

No.

TECHNICAL INFORMATION
ON
TROPICAL FORESTS

II

MARCH, 1992

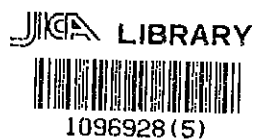
JAPAN INTERNATIONAL COOPERATION AGENCY

(J I C A)

FDD
JR
91-61



TECHNICAL INFORMATION
ON
TROPICAL FORESTS
II



MARCH, 1992

JAPAN INTERNATIONAL COOPERATION AGENCY
(J I C A)

国際協力事業団

23512

CONTENTS

1.	FOREST ENVIRONMENT	1
	- climate, ecology, forest resources, etc.-	
2.	SILVICULTURE	11
2-1	Choice of Species	11
	- trials of species, provenance trial, etc.-	
2-2	Seed (for Propagation)	17
2-3	Nursery Practice	20
2-4	Plantation Establishment	29
	- site preparation, planting, coppice, direct seeding, mycorrhiza, enrichment planting, soil, etc.-	
2-5	Tending	44
	- weeding, pruning, thinning, fertilizing etc.	
2-6	Tree Breeding	48
2-7	Natural Regeneration	49
3.	FOREST DAMAGE AND PROTECTION	53
3-1	Forest Fire	53
3-2	Pests and Diseases	54
4.	FOREST MEASUREMENT AND MANAGEMENT	61
4-1	Growth, Increment of Trees and Stands	61
4-2	Harvesting	63
4-3	Forest Management	65
5.	FOREST CONSERVATION	67
5-1	Watershed Management	67
5-2	Soil Conservation	72
6.	FOREST PRODUCTS	76
6-1	Timber	76
6-2	Non-timber Products	79
7.	SOCIAL FORESTRY	86
8.	OTHERS	95

APPENDIX LIST OF INFORMATION RESOURCES

READERS' GUIDE

1. Geographic coverage of information.

This paper covers mainly the Philippines and Thailand 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.

¹⁾Sofwan Bustomi & Komar Soemama

²⁾Regeneration and standing stock study on logged-over area in Laban forest complex, Forest District of Berau, East Kalimantan

³⁾Buletin Penelitian Hutan (Forest Research Bulletin), Indonesia

⁴⁾No. 479, ⁵⁾1-16, ⁶⁾1986, ⁷⁾Indonesian

⁸⁾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 mits 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 | 5) Page numbers |
| 2) Title | 6) Year of publication |
| 3) Journal/Book title | 7) Language of text |
| 4) Volume | 8) Abstract |

1. FOREST ENVIRONMENT

-- climate, ecology, forest resources, etc.--

KIATKONG PITPREECHA, SHOZO NAKAMURA

Research activities and achievements of the forest ecology section (Phase II)

Research and Training in Re-afforestation Project (RFD-JICA), Thailand, 146, 1991, English

The papers presented here are the results of successful joint research activities which have been carried out by the subdivision, RFD, and the JICA experts on forest ecology, in the Research and Training in Re-afforestation Project (Phase II).

In this report, there are four research areas in research report. Area (I) is "Study on the structure, primary productivity and dynamics of mangrove forest", and consists of 4 reports. Area (II) is "Growth of some domestic economic tree species planted under a canopy of fast-growing species stand", and consists of 2 reports. Area (III) is "Yield-density effect of some economic tree species", and consists of a report. Area (IV) is "Study on the structure and regeneration of the natural forest at the Ubon Ratchathani Gene Conservation Station", and consists of a report.

Key words: Mangrove, Fast growing species, Ecosystem, Ecology, Natural forest

FOREST DEPARTMENT MYANMAR

Forest Resources of Myanmar, conservation and management

Forest Department Myanmar, Myanmar, 13, 1991, English

This brochure provides an overview of the forest resources in Myanmar, not from narrow confines of economics but from the wider perspective of forestry for people, wildlife and culture.

The contents are as follows. 1. Topography, 2. Climate, 3. National Forest Policy, 4. Forest Legislation, 5. The Forest Resource Base, 6. Status of Forest Cover, 7. Legal Classification of Forests, 8. Forest Ecosystems and their Extent, 9. Forest Plantation, 10. Management of Forest Resources, 11. Timber Resources, 12. The Wildlife Resources, 13. Forestry Sector Development and 14. Forest Department.

Key words: Forest resources, Plantation, Forest management

RYUICHI TABUCHI, SOMBOON KIRATIPRAYOON, et al.

Research Report No. 1

Research and Training in Re-afforestation Project, RFD-JICA, Thailand, 32, 1989, English

There are two papers in this report. The title "Structure and dynamics of Mangrove forest on Tura Island, Kantang, Trang Province" is a brief description of permanent plot established in natural stand as well as plantation sites around.

Since present stand is the result of forest dynamics in the past, some aspect on the structure may be applicable to analyze the history or succession. Some characteristics about species composition, size structure as well as stand growth are accounted. With these characteristics, the process of establishment of mangrove on Tura island is sketched.

Another report is "Fine root density of young mangrove stands, Kantang, Trang Province". Root density of fine and small size roots was examined on 7, 10, 15 and 20 years old plantation as well as some site in various stand largeness from gap to dense part in natural forest. Methodological reliability was discussed so that sampling by soil auger was enough useful so far as fine to small roots.

Key words: Mangrove, Natural forest, Root density, Ecology

VALERIO B. MENDOZA et al.

Manual on vegetational analysis for grassland and forest ecosystems

Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), Philippines, No. 50, 128, 1987, English

This manual discusses important preliminary topics which are requisites to a systematic and successful vegetational analysis. These are the research and development in grassland and forest ecosystems, the preparation of keys for identification and collection of plant species, collection, preparation, classification and identification of herbarium specimens.

Methodologies for the conduct of vegetational analysis for grassland and forest ecosystems are thoroughly discussed to guide the users of the manual.

Key words: Ecosystem, Vegetation

TEM SMITINAND, KAI LARSEN, BERTEL HANSEN et al.

Flora of Thailand Volume two

**Thailand Institute of Scientific and Technological Research, Bangkok, Thailand
464, 1970-1981, English**

This volume II deals with the gymnosperms and a number of the angiosperm families without regard to the order of families, i.e.: *Actinidiaceae*, *Apostasiaceae*, *Balanophoraceae*, *Bommetiaceae*, *Camabidaceae*, *Cardiopteridaceae*, *Centrolepidaceae*, *Cephalotaxaceae*, *Connaraceae*, *Cupressaceae*, *Cycadaceae*, *Dilleniaceae*, *Ebenaceae*, *Flacocarpaceae*, *Flagellariaceae*, *Gnetaceae*, *Goodeniaceae*, *Haloragaceae*, *Hanguanaceae*, *Hippocastanaceae*, *Icacinaceae*, *Illiciaceae*, *Irvingiaceae*, *Juncaceae*, *Lowiaceae*, *Magnoliaceae*, *Nyssaceae*, *Ochanaceae*, *Oxalidaceae*, *Pinaceae*, *Podocarpaceae*, *Portulacaceae*, *Rafflesiaceae*, *Restionaceae*, *Rhizophoraceae*, *Rosaceae*, *Saurauaceae*, *Schisandraceae*, *Simaroubaceae*, *Smilacaceae*, *Sphenocleaceae*, *Stylidiaceae*, *Symplocaceae*, *Theuceae*, *Triuridaceae*.

Throughout the work descriptions of the families, genera and species of all known native plants and some of the introduced and cultivated vascular plants found in Thailand are provided; keys have been prepared to make identification of the plants as simple as possible, as well as notes on its distribution, ecology, economic uses and vernacular names are mentioned.

Key words: Flora

TEM SMITINAND, KAI LARSEN, IVAN NIELSEN

Flora of Thailand, Volume Three

**The Forest Herbarium, Royal Forest Department, Thailand
621, 1979-1989, English**

This volume deals with the fern flora of Thailand consisting of the following families: *Aspleniaceae*, *Athyriaceae*, *Azollaceae*, *Blechnaceae*, *Cheiropleuriaceae*, *Cyatheaceae*, *Davalliaceae*, *Dennstaedtiaceae*, *Dicksoniaceae*, *Dipteridaceae*, *Dryopteridaceae*, *Equisetaceae*, *Gleicheniaceae*, *Grammitidaceae*, *Hymenophyllaceae*, *Isoetaceae*, *Lindsaeaceae*, *Lomariopsidaceae*, *Lycopodiaceae*, *Marattiaceae*, *Marsileaceae*, *Oleandraceae*, *Ophioglossaceae*, *Osmundaceae*, *Parkeriaceae*, *Plagiogyriaceae*, *Polypodiaceae*, *Psilotaceae*, *Pteridaceae*, *Salviniaceae*, *Schizaceae*, *Selaginellaceae*, *Thelypteridaceae*, *Vittaceae*.

Key words: Flora

TEM SMITINAND, KAI LARSEN, BERTEL HANSEN

Flora of Thailand, Volume four, Part one

**The Forest Herbarium, Royal Forest Department
129, 1984 English**

About Leguminosae-Caesalpinioideae, there are one hundred and fifty genera with 2,200 species in pantropic - subtropic area. In Thailand there are 20 genera with 113 species. This volume deals with following genera: *Aerocarpos*, *Azelia*, *Amberstia*, *Bauhinia*, *Caesalpinia*, *Cassia*, *Crotila*, *Cynometra*, *Delonix*, *Dialium*, *Erythrophloeum*, *Intsia*, *Koompassia*, *Parkinsonia*, *Peltophorum*, *Phyllocarpus*, *Pterolobium*, *Saraca*, *Sindora*, *Tamarindus*.

Key words: Flora

TEM SMITINAND, KAI LARSEN, BERTEL HANSEN

Flora of Thailand, Volume four, Part two

**The Forest Herbarium, Royal Forest Department
131-220, 1985, English**

This volume deals with the following genera: *Acacia*, *Adenanthera*, *Albizia*, *Archidendron*, *Cathornion*, *Dichrostachys*, *Entada*, *Leucaena*, *Mimosa*, *Neptunia*, *Parkia*, *Pithecellobium*, *Samanea*, *Serianthes*, *Xylocarpus*.

