to its botanical, ecological and utilisation aspects. A special feature of the species is its ability to grow on very harsh sites where a number of other species fail. It grows rapidly even on infertile sites, and tolerates both highly acidic and alkaline soils.

334

Turnbull, J.W. (1988).
Australian acacias in world forestry.
Paper, Bicentennial Forestry Conference held in Albury, NSW, Australia, 25 April-1 May 1988, 15 pp.

This paper reviews the use of Australian acacias in Australia and in other countries and draws attention to the exploration of the gene resources of Australian acacias. Information on some of the most recent trials in tropical countries in also provided.

Acacia auriculiformis has been planted in Asia for more than 50 years, principally for ornamental purposes, fuelwood or to revegetate denuded land following mining activities. The tree in China is said to be a host for lac insect, and edible fungi are grown on its wood. Most plantations of this acacia are in India and China where it has the ability to thrive on laterites and impoverished, often poorly drained, sites. However, its crooked stem and heavy branching habit which have typified most planted trees in Asia appear to bo the major factor preventing wider utilisation of the species.

Some early results from trial plots in Malaysia, Thailand and China are discussed. The species has shown an early faster growth rate when compared with local collected seed, particularly on unfavourable sites.

335

Turnbull, J.W. (1989).
Australian trees for reforestation of wastelands.
P 53-64 *in* proceedings of an FAO regional workshop on wasteland development for fuelwood and other rural needs held in Vadodara, Gujarat, India, November 1988.

The paper discusses some of the characteristics of Australian trees and shrubs which make them suitable for wasteland reforestation, and refers to results from recent field and laboratory studies with Australian species. The characteristics discussed include salt tolerance, nitrogen fixing, tolerance of infertile soils and tolerance of acid soils. *Acacia auriculiformis* is one of many Australian species known to possess all these characteristics.

336

Turnbull, J.W., Skelton, D.J., Subgyono, M. and Hardiyanto, E.B. (1983).
Seed collection of tropical acacias in Indonesia, Papua New guinea and Australia.
Forest Genetic Resources Information, FAO, (No 12): 2-15.

The article reports FAO-supported seed collections of tropical *Acacia* species in Indonesia, Papua New Guinea and northern Australia. Distribution, ecology and utilisation of 8 acacias in these countries are described followed by detailed information on flowering, fruiting and seed collection techniques. It is stressed that seed collections in Western Province of Papua New Guinea is time-consuming and difficult to organise as land transport is very limited.

In Papua New Guinea, acacias flower between April to July. *Acacia auriculiformis* flowers later than *A. mangium*, *A. crassicarpa* and *A. aulacocarpa*. Seed ripens towards the end of September, *A. mangium* first followed by *A. auriculiformis* and others. Fruit ripening occurs shortly after pods turn from green to brown, and pods then open within two days. It is suggested that seed collection in the Morehead area must take place between the last week of September and the last week of October. At the Oriomo River it can be one or two weeks later.

In northern Australia, fruits of *A. auriculiformis* mature in October to

November and seed remains on the trees until December or January.

The difficulty of seed collection in Papua New Guinea is clearly demonstrated. *Ex situ* seed production and gene conservation should be considered for those species proved to be important reforestation species such as *A. auriculiformis* and *A. mangium*.

337

Ugalde, L.A. (1983).
Initial growth and survival of *Acacia auriculiformis*, *Albizia falcataria*, *Calliandra calothyrsus*, *Leucaena leucocephala* and *Sesbania grandiflora* at two sites in Costa Rica.
Centro Agronomico Tropical de Investigacion y Ensenanza, Catie.
Departmento de Recursos Naturales Renovables, Turrialba, Costa Rica. (Es)

Species trials were established at two sites in Costa Rica, at San Carlos: latitude 10°21'N, longitude 84°32'E, altitude 160 m, annual rainfall 2,900 mm and mean temperature 26°C, and at San Isidro: latitude 9°22'N, longitude 83°42'E, altitude 700 m, annual rainfall 3,000 mm and mean temperature 23°C. Soil at San Carlos is sandy and has better drainage than at San Isidro which has a heavy clay.

