

**TECHNICAL INFORMATION**  
**ON**  
**TROPICAL FORESTS**  
**I**

August, 1991

JAPAN INTERNATIONAL COOPERATION AGENCY  
( J I C A )



FDD
JR
91-28



JICA LIBRARY



1094424(7)

23057



**TECHNICAL INFORMATION**  
**ON**  
**TROPICAL FORESTS**

**I**

August, 1991

JAPAN INTERNATIONAL COOPERATION AGENCY

( J I C A )

国際協力事業団

23057

## CONTENTS

1.	Forest Environment . . . . .	1
	– climate, ecology, forest resources, etc. –	
2.	Silviculture . . . . .	12
1)	Choice of Species . . . . .	12
	– trials of species, provenance trial, etc. –	
2)	Seed (for Propagation) . . . . .	15
3)	Nursery Practice . . . . .	24
4)	Plantation Establishment . . . . .	38
	– site preparation, planting, coppice, direct seeding, mycorrhiza, enrichment planting, soil, etc. –	
5)	Tending . . . . .	58
	– weeding, pruning, thinning, fertilizing etc. –	
6)	Tree Breeding . . . . .	64
3.	Forest Damage and Protection . . . . .	67
1)	Forest Fire . . . . .	67
2)	Pests and Diseases . . . . .	68
4.	Forest Mensuration and Management . . . . .	73
1)	Growth, Increment of Trees and Stands . . . . .	73
2)	Harvesting . . . . .	81
3)	Forest Management . . . . .	85
5.	Forest Conservation . . . . .	88
1)	Watershed Management . . . . .	88
2)	Soil Conservation . . . . .	92
6.	Forest Products . . . . .	97
1)	Timber . . . . .	97
2)	Non-timber Products . . . . .	100
7.	Social Forestry . . . . .	105
8.	Others . . . . .	107

## APPENDIX LIST OF INFORMATION RESOURCES





## READERS' GUIDE

1. Geographic coverage of information.

This paper covers mainly Malaysia, Brunei Darussalam and Indonesia in the Asian Region.

2. Titles.

Titles are given in the original language if English is used. Japanese is given in English translation for whole publication.

3. What an abstract contains.

<sup>1)</sup>Sofwan Bustomi & Komar Soemarna

<sup>2)</sup>Regeneration and standing stock study on logged over area in Laban forst complex, Forest District of Berau, East Kalimantan

<sup>3)</sup>Buletin Penelitian Hutan (Forst Research Bulletin), Indonesia

<sup>4)</sup>No. 479, <sup>5)</sup>1-16, <sup>6)</sup>1986, <sup>7)</sup>Indonesian

<sup>8)</sup>The system linear sampling with several sampling intensity have been tried as the initial study on natural regeneration and standing stock on logged-over areas at the Forest District of Berau, West Kalimantan.

The recording units were used as a line plot with 5 m width for saplings, 10 m for poles and continuous strips unit of 20 m width for standing stock of the remain stand. All tree species are grouped into commercial species that consist of Dipterocarps and non-Dipterocarps, non commercial and the total of all species.

Key words: Natural regeneration, logged-over area, Forest type, Stand condition

1) Author

2) Title

3) Journal/Book title

4) Volume

5) Page numbers

6) Year of publication

7) Language of text

8) Abstract



## 1. Forest Environment

– climate, ecology, forest resources, etc. –

Sustriayu Nalim, Widiarti & Hohammad Sudomo

The effects of mangrove forest opening on the increase of malaria cases in Indonesia  
Ekosistem Mangrove (Prosiding Seminar III), Indonesia, 174–178, 1987,  
Indonesian

In the years that have passed, malaria outbreaks at coastal towns were frequently reported. These outbreaks were generally correlated to the vast increase of the malaria vector, *Anopheles sundaicus*. The larvae of this malaria mosquito inhabit the brackish water ditches and pools in the coastal areas.

The opening of mangrove land for other purposes usually gives rise to the increase of brackish water pools. Algal growth that subsequently develops in the pools is a good hiding place for the *Anopheles* larvae. The chance of a malaria outbreak increases.

This paper discusses the typical characteristics of *A. sundaicus* breeding sites, particularly the ones closely associated with settlement surroundings. On the basis of such an understanding, appropriate measures for preventing the formation of such breeding places could be planned.

Key words: Ecosystem, Mangrove, Felling

Soeroyo

Structure and litter fall of mangrove forest in Kembang Kuning, Cilacap  
Ekosistem Mangrove (Prosiding Seminar III), Indonesia, 110–114, 1987,  
Indonesian

Mangrove forest is an ecosystem capable of producing high amount of organic matter. Most of the organic particles in water come from mangrove trees especially the leaves. Organic matter plays a very important role in the productivity of estuarine water.

A study on the litter fall of mangrove forest in Kembang Kuning, Cilacap, has been carried out from September to November 1984. In this area the dominant tree species that have important value of more than 50% were *Aegiceras comiculatum* (126.84%) and *Rhizophora mucronata* (96.66%). The litter fall of these trees was also the highest. With a density of 17,008 trees/ha and a basal area of 12.21 m<sup>2</sup>/ha the litter production was 2.12 gram dry weight/m<sup>2</sup>/day or about 7.75 ton dry weight/ha/year.

Key words: Mangrove, Litter, Ecosystem

D. Sapulete, Soetomo, S. Prawiroatmodjo et al.

Structure and composition of mangrove communities around Sorong,  
Irian Jaya

Ekosistem Mangrove (Prosiding Seminar III), Indonesia, 80-85, 1987,  
Indonesian

Study on the structure and composition of mangrove communities on the coastal area of Ombre Island, off Sorong, recorded 25 species of mangrove and terrestrial plants. Among these the dominant species were: *Rhizophora apiculata*, *Bruguiera gymnorrhiza*, *Ceriops tagal* and *Lumnitzera littorea*. Tree density ranged from 169 to 368 trees per hectare with basal area of 7.57-36 m<sup>2</sup> per hectare. Saplings consisted of 2,474-4,456 plants per hectare with basal area of 5.38-5.91 m<sup>2</sup> per hectare. Seedling density were 3,400 - 33,637 per hectare. Some other ecological aspects such as zonation, structure vs forest type and their relationship to ecological factors are also discussed in this report.

Key words: Ecosystem, Tree density, Mangrove

Triwasono

Conversion of swamplands into productive lands and its impacts on mangrove

Ekosistem Mangrove (Prosiding Seminar III), Indonesia, 55-62, 1987,  
Indonesian

More lands are needed for agricultural expansion due to the rapid growth of the Indonesian population and the increasing of the existing agricultural lands into other uses. Extensification program in agriculture carried out both in upland and swampland areas either tidal swamplands or non tidal ones. These are about 39,424,500 ha of swamplands in Indonesia, but only 5,600,000 ha are suitable for agriculture. A total of 671,200 of tidal swamplands have been reclaimed for agriculture since 1964 to 1984, especially in Sumatra and Kalimantan. Mangrove area is considered unsuitable for agriculture, therefore, only little impacts of tidal land reclamation arises on the mangrove ecosystem.

Key words: Land-use, Mangrove, Forest utilization

A. Darsidi

Mangrove forest utilization in Indonesia

Ekosistem Mangrove (Prosiding Seminar III), Indonesia, 27-38, 1987,  
Indonesian

The mangrove forest, which has a total extent of 4.2 million ha. has a great potential to be utilized by several sectors of development. About 20.6% or 877,000 ha has been given out as forest concessions. The average standing stock consists of *Rhizophora* spp. 40.7 m<sup>3</sup>/ha, *Bruguiera* spp. 13.6 m<sup>3</sup>/ha, *Avicennia* spp. 11.6 m<sup>3</sup>/ha and *Sonneratia* spp. 7.6 m<sup>3</sup>/ha.

Some of the mangrove forests have been converted into agricultural land, settlement and fish ponds. About 369,000 ha has been planned for fish ponds. A total area of 571,000 ha, especially in Irian Jaya and East Kalimantan, has been put aside as conservation forest.

For the optimal utilization of the mangrove forest the following are suggested:

- 1) to establish a forest landuse plan for mangrove forest;
- 2) to reevaluate the location of the fish ponds;

- 3) to rehabilitate or regenerate the mangrove forest in some critical areas, especially near the densely populated settlement centers;
- 4) to define a rational method of assigning a mangrove forest green belt based on the Ciloto formula;
- 5) to form an Inter-Departmental Team to deal with problems related to mangrove forest.

Key words: Forest management plan, Protection forest, Mangrove

I. Soerianegara

Approaches to determine mangrove green belt

Ekosistem Mangrove (Prosiding Seminar III), Indonesia, 38-44,  
1987, Indonesian

Several Decrees and Regulations on the establishment of mangrove green belt have been issued. However, some of them are rather contradictory to each other. Moreover, what is meant by a mangrove green belt has not been commonly understood.

This paper discusses several approaches to determine a mangrove green belt. Based on research on the interrelationship between the organic production of mangrove forest and the production of coastal biota, and the relation between the width of the mangrove green belt and the highest tidal range, the following generalized formula has been made:

Width of mangrove green belt (m) = 130 x mean spring tide range

Key words: Protection forest, Mangrove

I. Madf Sandy

Mangrove and its growth

Ekosistem Mangrove (Prosiding Seminar II), Indonesia,  
133-143, 1984, Indonesian

Mangrove does not grow at any shore except when a part of the shore is covered with stagnant water. Stagnant water permits the settling of mud particles upon which mangrove may grow. There are two types of stagnant waters, one is fixed at the shore, the other is the moving type which is influenced by the general pattern of the sea current. Mangrove living in the fixed type of stagnant water will recover after having been cut down for sometime. Mangrove growing in the moving type of stagnant water is susceptible to erosion. On the other hand, mangrove which grows in fixed stagnant water may have to face the danger of extension and accumulation of sediment. These processes will in the end destroy the mangrove.

Key words: Mangrove, Ecosystem

P.S. Haditenojo & Abas Ts

On the management of mangrove forest at Cilacap

Ekosistem Mangrove (Prosiding Seminar II), Indonesia,  
65-73, 1984, Indonesian

Mangrove forest at Cilacap which formerly covered a total area of 22,512.7 ha, now remains approximately 14,000 ha. The remaining forest consists of a damaged forest, young plants and commercially low value species. The need for land for agricultural and settlement purposes, illegal felling, siltation, and pollution of the sea, are recognized as serious problems which cause the degradation of this forest. Beside these problems, limited facilities and manpower as compared to the large area to be managed, make the security measures difficult to implement.

Efforts have been made for rehabilitation through artificial regeneration by planting *Bruguiera gymnorhiza* Lmk. and *Rhizophora mucronata* Lmk. In addition, planting of these species are also done by local people through the intensified intercropping tambak system with *Penaeus monodon* and *Chanos chanos*. This system seems to be recommendable to provide employment for the local people. *Rhizophora* seedling which were kept in the nursery before being planted in the field showed better results for the artificial regeneration purposes than those which were planted directly from the parent trees.

Key words: Mangrove, Intercropping, Agro-forestry

Adnan Kasry  
Management of the forest of Rokan River Basin  
Ekosistem Mangrove (Prosiding Seminar II), Indonesia,  
41-49, 1984, Indonesian

The declining fishery product of Bagansiapi-api watershed and its surrounding's is believed to be due to the intensive fishing, fast rate of siltation, oil pollution and destruction of mangrove forest. The fast siltation process steadily reduced the sea of fishing ground. Destruction of mangrove forest coupled with intense trawlings depleted the stock of commercial fish and shrimps.

To gradually restore the productivity, a well formulated planning and management of the forest and land of the Rokan river-basin, as well as that of the mangrove forest along the coast of Bengkalis Regency, should take into account the ecological impact to this water. Coastal fishery resource exploitation should be based not only upon socio-economic consideration but also on conservation principles.

Key words: Ecosystem, Mangrove, Watershed

Amir Husni Mohd. Shariff, Mona Zakaria et al.  
Nutrient dynamics of Tekam Forest Reserve, Peninsula  
Malaysia, under different logging area  
Journal of Tropical Forest Science, FRIM, Malaysia,  
Vol. 2 (1), 71-80, 1989, English

The effects of logging on soil chemical properties under tropical rain forest ecosystem are presented. Using ANOVA, a comparison was made on soil chemical properties. A significant loss of soil nutrients was observed immediately after logging and recovery was encouraging for N and exchangeable K but not for soil pH at the topsoil and subsoil.

Relatively fertile topsoils tended to lose more nutrients than less fertile sites and

recovery was poor especially for exchangeable bases of Ca and Mg. Recovery for mineral N and exchangeable K was encouraging but soil pH deteriorated significantly even one year after logging.

Key words: Logging, Soil texture, Soil fertility, Chemical properties

S. Hardjowigeno

State of knowledge of mangrove soils in Indonesia

Ekosistem Mangrove (Prosiding Seminar III), Indonesia,  
156-163, 1987, Indonesian

The state of knowledge of mangrove soil in Indonesia is discussed based on the studies conducted by mangrove experts and soil scientists. Although mangrove forest in Indonesia covers more than four million hectares, research on mangrove soils are still limited. The existing data indicate that the common characteristics of mangrove soil in Indonesia are fine textured, low ripeness, high salinity and alkalinity, and sometimes contain sulfitic material (cat clay). The clay and silt contents are commonly high, except for those soils found coral islands that contain high sand or coral fragments. Peat layer with high salt contents is sometimes found in mangrove soil either on coral islands or on clay sediments.

From the sea coast to the inland the salinity and alkalinity of the soils decrease, and the cation composition in the absorption complex changes in the following order: Na>Mg>Ca into Mg>Ca>Na and Ca>Mg>Na. The high content of Na in mangrove soils was not significantly followed by an increase of pH, due to various sources of acidity in the soils. Because of the high salinity and to some extent due to the presence of cat clay, mangrove soils are not suitable for agriculture or only marginally suitable. The change of the soil properties from the sea coast to the inland is indicated by the distribution of soil types as follows. Halis Sulfic Hydraqvents, Halic Sulfaquents. Histic Halic sulfaquents, Terric Halic Sulfithemists, Typic Sulfaquents, Terric Sulfihemists, Terric Tropohemists, and Typic Tropohemists.

Key words: Mangrove, Soil survey, Soil type

Seiichi Ohta

Soil of low land dipterocarp forest in East Kalimantan, Indonesia

JICA Project Report (Final Report of a long-term Expert),

Indonesia, 175 pp., 1987/1988, English

The research area of forest site classification is to cover two major research subjects, 1) soil survey and classification, 2) soil productivity.

The research was focused mainly on Acrisols under lowland dipterocarp forest and especially aimed at elucidating the variation in physico-chemical characteristic and level of major nutrients at lower category of soil classification expecting to contribute to understanding regularity of soil distribution in the area, and furthermore to formulating soil mapping unit of lower category which stand up to practical use in forest management operations.

The main research field was set up in Bukit Soeharto Conservation Forest which is one of a few accessible area of lowland dipterocarp forest remaining less disturbed by human

impacts and of variety in topography and geology.

Key words: Soil survey, Soil texture, Soil map

Kaoru Niiyama, Rosli HJ. Jilli & Shigeo Kobayashi  
Classification of under-story vegetation types in the proposed  
plantation area related silviculture planning  
Forest Research Note in Brunei Darussalam, Brunei, No. 7, 13 pp.,  
1986, English

The purpose of this study is to classify the under-storey vegetation and to clarify the relationships between topography, soil and vegetation.

Under-story vegetation is categorized into four types: Dipterocarp seedling or sapling type (D-type), Monocotyledon dominant type (M-type), Fern dominant type (F-type), and nondipterocarp woody species type (N-type).

D-type is mainly distributed on the ridge of the eastern part of the study site. M-type is restricted to the gentle slope and bottom. F-type is randomly distributed on the western part of the study site. N-type is the substrate vegetation of this area.

The relationship between soil type and vegetation type was not clear, however, M-type is usually distributed in Yellow wet soil and F-type is in Yellow dry or moist soil.

Key words: Undergrowth, Soil type

F.S.P. NG C.M. Low & Mat Asri Ngah Sanah  
Endemic trees of the Malay Peninsula  
Research Pamphlet, FRIM, Malaysia, No. 106, 118 pp., 1990, English

The purpose of this book is to provide a handy check list to species of trees and their congeneric relatives which are endemic to the Malay Peninsula from the isthmus of Kra to the island of Singapore.

There are altogether 532 tree-genera in the Malay Peninsula, belonging to 100 families, and embracing a total of 3,395 species. Of these, 2,830 species are trees and the remaining 565 species are climbers, shrubs or herbs. The number of endemic trees totals 746 species which represents 26.4% of the total number of tree-species.

The families with the largest number of tree-species are *Euphorbiaceae* (286), *Rubiaceae* (222) and *Myrtaceae* (204). The genera with the largest number of tree species are *Eugenia* (191), *Diospyros* (70) and *Shorea* (57).

Key words: Ecosystem, Tree species, Native tree species

Paulus Mattus, Yasuyuki Okimori et al.  
Secondary succession and dynamics of tropical lowland  
Dipterocarps forest largely burned  
JICA Project Report (the Tropical Rain Forest Research Project),  
Indonesia, 63 pp., 1987/1988, Indonesian



Forest fire which occurred in 1982/1983 as a result of the long dry season had damaged Bukit Soeharto Education Forest, Mulawarman University. The conditions of forest damage in this research area was temporally classified into three stages: the lightly damaged forest, moderate damaged forest and heavily damaged forest.

Regarding as natural regeneration, young trees, saplings and seedlings at the lightly damaged forest were dominated by the primary species. At the moderate damage forest; the number of young trees and saplings were almost equally consist of both the primary species and pioneer species. But the number of seedlings of the primary species was more than the pioneer species. At the heavily damaged forest, any species of *Dipterocarpaceae* were not seen at all regeneration stages and otherwise the pioneer species was dominant.

Key words: Forest fire, Ecosystem, Natural regeneration, Pioneer species

Sofwan Bustomi & Komar Soemarna  
Regeneration and standing stock study on logged over area in  
Labanan forest complex, Forest District of Berau, East Kalimantan  
Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia,  
No. 479, 1-16, 1986, Indonesian

The systematic linear sampling with several sampling intensity have been tried as the initial study on natural regeneration and standing stock on logged-over areas at the Forest District of Berau, West Kalimantan.

The recording units were used as a line plot with 5 m width for saplings, 10 m for poles and continuous strips unit of 20 m width for standing stock of the remain stand. All tree species are grouped into commercial species that consists of Dipterocarps and non-Dipterocarps, non commercial and the total of all species.

According to number of natural regenerations per hectare with 520 saplings and 705 poles of commercial species, this area is fully stocked, but less evenly scattered over the area with their intensities as low as 40 percent. Consequently, enrichment planting should be carried out in order to get a fully stocked forest stand.

From the point of view of their accuracy, sampling intensities of 5% and 10% for saplings and poles seem to be sufficient for the practices. Whereas for the standing stock of the remain stand, sampling intensity of 20% is adequate.

Key words: Natural regeneration, Logged-over area, Stand condition, Forest type

Paulus Matius & Yasuyuki Okimori  
Secondary succession and dynamics of lowland forest in  
East Kalimantan  
JICA Project Report (Final Report), Indonesia, 86 pp., 1989/90, English

This study has been advanced from the vegetation research in 1987/1988, which has been done on the floristic and structural change of the variously disturbed forest in Bukit Soeharto Protection Forest.

The objectives of this research are:

(1) to comprehend impact of shifting cultivation on tropical lowland dipterocarp forest,

(2) to clarify sequence of secondary succession of tropical lowland dipterocarp forest in a way of monitoring the recovery stages of vegetation and ecological dynamics, and (3) to try to find and advance the reasonable ways in natural and artificial regeneration of the above area.

Key words: Natural regeneration, Ecology, Succession

Susumu Shiraishi et al.