Key words: Flora

TEM SMITINAND, KAI LARSEN & IVAN NIELSEN

Flora of Thailand, Volume five, Part one

The Forest Herbarium, Royal Forest Department, Thailand

138, 1987, English

This volume deals with the following families: *Aristolochiaceae*, *Bignoniaceae*, *Droseraceae*, *Euphorbiaceae*, *Gentianaceae*, *Opiliaceae*, *Phyllanthaceae*, *Proteaceae*, *Salicaceae*, *Thymelaeaceae*, *Valerianaceae*, *Xyridaceae*.

Key words: Flora

PASCUAL B. REYES

Species composition of Philippine mangrove forest

Canopy International, FORI Publication, Philippines, 4(4), 4, 1978, English

Mangrove forests are misconstrued by most people as purely *bacauan* species. The Philippines has 41 identified mangrove species which are further grouped into true mangrove species and mangrove associates.

With the country's growing interest in mangrove research, more species will hopefully be identified.

Key words: Mangrove, Stand composition, Tree species

DICK M. MELANA

***Bacauan*, Mangrove's aggressive colonizer**

Canopy International, FORI Publication, Philippines 5(9), 12, 1979, English

The author discusses why the *bacauan* (*Rhizophora*) species are termed as aggressive colonizers. As *bacauan*'s viviparous seeds mature, they drop into the water. They drift with the water current. Gradually their root ends begin to absorb water and the seeds turn upright for self anchoring. If the landing site is suitable, rapid growth begins. Eventually, the young tree forms its own seeds, spreads outward and continues colonizing new land.

Key words: Mangrove, Seed, Regeneration

LAWRENCE S. HAMILTON & SAMUEL C. SNEDAKER

Handbook for mangrove area management

United Nations Environment Programme and East-West Center, Environment

and Policy Institute, USA, 123, 1984, English

This handbook summarizes the most up-to-date information on the range of products, benefits and services provided by the world's mangrove resources, and guidelines are provided throughout the handbook for sustainable, multiple-use management of mangrove ecosystems. Sustainable use is a theme of prime importance in approaches for better utilization of the mangrove resource.

The approach in this handbook consists of four sections. Section I is written to foster increased understanding so that better decisions on land-use allocation might be made. Section II deals with the uses of individual mangrove species, the critical processes essential for sustainable mangrove ecosystems, and the problems, constraints and management methods. Section III covers the approach and some techniques for using available intertidal land to expand, restore, and establish new mangrove vegetation so that it can serve many local purposes. Section IV deals in detail with the economic aspects of a sustainable multi-use approach to mangrove resource management.

Key words: Mangrove, Ecosystem, Ecology, Multiple purpose forestry

**PHILIPPINE COUNCIL FOR AGRICULTURE AND RESOURCES RESEARCH
AND DEVELOPMENT**

State of the art: Environmental protection research

Philippine Council for Agriculture and Resources Research and Development (PCARRD),

Philippines, 50, 1982, English

In keeping with the demands of the times, the national research program in agriculture and natural resources focuses on a number of major thrusts which include, among others, the enhanced production of export commodities and import substitutes, the improvement of the nation's socio-economic well-being, and environmental protection hand in hand with resources conservation.

The high cost of fossil fuel energy, combined with growing public sensitivity to environmental hazards, challenges researchers into thinking of new ways of tapping resources without dealing a savage blow to ecological balance.

PCARRD's state of the art series now highlights environmental protection research -- analyzing and identifying baseline technology, updating information previously collated, assessing the component disciplines for a realistic identification of research gaps, and finally coming up with a research program truly responsive to current needs. It embodies the research sector's response to the need to strike a balance between mineral exploitation and the maintenance of environmental equilibrium.

Key words: Environmental conservation, Environmental protection, Environmental assessment, Research and development

UPLAND HYDROECOLOGY PROGRAM

Fire ecology study

University of the Philippines at Los Baños, Philippines, 141, 1980, English

The regular and extensive fire occurrences in many grasslands and forest areas especially those located in critical watersheds around the country is a well documented phenomenon. Yet, the periodic but continuous concern on the possible effects of extensive burning is not scientifically documented to provide decision makers with valid basis in the formulation of policies and guidelines on the use of fire as a tool in grassland and forest management. This report covers the salient findings of an interdisciplinary research on the effect of time of burning and grass management treatments in a cogon-talahib (*Imperata-Saccharum*) grassland at Mount Makiling, Pating Lupa, Calamba, Laguna.

Key words: Forest fire, Vegetation, Ecology, Forest management

TEM SMITINAND & KAI LARSEN

Flora of Thailand: *Scrophulariaceae*

Volume Five, Part Two, Royal Forest Department, Thailand

139-238, 1990, English

Scrophulariaceae consists of about 220 genera with 4,500 species. Thailand has 30 genera with 106 species.

This volume documents plants of 30 genera in Thailand.

Key words: Flora

EPPIE M. ENCENDENCIA

Mangrove species distribution

Canopy International, FORI Publication, Philippines, 7(8), 10-11,

1981, English

Several examinations made on the physico-chemical environment of a mangrove ecosystem revealed that there are 2 causal agents of species distribution classified as intraspecific causes and interspecific causes. Interspecific causes refer to the physical and morphological features and the chemical composition of the species such as the size, weight and longevity of seeds. The degree to which seeds are dispersed is due to their size and weight. Intraspecific causes refer to the environment in which the species thrive such as water, temperature, light, soil and other plants. Some species can thrive in sandy and loose soil while others can thrive in damp and water-logged areas.

Key words: Mangrove, Ecosystem, Distribution, Seed

ERNESTO N. LORENZO, BENJAMIN R. DE JESUS JR. & ROBERT S. JARA

Assessment of mangrove forest deterioration in Zamboanga Peninsula,

Philippines, using landsat MSS data

NRMC Research Monograph No. 2 Series, Philippines, 8, 1976, English

An attempt was made to assess the feasibility of using multitemporal LANDSAT imagery to evaluate mangrove forest deterioration in the Zamboanga Peninsula. LANDSAT MSS data recorded by LANDSAT-1 in 1973 and LANDSAT-2 in 1976 covering the study area were digitally processed using the supervised classification technique. Two categories of mangrove were studied: (1) the pure mangrove stands and (2) the logged-over or denuded area. The digital classification results were used in the preparation of thematic maps and compilation of areal statistics. Comparative analysis of 1973 and 1976 results was conducted to evaluate mangrove forest deterioration.

Results indicate that digital analysis of multitemporal LANDSAT imagery can be extremely useful for identifying recently cleared or altered areas and for determining the rate of conversion of mangrove forests. The results further demonstrate LANDSAT MSS data can be a potential tool for effective mangrove resource assessment and monitoring.

Key words: Mangrove, Forest inventory, Cut-over area

F.D. VIRTUCIO, L.S. MICOSA & L.C. MABLANGAN

**Species composition and some aspects of stand structure of newly logged dipterocarp forest
Sylvatrop, Philippine Forest Research Journal, Philippines 2(2), 73-109, 1977, English**

As an initial step towards complete timber utilization to broaden the raw material base of the country's wood industry, an inventory of tree-species was conducted in some selectively logged dipterocarp forests.

Newly established inventory plots totalling 231 in second growth forest in 12 provinces were used. The 341 species found in the plots were categorized into 4 broad groups: commercial dipterocarps, 22; commercial non-dipterocarp, 23; potentially commercial species, 35; and lesser-known species, 261. About one-half of the total trees were classified as lesser-known species with an average volume of 39 m³/ha, approximately one-fourth of the average volume of a newly logged dipterocarp forest stand.

The stand structure was defined through regression analysis, showing the functional relationship of the number of trees and volume/ha and the merchantable height, with the diameter at breast height for each of the 4 species.

Key words: Dipterocarps, Secondary forest, Stand composition, Commercial tree species

T.L. MICOSA

**Sampling method for inventory of Philippine rattan and its distribution
Sylvatrop, Philippine Forest Research Journal, Philippines 3(3), 155-70, 1978, English**

This study is the first local attempt to determine an efficient sampling technique for the inventory of rattan species so as to obtain "good" estimates at low cost. Based on a 100% inventory of rattan stands on a one-hectare area in Bayugan, Agusan del Sur, plots of 6 rectangles and 3 squares were tested. The 10 x 10 m plot was found the most efficient one to use, giving the smallest sampling error for a 3-hr. cruise. To determine the distribution of rattan, 3 mathematical distribution functions, namely binomial, poisson and negative binomial, were fitted to the observed frequency distribution. The empirical distribution of each rattan species was found best fitted by the negative binomial. In another 1 ha area in the forests of Hinobaan, Negros Occidental the 10 x 10 m. plot again came out as the most efficient, and the negative binomial the best fit.

Key words: Rattan, Minor forest products, Forest inventory method

FLORENCIO P. MAURICIO

**Study cites environmental changes in selectively-logged Surigao forest
The Philippine Lumberman, Philippines, 30(6), 7-13, 1984, English**

This study had for its objectives; 1) to determine some changes in the vegetation as a result of selective logging 2) to determine some changes in the soil following selective logging; and 3) relationships among the changes.

This study was conducted in the license area of the Paper Industries Corporation of the Philippines (PICOP) located within the provinces of Surigao del Sur, Agusan del Sur, Davao Oriental and Davao del Norte. Sampling was carried out from June 1977 to May 1978 in unlogged areas, in set-ups recently subjected to

selective logging and those logged, one, three, five, ten and fifteen years before.

Density, site index, natural regeneration and potassium of the top soil decreased greatly after logging then gradually increased with the years. The light exposure, organic matter, pH, nitrogen and phosphorous of the top soil and potassium of the sub-soil increased after logging then decreased/fluctuated as the years passed. The changes are generally greatest immediately after logging or at the early stages up to the fifth year then fluctuate in increasing/decreasing amounts thereafter until the stands show trends of stabilization at the tenth to fifteenth years.