Four leguminous species (*Acacia auriculiformis*, *Albizia falcataria*, *Calliandra calothyrsus* and *Leucaena leucocephala*) were tested. Height and survival data measured at 6, 12 and 24 months after planting are tabulated for these species. The data obtained at 24 months are summarised as follows:

Species	San Carlos		San Isidro	
	Height (m)	Survival (%)	Height (m)	Survival (%)
A. auriculiformis	5.3	58	1.4	65
A. falcataria	5.6	55	0.5	41
C. calothyrsus	4.6	55	0.7	53
L. leucocephala	5.6	80	0.4	57

At San Carlos, all species appear to have satisfactory growth rate, but *L. leucocephala* has the best survival. Growth at San Isidro is notably poorer, and survival of *L. leucocephala* is also lower. It is concluded that the poorer growth at San Isidro is due to the poor drainage (heavy clay) of the soil and probably to lower temperatures at the higher altitude.

Of special note is the performance of *A. auriculiformis* at both trial sites. At San Carlos, the species tended to grow slower than other species in the first 12 months but after 24 months its height growth is close to the tallest species (*L. leucocephala*). At San Isidro, only *A. auriculiformis* has continued to grow in height after 12 months and the other species suffered high mortality, especially *L. leucocephala*.

The performance of *A. auriculiformis* at two different sites in Costa Rica is more evidence indicating its wide adaptability to site conditions. Under favourable conditions, *Leucaena leucocephala* and *Albizia falcataria* are generally found to grow faster than *A. auriculiformis*. When growing conditions become more adverse, *A. auriculiformis* will exhibit better relative performance.

338

Venkataramany, P. (1963).
The silviculture of Indian trees No. 21.
Government of India Press, Nasik, p 3-4.

The article describes *Acacia auriculiformis* in respect of growth habit, morphology, site factors, silvicultural characters, artificial reproduction, afforestation, rate of growth and utilisation. The species is reported to be suitable for introduction to India at low elevations up to 400 m, low to moderate rainfall, and impoverished soils.

339

Vercoe, T.K. (1989).
Fodder value of selected Australian tree and shrub species.
P 187-192 *in* Trees for the tropics - growing Australian multipurpose trees and shrubs in developing countries (ed Boland, D.J.), ACIAR Monograph No. 10.

Foliage from 39 Australian tree and shrub species cultivated in field trials near Gympie in Queensland, Australia, was analysed for dry matter digestibility (DMD), protein content (estimated from N content), phosphorus, potassium, sodium, calcium, magnesium, copper, zinc and manganese concentrations. Twenty-five species including *Acacia auriculiformis* are recommended for further investigation. The following data were recorded for *A. auriculiformis* from three different sources.

	Springvale Qld	Oenpelli NT	Iokwa PNG
Predicted in vitro DMD (%)	33.5	34.9	36.9
Crude protein (%)	13.8	14.0	16.2
P (%)	0.11	0.06	0.09
K (%)	0.72	0.45	0.62
Na (%)	0.30	0.49	0.54
Ca (%)	0.77	0.52	0.59
Mg (%)	0.20	0.24	0.18
Ca/P ratio	7.00	8.67	6.56
Cu (ppm)	3.80	4.40	1.90
Zn (ppm)	32.0	31.0	25.0
Mn (ppm)	50.0	53.0	29.0

340

Verdcourt, B. (1979).
A manual of New Guinea legumes.
Bulletin No. 11, Office of Forests, Division of Botany, Lae, Papua New Guinea. 645 pp.

Provides keys to identify members of three subfamilies, Mimosoideae, Caesalpinioideae and Papilionoideae of family Leguminosae in New Guinea. 14 acacias including *A. auriculiformis* belong to the subfamily Mimosoideae. The following is the key given for identifying *A. auriculiformis* which appears on page 161-162.

1. Leaves reduced to apparently simple leaves which are actually phyllodes (modified petioles)
2. Flowers in panicles of spikes
3. Branchlets slender, not or less angular; secondary nerves of phyllodes not anatomosing or only slightly so or if forming a fine reticulum then fruits neither linear nor turgid
4. Fruits 1.3 cm or more wide with transverse seed, often transversely veins with wavy margins
5. Secondary nerves at least occasionally anatomosing; fruits with undulate margins, up to 1.5 cm wide

341

Verhoef, L. (1943).
Root studies in the tropics. VI. Further data about the oxygen requirements of the root system.
Korte Meded. B.P.S. 81, 1-65. (Nl, en)

In a study in Indonesia, *Acacia auriculiformis* is found to be quite tolerant to oxygen deficiency, being able to survive for about 75 days. It is concluded that species from the lowlands have a higher resistance to oxygen deficiency than those from the mountains.