Genecological study on alan

Forest Research Note in Brunei Darussalam, Brunei, No. 51, 16 pp., 1990, English

Alan (*Shorea albida* sym.) is one of the most common forest tree species in Brunei. Alan possesses many desirable characteristics such as a straight bole and good wood qualities and is therefore an economically important tree species. It is widely distributed from the Tutong valley, Brunei, to G. Pueh F.R., W. Sarawak and Sambas. In Brunei, it is confined to peat swamps in the lower area of Sungai Belait and forms gregarious communities.

There are three types, referred to as "Alan Batu", "Alan Bunga" and "Padang Alan" and they differ in morphological characteristics. It is not clear whether these morphological differences have been caused by genetical factors by environmental condition. In order to approach the problem, neutral isozyme genes were used as marker gene in this study.

As the research result, it would appear that these morphological types have been caused by environmental conditions. So it is necessary to study, in detail, the relationships between tree growth and environmental factors.

Key words: Ecology, Land description, Dipterocarps, Heredity

C.H. Hon & L.T. Chim

Major management problems in dipterocarp forest in Sabah

The Malaysian Forester, Malaysia, Vol. 41, No. 2, 201-208, 1978, English

Major management problems in dipterocarp forest in Sabah are identified and classified as:

1. Intrinsic problems:

In Sabah, it has been recorded that flowering was irregular for the past fifty odd years. Different types of dipterocarp forests are not only floristically and climatically different but show different physiological responses in periodicity. Prediction of heavy fruiting in dipterocarp species is not possible. Seedling survival is important in that it ensures an adequate amount of seedlings on the forest floor. There remains the problem of identifying areas which are inadequately stocked before logging.

The dipterocarp forest is basically a tree-dominated community. The trees occupy a wide range of sizes in both diameter and height. The presence of climbers aggravates the situation. It is estimated that there are a total of 300-350 species of climbers in Sabah.

2. Human interference and accessibility problems:

As demand for timber grows, heavy mechanization is necessary. The degree of damage by tractor logging nowadays ranges from 30-50 percent.

During the past few years, the average rate of exploitation in forest reserves alone was

305,000 hectares per annum. At this rapid rate of exploitation, silviculture finds it difficult to catch up with logging. A recently logged area is quickly taken over by vines and creepers such as *Caesalpinia nuga*.

Logging roads are usually poorly designed and bridges constructed on a temporary basis. These quickly deteriorate due to weathering, especially under the hot and wet conditions in a tropical rain forest.

Key words: Dipterocarps, Forest management plan, Ecosystem, Logging operation

Yasuyuki Okimori

Research on regeneration process in secondary forest of tropical rain forest, East Kalimantan

JICA Project Report (Final Report (I)), Indonesia, 209 pp., 1991, English

This report has four research subjects such as 1) Forest regeneration process, 2) Analysis of forest function, 3) Forest type classification and 4) Association of animal.

The contents of this report are follows:

- I. Phenology of lowland dipterocarp forest
- II. Change of vegetation and structure of low land dipterocarp forest after forest fire
- III. Natural treefall concurrently happened in December, 1988 in B. Soeharto Forest
- IV. Regeneration process of secondary forest after swidden cultivation in Barong Tongkok
- V. Structural change of logged over forest
- VI. Natural regeneration of seedlings of *Shorea pauciflora* and *Eusideroxylon zwageri*
- VII. Longevity experiment of dipterocarp tree seeds

Key words: Tropical forests, Succession, Dipterocarps, Secondary forest, Seed viability, Phenology

Paulus Matius & Yasuyuki Okimori

Secondary succession and dynamics of lowland forest largely burned in East Kalimantan

JICA Project Report (The Tropical Rain Forest Research Project), Indonesia, 42 pp., 1989/1990, English

The abandoned place of ex-swidden cultivation at the first was invaded by pioneer species and established in a few years. The sequence of process of floristic replacement from pioneer to climax primary forest is still not yet known well in rain forest. The second research in Mencimai will be hoped to give some answers to the above problems.

It was possible that dipterocarps trees were established and grew well at the ex-swidden cultivation place. The important thing was existence of mother trees near the cultivated place.

The floristic tends to change during 75 years after swidden cultivation from pioneer to primary species, but the size of most trees not yet reach a climax forest.

Durian garden forest will also give a light to consider conservation of forest to human activities.

Key words: Shifting cultivation, Natural regeneration, Dipterocarps, Succession

P.F. Cockburn B.A.

Trees of Sabah, Volume one

Sabah Forest Record, Sabah, Malaysia, Vol.1, No. 10, 257 pp., 1973,

English

In the two volumes of this book will be described, approximately, 259 genera and maybe 1,000 species. Many of these plants reach timber size, and have varied and useful properties. They may sink, or be difficult to fell, or present other problems, but in the writing of this book, an expansion of utilization has always been one of the main concerns.

Key words: Hardwood, Tree species, Tropical forests

W. Meijer & G.H.S. Wood

Dipterocarps of Sabah

Sabah Forest Record, Sabah, Malaysia, No. 5, 336 pp., 1964, English

The object of this record is to provide as much useful information as possible about the known members of the family *Dipterocarpaceae* in North Borneo.

The contents are as follows.

- I. Geography and Ecology
- II. General knowledge about commercial group of dipterocarp timbers.
- III. Minor Forest Products from dipterocarps.
- IV. Field characters, botanical characters, and names.
- V. Specific descriptions arranged in natural groups.

Key words: Dipterocarps, Commercial tree species, Minor forest products

Triwilaida & Ag. Pudjiharta

Decomposition and soil nutrients under *Leucaena leucocephala* stand on association of Brown Andosol and Brown Regosol, Goal Para, West Java

Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia, No. 533, 23-35, 1991, Indonesian

In West Java the foliage of lamforogung (*Leucaena leucocephala*) is harvested in times of cattle food shortage (dry season) to be used as supplement in live stock feed. In order to study the effect of leaf harvest on the fertility status of soils under *L. leucocephala* an experiment was conducted in a plantation of 4 years, located in the forest district Sukabumi (W. Java) at an altitude between 100 and 1,200 m, growing on an andesitic soil. The trees were planted in contoured line, 3 m apart and at 2 m spacing within the lines.

The experiment was laid out in a randomized block design using plots of 90 m<sup>2</sup> and lasted from February to June 1985. The following treatments in 3 replications were given (a) control (b) trees were cut to height of 60 cm, the leaves and twigs were removed (c) similar

to (b) but the twigs and leaves were returned to the soil. The twigs and leaves decomposition rates were measured in plots of 1 x 0.5 m. The litter was caught in litter traps measuring 0.90 m<sup>2</sup> and analyzed for C, N, P, K, Ca and Mg content. Bulk samples of soils under and adjacent to the *L. leucocephala* stands were analyzed to determine their chemical and physical properties.

The results of the experiment indicated that:

- the annual litter fall was estimated 4,579.7 kg dry weight/ha/year.
- the weight loss of decomposing litter (twigs and leaves) in the 2nd, 4th, 6th and 8th weeks were 13.04, 59.80, 78.34 and 82.91% respectively.
- C/N ratios of decomposing litter determined after 0, 2, 4, 6 and 8 weeks were 15.76, 18.86, 19.39, 20.07 and 24.92 respectively.
- the effect of the treatments on the reserves of available elements were not significantly different. It appeared that the accession of chemical element released to the forest floor through mineralization were rapidly washed off from the experimental site due to the rough topography and high rainfall on the spot.

Key words: Plantation, Litter, Leaf

Abdullah Syarief Mukhtar & Pratiwi

Diversity of land use in the buffer zone of the Gunung Leuser National Park (Achin) and the consequences to its management  
Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia,  
No. 509, 1-15, 1989, Indonesian

This report describes the extent and diversity of land use in the buffered area of the Gunung Leuser National Park. The aim of the survey is to collect informations about the biophysical environment, socio-economic conditions and cultural habits of the local indigenous people. Informations were gathered on the bio physical environment in the buffer zone, socio-economic conditions and its developmental potential.

Data from the survey on the bio-physical conditions which include topography, vegetation and climate are presented. informations of the socio-economic conditions involving land use preferences, income, population growth and pressure were obtained by interviewing the local land users. Respondents were picked purposively on a 2% sample in the Langkat and Southeast Achin regencies.

The results of the survey showed, there exists a great variety of land uses in the buffer zone of the Gunung Leuser National Park; for the greater part the lands are converted into plantations or cleared for shifting cultivation and rice paddies. The increasing pressure on the land from higher population densities makes the physical state of lands in the buffer zone more crucial. One of the probable consequences is destruction of woodland in the nature reserve zone where legally no hunting or clearing are permitted.

Key words: Land-use, Baffer zone, Forest utilization, Multiple purpose forestry

## 2. Silviculture

### 1) Choice of Species

- trials of species, provenance trial, etc. -

P.S. Srinivasan, R.S. Vinaya Rai & R. Jambulingam

*Acacia*: Variation between species in early growth and a few drought-adaptive attributes

Journal of Tropical Forest Science, FRIM, Malaysia, Vol. 2 (2), 129-134, 1989, English

Fifteen species of *Acacia*, one each from Guatemala, Papua New Guinea and Kenya, and five from Australia were field-planted in a statistically designed experiment in 2 m squares. Three years after planting, height and growth plus bark moisture content, total chlorophyll content, stomatal resistance and transpiration rate were recorded. Differences between species were significant in respect of all variables. *Acacia auriculiformis* possessed the least value for transpiration rate and maximum values for other variables. Inter se correlation among the variables revealed height growth to be associated positively with bark moisture content and total chlorophyll content and negatively with transpiration rate. Transpiration rates showed inverse relationships with all variables except diameter at breast height.

Key words: *Acacia*, Variety, Transpiration

Anuar Mohamad

Preliminary assessments of *Acacia* spp. trial on a logged over forest in Sabah

Workshop paper of "The role of Australian Acacias in Developing Countries" at Gympie, Australia, 1-18, 1986, English

Even though *Acacia mangium* has been identified as a major plantation spp., research in finding other potential *Acacia* species is still being undertaken by the Sabah Forest Department.

Therefore, the growth of *Acacia mangium*, *A. auriculiformis* and *A. cincinnata* on a logged over forest was evaluated approximately 4 years after planting in this study. Seed of *A. auriculiformis* and *A. cincinnaata* were imported from Australia, while seeds of *A. mangium* were procured locally from two different locations.

From this preliminary assessment, *A mangium* recorded the best growth both for height and diameter, followed by *A. cincinnata* and *A. auriculiformis*. *A. cincinnata* appears to have the potential as a plantation species in Sabah. Its height growth is comparable to that of *A. mangium* however the diameter growth is quite slow. Further assessments are needed to confirm the species potential.

Key words: *Acacia*, Species trial

Asmanah Widiarti & Harum Alrasjid  
Introduction of fuelwood trees species on degraded lands in  
Paseh and Kadipaten area  
Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia,  
No. 488, 1-17, 1987, Indonesian

Fuelwood still plays an important role in rural communities. It is likely that the fuelwood consumption in the rural community will increase continually every year. To meet the demand of fuelwood, the local population should be given incentives and encouragement to establish energy plantations on their own lands.

Usually the rural communities owned lands are impoverished, furthermore the per capita income is very low.

The objectives of these trial plantation were as follows:

- a. selection of fuelwood tree species suitable to degraded soils.
- b. study of the coppicing ability of the fuelwood tree species and their production potentials.

The experiment comprised of 10 species viz. lamtoro (*Leucaena leucocephala*), kaliandra (*Calliandra calothyrsus*), kayu afrika (*Maesopsis eminii*), gamal (*Gliricidia maculata*), *Hymenaea courba*, angkana (*Pterocarpus indicus*), *Enterolobium cyclocarpum*, khaya (*Khaya anthoteca*), turi (*Sesbania grandiflora*) and akor (*Acacia auriculiformis*), Tree planting as started in 1985.

The research shows the following results:

- a. Kaliandra can be taken into consideration for a large scale plantation in the Kadipaten area because of its fast growth relative to other species.
- b. Kaliandra, akor, turi, lamtoro and gamal fuelwood have high calorific values and their growth rate is sufficiently high.
- c. Kaliandra, akor, turi, lamtoro and gamal can be recommended for a large scale plantation, because in comparison with the other species they have a high growth rate.
- d. the coppice silvicultural system can be applied in the management of lamtoro, gamal and kaliandra stands because of their high coppicing ability.
- e. the height of the stump did not significantly affect the biomass production of lamtoro, kaliandra and gamal.

Key words: Fuelwood tree species, Fuelwood, Coppice forest

B. Kingstom

The choice of species for forestry in Indonesia

Forestry and Forest Products Development, Indonesia, FO:INS/78/054

Working paper 8, Sept., 1980, 43 pp., 1980, English

This is a project report of forestry and forest products development in Indonesia by FAO.

Factors to be considered in making the choice of planting species in Indonesia are mentioned in the report and these factors are discussed from the viewpoint of silvicultural, utilization and environmental considerations. And also, several factors to condition the choice of species in Indonesia are studied. These factors are discussed based on the institutional and environmental aspects which form the basic condition for forest management.

A workshop meeting on choice of species was held at Gajah Mada University, from 14-17 November, 1979 and a list of the species suggested based on the paper presented at this meeting was made, classified according to the purpose for which they are recommended. This list is presented in the report. Out of a total of 53 species the most popular are *Pinus merkusii*, *Albizia falcataria*, *Luecaena leucocephala*, *Calliandra calothyrsus*, *Eucalyptus alba*, *E. deglupta* and *E. urophylla*.

Key words: Choice of species, Pine, Eucalypt, Plantation

Jaffirin Lapongan & Low M. Teck

*Acacia mangium* provenance trials in Sabah

FRC Publication, Sabah, Malaysia, No. 3, 23 pp., 1986, English

Provenance trials of *Acacia mangium* have only recently been established in Sabah in early 1980s. To date, there have been four phases of provenance trials on *Acacia mangium*. All the trials were established in Kolapis A, Kolapis B, Telupid, Sook, Silam and Brumas. The objective of this research is to know the effects of provenances to the growth of *Acacia mangium* in Sabah. The first provenance trial shows that the Daintree provenance from Queensland performed the best. In the second trial, the Claudie River provenance put on the best height and diameter growth. The third provenance trial shows three provenances viz. the Claudie River, Oriomo and Iokwa provenances occupying the top three placings in vigour. The fourth provenance trial also shows the same three provenances of Caludie River, Oriomo and Iokwa occupying the first three positions. The provenances from Sabah and Indonesia did not fare very well in growth when compared to the provenances from Papua New Guinea and some of the provenances from Queensland.

Key words: Acacia, Provenance trial



## 2) Seed (for Propagation)

H.T. Tang

Preliminary tests on the storage and collection of some *Shorea* species seeds

The Malayan Forester, Malaysia, Vol. 34, No. 2, 84-98, 1971, English

Preliminary storage tests were conducted with seeds of *Shorea curtisii* Dyer ex. King and *S. platyclados* V. SI. ex. Foxw. which normally have high moisture contents.

The results show clearly that seeds lots collected from the ground included considerably more defective seeds than lots collected from the tree. This would have been due to the fact that most of the former seeds would have lain on the ground for varying periods. The chances of attack by forest fauna would have increased directly with time. The collection figures for each tree were from only 2 to 4 branches. Therefore, for purposes of large scale planting, we should be able to get at least 10,000 to 15,000 seeds from each selected mother tree. If carefully carried out, minimal damage will be done to the tree.

It was found that by reducing the moisture content of *S. platyclados* seeds from about 40% to about 20 - 25% and storing them in charcoal, sawdust or vermicullite at 15.6° C, the period of viability could be extended from about one week to about 3-4 weeks.

Unfortunately, the main factors contributing to the variable results may have been the media used which had not been sterilised. Also, no fungicide was used on the seeds. As a result, mortality due to fungal attack complicated an assessment of the effectiveness of the treatments used. It can be expected, therefore, that under stricter conditions of seed handling, pre-treatment, packaging, storage and media preparation, seeds of Meranti bukit and other Merantis can be kept viable for at least a month, probably very much longer.

Key words: Dipterocarps, Seed collection, Seed storage, Germination

H.T. Tang & C. Tamari

Seed description and storage tests of some dipterocarps

The Malaysian Forest, Malaysia, Vol. 36, No. 2, 38-53, 1973, English

Quantitative descriptions and preliminary storage test were carried out on various dipterocarp seeds.

The weight per litre of seeds and the number of seeds per kilogramme were estimated from the seeds available. The mean weight and dimensions were calculated from 100 seeds except where fewer seeds were available.

In the nursery, no difference was observed in the total germination percent of *Dryobalanops aromatica*, *Shorea leprosula* and *Shorea parvifolia* seeds with the wings intact or removed, whilst in the laboratory, *D. aromatica* seeds with wings showed a lower germination percent than dewinged seeds.

*Hopea helferi* seeds showed over 90% germination at temperatures between 5° C and 35° C. At 40° C and above, the percentage germination dropped sharply. *H. helferi* and *H. odorata* seeds could be kept viable for at least one to two months at 15° C. At 10° C, viability of the seeds decreased rapidly with time. *H. helferi*, *H. odorata* and *D. aromatica* seeds could be dried at 35° C to 25%, 33% and 19% respectively and maintain over 60%

germination. Below these moisture content levels the germination percent dropped rapidly. The results obtained suggest that by reducing the moisture content in the seeds and storing them at 15° C (or even lower) the viability period of many of our dipterocarp seeds can be prolonged.

Key words: Dipterocarps, Seed, Seed storage, Germination

S. Sasaki

Storage and germination of dipterocarp seeds

The Malaysian Forester, Malaysia, Vol. 43, No. 3, 290-308, 1980, English

Typically non-dormant dipterocarp seeds have high moisture contents and continue to be very active biologically even after maturation. Therefore, storage of *Dipterocarpaceae* seeds is more difficult than that of typically dormant seeds.

As dipterocarp seeds matured they reduced moisture contents to 50 to 60% of the dry weight. The mature seeds germinated faster, and their percentage of germination was higher than that of the immature seeds. Therefore, timing of seed collection is very important for practical silviculture.

Dipterocarp seeds lost viability at low moisture contents below 20 to 30% of the dry weight. For the storage of dipterocarp seeds, the moisture content must be maintained above the critical level in each species. In order to maintain the moisture content, seeds may be stored in a plastic bag or a closed container to keep the relative humidity above 95% at 25° C. The relative humidity can also be maintained at over 95% by circulating air bubbled through water or 11% H<sub>2</sub>SO<sub>4</sub>.

Dipterocarp seeds may be classified by their degree of tolerance of low temperatures. Most of White Meranti seeds survived at 4° C for at least 2 months, whereas those of Red Meranti and Balau needed temperatures above 15° C for survival. Some *Hopea* and *Dipterocarpus* seeds also survived at 4° C for at least a month. Of all the seeds tested seeds of *Shorea talura* were the best in terms of storage, showing ability to survive for more than 6 months at 4° C.

Key words: Dipterocarps, Seed storage, Seed viability, Germination

C. Tamari

Phenology and seed storage trials of dipterocarps

FRI Research Pamphlet, Malaysia, No. 69, 77 pp., 1976, English

These research works were carried out mainly in the Forest Research Institute, Kepong, Peninsular Malaysia for 3.5 years since November, 1971.

The thirty-eight (38) flowering cases in the lowland forests surrounding Kuala Lumpur suggested that dipterocarps have two flowering seasons every year and these coincide with the pronounced rainy seasons. Some variation may be caused by abnormal dry and wet seasons. It appears that for most dipterocarps, the flowering-to-fruiting period is between 2-5 months. The loss of the flowers and young fruits by natural influences of physiological factors, insects, etc., during the seed maturation process was over 90% of the flowers.

Although the seed dry weight is a possible indicator of timing of the seed collection,

it is recommended that preparations for collection be made as soon as the seed-wings begin to turn brown, without waiting for the seeds themselves turn brown.