Timber extraction and elevation positively affected the logging damage to residual trees. Vertical arrangements of the residual stands were found to change from the original condition as to continuity of each canopy layer either vertically or horizontally. Uncontrolled removal of utilizable timber at the tenth to fifteenth years after logging caused excessive destruction to the residual stands.

Timber stand improvement and enrichment planting during the first and fifteenth years caused the restructuring of immature residual stands for faster rate of growth and consequently greater utilizable wood biomass production within the prescribed cutting cycle.

Key words: Natural regeneration, Selecting cutting, Vegetation, Soil texture, Enrichment planting

MERAS S. ANTONE

Vegetation changes after logging in dipterocarp forest

The Philippine Lumberman, Philippines, 32(7), 6-12, 1986, English

A brief description of stable dipterocarp forest in the Philippines and selective logging practices for stand improvement is followed by a discussion of problems created by logging (destruction of other plants, effects on soil, encroachment by shifting cultivators) and vegetation changes following logging. Regeneration of cleared forests, characteristics of pioneer species and successional patterns after disturbance are considered.

Key words: Dipterocarps, Logging, Selective cutting, Vegetation, Succession

EDWINO S. FERNANDO & J.V. PANCHO

Mangrove trees of the Philippines

Sylvatrop, Philippine Forest Research Journal, Philippines 5(1), 35-54, 1980

English

There are 39 species and one variety of mangrove trees (marginal species included) distributed in 26 genera and 23 families in the Philippines.

Species of *Avicennia* and *Sonneratia* dominated the seaward side of mangrove forests. *Osbornia octodonta* is often observed to be associated with these species and forms almost pure thickets. Stiltrooted species of the genus *Rhizophora* often occupy areas in the swamp most deeply flooded by the tides. They are found associated with *Scyphiphora hydrophyllacea*. Species of the genera *Bruguiera*, *Ceriops*, *Lumnitzera*, *Aegiceras* including *Camptostemon philippinense*, *Excoecaria agallocha*, *Heritiera littoralis* and *Cerbera manghas* are found on the inner edges of the mangrove forest. Along the borders of the mangrove forest occur *Glochidion littorale*, *Hibiscus tiliaceus*, *Thespesia populnea*, *Thespesia populneoides*, *Barringtonia racemosa*, *Dolichandrone spathacea*, and other minor species which may be rare to frequent.

This report also presented a field key for identification of the different species and varieties, and brief notes on the morphological characters, ecology, and distribution of mangroves in the Philippines.

Key words: Mangrove, Ecology, Plant community

C.C. TOMBOC & J.B. BRUZON

Ten-year dynamics of logged-over forests in Surigao Del Sur

Sylvatrop, Philippine Forest Research Journal, Philippines 4(3), 103-122, 1979

English

If properly managed, the present logged-over forest can become the major source of wood raw materials when the old growth forest shall have been exhausted. Yet very little effort has been exerted to understand the complexities of the logged-over forest for the generation of appropriate forest production technologies.

Comparisons were made on the stocking density of dipterocarps and non-dipterocarps, mortalities and reproduction counts of the initial year and the 10th year remeasurement periods. Thirty-three 10-yr old continuous forest inventory plots established in the logged-over forest of 4 working units in Surigao del Sur

were the sources of the data. The frequency of occurrence of dipterocarp species were analyzed.

The analyses of the annual diameter growth of residual trees at different diameter classes indicate the possibility of adopting a flexible minimum diameter cutting limit in the climatic type or regional bases, depending upon biological, technical and economic factors. The adoption of the bicyelic cut in the selective logging system is justified. Other recommendations are the compulsory removal of derelict trees in logging the old growth, the application of appropriate silvicultural practices in the logged-over forest and the use of natural regeneration to restock the logged-over forests.

Key words: Cut-over area/Felling blank, Dipterocarps, Selective cutting, Diameter increment/growth

KERALA FOREST RESEARCH INSTITUTE (India)

Dipterocarps of South Asia

RAPA Monograph 1985/4, FAO Regional Office for Asia/Pacific, Bangkok, Thailand, 321, 1985, English

Published information on Dipterocarps of South Asia is scant. However, in the countries covered by this study (Bangladesh, Burma, India, Nepal and Sri Lanka), voluminous data, particularly on distribution, ecology, silviculture and utilization is contained in unpublished materials. This study was commissioned by FAO regional Office for Asia/Pacific in order to collate data from published and unpublished sources and make available to practicing foresters, researchers and forestry students reference material on a major group of woody plants of economic importance to the Region.

The extent of distribution of the dipterocarps is shown on the map, based on the putative taxonomic diagnosis according to which there are 10 genera and 99 species in the region. This publication provides voluminous data including pest and diseases on the dipterocarps in South Asia.

Key words: Dipterocarps, Pest and disease, Ecology, Forest type, Phenology, Silviculture technique

PHIKUL THONG STUDY CENTER

Flora in peat swamp areas of Narathiwat

Royal Forest Department, Thailand, 368, 1991, English

The Royal Forest Department have intensively conducted a botanical survey of the Toh Daeng Peat Swamp Forest in Narathiwat province. During the six-year study period, conforming to the international botanical research basis, herbarium specimens have been thoroughly collected. The girth and height of every tree in sample plots along the base line were measured; and their structural form were recorded. The result of the study revealed that Narathiwat's peat swamp contains 470 plant species, among these 50 species are new records for Thailand.

In this publication, the information on the vegetation in the peat swamps of Narathiwat are provided, especially field characters such as crown, bark, inner bark, buttresses, stilt roots, pneumatophores, etc.; together with lined drawings and colour illustrations.

Key words: Peat swamp forest, Vegetation, Flora, Buttress, Bark, Crown

**PHILIPPINE COUNCIL FOR AGRICULTURE, FORESTRY AND NATURAL RESOURCES
RESEARCH AND DEVELOPMENT**

State of the art mangrove research, Forestry Research Series No. 4

Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), Philippines, 83, 1987, English

Though smaller in area than of the upland tropical rain-forest, the Philippine mangrove is a valuable asset to the country. Besides being a source of wood for fuel, furniture and construction, mangrove plays a vital role in cushioning the impact of strong winds and in minimizing soil erosion and water pollution. Despite its usefulness, however, conservation and development of the Philippine mangrove has not been given much attention. Consequently, the mangrove resources have rapidly dwindled due to exploitation. To date, there have been only 239,000 hectares of mangrove area left.

To promote mangrove conservation and appreciation of its values, various traditional and potential uses of mangrove have been subject of many researches.

This publication provides various information to establish the status of mangrove resources and the

present level of knowledge on the Philippine mangrove.

Key words: Mangrove, Natural forest, Ecology, Forest utilization, Forest resources

EUSTAQUIO G. ARAGONES, JR.

Vegetation-soil pattern along altitudinal gradient in the western slopes of Mt. Banahaw, Luzon, Philippines: I. The forest communities and changes in forest composition with altitude

Sylvatrop, The Technical Journal for Philippine Ecosystems and Natural Resources, DENR, Philippines, 1(1), 15-45, 1991, English

Forest communities were sampled in a 4200 sq m quadrat at 550 m, 750 m, 950 m, 1200 m, and 1500 m altitudes and the summit zone at 1800 m and 2100 m.

Results of vegetation analysis showed that importance and dominance in the different forest communities are shared by various plant groups. At 550 m altitude in a coffee plantation where undergrowth was predominantly weeds, the families *Rosaceae*, *Compositae* and *Leguminosae* overshadow other groups of lesser importance. The community at 750 m altitude was most diverse and dominance was shared by members of the *Meliaceae*, *Staphyleaceae*, *Nyctaginaceae*, *Flacourtiaceae*, *Bischofiaceae*, *Myristicaceae*, *Lauraceae*, *Moraceae* and *Euphorbiaceae*. Dominance was controlled by the myrtaceous flora and moraceous species at 1200 m. Oak (*Fagaceae*) was dominantly associated with representatives of the *Lauraceae*, *Myrtaceae*, *Meliaceae*, *Symplocaceae* and *Theaceae* at 1500 m.

The summit zone showed *Fagaceae* predominating over the coniferous species (*Podocarpus* and *Dacrycarpus*) and *Taxaceae* at 1800 m while the simpler and more homogeneous community at 2100 m displayed peak development of the conifers and taxads (*Taxus*) with their associated high elevation groups such as *Winteraceae*, *Ericaceae*, *Theaceae*, *Clethraceae*, *Symplocaceae* and *Aquifoliaceae*.

Key words: Vegetation, Vegetation survey, Undergrowth, Dominant tree, Elevation

ASIAN DEVELOPMENT BANK

Integration of environmental considerations in the program cycle

Asian Development Bank, Philippines, 21, 1990, English

This paper is the fifth of a series to be published by the Asian Development Bank. The series deals with environment and natural resources planning and management in the Asia-Pacific region and covers, among others, environmental legislation and its administration, sustainable development, environmental quality criteria and standards, coastal zone management, and the use of geographic information system. Environment Paper 5 explains the mechanism by which environmental considerations are integrated into the Bank's program cycle during the identification of projects.

Key words: Sustainable management of forest, Environmental conservation, Environmental protection

SANTIAGO R. BACONGUIS

Evaluation of drought period and intensity of a small dipterocarp forest catchment in San Lorenzo, Norzaragay, Bulacan

The Philippine Lumberman, Philippines, 16-23, 1981, English

An evaluation of drought occurrence, duration and intensity was conducted within the Angat river watershed. The computation was made on 3.81 ha dipterocarp forest catchment based on hydrometeorological data. For the period from 1975 to 1979 drought condition was recorded to occur from 4 to 6 months in a given year. About 10.01% equivalent annual rainfall was the average annual water deficit. The highest drought intensity recorded within the five year period was - 147.0 mm. The maximum intensity estimated on the average was - 112.80 mm which occurs in the month of April.