342

Vietmeyer, N. (1979).
Tropical tree legumes : a front line against deforestation.
CERES 12(5), 38-41, FAO, Rome, Italy.

Experience of growing *Acacia auriculiformis* in Australia, Malaysia and Indonesia is discussed.

343

Vimal, O.P. and Tyagi, P.D. (1986).
Fuelwood from wastelands.
Yatan Publications, New Delhi, India, 316 pp.

Acacia auriculiformis is among several species considered to be suitable for energy plantation on wastelands in India. The wastelands where *A. auriculiformis* is recommended include saline and alkaline areas, waterlogged areas and coastal regions. Factors contributing to the development of these areas are discussed.

Also presented in appendices are information on a range of characteristics of the recommended species i.e. chemical composition of wood and bark, oils and waxes, and gum. The following is given for *A. auriculiformis*.

Chemical compositions of wood (%)	
Cellulose	59.17
Lignin	23.61
Pentosan	18.70
Ash	0.41

Chemical compositions of bark (%)	
Tannins	12.16
Non-tannins	2.3

Physio-chemical characteristics of fatty oils	
Part	seed
Yield (%)	26
Refractive index	1.47
Acid value	0.4
Iodine value	62
Saponification value	105

Physio-chemical characteristics and composition of bark gum	
Nitrogen	0.92
Equivalent weight	633
Viscosity	25
Glucuronic acid (%)	17.6
D-Galactose (%)	59
L-Arabinose (%)	8
L-Rhamnose (%)	5

Seed gum	
Water soluble mucilage (%)	6.0
Protein in mucilage (%)	29.6

344

Visaratana, T. (1989).
Biomass studies in Thailand.
ACIAR Forestry Newsletter No. 8. Australian Centre For International Agricultural Research.

A brief account of results of biomass measurements of 3-year-old trees of selected species at three ACIAR field trials in Thailand. On sites where soil moisture is not limiting, *Acacia auriculiformis* from Balamuk, Papua New Guinea produced an above-ground biomass up to 135 t/ha while the same material produced only 40 t/ha at drier site. On drier sites, *Eucalyptus camaldulensis* appeared to do better than *A. auriculiformis* and *A. crassicarpa* but the reverse is true on a wetter site.

345

Visaratana, T. and Puriyakorn, B. (1988).
Coppicing experiments using 3-year old plantation trees of *Acacia auriculiformis* A. Cunn. ex Benth. at two sites in Thailand.
Paper, ACIAR/CAF workshop on "Use of Australian trees in China", Guangzhou, China, 2-11 October 1988.

Report on coppicing experiments conducted at two sites in Thailand on 3-year-old plantation trees of *Acacia auriculiformis*. Trees were cut by hand-saw in a horizontal fashion at 0.1, 0.5 and 1.0 m above ground level with all side branches removed. A fourth treatment consisted of a cut at 1.0 m with the proviso that one live branch was left. In general, the species can coppice at all cutting heights but numbers of coppice shoots and number of stumps coppicing (hence survival) was greater in the higher than in the lower stump heights.

The number of coppice sprouts was highest between 2 to 4 months after cutting. After this period sprouts tended to die off leaving fewer more sturdy shoots. The trend was even more pronounced for those stumps cut at 1 m with one live branch which suffered more losses of the coppice sprouts. The length of coppice shoots was longer when stump height was higher (1 m) compared with shoot lengths from low stumps (0.1 m).

There was a strong suggestion that stump diameters greater than 11.5 cm tended to inhibit coppice shoot production although the cause for this is not known.