The optimum temperature for germination of *Hopea helferi* seeds was 25° C and 30° C. The after-ripening or a resting period of most tropical tree seeds is generally almost unknown. However, it was found in the present study that the germination of *Hopea* seeds was apparently effected by the pre-chilling treatment despite of many observations of germinated seeds on branches ahead of seed collection. Most dipterocarp seeds have over 60% moisture content at the time collected, but they dry up rapidly in a few days under normal conditions. The limiting moisture content of dipterocarp seeds, which would not result in serious deterioration of the seeds, was about 35% on the fresh weight basis.

Key words: Dipterocarps, Phenology, Flowering and fruiting, Seed collection, Germination

P.F. Cockburn

Phenology of dipterocarps in Sabah

The Malaysian Forester, Malaysia, Vol. 38, No. 3, 160-170, 1975, English

The data available from various sources in Sabah is analyzed. Individual trees may flower only once in 3-8 years. However, at species level, at least some individuals of most species have been observed in flower in most years. The family as a whole is certainly represented by some flowering individuals every year; there is no year in which the family is completely sterile. Nevertheless, "good" seed years occur only at intervals of 1-9 years. The definition of a "good" seed year is somewhat subjective. In a "good" year only about 50% of the individuals in a stand may actually be involved in flowering. The factors controlling flowering in dipterocarps are still not understood because of inadequate experimentation and observation. Some suggestions for future research are made.

There is evidence to show that evocation can take place in the plant by a variety of external pathways. In *Silene amneria* for example by exposure to long days, by exposure to short days at low temperature or by exposure to short days at high temperature or indeed by G.A7 (Giberellin No. 7). Many short day plants have been evoked into flowering in long days or in sub-threshold conditions with the addition of various concentrations of many known phytohormones as well as sugar, and some mineral salts.

In the *Dipterocarpaceae* almost nothing has been done to try to test any of the hypotheses produced from work on the more convenient herbaceous plants. Dipterocarps are enormous and do not fit into bell jars, but it might be possible to graft older twigs from mature trees to saplings of immature trees and produce flowers. This would enable properly controlled experiments to be conducted in the laboratory.

Key words: Dipterocarps, Flowering and fruiting, Phenology

F.S.P. Ng

Age at first flowering in dipterocarps

The Malayan Forester, Malaysia, Vol. 29, No. 4, 290-295, 1966, English

The age at which dipterocarps, which have been estimated to have a life cycle of 300 to 1,400 years or more, begin to reproduce, is one very little known aspect of dipterocarp

biology. A very early seeding species may produce a very uneven-aged stand at the end of rotation whereas a very late-seeding one may not produce sufficient regeneration for the next crop.

In order to obtain data on age at first flowering, it is necessary to grow trees from seed and arrange for regular inspections to be made over an indefinite number of years. One place where this has been done is in the arboretum of the Forest Research Institute. The records are not complete for all species and it is only too easy to miss a flowering especially if flowering is very sparse. Sometimes, even experienced observers may be fooled.

In this study, 83 individuals of 50 species in the arboretum of the Forest Research Institute were investigated.

It is apparent from the records that many, perhaps most, species of dipterocarps may be expected to flower between their 20th and 30th years. However, the range of variation between early and late-flowering individuals of the same species may be considerable. Detailed information on such variation is lacking except in the case of kapur for which the range is 18-29 years. The number of trees of other species in the arboretum is too few for reliable figures to be obtained.

Key words: Dipterocarps, Flowering and fruiting, Seed

C. Tamari & I. Domingo

Phenology of Philippine dipterocarps

Tropical Agriculture Research Series, Japan, No. 12, 131-139, 1979, English

Generally, there are many tree seeds with a short life in the tropics. Among them are the dipterocarps, which have a notoriously short viability - only 2 to 3 weeks - under normal conditions. For this reason, the collection must be perfectly timed, otherwise the fruits will die before they are collected. Proper timing is made possible through knowledge of the phenology of the various species of dipterocarps.

Forty seven dipterocarp trees belonging to various species were selected from natural and planted trees in the Makiling Forest, Los Banos, Laguna for phenological observations.

This area is located in the dry region, but the flowering and fruiting seasons of dipterocarps are rather similar to those of the wet region.

Data based on the continuous observation indicate that the flowering season of dipterocarps takes place from February to May with widely extended season. From August to December, flowering of dipterocarps is scanty with rare fruiting. maturation of dipterocarp fruits takes place from May to October, coinciding with the wet season, in Makiling.

According to the general analysis of dipterocarp phenology in the Philippines, the peak flowering season of dipterocarps occurs in April in the dry climatic region, in May in the intermediate climatic region, and in May and June in the wet climatic region with widely extended seasons.

The flowering and fruiting seasons of the dipterocarps in the wet and intermediate climatic regions extend over a longer period than those of the dipterocarps growing in the dry climatic region.

The best season for seed collection is difference depending on the species. Seeds should be collected when the wings turn brown. The best seeds are usually those collected in seed-years.

Key words: Dipterocarps, Phenology, Flowering and fruiting, Seed collection

P.F. Bruggess

Studies on the regeneration of the hill forests of the Malay Peninsula  
The Malayan Forester, Malaysia, Vol. 35, No. 2, 103-123, 1972, English

Dipterocarp trees, mostly species of the genus *Shorea*, form almost the entire timber stand in the commercially valuable hill forests of the Peninsula. Successful natural regeneration of the forests after timber exploitation is absolutely dependant on the presence of adequate dipterocarp regeneration on the forest floor before felling commences, and information on the periodicity, season, and relation of flowering to recorded meteorological phenomena is of fundamental importance to enable seeding to be predicted and fellings regulated accordingly.

Flowering records from 1925 to 1970 are examined and it is concluded that most dipterocarp tree species flower gregariously at intervals of two to five years, and the important hill forest species *Shorea curtisii* and *Shorea platyclados* at the intervals not exceeding five years. For the period 1960 to 1970 the combination of all data showed a clear peak of flowering in May; subsequent analysis by years suggests that the peak month may vary from March to July in any one year. In the dry zone of the north-west, flowering peaks were less distinct and flowering tended to start earlier in the year. No clear correlation between available meteorological records and flowering was found, though flowering generally occurs on new growth produced a few months before. Though flowering tends to follow drought, not all dry periods followed by rain produced flowering, and it appears that a further factor, possibly bright sunlight, or a fall in temperature, is also required. Suggestions are made for further research.

What is now required is the establishment and observation of series of small phenological plots, confined perhaps to the four species *Shorea curtisii*, *Shorea platyclados*, *Shorea leprosula*, and *Shorea parvifolia*, in a wide range of habitats with simultaneous monitoring at each plot of rainfall, evaporation, soil moisture content, air temperature in the canopy, and sunshine hours. Records should be kept not only of the appearance of flowers and production of fruit, but also of leaf flushes, and sample material should be collected.

Key words: Dipterocarps, Flowering and fruiting, Natural regeneration

Masano

The effect of wing colour on the germination of *Shorea pinanga* and  
*Shorea stenoptera* seed  
Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia,  
No. 503, 43-53, 1988, Indonesian

Colour is an indicator of the maturity of seeds. To determine the best time for collecting of seeds, nursery experiment based on wing colour of *Shorea pinanga* and *Shorea stenoptera* seeds have been carried out.

Result of this experiment show that wing colour significantly influences the percentage of germination. Partially brown winged seeds were the best.

Based on above information it is recommended that the best time for collecting of the

fruits of *S. pinanga* and *S. stenoptera* is when a part of the colour changes to the brown. Delay on collection time will decrease the germination percentage.

Key words: Dipterocarps, Seed, Germination

Dida Syamsuwida & Rina Kurniaty  
Sowing qualities of seeds of *Shorea compressa* and *S. pinanga* in relation to harvest date and length of storage  
Beletin Penelitian Hutan (Forest Research Bulletin), Indonesia, No. 514, 1-10, 1989, Indonesian

Obtaining adequate of the right kind and quality of seed is the key to successful operations in the establishment of industrial forest plantations. For collections to be successful the seed crop to be harvested must be studied so that in one operation the maximum quantity of fully ripe seed is obtained.

Knowledge of fruit development—size, appearance, color change and dormancy is essential of precise timing of seed collection to maximize yield of viable seed. The seed of *Dipterocarpaceae*, a family with potential in Indonesia is hard to obtain because the trees fruit irregularly is affected by environmental factors.

Ripening of seeds of *S. compressa* and *S. pinanga* grown in the Experimental Forest of Haurbentes was studied. Fruit ripeness was assessed in batches collected at different dates, namely at 4, 5 and 6 months after anthesis. The collected seeds were stored at room temperature for 1, 2, 3, 4, 5 and 6 weeks and there after the germinative capacity is determined.

A 3 x 6 factorial experiment in a randomized complete block design in replications was conducted.

The results of data analysis show significant interactions between harvest date and length of storage. Seeds of *S. compressa* and *S. pinanga* collected 5 months after anthesis showed about 83% and 80% germination in average respectively. It is concluded that with respect to retention of viability after storage, the best time for harvesting *S. pinanga* and *S. compressa* seeds are 5 months after anthesis.

Key words: Dipterocarps, Seed collection, Germination, Seed storage

Rina Kurniaty & Dida Syamsuwida  
The effort of *Shorea pinanga* seed storage to lengthen the dormancy  
Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia, No. 497, 21-28, 1988, Indonesian

There is a great demand for a large amount of high quality seed in order to make a reforestation and enrichment planting successful. One of the main problems that the silviculturist encounters is the preservation of seed viability, especially when the planting site is located at a distance from the seed source and the species bears an abundant seed crop at irregular intervals.

Dipterocarp seeds in general are not capable of retaining their viability in long period

because there is very little or practically no dormancy at all. This makes them difficult and hazardous to store for a long time.

The storage investigation was established as to have information about the period over which *Shorea pinanga* seeds remain viable in storage. Batches of 10 fresh seeds were stored for 4 weeks in wax coated wooden boxes and non coated ones. For the control the seeds were spread in open zinc trays. The experiment was replicated three times.

After storage the percentage of germination was assessed. It turned out that 62.5 percent of the seeds stored in sealed boxes retained their viability, those in non sealed boxes 45.8 percent, while the control seed batches were entirely lost.

Key words: Dipterocarps, Seed storage, Dormancy, Seed viability

Jacob S. de Muckadell & Pilis Malim

Preliminary observations on harvesting, handling and storage of seeds from some dipterocarps

Working Paper No. 18 FAO/UNDP-MAL/78/90, 42 pp., 1983, English

This paper describes work carried out by the staff of the Food and Agriculture Organization (FAO) and counterparts to the United Nations Development Programme (UNDP) project "Seed Sources Establishment and Tree Improvement - Sabah" (MAL/78/009) between June 1982 and March 1983.

Harvesting and handling seeds from dipterocarps indigenous to Sabah is very different from the exercise of collecting seeds or fruits from the exotic plantation species. Collection of seeds from these species is of a more random nature than for plantation species where regular inspection and harvesting is fairly easy. The scattered occurrence of a species and the irregular fruiting makes harvesting of a representative large collection from any given area difficult.

In the paper, six species belonging to *Dryobalanops*, *Depterocarpus*, *Shorea* and *Parashorea* are studied on phenology, seed handling, seed storage and seed test.

Key words: Dipterocarps, Seed, Phenology

M.R. Bowen & T.V. Eusebio

*Acacia mangium* seed harvest 1982

Working Paper No. 15 FAO/UNDP-MAL/78/009, Sabah, Malaysia, 23 pp., 1982, English

In 1982 harvests of *Acacia mangium* Willd. seed were made by the Seed Section of the Sabah Forest Research Centre at five locations in Sabah. A total of 171 kg of seed was collected and stored at Sepilok. This paper gives details of collection of processing methods, labour requirements and lists the collections made. Also included is a summary of *A. mangium* seedlots presently in store at FRC. Collections handled by SAFODA and Sabah Softwoods Sdn Bhd in 1982 are also listed.

Key words: Seed, Seed collection, Seed storage, Acacia

Rina Kurniaty & Acep Akbar  
Effects of extraction method and fruit color of *Gmelina arborea*  
Linn. on its germination  
Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia,  
No. 532, 37-47, 1991, Indonesian

*Gmelina arborea*, one of the broadleaf tree species of the Verbenaceae family, is a fast-growing tree which occurs extensively in the tropic. The fruits may fall from the trees while they are still green. Green fruits would to some extent contain immature seeds, which mature during the period when the fruits turn yellow. With the change of color into brown or black, an increasing fraction of the seed would obviously deteriorate.

In order to get a high level of seed quality, proper extraction and drying of seeds are very essential. During the cleaning process, physical damage may occur or may produce imperfectly clean seeds.

In this investigation some extraction methods were carried out, such as by peeling, striking and ripening of various fruit colors of *G. arborea* (green, yellow, brown and black).

A 3 x 4 factorial design with three replications was used in this investigation with completely randomized design.

The results showed that extraction by striking gave the best percentage of germination on yellow and green fruits followed by yellow fruits by peeling, e.g. 73.04%, 71.97% and 70.90% respectively.

Key words: Hardwood, Seed, Seed cleaning, Germination

F.S.P. Ng

Seed for reforestation: A strategy for sustained supply of  
indigenous species

The Malaysian Forester, Malaysia, Vol. 37, No. 4, 271-277, 1974, English

In this paper the author is concerned with ways and means of clearing the very serious bottleneck of seed-supply, which is hampering enrichment planting efforts with indigenous species in Peninsular Malaysia. The nurseries are unable to maintain a constant output of seedlings because the supply of seeds is variable and unpredictable. As an alternative, wildings are often collected from primary forest and used in enrichment planting of logged-over areas but surveys by the Silviculture Branch of the Forest Research Institute indicate that transplanted wildings suffer much higher rates of mortality than nursery-raised stock.

In order to keep forest nurseries constantly supplied with seeds, it is recommended that each nursery should assign staff to the task of keeping potential seed trees under regular 3 weekly or monthly observation for fruiting and flowering. To help seed collectors, prediction tables are being prepared which give the periods between flowering and fruit-ripening for the different species. It is also recommended that priority should not be restricted to dipterocarps alone. Serious attention should be paid to the hardseeded leguminous trees because their seeds are much easier to store than those of most other indigenous species. Attention is drawn to the need to intensify research in phenology, vegetative propagation seed storage and need pest control.

In the long term, seed orchards should be set up using vegetatively propagated stock from trees having desirable characteristics. One of these characteristics should be the ability to produce good crops of fruits at frequent intervals. The detection of such trees should be



the responsibility of the phenological teams set up to look for flowering and fruiting.

Key words: Seed, Seed tree, Seed orchard

S. Miyatake, M.Y.B.A. Rahman & A.B. Mohamad  
Phenological study on some tropical rainforest tree species  
Forest Research Note in Brunei Darussalam, No. 50, 36 pp.,  
1991, English

This paper is concerned with the data collected over two years for Phenological observation. The growth increment (girth) was measured and the results are also briefly discussed.

The main objective of this Phenological study was to ascertain the major factor causing flowering in each species. Flowering is induced by the hormone, Florigen, and water condition is one of the most important factors influencing the activity of the hormone. Therefore, the study of soil water tension is fundamental to understanding the mechanism of the flowering system of Tropical Rainforest Tree Species. The pF value is measured therefore, as an indicator for a discussion on this topic.

Key words: Phenology, Flowering and fruiting, pF

Isamu Yamada  
Report on the forest research in Negara Brunei Darussalam  
from 1984 through 1986  
Forest Research Note in Brunei Darussalam, No. 3, 23-50,  
1987, English

The report is a study conducted by JICA Forestry Research Project in Brunei. Several aspects of forest research are discussed in the report.

In chapter II and III, phenological observation and phenological activities are reported as the following.

Phenological study was conducted at four sites where biweekly observation of leafing, flowering and fruiting were carried out for 18 month. The study is the preliminary study on the phenology of main tree species at four sites, i.e. two sites at Mixed Dipterocarp forest, one each at Agathis and Alan bunga forest. The purpose of the study is to get basic information of phenology of main species and apply these results to the seed study and forest breeding study in the future.

As for phenological activities, besides the annual growth by diameter tape, the micro diameter growth was measured by using aluminum band tape dendrometer and the relationship of micro diameter growth to the phenological activities are discussed briefly.

Key words: Phenology, flowering and fruiting

### 3) Nursery Practice

Rina Kurniaty

The effects of sulphuric acid treatment on the germination of *Maesopsis eminii* Engl.

Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia, No. 448, 35-44, 1987, Indonesian

The most widespread and serious cause of seed dormancy is the hardness or the thickness of the seedcoat. It means that the seedcoat fails to absorb water or is impermeable to oxygen and offers also mechanical resistance that inhibits embryo growth; therefore the seed is still dormant. Removal of dormancy from such seed would accelerate embryo growth.

Concentrated-sulphuric acid treatments are highly effective on the germination of many species.

To investigate the effect of this treatment on the germination of the seed of *Maesopsis eminii* Engl. an experiment has been conducted using various concentrations of sulphuric acid (5, 10, 15, 20, 25 N) and lengths of soaking time (10, 15, 20, 25 and 30 minutes). A completely randomized design with two treatments and three replications was employed.

The results of this experiment suggested that soaking of the seed in 20 N sulphuric acid solution for 20 minutes appeared to be the most effective method in hastening and improving the germination of *Maesopsis eminii* seed.

Key words: Seed, Germination, Pre-sowing seed treatment

R.M. Basada

Effect of seed size on germination, seedlings survival and height growth of white lauan (*Shorea contorta*)

Sylvatrop Philipp. For. res. J., Philippines, 4 (2), 77-88, 1979, English

The study was conducted at the DRC (Dipterocarp Research Center) office and nursery site at San Roque, Bislig, Surigao del Sur from december 1977 to February 1978. Seeds used were a mixture of fresh fallen seeds collected on 3 December 1977 from three adjoining fruiting trees in the northeastern portion of the 38-hectare DFRC office and nursery site. Diameters and total heights of the mother trees were 95.5, 79.5 and 95.5 cm, and 35.44, 33.31 and 34.43 m, respectively. All three mother trees were dominant in the area and were bearing fruits profusely.

Classification of the seeds into three sizes was made by establishing a weight range: big seeds, 6 to 9 gm; medium seeds, 4.5 to 5.5gm; small seeds, 2.5 to 4gm.

Survival and height data (measured from ground level to tip of shoot) were collected 60 days after the date of sowing. Assessment of germination performance in terms of mean daily germination, peak value, and germination value was done.

Small seeds had the highest mean germination value, but not significantly different as compared with medium and big seeds. Total germination rate was highest in big seeds and is significantly different from medium and small seeds. Seed size has also a significant effect on the survival of seedlings and seedling height growth 60 days after sowing.

Therefore in actual production of nursery plating stock of white lauan, the use of big seeds is recommended. However, in cases where big seeds are not in sufficient quantity, medium and small seeds may be used provided they are not sown in mixture. Seeds should be graded first according to size before they are sown to come up with uniform seedling size and to avoid additional labor and cost in segregating and culling suppressed seedlings.

Key words: Diptrocarps, Seed, Germination, Seedling, Height growth

Herman Daryono

Effects of soil type and seed treatment with hot water to the seed germination and growth of *Acacia mangium* Willd. seedlings  
Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia,  
No. 496, 17-30, 1988, English

This experiment was conducted primarily to study the effect of potting medium and hot water treatment on germination and growth characteristics of *Acacia mangium* Willd seedlings.

The experiment was carried out in the nursery of the Forest Research and Development Center in Bogor, located at 253 meter above sea level. *A. mangium* seed was collected in the Experimental Garden at Yanlapa, Bogor.

Prior to sowing the seed were dipped in boiling water for various length of time, thereafter they were sown in polyethylene pot of 18 x 25 cm containing different soils. To study the effect of the potting medium and hot water application on germination percentage and speed, a 5 x 6 x 2 factorial design was used. The potting media used Inceptisol/Andosol (a<sub>1</sub>), Entisol/Regosol (a<sub>2</sub>), Alfisol/Latosol (a<sub>3</sub>), Ultisol/Red yellow Podzolic (a<sub>4</sub>) and Vertisol/Grumusol (a<sub>5</sub>). The hot water treatment were given at six levels namely, dipping for 1 second (b<sub>1</sub>), 30 seconds (b<sub>2</sub>), 60 seconds (b<sub>3</sub>), 90 seconds (b<sub>4</sub>), 120 seconds (b<sub>5</sub>) and 150 seconds (b<sub>6</sub>). In each treatment combination 20 pots were used and in each pot one seed sown. Six months after germination, the performance of 10 seedlings subjected to each treatment combination was evaluated, the height and root growth in particular.