Key words: Dipterocarps, Drought, Catchment, Meteorology

DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

Integrated research and development plans and programs

Department of Environment and Natural Resources, 427, 1989-1993, English

The R&D framework focuses on the Philippine ecosystems, namely: (1) forest, (2) upland farms, (3) grassland and degraded area, (4) coastal zone and freshwater and (5) urban.

The natural-resource component, which is part and parcel of each ecosystem was taken into consideration.

The status, issues and problems under each ecosystem were presented as part of the R&D framework together with the corresponding researchable areas and the programs to be developed for 1989-1993.

Key words: Ecosystem, Research and development

MONINA T. URIARTE & FELIZARDO O. VIRTUCIO

**Growth composition and structure of logged-over Dipterocarp forests
Ecosystems Research and Development Bureau, DENR, Philippines, No.2,
40, 1988, English**

This paper deals with the changes in growth, species composition and stand structure that have taken place five years after logging in the different regions and climatic types of the country.

Growth and yield data from 891 permanent plots in selectively logged-over dipterocarp forests were analyzed. Observations were evaluated by species groups such as dipterocarps and non-dipterocarps for each region and climatic type. The basal area volume per hectare was assessed with the use of the regional and volume equations for the dipterocarps and non-dipterocarps.

Result showed that growth, species composition and stand structure vary widely among regions and climatic types.

Key words: Dipterocarps, Climatic type, Growing stock, Cut-over area, Stand composition

MONINA T. URIARTE & FELIZARDO O. VIRTUCIO

**The dynamics of second-growth forests in northern Luzon
Ecosystems Research and Development Bureau, DENR, Philippines, No.3,
30, 1988, English**

This study involves the evaluation of the second growth forest in northern Luzon in terms of stand structure (diameter distribution) and stocking. The data were taken from 426 Continuous Forest Inventory growth plots of eleven concessions in Northern Luzon.

These plots were assumed to represent the general situation of the growth plots in Northern Luzon.

For site quality determination, total heights of dominant and co-dominant trees were taken for analysis. Regression analysis was used to determine the site index guide equations from which the corresponding site index equations by species groups for each concession were determined.

The stand structure equations using the negative exponential distribution were also determined.

Regression analysis was also used to determine the more important variables affecting the number of trees per hectare.

Key words: Secondary forest, Tree height, Tree density

ROYAL FOREST DEPARTMENT, THAILAND

**Types of forests of Thailand
Royal Forest Department, Thailand, 12, 1962, English**

The forests in Thailand may be broadly divided into two categories, the evergreen and the deciduous. Evergreen forests may be classified into four broad types as follows: (a) Tropical evergreen forests, (b) Hill evergreen forests, (c) Coniferous forests, and (d) Mangrove forests.

Deciduous forests may be divided into 2 broad types: (a) Mixed deciduous forests, and (b) Deciduous dipterocarps forests.

There are also many other minor types which are not of much economical importance at present. They are beach forests and swamp forests.

Key words: Evergreen tree, Deciduous tree, Dipterocarps, Mangrove, Forest type

NIPON TANGTHAM, VASA SUTTHIPIBUL

**Effects of diminishing forest area on rainfall amount and distribution
in northeastern Thailand**

Thai Journal of Forestry, Thailand, 7(2), 141-156, 1988, English

Based on 36 stations of 34 yr rainfall data (during 1951 to 1984) recorded by Royal Irrigation Department and the Meteorology Department together with the forest maps in different periods produced by Royal Forest Department and Faculty of Forestry, the effects of diminishing forest area in the Northeast on rainfall amount and distribution within the region was investigated. Statistical analysis based on year-by-year observed data showed insignificant relationship between given periodical rainfall amount, i.e., monthly seasonal and annual, and the remaining forest area. When considering upon time-trend basis, statistical parameters obtained from using the moving average of time series 5, 10, 15, 20 25 and 30 year indicated that rainfall amount tends to significantly decrease along with the depletion of forest area while the number of rainy days significantly increases.

Key words: Precipitation, Cutting, Forest resources

SUDARAT NGAMKHAJORNWIWAT, SUWAN TANGMITCHAROEN

Development of pollen and ovule in *Pterocarpus macrocarpus* Kurz.

Thai Journal of Forestry, Thailand, 8(3), 269-273, 1989, English

Pterocarpus macrocarpus Kurz, has a perfect flower which is borne upon the peduncle. During the early stage of flower development, the anther consisted of anther wall and sporogenous cells. Later stage, the middle layers regenerated but the sporogenous cells still underwent cell division and formed pollen. As the later stage of flowering, the ovule contained one embryo sac covered with 2 integuments, outer and inner integuments. Each embryo sac consisted of three antipodal cells, two endosperm mother cells and egg apparatus. The development of pollen and ovule completed within one month.

Key words: Pollen, Pollination

JESADA LUANGJAME

Salinity effects on transpiration in *Eucalyptus camaldulensis* and *Combretum quadrangulare*

Thai Journal of Forestry, Thailand, 9(3), 149-162, 1990, English

The aim of this study was to investigate the transpiration rates in two salt-tolerant tree species, *Eucalyptus camaldulensis* Dehnb. and *Combretum quadrangulare* Kurz. A greenhouse experiment with different levels of NaCl salinity (0, 0.5, 1.0, 1.5 and 2.0%) was step up and the results were compared with those of a field study on non-saline and saline soils.

In the greenhouse experiment, transpiration increased at low salinity but decreased at high salinity levels. Transpiration rates always increased with temperature. With irradiance they only increased up to medium photon flux density (up to $1,500 \mu\text{mol m}^{-2}\text{S}^{-1}$) and then decreased to $2,000 \mu\text{mol m}^{-2}\text{S}^{-1}$. In the field study, transpiration rates increased with temperature and irradiance in both species and they were much higher in *E. camaldulensis* than in *C. quadrangulare*. The relationships between transpiration rate, temperature and irradiance did not indicate any distinct effects caused by salinity.

Key words: Eucalypt, Transpiration, Salinity

BUARED PRACHAIYO, TOSHIO TSUTSUMI

On the rate of wood litter decomposition in dry evergreen forest in the northeast of Thailand

Thai Journal of Forestry, Thailand, 9(3) 212-218, 1990, English

The study on the wood litter decomposition was carried out in a dry evergreen forest at Khon Kaen University Farm at Nam Phram Dam. Samples were collected from six individual trees, and were kept on the forest floor. The weight of samples remaining on the floor were measured at nearly one year intervals for four years. Four samples among six lost more than 93% of their weight and other one lost 83%, while the remaining one lost only 39% during four years. The rate of decomposition and factors connected to the rate were discussed.

Key words: Litter, Humus layer, Decomposition, Forest floor

S. MAHAPHOL

Teak in Thailand

Royal Forest Department, Thailand, 31, 1954, English

Locally called "SAK", teak is the best known, most universally used and the most valuable timber tree of Thailand. It is, by law, a specially reserved tree which cannot be cut without permit, no matter wherever grown.

The Thai people of the North-western Highlands have been intimately associated with teak since their earliest settlements. Fields have been carved from rich teak lands on alluvial flats along stream banks: valuable teak forests on hill sides have been cleared and burnt just for very meagre crops of hill rice, chilli, brinjals and other tubers which can barely feed them for the whole year.

Local timber traders and saw-millers of long experience are supposed to possess the knowledge of the types of timber produced by different forest areas, and there has actually been a considerable amount of prejudice in prices paid for logs from various forest areas on this account. Whether these divergences are due to site and environmental factors or to botanical variations in the species still remains to be scientifically determined.

Key words: Natural forest, Commercial tree species, Useful species, Tree species

C.W. YEATMAN

Conservation of genetic resources within managed natural and man-made forests

ASEAN-Canada Forest Tree Seed Centre, Thailand, No. 1, 8, 1991, English

Conservation of genetic resources requires only that selected, representative populations be regenerated from generation to generation. Indigenous tree species and populations are most effectively maintained in situ by natural regeneration and/or by planting trees of local origin and of wide parentage. Genetic resources of introduced species can best be developed as land races in plantations designed to retain a broad genetic base of selected, regionally-adapted, populations and genotypes.

Key words: Genetic resources, Man-made forest, Natural forest

2. SILVICULTURE

2-1 Choice of Species

- trials of species, provenance trial, etc.-

ECOSYSTEMS RESEARCH AND DEVELOPMENT BUREAU (ERDB)

Sago or lumbia palm (*Metroxylon sagu* Roth.) tang-ag (*Kleinhovia hospita* L.)

RISE Res. Inf. Series on Ecosystem, ERDB, DENR, Philippines, 3(11), 20, 1991, English

RISE has been featuring reforestation species of great importance in various ways and forms. As answers to inquiries about reforesting freshwater wetlands and floodplains, this publication features sago (*Metroxylon sagu*) and tan-ag (*Kleinhovia hospita* L.).

Sago is a tall monocarpic feather palm growing well in clumps along streams and riverbanks, especially in fresh water swamps. Plant parts of sago have various uses such as production of starch, sago flour and thatching materials which are significant in both export and domestic use. Ecologically, sago stands serve as protection against soil erosion and wildlife habitat.

Tan-ag is a tree that grows along floodplains, riverbanks and upland wetlands. It also grows in moist thickets, secondary growth forests and deserted clearings at low and medium altitudes throughout the Philippines. Tan-ag is used in making boxes for tomatoes and fruits as well as for low-cost housing materials and firewood. Like other riparian trees, tan-ag can stabilize floodplains.

Key words: Tree species, Reforestation

ECOSYSTEMS RESEARCH AND DEVELOPMENT BUREAU (ERDB)

Pigeon pea (*Cajanus cajan* (L.) Merr.) Malabulatong (*Flemingia macrophylla*

Blume ex Mig.) Neem (*Azadirachta indica* A. Juss)

RISE Res. Inf. Series on Ecosystems, ERDB, DENR, Philippines, 3(6), 26, 1991,

English

This volume introduces Pigeon pea and Malabalatong, two agroforestry species that belong to Leguminosae family and Neem, which belongs to Meliaceae family.