346

Voogd, C.N.A. de. (1948).
The Janlappa forest plantations.
Tectona 38, 63-76. (Nl)

Describes the difficulties in revegetating land eroded by shifting cultivation in the Janlappa forest reserve in West Java. The planting area received high rainfall (2,000 mm) but was P deficient and heavily covered with *Imperata cylindrica* grass. Only a few species performed well e.g. *Schima banacana*, *Fagraea fragrans* and *Swietenia macrophylla*. *Acacia auriculiformis* and *Cassia multijuga* were sown between rows in new plantations in 1939, and were found to suppress *Imperata cylindrica*.

347

Voss, R.L., Priasukmana,S., Tangketasik, J. and Leppe, D. (1987).
***Acacia mangium* in Kalimantan Timur, Indonesia.**
Nitrogen Fixing Tree Research Reports 5, 22-25.

Acacia mangium is said to have been introduced to Kalimantan Timur in the early 1940s. Poor tree form, i.e. heavy branching and crooked stem, is the major concern of planting the species, and it is believed that the poor form may have caused by the crossing with *A. auriculiformis* although there are not many trees of *A. auriculiformis* in the area.

348

Wardi. (1955).
Work plan of Forest Industry Planning Division.
Rimba Indonesia 4, 360-366. (In)

In the early 1950s *Acacia auriculiformis* was one of the many species recommended for plantation establishment to meet the industrial wood demand in Indonesia.

349

Wasuwanich, P. (1989).
Phenological investigation of Australian tree species in field trials in Thailand.
Report to the Australian International Development Assistance Bureau.

Australian Tree Seed Centre, CSIRO, Canberra.

Reports on phenological characteristics of Australian tree species planted under field trials during 1985 and 1986 in Thailand. The characteristics reported cover shoot growth, flowering, fruiting and seeding of which data were collected from a total of 140 seedlots from 97 species.

Four provenances (two each from Australia and Papua New Guinea) of *Acacia auriculiformis* were planted at two to six sites. Shoot elongation was active throughout the year for all seedlots at all sites. The age of first flowering varied considerably with planting sites and with seed sources. Most seedlots had first flowering at 18-20 months old (from germination). One seedlot from Iokwa, Papua New Guinea was notably late in flowering, it did not flower until 46 months old. The flowering period was generally from July to January.

350

Webb, D.B., Wood, P.J., Smith, J.P. and Henman, G.S. (1984).
A guide to species selection for tropical and sub-tropical plantations.
Tropical Forestry Papers No. 15 (2nd edition, revised), Commonwealth Forestry Institute, University of Oxford, 256 pp.

The guide aims to assist foresters in the selection of species for inclusion in initial species trials. Species characteristics are presented in the form of data sheets for each species on the species' natural occurrence, climatic and edaphic preferences, silvicultural characteristics, production potential, wood properties and uses, seed supply and nursery requirements. Some environmental preferences suggested for *Acacia auriculiformis* are:

Climate:

Altitudinal range	0-500 m
Mean annual rainfall	1300-1700 mm
Rainfall regime	Summer
Dry season	4-6 months
Mean maximum temperature -hottest month	28-34 °C
Mean minimum temperature -coldest month	20-24 °C
Mean annual temperature	24-29 °C

Soils:

Texture	Light/medium/heavy
Reaction	Alkaline/neutral/acid
Drainage	Seasonally waterlogged
Other characteristics	Tolerate shallow soils and is adaptable to most soil conditions

It is evident, as shown in other references, that *A. auriculiformis* can grow satisfactorily in areas having annual rainfall much lower and higher than the range suggested in the guide. The temperature range can also be extended especially the mean maximum temperature range (i.e. up to 38°C).

351

Wepf, W. (1954).
Teak cultivation on Java.
Rimba Indonesia 3, 378-416. (Nl & In)

Acacia auriculiformis and *Eucalyptus* species are recommended for planting in areas where soil is too poor for teak.

352

Westwood, S. (1987).
The optimum growing period in the nursery for six important tree species in lowland Nepal.
Banko Janakari 1(1), 5-12.

It is suggested that seedlings of *Acacia auriculiformis* be grown in nursery for 14 weeks from sowing before transplanting in the field. Container (pot) size should be 7.5x18 cm.