The effect of potting medium on seed germination percentage and speed, height and root growth of *A. mangium* seedlings was highly significant. Inceptisol/Andosol and Vertisol/Grumusol gave the best results. The fastest germination speed was obtained when the seed was dipped in boiling water during 90 seconds. There was no evidence of interaction between potting medium and the duration of dipping on germination nor on growth characteristics.

Key words: Pre-sowing seed treatment, Germination, Acacia

Hendromono

Effects of scarification and size of eboni (*Diospyros celebica* Bakh) seeds to their germination and initial growth  
Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia,  
No. 515, 1-8, 1989, Indonesian

Eboni (*Diospyros celebica* Bakh) has a good prospect for timber estate plantation due

to its wood is very expensive. The first step of eboni plantation is seed germination in the nursery. Usually, germination of eboni seed is too long because of hardness of the seedcoat, so that can increase possibility the seed damaged by pests or diseases. Scarification can soften the seedcoat and accelerate germination process. The purpose of this experiment is to know the best of scarification and size of eboni seeds to their germination and initial growth.

This experiment was conducted by using three sizes of eboni seeds and three kinds of scarification. The experiment was arranged as a factorial experiment in a completely randomized block design.

The results of this experiment suggested that before germinating of eboni seeds, it is better to soak the seeds in the water during 10 hours, but don't soak the seeds in the hot water (100° C). For plantation material, we ought to choose mature, large, dense and undamaged seeds.

Key words: Germination, Seed, Pre-sowing seed treatment

P.B.L. Srivastava & P. Manggil

Vegetative propagation of some dipterocarps by cuttings

The Malaysian Forester, Malaysia, Vol. 44, No. 2, 3, 301-313, 1981,

English

Stem cuttings of *Anisoptera scaphula*, *Shorea bracteolata*, *Shorea leprosula*, and *Dipterocarpus chartaceus* were studied.

The cuttings were about 12-15cm in length. On some cuttings, especially those from the upper portion of stems and branches, a few leaves were retained. However, the leaf area on these cuttings was reduced by clipping off half of each leaf.

The cuttings, immediately after separating from the stock plant, were treated with a talc preparation of indole-butyric acid (IBA), in four concentrations viz., 100 ppm, 500 ppm, 1,000 ppm and 2,000 ppm. Watering was done at frequent intervals by misting heads to create high humidity inside the propagating frames.

There was marked variation between species, with *S. bracteolata* yielding the highest rooting success (100%) followed by *A. scaphula* (80%), *D. chartaceus* (60-80%), and *S. leprosula* (40%) in some treatment combinations. Treatment with IBA did not conclusively improve rooting percentage. However, it did promote heavier rooting in *S. bracteolata* at 500 ppm and in *A. scaphula* and *S. leprosula* at 2,000 ppm IBA.

an important factor in the present trial was the age of stock plants from which the cuttings were taken.

There appears to be some relationship between rooting ability and coppicing power of the species. *A. scaphula* and *S. bracteolata*, which gave highest rooting success, coppiced profusely from the seedling stumps left after the preparation of cuttings. *S. leprosula* and *D. chartaceus* on the other hand, coppiced poorly. The stumps of profusely-coppicing species can be developed into bush sources for producing a large number of cuttings.

Key words: Dipterocarps, Vegetative propagation, Cuttings, Hormone

F. Halle & H. Kamil

Vegetative propagation of dipterocarps by stem cuttings and

air-layering

The Malaysian Forester, Malaysia, Vol. 44, No. 2, 3, 314-318, 1981,  
English

Simple, easy methods are needed in Indonesia for the propagation of important timber species. In this experiments it has attempted to propagate dipterocarp species by use of two vegetative methods, namely stem cuttings and air-layering.

The stem cutting experiments were conducted with five dipterocarp species of Indonesian timber trees: *Shorea palembanica*, *S. seminis*, *S. leprosula*, *Vatica pauciflora* and *Hopea mangarawan*, in BIOTROP Bogor-Indonesia. The cuttings were taken from the vertical axis of young trees, 3-4 years old, and 4-5m tall. The cuttings measuring 15-20cm long, were made with a sharp knife, and consisted of several nodes with leaves attached.

Concentrations of the hormones varying from 1,000 ppm to 4,000 ppm in 95% alcohol were prepared and the bases (1-2cm) were dipped in them for a short time (3-5 seconds) and quickly dried off with a fan, then the cuttings were inserted into rooting medium. Successful propagation was only achieved with *Vatica pauciflora* when 0.2% conc. of IBA was applied.

The experiments using air-layering were conducted with three dipterocarp species namely *Shorea palembanica*, *S. stenoptera*, and *Vatica pauciflora*. Three different concentrations of IBA were applied to promote root growth.

After two months, the air-layers were inspected. 80% of *Shorea palembanica* and *V. pauciflora* with 0.5% conc. of IBA had successfully rooted. Air-layers made on plagiotropic branches of *S. stenoptera*, did not give good results. Air-layers not treated with IBA still produced roots, however, the percentages of rooted air-layers was too small.

Key words: Dipterocarps, Vegetative propagation, Cuttings, Hormone

W.T.M. Smith

Vegetative propagation of *Shorea* CF. *obtusata* and *Agathis dammara* by means of leaf-cutting and stem-cutting

The Malaysian Forester, Malaysia, Vol. 46, No. 2, 175-185, 1983, English

Economically *Shorea* is the most important genus of the *Dipterocarpaceae*, a family of tropical hardwood species, mainly confined to South-East Asia. They make up about 25% of the 1978 world trade in hardwood timber. *Agathis* is a coniferous genus of some thirteen species of tall resinous trees in the family *Auracariaceae*. Most *Agathis* species have good self-pruning characteristics. The wood is in high demand and has the typical long coniferous fibres.

In nature, some *Agathis* occur as almost pure stands.

Stem-cuttings and leaf-cuttings of *Shorea* cf. *obtusata* and *Agathis dammara* were treated with indolebutyric acid (IBA) and planted in washed riversand and in a 1:2 mixture of peat and sand. The cuttings were placed under glass with 95% air-humidity.

All treatments with IBA showed higher rooting percentages than those without. Both *Shorea* cf. *obtusata* and *Agathis dammara* obtained 100% rooting in some treatments.

With *Shorea* cf. *obtusata*, no differences with regard to rooting were found between leaves of higher and lower positions. With *Agathis dammara*, striking differences with regard to rooting were encountered, related to the original position of the cutting in the plant.

Cuttings of *S. obtusata* placed at a temperature about 18° C did not produce roots even

after sixteen weeks, also less callus was produced. This low temperature also retarded rooting of *Agathis dammara* cuttings.

Key words: Cutting, Vegetative propagation, Hormone, Rooting

Sudradjat

The effects of Rootone F hormone on the growth of *Morus shima* plants from cuttings

Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia,  
No. 491, 26-33, 1987, Indonesian

The objective of this experiment is to understand the effect of various concentrations of applied Rootone F hormone on the growth of two months old *Morus shima* plants raised from cuttings. The experiment was conducted in the nursery owned by the Sericulture Division of the Forest Research and Development Centre at Kreteg Bogor, lasting from December 1985 until January 1986.

A Completely Randomized Block Design with five treatments in three replications was used in this experiment. Concentrations of 0, 50, 75, 100 and 125 mg of Rootone F hormone were applied to the cuttings. Plants from these cuttings were grown in plastic bags filled with soil.

The result of this study showed that maximum number of roots, average root length and total rootweight per plant occurred at application of 75 and 100 mg of Rootone F hormone.

Key words: Cutting, Hormone, Root system

B.P. Bhatt & N.P. Todaria

Vegetative propagation on tree species of social forestry value in Garhwal Himalaya

Journal of Tropical Forest Science, FRIM, Malaysia,  
Vol. 2 (3), 195-210, 1990, English

Stem cuttings of *Debregeasia salicifolia* (D. Don) Rendl., *Sapindus mukorossi* Gaertn. Fruct., *Lagerstroemia parviflora* Roxb., *Prunus cerasoides* D. Don and *Quercus leucotrichophora* A. Camus were treated for 24 h with different concentrations of indole 3-acetic acid (IAA), indole butyric acid (IBA), naphthalene acetic acid (NAA) and dichlorophenoxy acetic acid (2,4-D) and planted in earthen pots containing garden soil and sand (1:1) as the rooting medium. Watering was done regularly and the experiment was conducted in a green house under natural conditions.

Season played a crucial role besides treatment with auxins for root initiation. Only spring planting was able to trigger rooting in branch cuttings up to some extent. No general pattern was present in the rooting responses. However, moderate overall rooting was observed in *S. mukorossi* (41%) and *D. salicifolia* (29%), and poor rooting in *L. parviflora* (13%) and *P. cerasoides* (6%) in some treatments. *Q. leucotrichophora* had only callus formation (7%). While IAA, IBA and NAA were effective in *D. salicifolia* and *S. mukorossi*, only IBA was effective for root initiation in *L. parviflora* (100 and 200 ppm) and *P.*

*cerasoides* (500 ppm). The sprout development in *D. salicifolia* was very fast and within 90 days the shoot length reached 96 cm.

Key words: Vegetative propagation, Rooting, Cutting

Harun Alrasyid & Asmanah Widiarti

The effect of IBA hormone application on survival percentage of *K. anthoteca* cuttings

Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia, No. 523, 1-22, 1990, Indonesian

Seed supply is one of the problems in large-scale plantation of *Khaya anthoteca* in Indonesia. For this reason an experiment on vegetative propagation by cutting was carried out. The objective of this research was to find out the optimum concentration of plant regulator needed to increase the survival percentage of cuttings.

In this experiment the following treatments were used:

- (1) Cuttings without treatment (control)
- (2) Cuttings soaked in IBA hormone at concentration levels of 50, 100, 200 and 300 ppm, for 1, 2 and 3 hours respectively.

The experiment was designed as a factorial experiment in Completely Randomized Design.

The results of this research showed that:

- (1) *K. anthoteca* can be propagated by cuttings.
- (2) The concentration of IBA hormone at 100 ppm level with soaking time of 1, 2 and 3 hours increased the survival percentage of cuttings as much as 23.75 - 36.25% compared with control.
- (3) The mean survival percentage of cuttings for the control treatment was 61.25%.

Key words: Cutting, Hormone, Vegetative propagation

Kendel Irving Thomas

The rooting of juvenile cuttings of the fast-growing hardwood extotics

FRC Publication, Sabah, Malaysia, No. 33, 53 pp., 1987, English

The rooting under automatic mist-spray of juvenile cuttings of *Acacia mangium* Willd., *Gmelina arborea* L., and *Paraserienthes falcataria* (L) Nielson. was examined at the Sepilok nursery. Treatment of cuttings with rooting hormone powders was tried.

An average of 78% of the *A. mangium* cuttings was dead after nine weeks under mist-spray, 84% of the *G. arborea* after seven weeks, and 98% of the *P. falcataria* after seven weeks. Low levels of light over the beds (2.5 to 15% of full sunlight) and inadequate misting were the most probable causes of mortality. Fungicide treatment of cuttings had no consistent effect on their survival.

Despite the high cutting mortality encountered, some of the results were promising. With the application of 0.2% indole butyric acid, 3% naphthalene acetic acid, or a mixture of the two, 51% of the cuttings remaining alive developed roots and were transplanted by

nine weeks. Higher order nodes had less mortality; rooting success was independent of node order. Rooted cuttings transplanted to soil, of *A. mangium* had 88% survival and good growth.

Cuttings of *G. arborea* with the application of hormone improved the rooting rate. By seven weeks, 88% of the cuttings that remained alive were rooted and transplanted. Cutting survival and rooting success were independent of node order.

Survival of *P. falcataria* cuttings under mist-spray was extremely low. Mortality appeared to be higher and to occur faster among cuttings of the higher node orders. One-half of the surviving cuttings developed roots.

The vegetative propagation system at the Sepilok nursery was modified to remedy the identified problems. New beds under 50% shading were constructed. *Gmelina arborea* was easily propagated under the improved conditions found in the new beds. Cutting survival and rooting success (based on number remaining alive) were 88% and 80%, respectively.

Key words: Vegetative propagation, Cutting, Hormone, Acacia

Darus H. Ahmad, S. Thompson & A. Pirrie

Vegetative propagation of *Acacia mangium* by stem cutting:

The effect of seedling age and phyllode number on rooting

Journal of Tropical Forest Science, FRIM, Malaysia, Vol. 2 (4),

274-279, 1990, English

The rooting percentage of *Acacia mangium* stem cuttings decreased significantly and mortality increased with increasing age of stock plants. Cuttings taken from 6 and 12-month-old stock plants rooted faster than stem cuttings of old stock plants and produced higher rooting percentages of 71.3 and 65.0% respectively. The presence of phyllodes is also an important factor for rooting success of *A. mangium* stem cuttings. Those with one phyllode or a half-cut phyllode produced better rooting percentages (66.0 to 76.0%), a faster rooting rate, and a very low mortality rate compared to leafless cuttings or cuttings with two phyllodes.

Key words: Cutting, Rooting, Seedling age, Acacia

Masahiko Tajima

Vegetative propagation of *Acacia mangium*

SAFODA-JICA Project Report, Sabah, Malaysia, 14 pp., 1990,

English

As this species has a high shooting tendency, it may be considered that cutting technology in particular will be efficient and economical.

When cuttings were examined according to scion level, those grown from 1st level scions scored a very low rate of about 3% (10/500), while 3rd level scions scored highest with about 66%. Of these 3rd level scions, this trial revealed that the rooting rate fluctuates according to scion level, but cannot be said to be much influenced by differences in cutting bed conditions.

These results show that all but the first level scions (i.e., 2nd to 5th level scions)



produce cuttings with a generally high rooting rate, the third level scions being the best. Of the three cutting beds, the Around Covered bed produced the best results.

It is known that, as a general rule, the rooting capability of a tree decreases with age. In the case of mature trees, if cuttings are taken from branch shoots (newly sprouted branches) comparatively close to the ground, the rooting rate will be greatly increased. A scion taken from a high location on a tree of mature age has an age roughly the same as that tree. But a scion taken from a new, shooting branch (branch shoot) is in fact derived from a cell cluster of a still young age. The theory is, using a shooting branch for scions is the same as using a juvenile tree.

Key words: Vegetative propagation, Cutting, Acacia

Kendel Irving Thomas

Propagation of *Araucaria cunninghamii* and *Araucaria hunsteinii* by rooted stem cuttings

FRC Publication, Sabah, Malaysia, No. 43, 52 pp., 1988, English

Main stem and branch cuttings of juvenile *Araucaria cunninghamii* Ait. ex D. Don and *Araucaria hunsteinii* K. Schum. were rooted under automatic mist-spray. Cutting survival and rooting, as influenced by hormone applications and the removal of lateral branches, was examined.

Without hormone, 88% of the main stem cuttings of *A. cunninghamii* with intact branches were rooted after 16 weeks; 79% developed into plantable trees. The application of rooting powder, 0.2% IBA, 3% NAA, and an equal mixture of both hormones, increased the rate of rooting and the number of roots formed without affecting the final proportion of cuttings successfully rooted. Mortality was higher among cuttings treated with hormone, relative to those receiving no hormone. Removal of branches from main stem cuttings increased mortality, accelerated the rate at which cuttings died, and decreased rooting. The survival and rooting of cuttings with intact branches did not vary by node level.

Main stem cuttings of *A. hunsteinii* with intact branches had 81% survival at 20 weeks, but only 46% developed into plantable trees. Rooting hormones decreased significantly cutting survival without influencing rooting. The survival and rooting of cuttings of *A. hunsteinii* was much poorer than that of *A. cunninghamii*.

Cuttings taken from the lateral branches of *A. cunninghamii* and *A. hunsteinii* were easily rooted and grew well. However, all branch cuttings retained their plagiotropism.

Key words: Cutting, Hormone, Rooting

S. Sasaki

Growth and storage of bare-root planting stock of dipterocarps with particular reference to *Shorea talura*

The Malaysian Forester, Malaysia, Vol. 43, No. 2, 144-160, 1980, English

Transpiratory water loss from seedlings appeared to be the most serious problem in transplanting of dipterocarp seedlings, particularly for bare-root planting. To minimize the water loss from the seedlings, tissues such as all the leaves and young portions of stem were removed from the transplants of *Shorea talura*. Such heavily pruned seedlings survived in

the open and developed axillary buds, with the uppermost bud taking over the role of the leader shoot. Therefore, the seedlings seldom developed multileader shoots. With these pruned seedlings of *Shorea talura*, and *Hopea odorata*, bare-root transplanting resulted in almost perfect survival. The growth of bare-rooted seedlings, however, was accelerated 10 months after transplanting. The pruned seedlings could be stored in a poly-ethylene plastic bag at least for several months, particularly *Shorea talura* and *Hopea odorata* seedlings which could remain viable for more than 7 months. In addition, the pruned seedlings of *Shorea talura* were propagated vegetatively by laying down the pruned leafless seedlings horizontally. Axillary buds developed into several plantlets growing vertically with their individual root system initiated. These results suggest that some of dipterocarp species have a potential as species for artificial regeneration.

It is necessary to grow seedlings with a well balanced shoot/root ratio. *Shorea talura* seedlings should be grown in the open or in a high light intensity area to promote root growth. Seedlings that have been grown in shade may easily be desiccated after transplanting probably because their transpiration rates are high.

Key words: Dipterocarps, Bare-root stock

Agusdin Djapilus & Hendromono

Effects of pruning and type of *Swietenia macrophylla* King seedlings to their survival and growth in the field.

Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia, No. 497, 1-6, 1988, Indonesian

Research on bare root planting effectivity of mahogany (*Swietenia macrophylla*, King) was conducted at Cikampek Experimental Garden (West Java).

Experimental design used is a 3 x 2 factorial experiment within a completely randomized design. Each treatment combination consisted of five seedlings with four replications. Three types of seedlings were tried: (A<sub>0</sub>) containerized seedlings, (A<sub>1</sub>) common bare root seedlings (A<sub>2</sub>) bare root seedlings which their taproots were cut 15 days before they were planted to the field. The seedlings were further treated: (B<sub>0</sub>) without pruning, (B<sub>1</sub>) with leaves and root pruning.

The results have shown that bare root mahogany seedlings which their taproot were cut 10 cm below root collar, 15 days before planting produced young plants which their growth and survival were not different with young plants from containerized seedlings. Common bare root mahogany seedlings produced young plants with low survival. Leaves and root pruning treatment to mahogany seedlings before planting time may decrease their initial growth, but their growth will be normal after six months in the field.

Key words: Bare root stock, Mahogany, Root pruning, Survival

Marfu'ah Wardani

The effect of wilding nurseried methods to growth of *Dipterocarpus hasseltii* Bl. seedlings

Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia, No. 514, 19-23, 1989 Indonesian

*Dipterocarpus hasseltii* Bl. is one of rare commercial trees, and for continuity this species is in urgent need of replanting. The seedlings from natural regeneration can be used for plant material. The effect of wilding nurseried methods to growth of *D. hasseltii* Bl. seedlings have been done in the Experimental Garden of Forest Research and Development Centre, in Bogor and conducted from July to December 1987. As experiment material were *D. hasseltii* Bl. seedlings from Yanlapa Forest, west Java.

The result of experiment showed that cutting on root were significant to survival percentage of seedlings but cutting on shoot of wilding were not significant to survival percentage. The cutting on root and left 10 cm from neck of root gave survival percentage bigger than left 5 cm from neck of root.