Pigeon pea and Malabalatong are both shrubby plants that grow to a maximum height of 3 to 5 m. They are planted to control soil erosion, aside from serving as windbreaks. Their leaves are utilized as animal feeds. Pigeon pea thrives in semi-arid regions while Malabalatong thrives in places with tropical climate and is known to be drought resistant.

Neem is a medium tree which grows up to 20 m in height and 25 m in diameter. It is endemic to India, Burma, Indonesia, Thailand and Togo. In the Philippines, it is a newly-introduced tree species. Like Malabalatong, Neem is also drought resistant and thrives in almost all types of soil.

Neem has multiple uses. Its wood is made into butts and tool handles while the leaves are used as feeds for livestock. The tree's bark, roots, leaves and seeds also have some medicinal and insecticidal values.

Key words: Tree species, Reforestation, Agro-forestry, Soil conservation, Erosion

ECOSYSTEMS RESEARCH AND DEVELOPMENT BUREAU (ERDB)

Kapok, silk cotton tree (*Ceiba pentandra* (L.) Gaertn.), talisai (*Terminalia catappa* L.), dita (*Alstonia scholaris* (L.) R.Br.)

RISE Res. Inf. Series on Ecosystems, ERDB, DENR, Philippines, 3(10), 26, 1991,

English

This volume covers three reforestation species.

Kapok is a deciduous, fast growing tree widely distributed in all tropical countries and is being cultivated in the Philippines for commercial purposes. Its fiber is used for stuffing cushions, pillows, mattresses and for manufacturing lifebelts and life saving jackets. Kapok tree can be used as telephone poles, for manufacturing plywood as well as pulp and paper production.

Talisai is a medium-sized tree that grows mostly in any soil provided that moisture is sufficient to sustain its growth. It is a very good species in reforesting sandy areas and even abandoned mining sites. Talisai can be used for house and building construction, fuelwood and has medicinal values for curing headache, rheumatism and even dysentery.

Dita is a smooth tree growing well in primary and secondary forests at low and medium altitudes throughout the Philippines. It has varied medicinal uses for ulcers, beri-beri and liver congestion. Its bark can be used to treat hemorrhoids, while its latex can relieve toothache or serve as ointment for rheumatic pains.

These species provide cheap sources of medicines and likewise support the reforestation campaign in the Philippines.

Key words: Tree species, Reforestation, Minor forest products

MARCELINO V. DALMACIO, REMILJO C. ATABAY & JUSTO P. ROJO

Species trials for biomass production: initial results

Canopy International, Forest Research Institute, DENR, Philippines

13(1), 3-5 & 11, 1987, English

Results of the study so far, indicated that *Acacia auriculiformis*, *Eucalyptus camaldulensis* and *E. teriticornis* are the most promising species for planting in adverse sites at Carranglan, Nueva Ecija. Even this early, it is safe to recommend the three species for planting in these areas. In addition to their fast growth and high survival, the trees have various uses that can benefit the people living nearby.

If these species will be used more extensively in reforestation in the country, it is necessary to conduct further studies, particularly on the following aspects:

- (1) Expanded species and provenance trials to include other agro-climatic types.
- (2) Silvicultural and management aspects to include plantation establishment techniques, fertilization, and density of planting. Special focus should be made to develop farmer-adaptive technologies.
- (3) Agroforestry or the potential uses of these species as intercrop with agricultural crops and/or livestock.

Key words: Species trial, Biomass, Fast growing tree species, Growth, Survival

AGENCY FOR INTERNATIONAL DEVELOPMENT

Firewood crops, shrub and tree species for energy production Volume 2

**Report of an Ad Hoc Panel, National Academy Press, Washington, D.C.,
U.S.A., 92, 1983, English**

The purpose of this report is not to delineate strategies for growing and utilizing firewood in any region of the world, but to provide some general concepts and methods for planners and technicians to consider. Primary emphasis is on species suitable for growing firewood for individual family needs. However, species suited to plantation cultivation for fueling small industrial factories, electric generators, and crop driers are also discussed. Most of the plants are little known in traditional forest production.

This book describes 27 tree species with promise for cultivation around the home or village or in firewood plantation.

Key words: Fuelwood tree species, Tree species, Plantation, Fuelwood

ALFREDO C. AGPAOA

Eucalyptus species trial

**Sylvatrop, Philippine Forest Research Journal, Philippines, 6(1), 29-32, 1981,
English**

The portion of Ambuklao Watershed within the municipalities of Bokod, Atok and Itogon, Benguet is extensively covered by cogon (*Imperata cylindrica*) grasses and sparsely spotted with Benguet pine (*Pinus kesiya*) plantations and left-over naturally-grown Benguet pine trees.

Most of the area is barren stony and precipitous. Stray animals of squatters/claimants are found in the area because a number of pasture permits were granted.

Reforestation has been carried out in these areas for a considerable time. However, the result was not encouraging due to forest fires and hence, low survival for planted Benguet pine seedlings. In 1968, trial plantings of agoho (*Casuarina equisetifolia*), alnus (*Alnus japonica*), *Eucalyptus saligna*, and *E. robusta* at Ambuklao, Bokod failed due to the critical conditions of the planting area aggravated by heavy grazing of loose animals.

Since Eucalyptus species were reported to grow favorably in arid and semi-arid conditions (Leloup 1955), this study was conducted to test the growth and survival of 5 Eucalyptus species in the Ambuklao watershed particularly in the Binga and Ambuklao localities.

Key words: Species trial, Eucalypt, Barren land, Reforestation

V. B. MENDOZA

**Adaptability of six tree species to Gogonal areas. III. Field experiment
and additional information**

**Sylvatrop, Philippine Forest Research Journal, Philippines, 3(2), 95-106,
1978, English**

A field experiment was conducted to determine the adaptive capacity of 6 tree species to grassland conditions. Seedling height and diameter growth were not significantly different. However, significant differences in survival among the 6 species were evident. The species tested were Ipil-ipil [*Leucaena leucocephala* (L.) Merrill] rate followed by Agoho (*Casuarina equisetifolia* Forest.), River Red Gum (*Eucalyptus camaldulensis* Dhenh), Benguet Pine [*Pinus kesiya* (Royle) ex Gordon], Binayoyo (*Antidesma frutescens* Jack), and Alibangbang (*Ptilostigma malabaricum* Roxb. Benth).

Concentration of elements in seedlings grown in the field was the same as that of seedlings grown in the box experiment.

Concentration of nitrogen, phosphorus, potassium and calcium in the seedlings were generally higher at the start of the experiment than at the terminal period. Ipil-ipil, River Red Gum, Benguet Pine, Binayoyo and Alibangbang seedlings, however, accumulated magnesium in their tissues. Nitrogen concentration in Ipil-ipil seedlings and phosphorus concentration in River Red Gum and Benguet Pine seedlings showed slight increases.

Air temperature was higher at 12 noon than at either 6 a.m., 5 p.m. or 12 midnight. Soil temperature was lowest in cogon grassland (23.8° C) at 8:30 a.m. and highest (34.5° C) at 1:30 p.m.

Key words: Species trial, Choice of species, Growth, Survival, Seedling, Treeless land

V.B. MENDOZA

Adaptability of six tree species to Gogonal areas. II. Additional

**Sylvatrop, Philippine Forest Research Journal, Philippines, 2(4), 225-234,
1977, English**

Investigations the adaptability of seedlings of Ipil-ipil (*Leucaena leucocephala* (L.) Merrill), Agoho (*Casuarina equisetifolia* Forest), River Red Gum (*Eucalyptus camaldulensis* Dhenh), Benguet Pine [*Pinus kesiya* (Royle) ex Gordon], Binayoyo (*Antidesma frutescens* Jack.), and Alibangbang (*Pilstigma malabaricum* (Roxb.) Benth) to a grassland ecosystem were conducted.

Performance of the seedlings was evaluated by growth in height, diameter, drymatter production and survival. Parameters such as microbial populations, soil and air temperature, light intensity, pH and tissue analysis were determined.

Height and diameter growth of seedlings grown in boxes, in the absence of cogen, were generally greater than the height and diameter growth of seedlings grown in the presence of cogen. There were significant differences in survival among the seedlings raised.

Key words: Special trial, Choice of species, Growth, Survival, Seedling

DOMINADOR FAUSTINO JR. & E. M. BASCUG

**Survival and growth of some promising tree species in eastern Mindanao
Sylvatrop, Philippine Forest Research Journal, Philippines, 2(3), 209-214,
1977, English**

A silvicultural research project was carried out to determine the most suitable tree species for the production of pulpwood, veneer logs and/or sawtimber in large-scale plantations in Bislig, Surigao within the concession of the Paper Industries Corporation of the Philippines.

At the time of the study, only 21 out of the 29 species under trial were at least 1 yr old in the experimental plots. The seedlings of these species were raised in an experimental nursery.

Total heights of trees up to 5 m were measured. Diameter growth for a particular species was measured if at least 50% of the test trees had attained at least 4 cm diameter at breast height.

Of the 21 species, Moluccan Sau (*Albizia falcataria*), Yemane (*Gmelina arborea*) and Payong (*Musanga cecropioides*) showed the most encouraging survival and growth responses after 1 yr of field performance. If factors like adaptability to wider range of soil/site conditions, ease of propagation and maintenance in plantations, suitability as wood raw-material sources of the company and ability to grow into large-size trees are taken into account, the following species, may be regarded as equally promising although they demonstrated slightly inferior overall responses: Bagras (*Eucalyptus deglupta*), Kaatoan Bangkal (*Anthocephalus chinensis*), Binuang (*Octomeles sumatrana*) and Ilang-ilang (*Cananga odorata*).

Key words: Species trial, Choice of species, Survival, Growth

KENNETH G. MACDICKEN

Nitrogen fixing trees for wastelands

**RAPA Publication: 1988/9, FAO Regional Office for Asia/Pacific, Bangkok,
Thailand, 104, 1988, English**

The word wasteland literally means land which is uncultivated, barren or without vegetation. Nitrogen fixing trees (NFT) which have the potential to fix significant quantities of N can have a very positive influence on yields in these N-deficient soils. Some NFT have been proven to be very efficient in Phosphorous uptake, and can effectively serve as "nutrient pumps" for this and other mineral nutrients. Some NFT species which are tolerant of acid, alkaline or saline soil may provide ground cover for soil which might otherwise remain worthless wasteland.