353

Wiersum, K.F. (1976).
Results *Acacia auriculiformis* and *Eucalyptus alba* measurements.
Upper Solo Watershed Management and Upland Development Project, 4 pp. (unpublished)

Data are presented for growth and volume production of *Acacia auriculiformis* measured in various plantations grown on sites affected by soil erosion in Indonesia.

Location	Age (y)	No.trees per ha	Height (m)	Diameter (cm)	Volume (m^3/ha)
Tangen (grumosol soil)	13	405	14.0	19.2	74.5
Wonogiri (latosol soil)	13	1690	16.6	13.8	226.6
Purwosari (eroded latosol)	7	750	12.2	13.4	67.1
Jatisobo (eroded & non-eroded latosol)	4	570	9.8	11.3	25.4

The lower production at Tangen reflects the adverse site condition (i.e. grumosol, erosion) and the low stocking rate. The effect of erosion was clearly demonstrated at Jatisobo, erosion was estimated at about 1 cm/year. Purwosari was also heavily eroded, and no vegetation other than *A. auriculiformis* was growing. Although the soil was partly covered by litter of *A. auriculiformis*, erosion is still continuing.

Eucalyptus alba is reported to be a much poorer performer than *A. auriculiformis* particularly in adverse site conditions.

354

Wiersum, K.F. and Ramlan, A. (1982).
Cultivation of *Acacia auriculiformis* on Java, Indonesia.
Commonwealth Forestry Review 61(2), 135-144.

Acacia auriculiformis has been cultivated since the early 1930s on Java primarily for fuelwood production and for environmental management such as control of *Imperata* grass and erosion as well as for roadside planting. During the early plantings the species was used mainly as a cover-crop but it was found later that it could be used as a main species especially on poor soils for fuelwood production. Indonesian experience with *A. auriculiformis* in respect of establishment and management is discussed in this article.

355

Williams, E.R. and Luangviriyasaeng, V. (1989).
Statistical analysis of tree species trials and Seedlot:site interaction in Thailand.
P 145-152 *in* Trees for the tropics - growing Australian multipurpose trees and shrubs in developing countries (ed Boland, D.J.), ACIAR Monograph No. 10.

Describes statistical analysis of a series of ACIAR species trials in Thailand using height data from 24-month measure. Various aspects of the analysis are discussed including the preprocessing of individual tree data, analysis of variance for separate trials and a model for combination of information over several trials. Genotype x environment interaction was investigated and different species were found to behave differently. In particular, *Eucalyptus camaldulensis* had the best overall height growth and was fairly stable across sites. On the other hand *Acacia crassicarpa*, whilst exhibiting good growth across sites, tended to do particularly well at the good sites, and is considered to be an unstable species. *A. auriculiformis* is less stable when compared with *E. camaldulensis* but it is more stable than *A. crassicarpa*.

356

Wirjodarmadjo, H. and Wiroatmodjo, P. (1983a).
A method to construct volume, biomass and energy tree table.
P 125-134 *in* Mesures des biomasses et des accroissements forestiers. Orleans, 3-7 October 1983.

Using a 14-year-old plantation to estimate biomass and energy produced by individual trees of *Acacia auriculiformis*, it was found that total biomass, total energy, biomass and energy of woody parts can be estimated based on breast height diameter with or without the total tree height involved. However, biomass and energy of leaves could not be predicted accurately based on tree diameter only but based on tree diameter and tree height.

357

Wirjodarmodjo, H. and Wiroatmodjo, P. (1983b).
Experience on growing mini-rotation woody species in Java.
P 283-284 *in* Mesures des biomasses et des accrissements forestiers. Orleans, 3-7 October 1983.

Growing short-rotation wood species to meet the high demand for fuelwood is important in Java which is the most densely populated island in Indonesia. *Acacia auriculiformis* and *Leucaena leucocephala* and a few other

leguminous species were found to be suitable in that these species suppress *Imperata cylindrica* and produce good quality fuelwood.

358

Wiroatmojo, R.S. (1952).
Wood species for industry in East-Java (summary).
Rimba Indonesia 1, 197-213. (In, en)

Acacia auriculiformis is recommended for planting on sites which were not suitable for teak on East Java. The choice of the species was due mainly to the wide adaptability to many site types and production of wood suitable for many industrial uses.