Key words: Dipterocarps, Wilding, Survival, Seedling

R. Mulyana Omon

The effect of NAA hormone on wilding growth of *Hopea mengarawan*

Miq. in Dramaga, Bogor

Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia,

No. 491, 20-25, 1987, Indonesian

The effects of NAA hormone on wilding growth of *Hopea mengarawan* Miq. was investigated. The experiment was conducted at plot number 79 in Dramaga Experimental Garden of the Forest Research and Development Centre (altitude 244 m asl and annual rainfall 4,962 mm). NAA hormone which applied to stimulate root growth of wilding was 0 ppm, 125 ppm, 250 ppm and 375 ppm respectively.

The result of experiment showed that the treatment with 125 ppm water gives significant difference either to height growth or to diameter growth of *H. mengarawan* wilding. Mean height and diameter growth of *H. mengarawan* wilding are 136.29 cm and 7.71 mm which applied by NAA hormone and 95.56 cm and 5.19 mm without applied by NAA hormone. Therefore an enrichment planting of *H. mengarawan*, is recommended to use wilding.

Key words: Wilding, Dipterocarps, Enrichment planting

Pratiwi, Marfu'ah Wardani & Abdullah Syarief Mukhtar

Commercial tree seedling identification in Sanggau, West

Kalimantan

Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia,

No. 532, 19-35, 1991, Indonesian

A study was made on commercial tree wildings in a woodlot within the concessional area of Sanggau Forest District, West Kalimantan.

The descriptions of the seedlings were made and then the drawings were produced using the fresh materials.

Twelve commercial tree wildings were covered by this work, comprising seven genera. *Shorea* was represented by 6 species, while *Dryobalanops*, *Hopea*, *Koompassia*, *Calophyllum*, *Payena*, and *Palaquium* each by a single species.

Key words: Commercial tree species, Wildling, Seedling

N.M. Capellan

Possibilities of bagtikan (*parashorea plicata*, Blandis), white lauan (*Pentacme contorta* Merr. & Rolfe), amugis (*Koordersiodendron pinnatum* Merr.), rain tree (*Samanea saman* Merr.) and spanish cedar (*Cedrela odorata* Linn.) wildlings as a nursery planting stock

The Philippine J. For., Philippines, 17 (1/2), 101-112, 1961, English

The five species were selected for study because they possess certain special characteristics and qualities, which make them suitable for planting in the different reforestation project. These qualities are durability, hardness, beauty of wood, fairly rapid height and diameter growth, and prolific seeding habits.

From under mother trees growing in fully stocked stands were gathered one hundred wildlings of each species. After lifting the required number of wildlings of each species, the leaves were trimmed to one-half the leaf area to reduce the rate of transpiration. The roots were then dipped in a mud-puddle and wrapped with a moist gunny sack. They were carried to the nursery where they were planted in the prepared transplant bed.

The results are as follows:

1. All of the species of wildlings studied, basing on the 94 percent survival for Spanish Cedar, 93 percent for Rain tree, 92 percent for Bagtikan, 89 percent for Amugis, and 59 percent for White Lauan, may be raised in forest nurseries as planting materials for reforestation purposes.
2. Since wilting occurred mostly during the first month, and decreases as the wildlings become established, the probable causes of mortality could have been the shock suffered by the wildlings and the injuries to the roots in the process of lifting. It was observed that death was caused principally by die-back.
3. Transplanting of wildlings from their natural habitat to the nursery induced root development and accelerated growth rate.

Key words: Wildling, Survival, Nursery

R. Mulyana Omon & Masano

The effect of NAA hormone on wildling and stump growth of *Dipterocarpus retusus* Bl. in Dramaga, Bogor

Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia, No. 479, 28-35, 1986, Indonesian

The effects of NAA hormone on wildling and stump growth of *Dipterocarpus retusus* Bl. were investigated at Dramaga Experimental Garden of the Forest Research and Development Centre (altitude 224 m asl and annual rainfall 4,962 mm).

NAA hormone which applied to stimulate root growth of wildling and stump with dosages of 0 cc/lt water, 5 cc/lt water, 10 cc/lt water and 15 cc/lt water respectively.

The result shows that the NAA hormone gives not significant difference either to survival percentage of wildling and stump or to height growth of *D. retusus* wildling.

The survival percentage of *D. retusus* wildling is bigger than that from ump and are highly significant difference.

Therefore an enrichment planting of *D. retusus*, is recommended to use wildling.

Key words: Dipterocarps, Hormone, Wildling, Root system

Marfu'ah Wardani, Sukawi Sutomo & Kade Sidiyasa

The influence of shading on diameter and height growth of *S. javanica* seedlings in Leuweung Sancang Nature Reserve, West Java

Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia, No. 491, 11-19, 1987, Indonesian

The growth observation of *Shorea javanica* K.et.V. seedlings has been conducted from December 1984 through January 1986 in Leuweung Sancang Nature Reserve, Garut, West Java. The objective of this observation is to study the effect of shading on the diameter and height growth of *S. javanica* seedlings. The rates of shading observation were 40%, 25% and 15%. The result of this observation showed that influence of the shading stages were not significant to both diameter and height growth of the seedlings.

Key words: Shading, Seedling, Nursery, Dipterocarps

I.M. Turner

A shading experiment on some tropical rain forest tree seedlings

Journal of Tropical Forest Science, FRIM, Malaysia,

Vol. 1 (4), 383-389, 1989, English

The growth of potted seedlings of *Shorea curtisii*, *Shorea macroptera* and *Gluta curtisii* was compared between three shade conditions. The treatments provided circa 1, 6 and 12% full sun photosynthetically active radiation (PAR) and altered the quality as well as the quantity of solar radiation reaching the plants, in order to simulate natural forest situations. All the species showed increased growth with increasing PAR. The two *Shorea* species grew better than *G. curtisii* in all the treatments. Whilst *S. curtisii* grew significantly better than *S. macroptera* in the 1 and 5% full sun treatments, the latter grew comparatively better in 12% full sun. This indicates that *S. curtisii* is more shade tolerant than *S. macroptera*.

Key words: Seedling, Sun-shade, Tolerant tree

P. Sundralingam, I. Hotta & Y. Osumi

Assessment of the nitrogen and phosphorus requirements of *Shorea ovalis* using sand culture

The Malaysian Forester, Malaysia, Vol. 48, No. 4, 314-323, 1985, English

A sand pot culture experiment was conducted to study the response of *Shorea ovalis* seedlings to N and P fertilizers in a 4 factorial combination using 0, 5, 20 and 50 mgN and

0, 1, 4 and 10 mgP.

The layout of the experiment was a completely randomized block design replicated thrice. Pure reagents of ammonium nitrate and sodium dihydrogen orthophosphate were used as sources of nitrogen (N) and phosphorus (P), respectively.

The first eight applications were carried out at fortnightly intervals and the last two at monthly intervals. At the termination of the experiment, the fresh weights of each part were determined.

The conclusion is as follows:

1. Statistical analysis of the results shows that nitrogen is the most important fertilizer required for better growth of *Shorea ovalis* than phosphorus.
2. The best treatment in terms of height and weight is 500 mg N and 40 mg P. The seedlings treated with the N and P mentioned above had a height increment of 59.2 cm in 8 months.
3. After considering the interaction effects, it was deduced that the range of nitrogen supplied was insufficient to induce maximum response and the highest level could have been increased to 80 mg. The highest level of phosphorus exceeded the optimum level and better choice of levels would probably have been 0, 2, 4, and 8 mg P.

Key words: Fertilizer application, Dipterocarps, Growth

Rosli bin O.K. Hj, Jilli & Y. Ocihai

The utilization of grass & sawdust for compost preparation

Forest Research Note in Brunei Darussalam, No. 53, 21 pp.,

1990, English

Developing countries, today, use compost made from various materials such as organic matter, agricultural waste, municipal waste, organic refuse and inflammable refuse which has undergone an industrial process.

This experiment has been carried out as continuation of the study entitled "The Utilization of Peat for Compost as compared with Sawdust Litter and Grass" (RNB-31, S. Kobayashi et al, 1989).

If mixture of sawdust and grass is used as compost material, it should be in a ratio of 50 -50. This is calculated from the weight and hot from unit volume.

When shattering the grass the straw should be separate otherwise it must be crushed completely before mixing it with other materials. This experiment indicated that the straw had not rotted and was very difficult to decompose even though a period of three months was allowed for the fermentation process.

Key words: Compost, Sawdust

Rita Tang I.O.

Forest nursery operation based on Malaysian Experience

with particular reference to Sabah

FRC Publication, Sabah, Malaysia, 20 pp., 1983, English

This paper outlines the various aspects of nursery operations with particular reference

to Sabah. It gives brief details of the requirements/specifications for the main tree species planted in Malaysia. An account of disease and pest problems in the nursery is given. Damping-off in eucalypt and pine seedlings can be a serious problem but precaution can be taken to prevent and control the disease. Foliage blight in *Pinus caribaea* is another potential serious problem in the nursery. Pest problems are generally less common and limited to defoliators and shoot borers. The importance of mycorrhizal fungi for certain species is reviewed.

Recommendations for improvement in operational areas and research are given. Nursery hygiene and fungicidal control measures should be improved. Identification of mycorrhizal association is species other than pine and epidemiological studies of various fungi are necessary to provide more basic information and understanding.

Key words: Nursery operation, Pest damage, Tree disease, Seedling

Hendromono

Utilization of peat and sawdust for mixed materials of  
*Eucalyptus deglupta* B1. seedlings

Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia,  
No. 500, 15-26, 1988

Growing medium for raising *Eucalyptus deglupta* seedlings in Indonesia usually using topsoil component. Ultisol soil as a growing medium has many problems, among other things its aeration is not good and its reactions is very acid. The aim of this experiment is to overcome the ultisol soil problem by mixing the soil with organic matters and liming it with dolomite to increase the growth and survival percentage of *E. deglupta* seedlings.

The research results show that the mixture of ultisol soil + Delta Upang peat (1:1 v/v) has a good prospect for *E. deglupta* medium. The best treatment combination for the growth and survival percentage of *E. deglupta* seedling is ultisol soil + Delta Upang peat (1:1 v/v) medium limed with dolomite 5 kg/m<sup>3</sup>. Dolomite dose 10 kg/m<sup>3</sup> is not recommended for increasing the growth of *E. deglupta* seedling in pure ultisol soil, ultisol soil + Delta Upang peat (1:1 v/v) or ultisol soil + sawdust (1:1 v/v).

Key words: Nursery, Seedling, Soil texture, Eucalypt

#### 4) Plantation Establishment

- site preparation, planting, coppice, direct seeding, mycorrhiza, enrichment planting, soil, etc. --

Suhardi & Agus Darmawan

Effect of light and mycorrhizal formation and growth of *Shorea academia* seedling

Proyek Peningkatan Perguruan Tinggi, Universitas Mulawarman, Indonesia, 35 pp., 1990, Indonesian

An experiment was carried out to determine the effect of light intensity on the mycorrhizal formation and growth of seedlings, effect of soil on the mycorrhizal formation and growth of seedlings, effect of fungus species in the mycorrhizal formation and growth of seedlings, and interaction of light intensity, soil and fungus species.

Each of 1 month-old *Shorea academia* seedlings was inoculated with 0.4 gr of small pieces of sporophore of *Scleroderma* sp. 10 ml sterilized water.

Light intensity was significant effect on growth of seedling. Heavy shade and medium shade gave higher height, diameter and biomass of seedlings than without shade seedlings.

There were significant effect of light intensity, soil type and inoculation on height, diameter, and biomass of seedlings. medium shade and Bukit Soeharto soil produced the highest height, diameter, dry weight, fresh weight were 20.3 cm; 5.9 mm; 8.0 gr; and 15.4 gr.

There were no significant effect of interaction of light intensity and inoculation (LM), soil type and inoculation (SM), and light intensity, soil type and inoculation (LSM) on the growth of seedlings.

Key words: Dipterocarps, Micorrhizal fungi, Light intensity

Shigco Kobayashi

Research report for the maintenance and effective use of forest resources in Negara Brunei Darussalam

Forest Research Note in Brunei Darussalam, Brunei, No. 11, 214 pp., 1988, English

The following rain forests were chosen in this study.

- 1) Peat Swamp Forest: *Shorea albida*, peat soil
- 2) Tropical Heath Forest: *Agathis dammara*, Kerangas soil,
- 3) Mixed Dipterocarp Forest: Mixed Dipterocarp, red - yellow soil.

These sites were measured and surveyed for the microclimate condition, the process of seedling establishment and vegetation recovery. Suitable silvicultural approaches were considered based on the data.

In the Peat Swamp Forests, two silviculture treatments were considered in order to improve the conditions: "Forest Patch Improvement" and line planting. "Forest Patch Improvement" treatment is devised for the acceleration of the natural regeneration of *Shorea*



*albida*. Line planting is devised for Hill and Bank planting methods. The two treatments are considered effective for increasing the forest resources in the Peat Swamp Forest.

For *Agathis dammara*, it is recommended that seedlings should be attached to mycorrhiza at nursery level and cone should be more than 8 cm in length, 7 cm in width and 200 g in weight when collected as supply of seeds. Seed storage is difficult. The viability of *Agathis* seeds drops rapidly and does not extend beyond a few weeks.

The condition of natural regeneration in the exploited area of Mixed Dipterocarp Forests was unsatisfactory. Therefore, impact of harvesting was clarified and a new harvesting method – Brunei Selective Harvesting System (BSHS) – was proposed. This method is intended to minimize tractor trail and to allow dipterocarp mother trees to remain satisfactorily. Silvicultural approaches to secondary forests are considered in this report.

Key words: Enrichment planting, Natural regeneration, Seed viability, Seed

Y. Ochiai, Rosli O.K. Hj. Jilli et al

Trial plantation study of indigenous species in proposed  
plantation area

Forest Research Note in Brunei Darussalam, Brunei, No. 33,  
21 pp., 1989, English

Recently, secondary forest spread widely. Sometimes, secondary forest is lacking valuable species. It is accordingly necessary to enrich the quality of the secondary forest with indigenous species for future forestry development, using scientific knowledge. Then the Forestry Department of Negara Brunei Darussalam proposed a plantation area near Andulau Forest Reserve for the experiment site. We chose our experimental site from this proposed area and named our experimental site "Proposed Plantation Area (PPA)". Suitable technique for enriching the quality of secondary forest, will be developed in this Proposed Plantation Area (PPA).

Two new techniques named Forest Patch Improvement (FPI) and Gap Formation Planting (GFP) will be introduced in this research note. Forest Patch Improvement (FPI) involves the felling of upper trees where they are many seedlings of commercial species, in order to improve the light condition for the seedlings. Therefore, FPI should be applied where there are many commercial tree seedlings. Gap Formation Planting (GFP) involves planting the seedlings of commercial species in artificially formed gap. GFP resembles regeneration in natural forests. In natural forests, when a large mother tree falls, a gap is created (referred to as gap formation) and more light is allowed to penetrate to the forest floor. Therefore, the seedlings in that gap grow quickly. GFP should be applied where there are no seedlings of commercial trees.

There will be special reference to these two techniques.

Key words: Secondary forest, Enrichment planting, Tending

Yukihito Ochiai

Silvicultural study on dipterocarp-species in Negara Brunei  
Darussalam

Forest Research Note in Brunei Darussalam, No. 48, 61 pp., 1990,

English

The study of dipterocarp species is necessary for the recovery of tropical rain forests. Dipterocarps make up the majority of species in tropical rain forests of South-east Asia.

If tropical rain forests continue to decrease, the dipterocarp family will not be able to hold the dominant position in the forest. Therefore, studies conducted in dipterocarp species is essential to the recovery of tropical rain forests.

This report deals with the silvicultural treatment of seedlings from dipterocarp species in order to assist the recovery of secondary forests which have been degraded by the exploitation of its timber. This report comprises three areas. Firstly, the observance of the seedlings in the natural forests in order to understand how the seedlings grow. Secondly, the investigation of characteristics of seed and seedling are in order to evaluate the resources of the plantation material. The seedlings of dipterocarp species are believed to have little resistance against strong sunlight. Therefore, seedlings are usually put under shade in the nursery and planted under the forest where they receive little light. However, the planting of seedlings in wide open areas should be considered in order to encourage fast growth. Thirdly, the silvicultural methods for enriching the secondary forests.

Key words: Dipterocarps, Seedling, Seed, Enrichment planting

R. Mulyana Omon

Growth and survival of *shorea ovalis* seedlings grown in strips of different width in Carita, Banten

Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia, No. 485, 47-53, 1986, Indonesian

In August 1984, 12 strips of different widths (0.5; 1.0; 1.5 meter), approximately 75 meter long and 5 meter apart were opened in a secondary forest on flat topography within the Carita Experimental Forest of the Forest Research and Development Centre. In the strips 4 months old nursery grown potted seedlings of *Shorea ovalis* were planted at spacing of roughly 3 meters. The experiment was laid out in Completely Randomized Design.

Height measurements were taken quarterly during one year and a half. It appears from analysis of available data showed that width of one meter gave significant different either to survival percentage or to height growth of *S. ovalis*.

Therefore an enrichment planting of *S. ovalis*, is recommended to use strip plot with optimal 1.0 m width.

Key words: Dipterocarps, Line planting, Enrichment planting

Tang Hon Tat & Harold Wadley

Report on the survival and development survey of area reforested by line-planting in Selangor

FRIM Research Pamphlet, Malaysia, No. 67, 30 pp., 1976, English

Implementation of line-planting as part of planned regeneration operations was initiated by Selangor, Peninsular Malaysia, in 1961 and Perak in 1967. These operations were

made in the face of increasing acreages of poor regeneration stocking after logging and with no guidelines or experience to follow.

The need to develop satisfactory planting and treatment techniques became urgent and this survey was initiated to first, assess the survival and development of planted areas and then to draw up guidelines for future operations.

On the whole, the survival percentages obtained are alarmingly poor. The higher survival percentages were obtained from only a few areas which had received post-planting treatments under "unusually" close supervision. The total cost incurred in all these operations is also surveyed. It appears obvious that the investments made in the planting programmes have been high, but the success achieved has not been commensurate with these investments.

The high mortality found in the survey could have been due to ecological factors e.g. species-site, compatibility, etc., and/or management factors e.g. execution and timing of treatments, staff shortage.

Key words: Line planting, Survival, Silvicultural technic

H.T. Tang & T.K. Chew

Preliminary results of two six-year old under planting trials at Tapah hills forest reserve, Perak

The Malaysian Forester, Malaysia, Vol. 43, No. 2, 193-211, 1980, English

In 1972, a series of trials on under-planting (*Shorea parvifolia*) was established at Tapah Hills F.R., Perak. The results of the preliminary analysis of two of the trials, Treatment trial and a Group planting trial, are presented here.

In the Treatment trial, the objective was to study the effects of the removal of shade along the planting lines at various times before and after planting. In the Group-planting trial, the objective was to compare the relative merits and demerits of group-planting against line-planting.

Based on the results of the preliminary analysis, the following conclusions are drawn,

- (1) The immediate removal of overhead shade using a chainsaw seemed to result in a higher initial mortality of the planted seedlings. However, the surviving seedlings did not suffer any adverse effect in terms of height growth.
- (2) The non-removal of overhead shade seemed to reduce the height growth of the planted seedlings. At 6 years, the mean diameters in the untreated plots were also significantly smaller than in the treated plots.
- (3) The removal of overhead shade should be carried out within 6 months of planting, but preferably within 3 months. Any delay beyond 6 months will probably result in a reduction in height growth of the planted seedlings.
- (4) Group-planting should be preferred to line-planting because of the many advantages it offers. At this stage, 4 trees per group planted at 10 x 10m spacing is recommended.

Key words: Underplanting, Enrichment planting, Tending

P. DeLa Cerna & S. Abarquez

Planting White Lauan (*Pentacme contorta* VID. merr. & Rolfe) in Cebu Reforestation Project by direct seeding and by nursery

raised seedlings

The Philipp. J. For., Philippines, 16 (3/4), 179-181, 1960, English

White lauan was planted under the teak plantation in the Cebu Reforestation Project by direct seeding and by nursery raised seedlings.