This publication provides descriptions of 31 NFT species for use on wasteland soils.

Key words: Barren land, Microorganism, Root nodule, Root nodule bacteria

FAO REGIONAL OFFICE FOR ASIA AND PACIFIC (RAPA)

Nitrogen fixing trees - a training guide

**RAPA Publication: 1987/15, FAO Regional Office for Asia/Pacific, Bangkok,
Thailand, 172, 1987, English**

This set of training modules provides structured lessons which could be covered during a 10 day training

session. The modules are sub-divided into session topics which can be logically covered in 1-2 hours of lecture or field exercise. The main objective of these modules is to provide a basic document which covers the most important aspects of the subject in a style which will be readily understood by mid-level managers who have been out of school for some 10 years or more. The modules contain session summaries which are brief abstracts of the session topic. The close of each summary includes several questions which highlight the most important aspects of the topic.

This publication has been prepared under the support of the Nitrogen Fixing Tree Association, Hawaii, USA.

Key words: Microorganism, Root nodule, Root nodule bacteria

ECOSYSTEMS RESEARCH AND DEVELOPMENT BUREAU (ERDB)

Rain tree (*samanea saman* Merr.), ilang-ilang (*Cananga odorata*)

RISE Re. Inf. Series on Ecosystem, ERDB, Philippines, 1(10), 21, 1989, English

Rain tree (*Samanea saman*) is a common plant in town plazas, parks, roadsides which provide shade during summer days due to its wide canopy. Ilang-ilang (*Cananga odorata*) is popularly known because of its fragrant flowers.

Both trees can be utilized for special purposes. Rain tree is a material for wood carving and furniture making. Ilang-ilang is a source of fuelwood and its beautiful flowers are made into leis and garlands. The oil derived from the flowers is exported for use in making perfumes.

This paper explains both trees concerning distribution, site requirements, seed technology, nursery practices and protection.

Key words: Tree species, Non-timber forest products, Silvicultural technique

ECOSYSTEMS RESEARCH AND DEVELOPMENT BUREAU (ERDB)

Compilation of RISE issues

RISE Re. Inf. Series on Ecosystem, ERDB, Philippines, 2(1 & 1-12), 256, 1990, English

This publication is a record set of research compilation contains information on reforestation species, their propagation, plantation establishment and management technologies. The species described in this volume are as follows.

Molave, Lumbaog, Bagias, Caribbean Pine, Almacigo, Kakawate, Buri, Nipa, Ipil, Salago, Akle, Ragtikan, Pili, Cashew, Stylo, Centro, Calopogonium, Sirato, Magsaysay stylo, Cinchona, Almon, Tindalo, Kalantas, and White lauan.

Key words: Reforestation, Tree species, Silvicultural technique, Plant propagation

ECOSYSTEMS RESEARCH AND DEVELOPMENT BUREAU (ERDB)

Compilation of RISE issues

RISE Re. Inf. Series on Ecosystem, ERDB, Philippines, 1(1-10), 225, 1989, English

This volume deals with integrated information on Diagnosing Forest Tree Diseases and some commercial tree species. The species introduced in this volume are as follows.

Yemane, Nana, Mahogany, Agoho, Moluccan sau, Japanese acacia, Gubas, Mangium, Teak, Mulberry, Bakauan species, Benguet pine, Kaatoan bangkal, Rain tree and Ilang-ilang.

Key words: Tree species, tree disease, Reforestation

S. TSHERING, A.K. HELLUM

Identification of some tree seedlings in Bhutan

Department of Forestry, Royal Government of Bhutan, 47, 1990, English

Bhutan has such a very rich flora and this poses special problems for field staff for identification. So, it is necessary to be able to identify tree seedlings in order to evaluate whether or not areas are regenerating adequately to meet national standards.

This booklet has been prepared to help people in the field with the job of identification. In this booklet, 33 species of hardwood, 8 species of softwood and 7 species of competitors are described.

Key words: Hardwood, Conifer, Tree species, Seedling

PRAUIT CHITTACHAMNONK, SUMET SIRILAK

Performances of Acacia species in Thailand

Thai Journal of Forestry, Thailand, 9(3), 203-211, 1990, English

Twelve Australian Acacia species were introduced in field trials in Thailand. These field trials were established in 1985 as a collaborative research work between the Royal Forest Department of Thailand and the Australian centre for international Agricultural Research of Australia.

A total of 23 seedlots of 12 Acacia species were planted in six trial sites throughout Thailand. The result in growth performance of these Acacias at 36 month after planting showed a very significant difference between species and seedlots. The best species were *Acacia crassicaarpa*, *Acacia auriculiformis*, and *Acacia aulacocarpa* all from Papua New Guinea which exhibited good growth performance at almost every trial site. On the other hand, *A. aulacocarpa* from Queensland, *A. cincinnata*, *A. shirleyi*, *A. melanoxylon*, and *A. polystachya* were the slowest growing Acacia species in all trial sites.

Key words: Acacia, Planting, Introduced variety, Species trial, Fast growing tree species

SOMSONG LEKSKUL, YUPA SITISARA, PAYAO RODPOTHONG

Abstracts on biological nitrogen fixation

Thailand Institute of Scientific and Technological Research, Thailand,

No. 10, 374, 1988, English

Information included in this book was gathered from abstraction journals, periodical articles, technical reports, university theses and conference proceedings. The search coverage ranges from 1968 to 1982.

In total 901 documents are listed in this volume.

Key words: Biomass, Nitrogen fixation, growth acceleration

MARK TREACY, JAMES L. BREWBAKER

Nitrogen fixing tree research reports

The Nitrogen Fixing Tree Association (NFTA), U.S.A., 211,

1989, English

This paper consists of eight sections. Section 1 is contributed papers involving several NFT genera. The countries are India, Indonesia, Nepal, People's Republic of China, Sierra Leone, Sri Lanka and U.S.A. Section 2 is contributed papers on involving one NFT genus. The species are Acacia, Albizia, Bauhinia, Calliandra, Cajanus, Casuarina, Erythrina, Gliridia, Parasarianthes, Prosopis, Robinia and Sesbania. Section 3 is NFTA network trials, Section 4 is reviews of publications, Section 5 is planting programs and sources of NFT seeds, Section 6 is list of NFTA associates, Section 7 is cumulative subject and species index for volumes 1-7, and Section 8 is species and subject index for Volume 7.

Key words: Nitrogen fixation, Tree species, Root nodule

F. SUHARTONO WIJOYO

Provenance trial and seed orchard establishment of *Eucalyptus deglupta* and *Paraserianthes falcataria*

ASEAN-Canada Forest Tree Seed Center, Thailand, No. 3, 6,

1991, English

This paper describes provenance trials and seed orchard establishment for *Eucalyptus deglupta* and *Paraserianthes falcataria* for a commercial plantation in east Kalimantan, Indonesia. Sampling of individual trees took place in natural stands at the same latitude as the concession. Trials are based on a randomized complete block design with at least five replications per provenance. The first stage consists of establishing a combination between progeny and trials. Individual plus trees are then selected.

Key words: Provenance test, Seed, Eucalypt, Fast growing tree species, Seed orchard

2--2 Seed (for Propagation)

ELPIDIO F. RIMANDO

Peak cone ripening and seed production of mindoro pine

(*Pinus merkusii* Jung + de Vr.)

Sylvatrop, Philippine Forest Research Journal, Philippines, 4(2), 97-101, 1979, English

Cones were collected from 28 mother trees replicated 4 times per collection month. One thousand and six hundred (1,600) mature, closed, green-brown and brown cones were collected for each collection period. Collection months were April, May, June and July. Right after each month of collection, only closed cones of more or less the same size were selected and oven-dried with the mechanical convex using a temperature of 60° C in 6 hours for green-brown cones, and 40° C in 4 hours for brown cones.

Cones were classified as closed, opened and partly opened. After oven-drying, seeds were extracted and counted only from opened and partly opened cones. Germination tests of the stored seeds were conducted in Petri dishes for 6 months from the time of collection. Four replications, 100 seeds/replication, were used.

Collection months and maturity have no significant effect on the number of collected cones and on the number of extracted seeds. However, collection months showed highly significant differences in the number of cones under 3 classifications (opened, partly opened and closed cones). Opened cones were most abundant during May.

Seeds extracted from brown cones exhibited higher germination than those extracted from green-brown cones. Seeds collected during May and June gave higher rates of germination than those collected in April and July. Generally, as storage period was prolonged, rate of germination declined.

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

SAMUEL R. PENAFIEL & JULIE B. BERSAMIN

Some ecological factors affecting the quality of benguet pine

(*Pinus kesiya* Royle ex Gordon) seeds for regeneration

Sylvatrop, Philippine Forest Research Journal, Philippines, 7(2), 83-92, 1982, English

Seeds with black discoloration had the highest germination percentage (80%) compared to brown (15.56%) and white seeds (21.11%).

Viability was not affected when seeds were subjected to temperature range from 40° C (for 10 minutes) to 80° C (for 5 minutes). Germination decreased considerably for seeds exposed at 20° C for 10 minutes and over 100° C for 5 minutes. There is a temperature range within which germination is enhanced.

Average number of seeds that fell to the soil surface was 3 seeds per 0.063 m²; with viability of about 48%. An average of 4 seeds were collected in 0.25 m² ground cover catchment under a Benguet pine stand.

A 13% reduction in germination was observed on Paraquat-treated seeds. Morphological symptoms of Paraquat toxicity were observed in the yellowing of cotyledons and the curling of true needles of germinants.