359

Wong, W.C. and Razali, A.K. (1982).
Use of wood as fuel in Peninsula Malaysia.
P 229-238 *in* Tropical forests: source of energy through optimisation and diversification (eds Srivastava, P.B.L. *et al.*), Penerbit Universiti Pertanian Malaysia.

Due to the increasing demand for fuelwood for industrial and domestic uses, charcoals produced from species other than local ones have been tried. *Acacia auriculiformis* charcoals are found to meet the specifications for iron-making industries as well as for domestic use.

360

Xu Yanqian and Hu Yingjiang (1982).
A study on the silviculture and utilisation of *Acacia auriculiformis*.
Tropical Forestry (Science and Technology) 1, 21-30. (Ch)

The paper reports results obtained from various planting trials of *Acacia auriculiformis* in the sub-tropical region of south China. Potential uses of the species include timber, firewood, fodder and soil improvement.

The authors noted that two forms of the trees could be distinguished. The first has smooth bark and straight stem. The second has rough bark and stem is generally crooked.

Young trees of *A. auriculiformis* normally have a rather smooth and white (greyish) bark which becomes rough and fissured with age. The two distinct forms of *A. auriculiformis* as noted by the authors bring about some doubts whether hybridisation (with *A. mangium* ?) has existed in China or the trees reportedly observed have been misidentified.

361

Yang Minquan, Bai Jiayu and Zeng Yutian. (1989).
Tropical Australian acacia trials on Hainan Island, People's Republic of China.
P 89-96 *in* Trees for the tropics - growing Australian multipurpose trees and shrubs in developing countries (ed Boland, D.J.), ACIAR Monograph No. 10.

Acacia auriculiformis is one of nine *Acacia* species in a series of *Acacia* species/provenance trials on Hainan Island, China. Newly-introduced provenances from Papua New Guinea and Australia particularly those provenances from Papua New Guinea (i.e. Iokwa and Balamuk) are found to grow faster than local seedlots. One provenance from Queensland, Australia (i.e. Springvale) is noted for its fine form with most trees having single stem.

The Springvale provenance from Queensland, Australia has also been found

to produce single-stemmed trees with good form in ACIAR species trials and provenance trials of this acacia in Thailand. Further seed collection of this provenance is warranted.

362

Yantasath, K. (1987).
Field trials of fast-growing, nitrogen fixing trees in Thailand.
P 176-179 *in* Australian acacias in developing countries: proceedings of an international workshop held at the Forestry Training Centre, Gympie, Queensland, Australia, 4-7 August 1986 (ed Turnbull, J.W.), ACIAR Proceedings No. 16.

A variety of trials on 18 nitrogen fixing tree species were planted at two sites in Thailand viz. Chan Thuk (northeast) and Chumphon (south). Three years after planting, *Acacia auriculiformis* was found to have good prospects for reforestation, pulpwood production, and commercial-scale cultivation to produce wood for furniture, plywood, structural timber, firewood and charcoal.

The trial at Chun Thuk was damaged by floods and it was observed that *Acacia auriculiformis* survived over 6 months of permanent waterlogging

363

Yantasath, K. (1988).
The role of nitrogen-fixing trees as MPTS for small farms.
P 122-123 *in* Multipurpose tree species for small-farm use: proceeding of an international workshop held November 2-5, 1987 in Pattaya, Thailand, (eds Withington, D., MacDicken, K.G., Sastry, C.B. and Adams, N.R.).

Research on multipurpose tree species conducted by Thailand Institute of Scientific and Technological Research reveals that *Acacia auriculiformis* has adapted well in both acidic and non-acidic soils and has great potential for fuelwood, charcoal, and other wood uses. The species should be planted densely as single or mixed stands or intercropped with agricultural crops in multipurpose planting on small farms.

364

Yantasath, K., Supatanakul, W., Ungvichien, I, Chamsawad, S., Chantrasiri, S., Patanavibul, S., Hyakitkosol, C., Prompetchara, S., Pithakarnop, N. and Chalermklin, P. (1985).
I. Species trials of NFT, II. Spacing trials of NFT, III. Distribution of biomass production of NFT using allometric regression equation, IV. Tissue analysis and heating parameters of NFT, V. Pulping and paper-making characteristics of fast growing trees.
Nitrogen Fixing Tree Research Reports 3, 48-56.