The teak trees at the time were 10 years old, with a stand density of 120-140 trees to a hectare.

Direct seeding: approximately 25,000 seeds were directly sown in the teak plantation of about 1.5 hectare.

Nursery raised seedlings: about 18,000 seeds (wing removed) were sown 15 x 20 cm apart in seedbeds of clay-loam soil.

A year after sowing, the seedlings attained an average height of 40-50 cm. Shortly before pulling the seedlings out from the nursery beds, they were trimmed half of their foliage to reduce transpiration. They were set out in the plantation by bare-root method and earth-ball method.

Fresh lauan seeds readily germinated if immediately sown. However, development of germinating seedlings in the plantation slows down after two or three weeks. This is attributable to the close canopy which permits very little light for the germinating plants. There was observed a big mortality of the seedlings.

The use of nursery-raised seedlings planted in the field by the earthball method is very successful in propagating lauan. A high percentage of survival can be expected because the seedlings are vigorous.

On the other hand, lauan is very sensitive to the bare-root method of planting. It is observed that seedlings 30-59cm tall have very poor root development and rootlets are easily crushed when seedlings are lifted from the seedbeds.

Key words: Dipterocarps, Direct seeding, Seeding, Underplanting

S. Sasaki & T. Mori

Growth responses of dipterocarp seedlings to light

The Malaysian Forester, Malaysia, Vol. 44, No. 2, 3, 319-345, 1981,

English

This paper deals with the growth responses of dipterocarp seedlings to various light conditions under forest canopies and in shade chambers.

The light reaching the forest floor consists of direct sunlight and diffused light, including the light reflected and transmitted through canopy layers. In the forest, sunflecks of direct sunlight, which usually provide above 50% of annual total light energy on the forest floor is superimposed on a background of diffused light. The frequency and intensity of the sunflecks appear to have a good correlation with the light intensity of the diffused light. The growth of seedlings (*Shorea talura*, *S. ovalis*, *Hopea helferi*, and *Vatica odorata*) showed a close correlation with the diffused light level in a range of light intensity below 20% of full sunlight. This result also revealed that the minimum light intensity for their continuous growth was about 1,500 Lux in the diffused light. The spectral composition of light under forest canopy was characterized by a low ratio of red to far-red light, and this light condition stimulated the internode elongation of seedlings and restricted the root growth. Other morphological changes of the seedlings grown under shade will be discussed.

Artificial shading is important for raising healthy nursery stocks. Young dipterocarp seedlings (*S. assamica*, *H. helferi*, *V. odorata*, and *Dipterocarpus oblongifolius*) were grown in shade chambers under five grades of light conditions (32–100% of full sunlight); the best growth was observed at 30 to 50% in the shoots and at 50 to 60% in the roots, respectively. The weight ratio of shoot to root increased with the decline of light intensity. Growth responses to light conditions varied considerably among species, with *S. talura* and *V. odorata* requiring stronger light than *H. helferi* for their best seedling growth.

Key words: Dipterocarps, Forest floor, Seedling, Light intensity

T. Suzuki & D.V. Jacalme

Response of dipterocarp seedlings to various light conditions  
under forest canopies

Bulletin of the Forestry and Forest Products Research Institute,  
Japan, No. 336, 19–34, 1986, English

This paper deals with the response of six dipterocarp species to various lighting conditions under forest canopies.

Four experimental plots under different forest canopies and one plot in open land were established in the Makiling Experimental Forest, which belongs to the College of Forestry, University of the Philippines at Los Banos.

Under the heavily shaded condition at 1.8% of full sunlight, the survival rates of *Shorea almon*, *S. polysperma* and *Parashorea malaanonan* seedlings were about 10–35%, within a few months of planting. However, the seedlings of *Hopea foxworthyi* and *Vatica mangachapoi* had high survival rates of 85.0% and 97.5% respectively at the same light intensity. The rate of *Anisoptera thurifera* was 65.0%. At 11.7% and 18.9% of full sunlight, all species tested in the experiments showed significantly high rates of survival. In full sunlight condition, about 20–50% of *S. polysperma*, *H. foxworthyi* and *V. mangachapoi* seedlings were damaged, probably due to the strong desiccation and high temperature during the dry season. The maximum growth in height, diameter and dry matter weight for all species was attained in full sunlight.

Since the diameter growth was inhibited more than the height growth under a certain shading, the H/D ratio increased in general with the reduction of light intensity. This remarkable tendency was observed in the 11.7% and 18.9% plots. Among the species, the degree of change in the H/D ratio with shading was relatively greater in the seedlings of *S. almon*, *S. polysperma*, *P. malaanonan* than in those of *A. thurifera*, *V. mangachapoi*.

There was a marked trend on the distribution of dry matter production into parts. As the relative light intensity decreased, the percentage of leaf to the total dry matter weight of seedling increased in general, while that of the stem portion did not change, and those of branch and root decreased.

Key words: Dipterocarps, Light intensity, Seedling, Natural regeneration

D.I. Nicholson

Light requirements of seedlings of five species of *Dipterocarpaceae*

The Malayan Forester, Malaysia, Vol. 23, No. 4, 344–356, 1960, English

Apart from planting or weeding the only method of influencing the composition of a regenerating dipterocarp forest is to manipulate the light conditions of the stand to favour or hinder the growth of certain species in accordance with their tolerance to light.

Seedlings of five species of *Dipterocarpaceae* were grown in plots having 100%, 87.5%, 75% and 50% of full daylight. Measurements were made of monthly height increment for a period of seventeen months. The lighting of the three shaded plots was then interchanged and measurements continued for another ten months. Soil temperatures were measured on two occasions and the final girths of the trees were also determined. It was found that all five species responded positively to some shading, the order of decreasing response being kapur, seraya tembaga, majau, urat mata, and keruing buloh.

In all cases, some shade increased the height and girth (and the green weight) of the plants. The explanation may lie in the fact that the leaf area of the partly shaded plants was greater and more than compensated for the lower assimilation rate per unit area.

It was found, however, that after "establishment" all species can tolerate and grow rapidly in 87.5% light and most probably in full light as well.

Key words: Dipterocarp, Natural regeneration, Light intensity, Seedling

C.C. Tomboc & R.M. Basada

White lauan (*Shorea contorta*) in the open and under second-growth forest canopy

Sylvatrop Philipp. For. Res. J., Philippines, 3 (4), 205-210, 1978, English

Freshly fallen white lauan seeds of uniform sizes were gathered from a mother tree near the Dipterocarp Forest Research Center nursery.

The mother tree had a diameter at breast height of 80 cm and total height of 35 meters, standing dominant in the multi-stored forest.

The seeds were sown:

A - under the secondary forest canopy. Sunlight filters through the multilayered canopy for at most one hour daily.

B - in the open. The seedbed could receive full sunlight from 8:00 AM to 4:00 PM.

When tested statistically, the differences in survival between the two treatments were highly significant. The survival of seedlings under the forest canopy was 67.8% better than that of seedlings receiving full sunlight, 15 days after sowing. After 90 days, the survival advantage on Treatment A was 51.4% over B or a decrease of 16.46% in a time interval of 75 days.

There was no change in the survival of the seedlings after 250 days from that in 90 days.

There were no significant differences in the height of seedlings between the two treatments 90 days after sowing. In percent, the difference is only 11 more in height for the seedlings in Treatment B. But after 250 days, the differences were highly significant for the seedlings under full sunlight. The average height difference was 59.50 cm more on B or 63.0% better. For B, the average increase in height was 75.5 cm in 160 days while A was only 18.1 cm.

The difference in the number of leaves between the two treatments was highly significant 90 days after sowing, 45.5% more for Treatment B. After 250 days, the same was also highly significant, the seedlings in B with an average leaf number of 80.4% more than

in A.

In size, the leaves of the seedlings in B were much bigger than in A, more vigorous in appearance.

Key words: Dipterocarps, Seedling, Direct seeding, Silvicultural technic

T.H. Tat & H.E. Wadley

A guide to artificial regeneration with particular reference to line-planting in Peninsular Malaysia.

FRI Research Pamphlet, Malaysia, No. 68, 41 pp., 1976, English

Silvicultural practice in the past in peninsular Malaysia has been based on natural regeneration. Since 1960's, however, it has become increasingly obvious that natural regeneration could no longer be relied upon for the renewal of the bulk of the productive forests after logging and the alternative means of obtaining a new economic crop by artificial regeneration has become increasingly more important.

This Preliminary Handbook was compiled as a result of the systematic survey of planted area carried out in 1972/1973. The main items editorialized are as follows.

1) Determination and planning of areas requiring artificial regeneration. 2) The planting stock. 3) Planting operation. 4) Survival and development sampling.

To effect the successful establishment and maintenance of the required acreage, more staff at all levels must be recruited and trained and the necessary infrastructural facilities must be built up under the guide. As most of the physical work in the nursery and in the forest are carried out by forest labourers, the success or failure of this work often depend on whether they fully appreciate the purpose and significance of their work.

Key words: Enrichment planting, Regeneration, Silvicultural technic, Line planting

B.B.H. Ghazali & J.B. Baharuddin

The emergence of enrichment planting in West Malaysian silviculture

The Malayan Forester, Malaysia, Vol. 35, No. 3, 209-218, 1972, English

Enrichment Planting, as the term implies, is essentially the process of supplementing the natural regeneration where it is considered insufficient, with seedlings (normal indigenous species) specially raised for the purpose.

The paper discusses the increasingly important role of enrichment planting as a silvicultural tool in view of the limited success of the Malayan Uniform System in rehabilitating the poorly stocked hill forests and other disturbed or inherently poor lowland forests. This role has gained urgency as land development programmes progress over fertile lowland areas at the expense of choice dipterocarp forests. The main bulk of the country's future timber resources will have to be derived from hill forests and lowland forests on poor sites. Rehabilitation measures will be required for most of these areas. Suggestions are made to reduce the need for enrichment planting.

Enrichment planting as an organized operation started in the mid 1960's in Selangor. Currently, at least five States are actively engaged in enrichment planting with a planned total

of some 8,000 acres annually. Indeed, enrichment planting has become a major development project of the Forestry Department which aims to enrich some 40,000 acres of poor forests over the five-year period of the Second Malaysia plan 1971-1975. The steady accumulation of backlog areas for silvicultural treatment presents a potential and rising need for rehabilitation measures. Assuming that half of the 580,000 acres of current backlog areas will eventually require enrichment, this would cost about M\$43, million at the present average establishment cost of about M\$150.00 per acre.

Key words: Enrichment planting, logged-over area, Regeneration

D.N.P. Chai

Enrichment planting in Sabah

The Malaysian Forester, Malaysia, Vol. 38, No. 2, 271-277, 1975, English

An area was selected from Coupe 1972 - A (3,022 acres) of Messers Sabah Timbers Company's concession at the Segaliud-Lokan Forest Reserve. The area was logged from August to October 1972.

A site of approximately 51.7 acres was artificially regenerated by enrichment planting using wildings of *Dryobalanops lanceolata*, *Parashorea tomentella* and other species.

A total of 3,516 wildings were planted. The overall survival rate of the planted wildings is 42.5%. Survival between species varies, *Dryobalanops lanceolata* (Kapur Paji) has the best survival with 44.6%, followed by *Parashorea tomentella* 36.6% and others 11.1%. The high mortality is due to the fact that the size of wildings planted is too large. Survival is best for seedlings less than 6" high. Most of the seedlings planted were larger than 7". Other major causes for the high mortality is the entanglement by climbers and flooding of low lying areas.

Although the mortality is high for the planted seedlings, it is within the limit of the objective. There will be more than 40 trees/acre which is the final target for main species. For those that survived one year after planted, mean height growth is 9.8".

The total cost for the entire project which lasted for 5 months (from the time of sampling and wilding collection to completely planting the whole plot) of M\$13,288 is expensive. This figure includes overhead expenditure such as Sundays and Holidays, Sick days, transport etc. If only the cost for sampling, cutting of planting lines (rentising) collection and tending of seedlings at nursery and planting is considered, the cost of M\$74/acre is reasonably low.

Key words: Enrichment planting, Wilding, Height growth, Survival

M.M. Maun

Growth and survival of malayakal and guiyo wildlings transplanted  
in brushland forest

Sylvatrop Philipp. For. Res. J., Philippines, 4 (3), 179-182, 1979, English

Malayakal (*Shorea seminis*) and Guijo (*S. guiso*) are dipterocarp trees of great economic importance. Their woods are mainly used for various building constructions. There is a need to develop a technique with which to artificially regenerate these species that are



considered vanishing.

The study site was at Magat Experimental Forest Lot, Diadi, Nueva Vizcaya, characterized by a brushland forest of homogeneous stand. The slope ranges from level, gentle to medium and with elevation of about 200 meters above sea level.

The treatments were 5 different height classes of the wildings as follows; (a) Up to 20cm, (b) 21–40cm, (c) 41–60cm, (d) 61–80cm and (e) 81–100cm. Each plot in a block was planted to 50 bare-root and mid-puddled wildings spaced 2m x 2m. Each wilding was trimmed to about two-third of its leaf area prior to planting using dug-hole method.

In survival rate for wild guijo seedlings, height class 41–60cm yielded the highest with 37.94%. In height increment height class 61–80cm obtained the highest, 0.518m.

In survival rate for wild malayakal seedlings, height class 0–20cm obtained the highest with 23.30%. In height increment, height class 0–20cm yielded the highest with 0.159m.

In planting wild guijo seedlings height class 41–60cm may be used. This height class was found more suitable for transplanting in both survival and height as compared with the other height classes.

In planting wild malayakal seedlings, height class 0–20cm may be employed. It was also observed more suitable for transplanting in both survival and height as compared to the other height classes. The seedlings were observed to readily recover after transplanting.

The correlation between the initial planting height and final height is negative in both species. The negative results on height in both species were due to adverse climatic condition during summer months causing dieback on height.

Key words: Dipterocarps, Wilding, Survival

N.S. Gianan & D.I. Peregrino

Effects of gibberellic acid on the survival, height and diameter growth of planted red lauan, mayapis and tanguile wildings

Sylvatrop Philipp. For. Res. J., Philippines, 11 (3&4), 103–127, 1986,

English

This study aimed to accelerate growth of outplanted tanguile (*Shorea polysperma*), mayapis (*S. squamata*) and red lauan (*S. negrosensis*) wildings in the open using gibberellic acid. Specifically, the objectives of the study were: (1) to assess the growth and survival of outplanted dipterocarp wildings treated with gibberellic acid, and (2) to determine the best rate or dosage of gibberellic acid to be used in dipterocarp wildings.

The stock solution was prepared by dissolving GA<sub>3</sub> in 95% ethyl alcohol and then diluting it with rain water to come up with a concentration of 900 ppm. From the stock solution, desired concentrations of 75 ppm, 50 ppm and 25 ppm were formulated.

For all species of wildings studied, survival was 100% after the application of GA<sub>3</sub>. This indicates that the different concentration levels of GA<sub>3</sub> used in the study have no adverse or toxic effects on the wildings. Wildings of tanguile with lesser and greater number of leaves require 50 ppm and 75 ppm GA<sub>3</sub>, respectively, to perform better height growth. This suggests that GA<sub>3</sub> can be used for tanguile to enhance height growth more than the diameter although the responses are slow to be observable within only 7 months.

There was no observable effect of GA<sub>3</sub> on height and diameter growth of mayapis wildings. GA<sub>3</sub> may not improve the growth and development of mayapis because the concentrations used might be so low to have an effect on either height or diameter growth.

Red lauan requires 50 ppm GA<sub>3</sub> to significantly increase diameter but not height growth.

Some wildings were attacked by beetles. It is recommended that further studies with insecticide should be conducted to obtain a more realistic growth.

Key words: Dipterocarps, Wilding

F.P. Mauricio

A preliminary study on the behavior of wild dipterocarp seedlings when transplanted in the forest

The Philipp. J. For., Philippines, 13 (3/4), 147-159, 1957, English

The bagtikan and white lauan wildings used in this study were selected from the vigorous natural reproductions under mother trees growing in the Makiling National Park. The mother trees were from 50 to 100 centimeters in diameter and about 20 to 30 meters high.

The wildings were classified into height classes by measuring from the root collar to the tip of the shoot as follows: 0-20 centimeters, 20-40 centimeters, 40-60 centimeters, 60-80 centimeters, and 80-100 centimeters. There were fifty wildings to each size class.

The wilding were mud-puddled and transplanted in the forest.

Mortality and survival, wilting and dying back of the wildings were noted. Three months after planting, monthly height measurements were made.

The results are summarized as follows:

1. Based on the percentage of survival (68.4 per cent in white lauan and 28.8 per cent in bagtikan), these species may be used for reforesting logged-over areas provided nurse trees are available. White lauan may be preferred to bagtikan, however, since the former attains a higher percentage of survival as well as a greater mean increment than the latter.
2. The period of wilting and average number of days of recovery of the transplants increase directly with the height class.
3. Based on mortality, the size of planting material that may be suitable for field planting is 20 cm and below because they can readily recover after transplanting.
4. The appropriate size of planting material based on the mean increment or rate of growth is 40-60 cm in height.

Key words: Dipterocarps, Wilding, Underplanting

Erdy Santoso

The effect of mycorrhiza on the stem diameter and dry weight of dipterocarp seedling

Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia, No. 504, 11-22, 1988, Indonesian

Forty five days old seedlings of several *Dipterocarpaceae* (*Hopea odorata*, *Vatica sumatrana*, *Shorea stenoptera*, *S. pinanga* and *S. compressa*) were grown for 6 months in potted fumigated red yellow podzolic soil, taken from the experimental plantations in Haurbentes, into which fresh inocula of *Russula* sp., *Scleroderma* sp. and *Boletus* sp. had been

incorporated. The inocula used were pieces of sporophores of the fungi root colonization was evaluated 6 months after inoculation.

At the end of the growing season, top/root ratios of all seedlings were calculated from determination of the dry material of leaves, stems and roots. This revealed an increased amount of root formation in the presence of mycorrhiza.

In general inoculation of the Dipterocarp seedlings with ectomycorrhiza fungi gave a tremendous increase in growth compared with the uninoculated controls.

Improvement of top/root ratios, increase of the dry weight of leaves, stems and roots and stem diameter of *H. odorata*, *V. sumatrana*, *S. stenoptera* and *S. compressa* seedlings peaked when they were inoculated with *Scleroderma*, while on *S. pinanga* the best results were obtained with the use of *Russula* sp.

Key words: Dipterocarps, Mycorrhizal fungi, Seedling

Erdy Santoso

Correlation between root length of *Dipterocarpaceae* with class of mycorrhizae fungus infection on roots of dipterocarp seedlings in Bukit Suligi protection forest, Riau, Sumatra  
Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia,  
No. 488, 18-27, 1987, Indonesian

In order to succeed in the establishment of a Dipterocarp plantation, the soil as a growth medium should be supported by fertility in order that the trees have the capacity to take up the available essential macro and micronutrients.

Not less important is the occurrence of fungi, which can form a significant source of ectomycorrhizal inoculations on seedling and tree roots. The fungi are capable to form an association with the tree roots.

Mycorrhizal fungi are most often found near the soil surface. Statistical analysis showed that soil depth had a significant effect on the development of mycorrhizae. This factor seems likely to influence the mycelial growth of the ectomycorrhizal fungi due to the poorer aeration and the higher bulk densities.

It is very important to compare the effectiveness of different mycorrhizal fungi in improving growth and yield of a Dipterocarp plantation.

Key words: Dipterocarps, Mycorrhizal fungi, Root system, Mycorrhiza

Erdy Santoso

Effect of mycorrhizal fungi on nutrient uptake of five Dipterocarp seedlings  
Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia,  
No. 532, 11-18, 1991, Indonesian

Forty five days old seedlings of five Dipterocarp species viz. *Hopea odorata*, *Vatica sumatrana*, *Shorea stenoptera*, *S. pinanga* and *S. compressa* were grown for six months in plastic containers filled with fumigated red yellow podsolic soil taken from the Dipterocarp experimental garden at Haurbentes, and each soil in the container was treated with one gram

inoculum containing basidiospores from sliced fruiting bodies of *Russula cyanoxantha*, *R. amatica*, *Russula* sp., *Scleroderma columnara* and *Boletus* sp.