Key words: Seed, Germination, Seed viability, Pine

E.L. BOADO & VICTORIA T. LASMARIAS

Extraction of seeds of green and green-brown mindoro pine (*Pinus merkusii*) cones soaked in lacquer thinner

Sylvatrop, Philippine Forest Research Journal, Philippines, 1(1), 15-20, 1976, English

Mindoro Pine is a promising native species for the pulp and paper industry in the Philippines because of its long fiber. However, besides the problem of limited source, seeds of Mindoro Pine have poor germination, 30% being considered normal.

This study was initiated to determine whether immersing green and green-brown Mindoro Pine cones in lacquer thinner before oven-drying would facilitate extraction and whether the lacquer thinner would affect germination. The cones were subjected to different times of soaking, namely: control (no soaking), 5 min., 10 min., 15 min., 20 min., and 25 min. After soaking they were oven-dried in a mechanical convex oven at 40° C

for 8 hrs., 50° C for 3 hrs. and 60° C for 8 hrs., including the control. Soaking in lacquer thinner did not significantly affect the opening of cones, number of extracted seeds, and percent germination. It appears that a treatment other than immersion in lacquer thinner is required.

Key words: Seed, Pine, Conifer, Germination, Seed production

S.P. PENAFIEL & B.F. NOBLE

Germination of benguet pine (*Pinus kesiya*) seeds gathered from different crown exposures

Sylvatrop, Philippine Forest Research Journal, Philippines, 3(1), 37-40, 1978, English

This study was carried out to find out differences in germination rate and germinative capacity among Benguet Pine seeds gathered from different crown exposures.

Benguet Pine cones were collected from the north, south, east, and west exposures on the upper crown. Seeds extracted from these cones were sown in seedboxes to determine differences in germination values and total germination percentages. Seeds gathered from the north exposure had the highest germination value (47.83%) as compared to 31.0%, 33.11% and 26.43% for the south, east and west exposures, respectively. Highest total germination percentage was recorded for the North exposure (95.32%) as compared to 86.3%, 84.6% and 79% for the south, east and west exposures, respectively. Exposure apparently has a significant effect on the germinative capacity and germination value of Benguet Pine seeds.

Key words: Seed, Germination, Pine, Crown, Seed viability

VICTORIA T. LASMARIAS & AIDA BAJA-LAPIS

Seed fumigation of benguet pine (*Pinus kesiya*) and Mindoro pine (*Pinus merkusii*)

Sylvatrop, Philippine Forest Research Journal, Philippines, 2(1), 49-53, 1977, English

In plant quarantine work, seeds are first fumigated before they are shipped to ensure mortality of all insect pests. The usual fumigant used is hydrogen cyanide, with a standard dosage of 4 lb/ft³ of container for 4 hr at 50° F or above. Reports received on the germination of Mindoro Pine and Benguet Pine indicated adverse effects of the standard dosage. This necessitates the determination of the right dosage of the fumigant.

With the exception of control all the seeds were subjected to fumigation of HCN in a 17.7 ft³ atmospheric chamber at 2, 4 and 6 lb/1000 ft³ for 2, 4, and 6 hr, respectively.

The chemical used was cyanogas containing 45% calcium cyanide. After fumigation, the seeds were stored in a refrigerator with a temperature of 0 to 49° C. Every 2 mo. thereafter up to the eight mo., germination tests were conducted in the Copenhagen tank, a standard germinator.

Results indicate that Mindoro Pine seeds could be stored for 4 mos. while Benguet Pine could be stored longer than 6 mos. without any significant reduction in germination. The 2-lb HCN with 2-hr fumigating time appears most desirable for Mindoro Pine seeds; 2-lb HCN with 4-hr fumigating time appears most desirable for Benguet Pine seeds.

Key words: Pine, Fungi damage, Mortality, Fumigation

D.I. PEREGRINO

Influence of storage conditions on longevity of tanguile

(*Shorea polysperma* (Blanco) Merrille) seeds

Sylvatrop, Philippine Forest Research Journal, Philippines, 4(3), 147-150, 1979, English

Tanguile trees intermittently produce large seed crops. Proper seed storage then is necessary to preserve the viability of these seeds.

The experimental design was split-plot with 4 storage durations in the subplot and 3 blocs as replicates. The storage conditions were 1) room temperature in polyethylene bags, 2) buried in sawdust in polyethylene bags, 3) room temperature in cloth bags and 4) low temperature (refrigerated) in polyethylene bags. The storage durations were 1) 1 day after collection, 2) 10 days after collection and 3) 20 days after collection.

No pre-treatment was given to either seeds sown one day after collection or seed being packed and

stored. Germination of seeds were assessed and recorded 3 days after sowing and everyday for 40 days. Survival and height of seedlings were recorded and measured 40 days after sowing. The data were analyzed using the analysis of variance for split-plot in RCBD. Treatment means were compared using Tukey's W-procedure.

Storage conditions did not significantly affect the germination, survival rates and height growth of Tanguile seeds. Durations significantly affected the germination, survival rates, and height growth of Tanguile seeds. Sowing of seeds 1 to 10 days after collection showed promise. Interaction between storage condition and storage duration did not significantly affect the stored Tanguile seeds.

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

R.M. BASADA & D.I PEREGRINO

Germination of White Lauan (*Shorea contorta* Vidal) seeds collected at different times during seedfall

Sylvatrop, Philippine Forest Research Journal, Philippines, 5(1), 55-60, 1980, English

White Lauan of the family Dipterocarpaceae is known to bear fruits at long intervals. It is a tall tree and seed collection is risky and difficult. Thus, seed collection is done by gathering the fallen seeds around the mother tree. This study was conducted to establish whether seeds that fall in the early part of the seedfall period possess greater germination value (GV) and germination capacity (GC) than those that fall in the middle or later part of seedfall.

Three treatments were used: a) seed gathered during the first week of seedfall, b) seeds gathered during the second week of seedfall and c) seeds gathered during the third week of seed fall. Percent GV and GC were used to compare the treatments. The GV was computed as the product of mean daily germination (MDG) and peak value (PV). The MDG was expressed as a percentage of full seed germination at the end of the test. The PV on the other hand was expressed as the maximum quotient derived from all of the cumulative full seed germination percent on any day divided by the number of days to reach this percentage. Data were analyzed with analysis of variance.

The GV during the first week was significantly greater than the second and third week of seedfall. The GC, however, was not affected by the treatments.

Key words: Dipterocarps, Seed, Germination, Seed viability

ESBEN SCHOLER & FINN STUBSGAARD

Seed testing; Lecture note No. C-8-September 1989

DANIDA Forest Seed Center, Humleback, Denmark, 33, 1989, English

The ultimate object of seed-quality testing is to determine the value of seed for planting. Reliable seed quality data are of great importance to all later operations with any particular seedlot e.g. in trade, storage and use in the nursery. The methods for seed testing used at Danida Forest Seed Centre (DFSC) are based on standards described by the International Seed Testing Association (ISTA). But in the daily seed laboratory routines at DFSC, a number of smaller modifications and additions to the ISTA-rules occur.

This book is compiled as a text book. It presents ISTA-rules as well as DFSC-standards.

Key words: Seed, Seed test, Germination, Seed viability

J.N. OWENS, P. SORNSATHAPORNKUL, S. TANGMITCHAREON

Manual, Studying flowering and seed ontogeny in tropical forest trees

ASEAN-Canada Forest Tree Seed Centre, Thailand, 134, 1991, English

This manual is based on: 1) the experience gained by scientists working in Canada and at the ASEAN-Canada Forest Tree Seed Centre, 2) a review of the literature on tropical forest trees, and 3) the selection of several established techniques used to study plant development and seed production of forest trees. It is designed to serve as an introduction to the reproductive biology of forest trees and as a manual of the techniques used to study the reproductive biology of forest trees and determine the causes of reduced seed, cane, and fruit production in forest trees. Most of the techniques used to study the reproductive biology of forest trees have been developed with north temperate conifers and hardwoods in mind.

Key words: Flowering and fruiting, Seed, Fruit, Seed production

B.S.P. WANG

Overview of seed technology in ASEAN region
ASEAN-Canada Forest Tree Seed Centre, Thailand, No.4, 13,
1991, English

This paper presents an overview of seed technology in the context of socioeconomic importance of forest resources in ASEAN region. Methods of seed collection, handling, processing, and storage are examined. Rules for seed testing are reviewed. Recommendations are formulated for establishing research priorities at the ASEAN-Canada Forest Tree Seed Centre.

Key words: Seed collection, Seed storage, Seed, Seed production

JOHN N. OWENS

Flowering and seed ontogeny
ASEAN-Canada Forest Tree Seed Centre, Thailand, No.5, 14,
1991, English

This paper reviews published literature on flowering and seed ontogeny with particular attention to floral initiation and induction in tropical hardwoods. A number of recommendations are formulated on priority research areas in ASEAN-member countries.

Key words: Seed, Flowering and fruiting, Seed production

ASEAN-CANADA FOREST TREE SEED CENTRE

Standard germination tests

ASEAN-Canada Forest Tree Seed Centre, Thailand, No. 2, 79,
1991, English

The objective of the training course in Standard Germination Tests of Forest Tree Seed in ASEAN at ACFISC, is to expose participants to up-to-date knowledge on seed germination tests. As B.S.P Wang states in his presentation on standardization and uniformity of seed testing, it is extremely important that seed tests be standardized throughout ASEAN to enable much more efficient seed use, storage, and exchange. If seed scientists in laboratories in the region know that they are all working with similar methods and that their results are reproducible, we will stand a much better chance of saving and improving the valuable tropical tree species on which so much of our environment depends.

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

2-3 Nursery Practice

HUDSON T. HARTMANN, DALE E. KESTER & FRED T. DAVIES JR

Plant propagation: principles and practices (Fifth edition)
Reprinted by National Book Store, Manila, Philippines, 647, 1959,
English

This book is written primarily as text for university-level plant propagation course. It provides information concerning the fundamental principles involved in plant propagation and, in addition, serves as a manual that describes the many useful techniques for propagating plants.