This is an early report of results up to 24 months of the trials of 18 NFT species including *Acacia auriculiformis* presented in Yantasath (1987). Data are presented in figures and tables for a variety of characteristics. Results obtained for *Acacia auriculiformis* are more or less the same as described earlier.

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Yap, S.K. (1987).
Introduction of *Acacia* species to Peninsular Malaysia.
P 151-153 *in* Australian acacias in developing countries: proceedings of an international workshop held at the Forestry Training Centre, Gympie, Queensland,

Australia, 4-7 August 1986 (ed Turnbull, J.W.), ACIAR Proceedings No. 16.

Acacia auriculiformis was first introduced to Malaysia for boundary markers in plantation plots of the Forest Research Institute in 1932. It was found later that the species is suitable for rehabilitation of tin tailings and *Imperata* affected areas. The drawback of the species is the crooked stem which makes it unsuitable for timber production. Young seedlings cannot tolerate drought conditions.

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Zheng Haishui. 1988.
The role of *Eucalyptus* plantations in southern China.
P 70-85 *in* Multipurpose tree species for small-farm use. Proceedings of an international workshop held 2-5 November 1987 in Pattaya, Thailand. (eds Withington, D., MacDicken, K.G., Sastry, C.B. and Adams, N.R).

In southern China, some problems with declining soil fertility and plantation yields are believed to be due to the long and continuous cultivation of *Eucalyptus* species. Mixed-plantings of eucalypt and *Acacia auriculiformis* have been trialed as an effort to improve the soil fertility.

Three years after planting, *Eucalyptus exserta* mixed with *A. auriculiformis* grows faster than when it is planted as monoculture. Mean height and dbh of the trees in the mixture are 6.14 m and 3.71 cm respectively compared to 5.60 m and 3.25 cm respectively of the monoculture trees. The biomass of mixed forests are 16% higher than that of pure stands. Further more, litter under mixed forests is 50-85% higher than under pure *Eucalyptus* stand. The top soil in mixed forests begins changing colour and its humus increases.

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Zheng Haishui, Lai Hanxing, He Kejun and Cai Mantang (1989).
A study on silviculture techniques of fast growing fuelwood crops in tropical China.
Nitrogen Fixing Tree Research Reports 7, 25-27.

Reports an experiment on growing trees for fuelwood under poor soils on Hainan Island, latitude 19°13'N, longitude 110°27'E, altitude 120 m, annual rainfall 2000 m. Soil is over-exploited, eroded yellow laterite of sandy shale parent material which is low in fertility having pH 4.9. *Acacia auriculiformis* is compared with *Eucalyptus exserta* under four different spacings (1x1, 1x1.5, 1.5x1.5 and 1.5x2 m). Fifty grams of P fertiliser was applied to each seedling at time of planting and another 40 g P and 25 g N in the second year. Growth of *A. auriculiformis* was approximately 2 to 3 times greater than that of eucalypt. *Acacia auriculiformis* appears to grow faster at medium spacings (1x1.5 and 1.5x1.5 m) than at the narrowest (1x1 m) or the widest (1.5x2 m) spacing. Total volume production and hence biomass produced is however greater the narrower the spacing due to more trees in closer-spaced plots.

Trees of *A. auriculiformis* were cut at 3 years old at 0.3, 0.5 and 1.0 m above ground, and it was found that the rate of coppice increased with stump height from about 80% to 100%.

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Zhou Xiangquan and Han Sufeng. (1987). **A preliminary study on the taxonomic position of root nodule bacteria from tree legumes.** Nitrogen Fixing Tree Research reports 5, 1-4.

The strain of *Rhizobium* isolated from *Acacia auriculiformis* is polar or subpolar flagellated and a slow-grower which never forms a serum zone in litmus milk. Similar organisms are associated with *Samanea saman*, *Dalbergia odorifera* and *Albizia chinensis*.

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References in this bibliography are classified according to the Oxford System of Decimal Classification for Forestry (ODC). The references are numbered sequentially in alphabetical order under the senior author's name. The ODC numbers are given based on the significant information relating to *Acacia auriculiformis* which contains in the references. Many references are classified under more than one subject.