The experiment was laid out in a 5 x 5 factorial design involving five Dipterocarp species and five mycorrhizal fungi arranged in a randomized complete block design with three replications.

The results revealed large differences in nutrient contents of stem and root tissues following inoculation. Mycorrhizae of *Scleroderma columnara* proved to have the highest absorption potential for nutrients except in *Shorea pinanga* and *Russula amatica* seemed to be the most suitable symbiont for *Shorea pinanga*.

The study indicated the need to inoculate planting stock of the future Dipterocarp industrial plantation with the most beneficial and effective mycorrhizal fungi.

Key words: Mycorrhizal fungi, Dipterocarps, Seedling

Erdy Santoso

The relationship between development intensity of mycorrhizae with growth of dipterocarp seedling

Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia, No. 516, 27-34, 1989, Indonesian

Seedlings of *Hopea odorata*, *Vatica sumatrana*, *Shorea stenoptera*, *S. pinanga* and *S. compressa* were grown for 6 months in plastic containers. The soil in this experiment was taken from an existing Dipterocarp plantation in Haurbentes and sterilized by fumigation with Vapam. The seeds were collected from trees growing in that plantation and sterilized by soaking in a sodium hypochlorite solution for 10 minutes. The seedlings were inoculated in the root zone when they were 45 days old with one gram segments of the fruiting body of either *Russula* sp., *Boletus* sp. or *Scleroderma* sp. fungus.

Growth (height, diameter, dry weight of leaves, shoots and roots) of all species was increased by inoculation with forementioned mycorrhizal fungi, except for *S. pinanga*, which showed a specific preference for *Russula* sp.

Key words: Dipterocarps, Seedling, Mycorrhizal fungi

Rahim Sulaiman

The state of the art of silviculture of fast growing species in Sabah  
FRC Publication, Sabah, Malaysia, No. 35, 60 pp., 1986, English

The development of commercial forest plantations in Sabah is not a matter of choice but of necessity. The era of plantation in the State commenced in 1974 with the establishment of Sabah Softwoods Sdn. Bhd. To date there are about 50,000 hectares of forest plantation in Malaysia, of which 44,000 hectares are in Sabah. A brief account of the present status of forest resources and the development of plantation forestry in the State is given. The main species planted in the State are *Acacia mangium*, *Eucalyptus deglupta*, *Gmelina arborea* and *Paraserianthes falcataria*. The state of the art of silviculture of these four establishment (Nursery phase), establishment and post-establishment phase.

Key words: Fast growing species, Plantation, Silvicultural technic

J. Wyatt-Smith

Manual of Malayan silviculture for inland forest, part III-  
chapter 8, red meranti-keruing forest

FRIM Research Pamphlet, Malaysia, No. 101, 89 pp., 1987, English

This chapter includes all those lowland forests which are rich in members of the genus *Dipterocarpus* (Keruing) and of the Red Meranti group of the genus *Shorea*. These comprise the most valuable commercial forests in the Malay Peninsula and are those which are most in demand by the timber operators.

The regeneration of the merchantable species are in general strong light demanders. They have rapid height growth in their early years and a sufficient percentage of regeneration can successfully compete for space if overhead light is provided. The necessity for a girdling operation of unwanted overwood, as early as possible after completion of timber exploitation, cannot therefore be over-emphasised if seedling and sapling regeneration is to grow. This is especially the case with the preferred dipterocarp species.

It is also strongly recommended that appropriate sampling be carried out whenever there is some doubt of the extent, status and distribution of regeneration. Linear regeneration sampling is sufficiently flexible to cater for all circumstances and is not expensive. Treatment will certainly be necessary during the period between being passed as regenerated and final felling for timber at the end of the rotation. The rotation is presently estimated to be 70 years but it will hopefully be less if treatment is provided. This chapter, also includes general silvics of principal timber species viz. flowering and fruiting, seed and seedling development, coppicing power and vegetative reproduction, pests and other damaging agencies, etc.

Key words: Dipterocarps, Silvicultural technic, Natural regeneration, Flowering and fruiting

K. Kamo, A. Sato & A.L. Javing

Coppice growth of some tropical tree species in Mindanao island,  
the Philippines

JARQ, Japan, Vol. 24, No. 3, 235-241, 1990, English

In many broad-leaved trees and some coniferous trees, new sprouts are produced from the stumps in response to impediments such as cuttings, mechanical injuries or fires. This method for reproducing forests is one type of asexual reproduction: it is called coppice. The coppice method is the simplest and perhaps the oldest way among all the methods used for regenerating forests. In temperate regions, the coppice system had been widely developed for the production of fuelwood.

A study on coppicing capability of some tropical trees, including *Leucaena leucocephala*, *Gmelina arborea*, *Tectona grandis* and *Pileostigma malabaricum* var. *acidum*, was undertaken with particular emphasis placed on their initial sprout growth and the factors affecting the production of sprouts in Mindanao Island, the Philippines. The growth of sprouts of these species was so outstanding: it was 5-10m in height and 4-6cm in diameter in the first year. This could lead to shorten the rotation period to a greater degree compared with temperate trees, provided that the site for coppicing is adequately selected. A stump size

was recognized to have a positive effect on the initial growth of sprouts. This suggests that larger trees may be cut to produce more and larger sprouts. A reciprocal relation existed between the sprout growth and the sprout density regarding the stump of *G. arborea* and *T. grandis*. On the basis of this relationship, a threshold density of sprouts was estimated in order to identify appropriate criteria in conducting a sprout thinning on a given stump. Concerning the cutting system, a clear-cutting or a heavy crown thinning would be suitable for producing larger and healthier sprouts to reproduce the stands.

Key words: Coppicing, Stump, Clear cutting

Winastuti Dwi Atmanto  
Inoculation *Rhizobium* on *Paraserianthes falcataria* Seedling  
with soil as Medium  
Laporan Penelitian, Universitas Gadjah Mada, Indonesia, 32 pp.,  
1990, Indonesian

The aim of this research is to learn and get information about the effect of *Rhizobium* inoculation on growth of *P. falcataria* seedlings, to find the best strain of *Rhizobium* for inoculation and try to compares *Rhizobium* inoculation with urea fertilizer.

Randomized Complete Block Design was used for this experiment, 5 blocks as replications, each block had 6 treatments, each treatment in block contains 5 seedlings. The 6 treatments as control, without inoculation + urea fertilizer, inoculation with a single strain of *Rhizobium*, inoculation with a single strain of *Rhizobium* + urea fertilizer, inoculation with a mixture of strains of *Rhizobium*, inoculation with a mixture of strains of *Rhizobium* + urea fertilizer.

The result showed that inoculation with a mixture of strains of *Rhizobium* is the best and the percent of urea fertilizer with lower concentration in *Rhizobium* inoculation, seedlings of *P. falcataria* would be better.

Key words: Root nodule bacteria, Seedling

Makoto Ogawa  
Ectomycorrhiza of dipterocarps and the utilization for  
reafforestation  
JICA Project Report (The Tropical Rain Forest Research Project),  
Indonesia, 23 pp., 1991, English

Importance of mycorrhizal formation for the growth of Dipterocarps has been well known. However, there is no available practical methods by which the fungi can be inoculated efficiently to host plant roots yet. The mycorrhiza of Dipterocarps, mycorrhizal fungi, inoculation methods and growth responses to mycorrhiza formation were studied for two years. Main points of the results are as follows.

1) Mycorrhizal fungi of Dipterocarps

Higher fungi were collected from Dipterocarp forests in East Kalimantan and stocked for identification. The fungal flora consisted of *Scleroderma*, *Amanita*, *Russula*, *Lactarius*, *Laccaria*, *Boletus* etc. Among them *S. columnare* and *Laccaria*

*vanaceoavellanea* which inhabited in young stands or plantation with unmaturred and infertile soil seemed to be useful as for inoculum.

2) Effects of inoculation on tree growth

In this experiment the effects of inoculation of *S. columnare* were clear after 3 months but it became negligible after 6 months because of natural infection in nursery. Growth response to the frequency of mycorrhiza formation on the seedlings which were planted in arboretum was traced for two years, and it was found out that there was clear correlation between them.

3) Soil improvement in nursery

In Kalimantan it seemed to be necessary to improve soil properties in order to make the roots and mycorrhiza grow well. So the preliminary work was tried using charcoal powder in 1990, and it became clear that mixing of charcoal 5% v/v was effective for growth and mycorrhiza formation, though the higher concentration was harmful for plant growth.

Key words: Dipterocarps, Mycorrhizal fungi, Soil improvement

S. Kobayashi, Y. Ochiai, R.O.K. Jilly & R.A. Wahid  
Interim report on the utilization of peat resources in  
Brunei Darussalam  
Forest Research Note in Brunei Darussalam, Brunei, No. 31,  
37 pp., 1989 English

Among tropical rain forests, peat swamp forest has a potential not only timber production, but also peat land used for agriculture.

In this study, chemical and physical properties of peat were clarified depended on different forest types.

Hemic material was dominated until 20–80cm in depth and loose fibric material became fluid in lower horizon (3.5m) held by roots system which appeared under the ground water level. Generally, bulk density was quite small (0.1 – 0.2), porosity was high (85–93%).

The pH of peats indicated quite low (3.3–3.5) and Cations were very poor, particularly calcium and potassium. Therefore, peat of Brunei was characterized as oligotrophic Tropofibrists. Nevertheless, surface of peat could not been determined sulfic acidity and had appeared to supply inorganic nitrogen gradually during mineralization and dehydration process. Therefore, peats of Brunei could be utilized as compost and agricultural field.

Possibility of peat utilization for compost, also was examined in this study.

Key words: Soil texture, Compost, Peat

Ign. Purwanto & Ombo Satjapradja  
A study of soil properties under *Swietenia mahagoni* plantations  
Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia,  
No. 527, 21–31, 1990, Indonesian

Studies were made in 6 (a), 16 (b) and 26 (c) years old *Swietenia mahagoni* forest

plantations established on a complex of red yellow mediterranean soil in Tanggeung, 80 km south of Cianjur (West Java). Soil samples were collected at 0 - 30 cm and 30 - 60 cm depths. Data are tabulated on physical properties.

The clay content under (a), (b) and (c) ranged between 65.38 - 75.30%, the silt content 14.58 - 25.00% and the sand content 3.62 - 13.04%.

The bulk densities of the top soils under (a), (b) and (c) tended to decrease with the age of the stands, they were 1.14; 1.03 and 1.06 g/cm<sup>3</sup> respectively, while those of the subsoils were about the same (1.16; 1.11 and 1.16 g/cm<sup>3</sup> respectively).

The age of the stand had probably no effect on the total soil porosity (v/v). They were in the 0 - 30 cm layer 58.24, 60.88 and 59.75% respectively and in the 30 - 60 cm layer 57.86, 57.86 and 58.11% respectively.

The soil water permeability was reduced in the older plantations. In the top layer they were 25.15, 12.87 and 10.34 cm/hr and in the subsoil 10.01, 2.91 and 0.89 cm/hr respectively.

The potential gravimetric available water storage capacity was highest in the 16 year old stands. They were in the topsoil in (a), (b) and (c) 11.41, 10.82 and 10.69% respectively and in the subsoil 2.48; 13.22 and 9.43% respectively.

Key words: Mahogany, Plantation, Soil texture

Rusli M.S. Harahap, M. Yamin Mile & Triwilaida  
Changes of soil pH under plantations in Darmaga, Bogor  
Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia,  
No. 507, 1989, English

The pH is sub canopy soils of pine plantations (*Pinus merkusii*, *P. oocarpa* and *P. caribaea*) in Darmaga Experimental Forest (250 m. a.s.l.) was measured over a period of up to ten years following establishment in 1977.

It has always been assumed, that because of an increase of organic matter storage in the forest floor of pine forests, the soil state is going to change during the measuring period. The result of this study will give more information whether to disclaim or to confirm this opinion.

The observations showed however, that there was no significant reduction of pH in soils under these pine plantations.

Because of the adversative conclusion with research findings elsewhere, the authors recommended that more observation be made in different locations under divergent environmental condition viz. soil type, rainfall, topography particularly under important industrial forest crops in order to determine the long term tolerance of a range of sites to acidification.

Key words: Pine, Plantation, Soil texture, Acid soil

Tati Rostiwati & Sutarjo Suriamihardja  
Impact comparative analysis of *Alunus nepalensis*, *Eucalyptus microcoris*  
and *Pinus merkusii* on soil physicochemical condition at Cikole  
Experimental Garden, West Java  
Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia,



No. 490, 33-40, 1987, Indonesian

*Alnus* is a non-leguminous plant genus, that has actinorrhizal root nodules and are therefore effective in fixing nitrogen and is able to support satisfactory plant growth in a degraded and to check soil erosion as well.

Recently on *Alnus* species namely *A. nepalensis* has been introduced in West Java and planted in the Cikole experimental garden at 1350 meter elevation. According to dependable information the seed came from Burma.

Composite soil samples under the *A. nepalensis* stand were analyzed for their chemical and physical properties and the results were compared with those under *Eucalyptus microcoris* and *Pinus merkusii* nearby.

The results of the analysis showed that the values of C/N ratios of soils under *A. nepalensis* suggested the presence of more favorable microbiological conditions than those under *E. microcoris* and *P. merkusii*.

The soil profile and *Alnus* was composed of more layers indicating its higher capacity to withstand erosion even if it was grown on a steeper slope than *E. microcoris* and *P. merkusii*.

Key words: Eucalypt, Pine, Erosion, Hillside erosion control

Chairil Anwar Siregar et al

Planting *Swietenia macrophylla* and *Leucaena leucocephala* as a mean of improving a degraded soil under *Melaleuca leucadend*

Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia,

No. 486, 21-33, 1986, Indonesian

Prior to this research early in 1981 seedlings of six forest tree species viz. *Swietenia macrophylla*, *Aleurites moluccana*, *Spathodea campanulata*, *Lagerstroemia speciosa*, *Durio zibethinus* and *Artocarpus heterophyllus* were interplanted in a stand of *Melaleuca leucadendron*. All through that trial period the seedlings showed extremely poor growth, which as characterized by stunting, die-back, reduced number of leaves and very high mortality. Nevertheless mahogany (*Swietenia* spp.) appeared to have the best prospects among the tried species.

Owing to this fact a continuation of the investigation was considered, using mahogany and leucaena, with the expectation that both species were suitable to be used for the improvement of degraded forest lands in association with agroforestry systems.

This study, which was begun in January 1984 was aimed at finding the first growth model of mahogany and leucaena using linear regression method etc.

In reference to many scientific reports, it is agreed to that the growth of mahogany and leucaena were not satisfactory as anticipated and it was probably affected by allelopathy, moisture stress or sulphur deficiency. It is well known that  $\text{SO}_4^{--}$  ion uptake of *Melaleuca* is anomalously high.

The cause of this contrariety needs to be investigated further. It is worthwhile to notice that the site quality was sensibly affected by mahogany and leucaena in particular.

Key words: Mahogany, Degraded forest, Soil improvement

M.N. Jha & P. Pande

Impact of growing *Eucalyptus* and sal monocultures on soil in natural

Sal area of Doon valley

Indian Forester, India, 110 (1), 16-22, 1984

In the recent past, there has been a controversy over the large scale *Eucalyptus* plantation in the country. Since not many studies have been made on the impact of *Eucalyptus* monoculture on soil properties, the present investigation was undertaken to study the impact of growing *Eucalyptus* and Sal (*Shorea robusta*) monocultures on soil of the Doon Valley by comparing it with the soil conditions under natural sal forest.

The area under study has a tropical monsoon climate with a conspicuously long winter period and humid monsoon season of about 4 months. The average annual rainfall is about 2,079mm. The soils have been developed in the old alluvium received from Siwaliks and Himalaya.

None of the monocultures (*Eucalyptus* or Sal) could surpass the natural Sal as far as Organic matter accumulation, total N, P and available N, P, K are concerned. *Eucalyptus* monoculture at 14 years of age has shown higher accumulation of Organic matter in comparison to a fairly old Sal monoculture. The soil under *Eucalyptus* monoculture has a tendency to retain more water in comparison to Sal monoculture.

*Eucalyptus* monoculture has resulted in an increase in soil pH, however, Sal monoculture has resulted in lowering of soil pH considering natural Sal as control.

It has been concluded that raising *Eucalyptus* monoculture in natural Sal area causes no damage to the soil fertility and proves superior to long standing Sal monoculture in Doon Valley.

Key words: Soil survey, Monoculture, Natural forest, Soil fertility, Physical characteristic, Chemical characteristic

Agustinus P. Tampubolon & Zoefri Hamzah

The effect of water conservation measures on the growth of teak seedlings grown in rainfed zones

Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia, No. 496, 1-15, 1988, Indonesian

The high rate of mortality and growth retardation of teak seedlings grown in rainfed zones due to moisture stress pose a serious problem to silviculturist.

A research has been conducted on the use of strip mulch of plastic, strip mulch of rocks and blind ditches in a teak plantation of 16 months old in Bungatan, Situbondo, East Java. This site was selected because of its low annual rainfall (1,319 mm). The objective of this research is to understand the effect of water conservation measures on the height growth of teak seedlings. The experiment has a completely random design with 4 treatments.

The result showed that plastic and rock mulch increased significantly height increment compared to the others. This mounted to an average of 49.35 and 44.46 cm respectively in a period of 6 months, while the blind ditches and control was only 32.93 and 32.96 cm. The growth increment after an eleven month period was more striking. The plastic mulch appeared to be more efficient than rock mulch, causing an increment of 128.27 and 109.79

cm respectively.

There were no significant differences in the effect of the use of blind ditches and control on height increment because in both cases the soil was exposed to water loss due to evaporation.

Key words: Planting, Mulching

5) Tending

- weeding, pruning, thinning, fertilizing etc. -

Wan Rasidah Wan Ab. Kadir, Ahmad Sahali Mardi et al.  
Comparison of different phosphorus sources on the early growth of  
*Acacia mangium*  
Journal of Tropical Forest Science, FRIM, Malaysia, Vol. 2 (2),  
97-103, 1989, English

The efficiency of phosphorus fertilizer from different sources of *Acacia mangium* was assessed using isotope dilution method. Of the four sources of fertilizer used, namely Christmas Island Rock Phosphate, Moroccan Rock Phosphate, Jordanian Rock Phosphate and Triple Super-phosphate, the last showed the highest uptake by the plants. However, Jordanian Rock Phosphate treated plants showed the highest increase in dry matter weight. For eight weeks after fertilizer application, the order of efficiency in uptake was as follows: Triple Superphosphate > Jordanian Rock Phosphate > Moroccan Rock Phosphate > Christmas Island Rock Phosphate.

Key words: Fertilization, Acacia, Fertilizer

Wan Rasidah bt. Abd Kadir, Aminah bt. Hamzah & P. Sundralingam  
Effect of nitrogen and phosphorus on the early growth of three  
exotic plantation species in Peninsular Malaysia  
Journal of Tropical Forest Science, FRIM, Malaysia, Vol. 1 (2),  
178-186, 1988, English

Experiments on the effect of nitrogen (N) and phosphorus (P) fertilizers on the early growth of *Acacia mangium*, *Eucalyptus camaldulensis* and *Paraserianthes falcataria* were carried out on Durian series (Plinthoxic Tropudult) soil in kemasul, Pahang, Peninsular Malaysia.

From this preliminary experiment, P is recommended for application when planting *A. mangium*, *E. camaldulensis* and *P. falcataria* on Durian series (Plinthoxic Tropudult) soil in Malaysia. In this experiment, the amount of P applied was 60g (30g TSP + 30g CIRP). It was surface broadcasted under the tree canopy for the initial growth of the trees. The optimum level of P was not determined here.

N fertilizer application is not recommended in these plantations. Sufficient N for the crop's requirement seems to be present in the soil.

Further experiments should be carried out to find the best method, frequency, optimum level and source of fertilizer to be applied.

Key words: Acacia, Fertilization, Fertilizer, Eucalypt

Toshifumi Kurosaki

A preliminary assessment of the effect of nitrogen, phosphorus and potassium fertilizers on the growth of eight months old *Acacia mangium* planted in a logged over areas

FRC Publication, Sabah, Malaysia, No. 50, 20 pp., 1988, English

*Acacia mangium* is found to be suitable for planting in a variety of soil, fast growth and versatility to grow on a variety of site.

In this paper, a preliminary assessment of the effects of nitrogen, phosphorous and potassium fertilizers on the growth of eight month old *A. mangium* which was planted at Kolapis A, a logged over areas in 1986 is reported. This experiment is only at its initial stage.

It was found that the effect of fertilizer (nitrogen, phosphorus and potassium) in promoting the height growth of the young *A. mangium* was small/little. At this stage, it was also unknown what kind of fertilizer elements affect significantly the *A. mangium*. This is probably attributed to the very young age of *A. mangium* which received only once fertilizer application at six months old. Thus, the information in this report is very preliminary and continuation of this study is essential.

Key words: Acacia, Fertilization, Fertilizer

Shinji Kaneko

Effect of fertilizer application on the growth of *Acacia mangium* in the field

SAFODA-JICA Project Report, Sabah, Malaysia, 60 pp., 1991, English

The effect of the fertilizer application on the growth of *Acacia mangium* had been obscure because few studies had been carried out. Therefore, in November 1988, fertilizer application trial for *Acacia mangium* was set up in the project site. The objective of this trial was to know how much or what kind of fertilizer was most effective for the growth of *Acacia mangium*.

Main points of the results are as follows.

1. The mean height and the mean DBH of *Acacia mangium* in plot 4, that is no fertilizer plot, were lowest in all plots. But, in other plots, the relationship of the amount of fertilizer applied and the growth of *A. mangium* was not clear.
2. The tree had a lot of branches and the figure of stem was not straight in some plots where much fertilizer was applied. In the same plots, double leader or forking tree and squirrel damage are observed.
3. The difference in nitrate and potassium of each plant sample was not regarded as significant.
4. Soil chemical analysis showed that the chemical properties of each soils were almost same.

Key words: Fertilization, Acacia, Fertilizer

Tan Kian Mon

Growth characteristic of *Pinus caribaea* var. *Hondurensis* in response to boron, nitrogen, phosphorus and potassium fertilizers  
FRC Publication, Sabah, Malaysia, No. 18, 26 pp., 1984, English

The effects of boron, nitrogen, phosphorus and potassium on the growth of *Pinus caribaea* Var. *hondurensis* were investigated in a field trial on orthic acrisol soil of the Paliu family in Sook, Keningau.

A growth response to phosphorus application was obtained after 4 1/2 years and the trend was consistent till termination (12 years) even though no fertilizer was applied after 7 years. No response was observed from addition of boron, nitrogen and potassium. After 12 years mean diameter and height of trees treated with phosphorus alone (230 mm and 20.1 m respectively) were comparable to trees treated with the complete treatment i.e., BNPK (247 mm and 20.3 m respectively).

Key words: Fertilization, Pine, Fertilizer

Murniati & Nina Mindawati

The effect of N and P fertilization on growth of young mahogany (*Swietenia macrophylla*) plantation in the field  
Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia,  
No. 528, 13-23, 1990, Indonesian

The effect on nitrogen and phosphate fertilizers on one year old mahogany (*Swietenia macrophylla*) plantation was studied during August 1988 until May 1989, in the compartment 56C, Kedung Galar Sub Forest District, Ngawi Forest District, East Java.

Nitrogen and phosphate fertilizers were applied by using broadcast method in circles of 30 cm radius around the tree. Six levels of nitrogen fertilizer: 0; 2.1; 4.2; 6.3; 8.4 and 10.5 g N/tree and six levels of phosphate fertilizer: 0; 2.3; 4.6; 6.9; 9.2 and 11.5 g P<sub>2</sub>O<sub>5</sub>/tree were used. The tree spacing is 2 x 2m.

Height and diameter growth were recorded from ten sample trees from each plot. To investigate the effect of fertilizer treatments on the parameters observed, the analysis of variance was used with randomized complete block design.

The results showed that nitrogen and phosphate fertilizers did not significantly affect height and diameter growth of mahogany, but the combined application of N<sub>3</sub>-P<sub>5</sub> fertilizers (6.3 g N/tree; 11.5 g P<sub>2</sub>O<sub>5</sub>/tree) increased height growth by 30.3% and the combined application of N<sub>4</sub>-P<sub>5</sub> fertilizers (8.4 g N/tree, 11.5 g P<sub>2</sub>O<sub>5</sub>/tree) increased diameter growth by 34.0% compared with control.

Key words: Fertilization, Mahogany

A.C. Manila

Growth responses and economic production of residual dipterocarp stands to timber stand improvement (TSI) treatments  
DENR, Philippines, 135 pp., 1989, English

In view of the unsatisfactory growth and yield of most selectively-logged forests, there are measures or approaches that ought to be revitalized to transform residual forest into more productive areas.

This study reports on the preliminary analysis of the five-year growth and yield data from the established TSI sample plots of the Philippine-German Projects in four important regions of the country.

The study stands are located at Kalinga-Apayao and Zambales in the northern part of the Philippines, and at Zamboanga and Surigao del Sur in the southern part.

The TSI treatments through the removal of undesirable stems were conducted to homogenize the stand composition with desired tree species and to improve the growth rates of the potential crop and favored trees left after logging.

Results showed that growth responses of residual stands were higher in the treated plots (with TSI treatments) than in the control plots, except on mortality rate of the study areas in five years period. The site factors such as light intensity, soil depth, pH, organic matter, available phosphorus and exchangeable potassium were greater or higher in quantities in the treated plots than in the control plots among study sites five years after plot establishment.

The economic effects of the study are greatly affected by the fluctuating production costs and prices of wood products in future.

Key words: Dipterocarps, Tending, Silvicultural technic, Selective cutting

L.T. Chim

Eradication of climbing bamboo in dipterocarp forests of Sabah

The Malaysian Forester, Malaysia, Vol. 36, No. 4, 243-246, 1973, English

In virgin forests, climbing bamboos are present in forest gaps which are opened up by fallen trees, landslides and other agencies. Following exploitation, the population of climbing bamboos increases due to increased incidence of light on the forest floor which induces the germination of its seeds which are present in abundance on the forest floor or in the soil. In one logged-over area near the road at the Segaliud-Lokan Forest Reserve, 300 to 400 climbing bamboo seedlings were recorded in one milliacre. It has been observed in the field that climbing bamboos may multiply vegetatively by producing sprouts and runners.

The presence of climbing bamboo in logged-over forests often prevents the establishment of dipterocarp seedlings at the early stage following exploitation.

This study indicates that climbing bamboos (*Dinochloa* species) can be effectively eliminated by cutting with a parang, but a combination of cutting and application of some chemicals may be a more effective method of eradication.

The chemicals used in this experiment were Dowpon and Dalapon which are the common formulations on the market for elimination of monocotyledons. The trial was carried out in coupe 1962 of the Segaliud-Lokan Forest Reserve. In all the methods used, except "dusting", the chemicals were given direct access to the growth tissue.

It is noted that climbing bamboos (*Dinochloa* species) can be effectively controlled by cutting, which achieved a kill of 98.4%. Cutting and applying Dalapon at the lower end of cuts at a concentration of 10% achieved a 100% kill, whilst, the combination of cutting and application of Dowpon at the lower end of cuts at a concentration of 10% gave a 98.8% kill. Basal dusting of Dowpon and Dalapon were relatively ineffective, achieving

approximately 80% and 90% of kills, respectively.

Key words: Dipterocarps, Pesticide, Improvement cutting, Bamboo, Natural forest

A.E. Beveridge

Arbicide trials in lowland dipterocarp rain forest of Malaya

FRIM Research Pamphlets, Malaysia, 211-225, English

Sodium arsenite has been extensively used for killing unwanted trees in Malayan silvicultural operations since 1935. The standard practice is to use a 20% aqueous solution of the poison (2 lb. sodium arsenite per gallon of water) applied to a frill girdle.

Recent small-scale trials at the Forest Research Institute and extended field trials in districts have indicated that 2, 4, 5-T butyl ester may be an acceptable non-toxic arbicide for replacing the toxic sodium arsenite which is now used extensively for killing unwanted trees.

The results are as follows:

Provided the frill girdle is carefully made, two per cent 2, 4, 5-T is effective, even when comparatively small quantities are applied with a can. Wastage may be avoided by using an oil of low viscosity applied from a can with a narrow spout.

If the amount of arbicide used in frill girdles does not exceed one gallon per acre, the cost of using two per cent 2, 4, 5-T in diesel oil would be about \$1.50 per acre for arbicide compared with \$0.76 cents for sodium arsenite at 2 gallons per acre.

Water-borne mixed 2, 4, 5-T and 2, 4-D formulated with emulsifying oil are less effective than oil solutions of 2, 4, 5-T alone.

Frill girdling is likely to continue to be the most effective method of applying arboricides in Malaya but basal sprays may be used for the susceptible latex-bearing species. Further trials should be made with higher volumes and higher concentrations of the basal sprays on large, buttressed trees.

Key words: Dipterocarps, Pesticide, Improvement cutting, Tending

S. Appanah & F.E. Putz

Climber abundance in virgin dipterocarp forest and the effect of pre-felling climber cutting on logging damage

The Malaysian Forester, Malaysia, Vol. 47, No. 4, 335-342, 1984, English

In 13 ha of virgin dipterocarp forest of Sungai Tekam Forest Reserve, Pahang, there were an average of 376 climbers/ha 2 cm dbh (diameter at 1.3m from the ground).

Climbers smother seedlings, their weight can cause saplings to bend over or snap, and they coil around saplings, strangling them. More significantly, climbers often grow from one tree crown to another, and it has been observed that due to intercrown connections, when climber-laden trees fall, they cause more other trees to fall than when similar sized climber-free trees fall. Climber (vine or liana) control in logging areas has become a major silvicultural effort in Peninsula Malaysia, but the basis for prescribing treatments is still inadequate.

Cutting of climbers before logging reduced the number of trees pulled down during



felling by approximately one-half and thus is a useful silvicultural tool.

Climbers exhibited a well developed capacity for regeneration from 1m long pieces of stems left on the forest floor. Of the 32 pieces of climber stems (25 species), 14 (41%) sent out shoots and/or roots within three months of cutting.

It recommends that climbers should be cut in two places, as high as the worker can reach and as near the ground as possible, so that the hanging stems are some distance from the basal part.

Treating the cut climbers with 2, 4, 5-T butyl ester proved highly effective in preventing coppicing; an average of only 5.5% of vines in the treatment plots survived. The average cost of 2, 4, 5-T for poisoning 1 ha of climbers came to \$17.00 at present market prices. Figuring a daily wage of \$10.00, the total cost of treating 1 ha of climbers at current prices will be \$27.00.

Key words: Dipterocarps, Climber cutting, Pesticide, Natural forest

P.M.S. Ashton & N.D. De Zoysa

Performance of *Shorea trapezifolia* (Thwaites) Ashton seedlings growing in different light regimes

Journal of Tropical Forest Science, FRIM, Malaysia, Vol. 1 (4), 356-364, 1989, English

Fruits were collected from four parent trees of *Shorea trapezifolia* (Thwaites) Ash. in wet evergreen rain forest of southwest Sri Lanka. They were planted in block design with two light treatments (partial shade  $1000 \mu\text{mol m}^{-2}\text{s}^{-1}$ ; full sun  $2000 \mu\text{mol m}^{-2}\text{s}^{-1}$ ). Measurements were made over a two year period. Seedlings of *S. trapezifolia* in the partial shade treatment grew significantly taller than those in full sun. Height was also significantly different between seedlings of different parent trees. No significant difference in either seedling leaf number or flushing rate could be found between light treatments or parent trees. Findings for these seedlings suggest height can be used to evaluate past growth, leaf number can be used to evaluate current growth and possibly predict future growth, and internodes can be counted to estimate the approximate age. Rate of flushing of seedlings growing in different light regimes was found to be approximately the same. Flushing was correlated to age and an age prediction table was constructed. It is important to note that when the forester uses the age table for *S. trapezifolia*, plants with terminal shoot dieback should be discarded.

Further studies under nursery conditions are needed to evaluate *S. trapezifolia* growth performance in light conditions <50% of full sun. Findings from this study can also be used to compare with field surveys of seedlings growing on the forest floor in different environments.

These results are proposed as a basis for a method of evaluating *Shorea* advanced regeneration for use in forest management.

Key words: Dipterocarps, Light intensity, Seedling

6) Tree Breeding

Eko B. Hardiyanto, Oemi H. Suseno & Sri Danarto  
Tree improvement programs in Indonesia  
Report, First Meeting of the Seed Origin and Genetic Resources  
Working Group, Thailand, 1-20, 1990, English

In Indonesia, tree improvement is now an accepted activity, along with other forest management efforts, to increase forest productivities.

Most of the tree improvement work so far has been initiated and funded by the Department of Forestry and Forest State Corporation. Recently, however, several private companies engaging in industrial forest plantations have started their own breeding programs and these companies are expected to assume bigger responsibilities in the future.

The Government of Indonesia has launched a big program to establish a large scale of industrial forest plantations. This program will be mostly conducted by private companies. Tree improvement programs in private companies are greatly encouraged. In addition, the Department of Forestry has maintained strong interest in tree improvement. This year, a tree improvement center will be established in Yogyakarta.

This paper reports the status and progress of tree improvement programs in Indonesia with particular reference to those conducted by the University of Gadjah Mada and the Directorate of Land Reforestation and Land Rehabilitation, Department of Forestry.

Key words: Tree improvement, Genetic resources, Seed origin

Carla Wynn Rufelds  
Quantitative Comparison of *Acacia mangium* Willd. versus Hybrid  
*A. auriculiformis*  
FRC Publication, Sabah, Malaysia, No. 40, 22 pp. 1987, English

Since the discovery of Hybrid *A. auriculiformis* (*Acacia auriculiformis* A. cunn. ex Benth × *A. mangium* Willd.) in Sabah, Foresters have been considering the value of the hybrid as a potential reforestation species. Various hybrid growth and form characteristics indicated that a hybrid breeding program could be beneficial. However, prior to establishment of a full scale program further research into breeding methods and vegetative propagation, as well as comparisons between the wood quality and the growth and form of the hybrid versus that of *A. mangium* were deemed essential.

This study is a statistical comparison of the growth and form of 80 *A. mangium* and hybrid *A. auriculiformis* trees growing in a plantation in North-Western Sabah. Results indicate that there is potential for gain in quality a hybrid breeding program should be undertaken. Considerations that must be incorporated into the program, such as Candidate Plus Tree (CPT) selection criteria and a stepping up of *A. auriculiformis* introductions, are discussed. Additional benefits, including improvement of *A. mangium* through backcrossing and widening of the *Acacia* genetic base in Sabah, are mentioned.

Key words: Acacia, Hybridization

Widaryanti W. Winarni

The first contaminant on planting explant in solid medium of Murashige & Skoog

Paper for "SYMPOSIUM ON THE APPLICATION OF TISSUE CULTURE TECHNIQUES IN ECONOMICALLY IMPORTANT TROPICAL TREES", Biotrop, Bogor, Indonesia, 7 pp., 1987, English

Tissue culture has been developing rapidly in the last century and considered as one of the methods which can contribute a lot of progress to biotechnology. One of the requirement in tissue culture is the existence of aseptic conditions. It is necessary to know the information about microorganism which quite after cause first contamination on the media to be controlled. On the observation on planting *Tectona grandis* L. and *Gmelina arborea* L. explant in MS solid medium which using Sublimat and autoclave to sterilize the explant and medium, has been found a kind of bacteria and two species of fungi: *Aspergillus* sp. and *Absidia* sp., two weeks after planting.

Key words: Tissue culture, Microorganism

Carla Wynn Rufelds

*Acacia mangium*, *A. auriculiformis* and Hybrid *A. auriculiformis* seedling morphology study

FRC Publication, Sabah, Malaysia, No. 41, 83 pp., 1988, English

Hybrid *Acacia auriculiformis* (*A. auriculiformis* A. Cunn. ex Benth × *A. mangium* Willd.) has been identified as a potential multipurpose fast-growing hardwood for reforestation in tropical countries. There are problems associated with the use of seed produced from natural or artificial hybridization between the two species. The species, being both outcrossing and inbreeding, and the inflorescences being too tiny to emasculate prior to pollination, leads to both selfing and crossing when pollination occurs. Thus, a method to differentiate between *A. mangium*, *A. auriculiformis*, and their hybrid at an early developmental stage was deemed necessary.

Various experiments undertaken in this study have revealed several characteristics which will enable a nursery person to make accurate seedling identification with eight to ten weeks. The pattern of true leaf development prior to the emergence of phyllodes is distinct for seedlings from each taxon. In addition, several taxonomic characteristics, such as the color and pubescence on the pinnule margin, are taxon specific. 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 such as light, water, and nutrients upon the distinguishing features of each taxon. Subsequently, the *A. mangium*, Hybrid *A. auriculiformis*, and *A. auriculiformis* Seedling Guide was developed and operationally tested in Experiment III.

Key words: Acacia, Hybridization, Pollination, Crossing

M. Charomaini, Z. Yulianti & Rusli M.S. Harahap

Cleft and side grafting on selected trees of *Swietenia macrophylla* King

Seed orchards, either to be used for seed production or research purposes can be established by planting genetically tested clones or seedlings. Clones for research purposes in a certain case seem to be suitable due to faster flowering and fruiting, mature but smaller size, therefore, beneficial for research purposes.

Producing clones both in small and large scale can be fulfilled by means of grafting, cutting, air layering, etc. Although skill is one of the restricting factors for grafting survivability, these vegetative propagation techniques are still favoured in forestry activities.

Results of grafting experiment on *Swietenia macrophylla* showed that cleft grafting was more successful than side grafting. Besides, storage of scions seems to affect the survival percentage. In this experiment, the symbols S<sub>1</sub>, S<sub>2</sub>, S<sub>3</sub>, S<sub>4</sub>, and S<sub>5</sub> were used to represent the scions collected from the first, second, third, fourth, and fifth selected parents respectively. The three-day stored scions from Malang, S<sub>2</sub> resulted in 96.6% survival percentage and S<sub>3</sub> was the lowest, namely 33.3%. Survival percentage of the nine-day stored scions 40% to 0% (S<sub>1</sub>: 20%, S<sub>2</sub>: 20%, S<sub>3</sub>: 0%, S<sub>4</sub>: and S<sub>5</sub>: 40% respectively). Scions that have been stored for three-days before grafting were still in high vigor to be grafted.

Scions from Gundih showed a survival percentage of 100% for S<sub>1</sub>, but only 50% for S<sub>2</sub>, 30% for S<sub>4</sub>; 20% for S<sub>5</sub> and 0% for S<sub>3</sub>.

Most of the scions from Magelang failed to be grafted.

Key words: Grafting, Mahogany, Vegetative propagation

### 3. Forest Damage and Protection

#### 1) Forest Fire

C.H. Stoddard & G.M. Stoddard

Protecting forests from fire, insects and diseases

Essentials of Forestry Practice, 4th Edition, John Willy & Sons,  
201-246, 1987, English

The protection of forests from fire, insects, diseases, and other destructive agents constitutes an important aspect of forestry. No matter how well managed a forest is, it may be destroyed by fire. Insects and diseases, which normally attack the weakest trees, will sometimes destroy an entire stand if not kept under control by forest managers. Wildlife and livestock can create significant problems for the forest by overgrazing, browsing and other destructive activities. And various forms of pollution harmful to trees are now severely affecting forests in various regions around the world.

In this paper, the forest protection as stated above is dealt with in a style of textbook.

Key words: Forest fire, Tree disease, Insect damage