It covers all aspects of the propagation of higher plants, both sexual and asexual, especially in reference to human efforts to increase plant numbers, as contrasted to plant reproduction in nature. The text is compiled into five major units. The first covers general information pertaining to the various types of propagation. The second unit deals with the production of seeds and the methods of using them in sexually producing new plants. The third unit considers all the types of asexual or vegetative propagation - cuttings, grafting and budding, layering, suckers and runners. The fourth unit deals with micropropagation and tissue culture. The fifth unit presents the accepted propagation methods for the important fruit and nut crops, the principal ornamental trees, shrubs and vines.

Key words: Plant propagation, Seed, Vegetative propagation, Tissue culture

JOSE O. SARGENTO & JOHN E. BARKER

Vegetative production of *Pinus caribaea* var. *hondurensis* Morelet and *Pinus oocarpa* Schneide by means of needle fascicles

The Pterocarpus, Philippine Science Journal of Forestry, UP, Philippines, 4(1), 52-61, 1978, English

Vegetative propagation of both species was highly successful with 97 and 67% rooting respectively for *P. caribaea* and *P. oocarpa*. Sixteen 16 weeks after setting, *P. oocarpa* appears to root less rapidly than *P. caribaea* so that rooting success might exceed 67% after more than 16 weeks. Application of captan helped prevent fungal damage and did not reduce rooting percentage and root length of *P. oocarpa* cuttings and increased the number of primary roots per cutting but did not affect the number of branch roots per primary root of both species. Transplanted root fascicles attained 97% survival and vigorous growth in both species 7 months after transplanting into pots.

Key words: Pine, Vegetative propagation, Hormone, Cutting

SAMUEL R. PENAFIEL

Depth of planting mulberry (*Morus alba* Linn.) cuttings

Sylvatrop, Philippine Forest Research Journal, Philippines, 1(2), 142-144, 1976, English

The world demand for raw silk has been increasing every year and more than 20 countries are now producing it because of good prospects. In the Philippines, sericulture is being promoted in Benguet Province and nearby communities where Mulberry trees grow well and seem to have acclimatized themselves. The leaves of the trees are used mainly to feed Mulberry silkworm (*Bombyx mori* Linn.) and other silk-producing insects.

Depth of planting, time of collection, size and kind of cuttings may all have effects on the rooting of Mulberry tree cuttings. This study, however, is limited to depth of planting in relation to initiation of roots. One hundred-eighty cuttings were prepared out of several branches collected from one Mulberry tree. Sixty cuttings, 18 to 20 cm long with 4 buds each and ranging from 1 to 1.5 cm in diameter, were assigned to a treatment. No rooting accelerator was applied to the cuttings.

Three depths of planting: 5, 10 and 15 cm, were tested on Mulberry cuttings 18 to 20 cm long. The 15 cm planting depth produced the highest rooting percentage (78%). Significant differences among rootings due to depths of planting were found at the 5% level. Only 65% of the cuttings rooted.

Key words: Cutting, Rooting

RHODORA M. RIMANDO

Growth and development of some fuelwood species in different potting media

Sylvatrop, Philippine Forest Research Journal, Philippines, 6(3), 91-100, 1981, English

Seedlings of kakauate (*Gliricidia sepium* (Jacq.) HBK), kamachile (*Pithecelobium dulce* (Roxb.) Benth.) and agoho (*Casuarina equisetifolia* Forst.) were potted in 7 different media.

Height growth, stem diameter, length of primary root, and shoot:root ratio were determined. All 3 species exhibited poor performance in 1:1 mixture of decomposed sawdust-coir dust and in humus-decomposed sawdust (1:2). Humus-sand (2:1) was found to be the best potting medium for agoho. Humus-decomposed coir dust (1:2) and decomposed sawdust are recommended in potting kamachile. Kakauate performed well in 4 different potting media, namely: humus-decomposed sawdust-coir dust (1:1:1) humus-decomposed coir dust (1:2), humus-sand (2:1), and decomposed sawdust.

Key words: Seedling, Nursery operation, Sawdust, Growth

BARTOLOME F. NOBLE & CESAR A. ORALLO

Pre-germination treatment and survival of petroleum nut (*Pittosporum resiniferum* Hemsl.)

Sylvatrop, Philippine Forest Research Journal, Philippines, 8(1), 39-45, 1983, English

Petroleum nut (*Pittosporum resiniferum* Hemsl.) seeds were pretreated with different sulfuric acid concentrations (50, 60 and 70%) for 30 minutes or with boiling water for 5 seconds to determine their effects

on the germination and survival rate of seedlings.

Seeds soaked in 50% and 70% sulfuric acid solution for 30 minutes and untreated seeds started to germinate 50 days after sowing. Seeds soaked in 60% sulfuric acid solution for 30 minutes began to germinate 59 days from sowing. Seeds dipped in boiling water for 5 seconds had a 4-day delay.

Untreated seeds produced significantly higher germination percentage than either those soaked in 60% and 70% sulfuric acid solution for 30 min. or those dipped in boiling water for 5 sec. But there were no significant differences in germination percentage between untreated seeds and those soaked in 50% sulfuric acid solution for 30 min. Likewise, no significant variations in germination percentage were found among seeds soaked in 50, 60 and 70% sulfuric acid solution for 30 min.

The control treatment gave the highest survival rate, while the lowest was in the set dipped in boiling water for 5 sec. The other treatments gave survival rates which were approximately the same as that in the control.

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

ALFREDO AGPAOA & ERLINDA PULMANO

Seed treatment of *Pinus kesiya* for germination

Sylvatrop, Philippine Forest Research Journal, Philippines, 3(4), 241-242, 1978, English

Seeds were obtained from a seedlot that had been stored for 1 yr in an airtight tin can and kept at room temperature (approx. 24° C). Germination medium was prepared from a mixture of 24% fine sand, 38% topsoil and 38% humus by volume. The seeds were given the following treatments before sowing: soaking in 100% sulfuric acid for 15 to 20 min. and then rinsing thoroughly with water; soaking in cold water (approx. 12° C) overnight for 15 hrs.; soaking in cold water for 24 hrs.; soaking in warm water for 2 hrs. (Boiling water taken away from the fire before soaking the seeds), no treatment (control).

None of the treatments improved germination performance. In fact, soaking the seeds in acid for 15 to 20 min. showed adverse effects.

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

ENRIQUE N. CRIZALDO, M.Q. AMATORIO & A.A. LANSIGAN

Effects of triacontanol on seedlings of Moluccan sau (*Albizia falcataria* (L.) Back)

Sylvatrop, Philippine Forest Research Journal, Philippines, 4(4), 262-267, 1979, English

This study explores the potentials of triacontanol application to produce vigorous planting stock for reforestation purposes. Triacontanol is a natural long chain alcohol (C28) commonly found in many waxy plants proven to significantly increase yield of many field crops.

Fifteen-day-old (from sowing) Moluccan Sau seedlings, were planted in plastic pots with pure sawdust compost produced by the 10-day decomposition process. The seedlings were sprayed weekly with 0.00, 0.05, 0.10, 0.15, 0.20, 0.25, 0.30, 0.35, 0.40, 0.45, 0.50, 0.55 and 0.60 ppm triacontanol for 5 consecutive weeks. Each treatment comprised about 40 plants. Seedling height was measured weekly; starting one week after spraying and reckoned from the cotyledon attachment up to the youngest growing tips. On the 5th week, 2 plants from each treatment were dug up. The soil was carefully removed by water jet and root development was examined.

Triacontanol was found to be effective in enhancing shoot growth and root development of Moluccan Sau seedlings when sprayed on the leaves at 0.10 and 0.15 ppm. Results indicate that triacontanol may be used to enhance growth and survival of Moluccan Sau seedlings.

Key words: Seedling, Root system, Growth promotion/acceleration

BARTOLOME F. NOBLE & CESAR A. ORALJO

Germinating buri palm (*Corypha elata* Roxb.) seeds under different pre-sowing treatments

Sylvatrop, Philippine Forest Research Journal, Philippines, 8(2, 3 & 4), 145-150, 1983, English

Different treatments were applied to buri palm seeds before sowing to hasten germination. Seeds soaked

in 40% sulfuric acid for 15 min. started to germinate 73 days from sowing. Seeds soaked in ordinary tap water for 96 hrs. germinated in 76.3 days. Untreated seeds germinated 78 days after sowing while seeds soaked for 30 min. in boiling water germinated after 80 days. Seeds slightly burned took 81.3 days to germinate. No significant variations in germination percentage were observed among the seeds soaked in 40% sulfuric acid for 15 min. (66%), those soaked in tap water for 96 hrs. (63%), and the ones untreated (52.7%). But these seeds had significantly higher germination percentages than the ones soaked in boiling water for 30 min or those slightly burned.

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

V.T. LASMARIAS

Survival and growth of akle (*Albizia acle* (Blanco) Kosterm.) and supa (*Sindora supa* Merr.) in various potting media
Sylvatrop, Philippine Forest Research Journal, Philippines, 4(3), 161-166, 1979, English

Seedlings of Akle and Supa were potted in polyethylene bags using the following soil media: (1) unwashed sand from the Laguna de Bay shore; (2) clay, consisting of 34% sand, 13% silt and 53% clay with pH 5.3; (3) ordinary garden soil (OGS) taken from a seedbed, consisting of 28% sand, 20% silt and 52% clay with pH 5.3; (4) humus, consisting principally of decayed tree leaves; (5) fresh sawdust, mostly of Malabayabas (*Tristonia decorticata* (Merr.); (6) OGS and humus mixture (1:1); (7) OGS and sand mixture (1:1); (8) OGS and sand mixture (2:1); (9) sand and humus mixture (1:1); (10) clay and sand mixture (1:1).

Heights were measured and the seedlings that survived were counted immediately after potting and once a month thereafter, until the seventh month. At the final measurements, the shoots and roots of 10 randomly selected samples per treatment per replicate were oven-dried and weighed to determine the shoot-root ratio of the seedlings.

Seven months after potting, OGS and sand mixture (2:1) and sand humus mixture (1:1) appeared to be the most satisfactory potting media for Supa seedlings. For Akle, OGS mixed with sand (2:1) was found to be the most suitable medium.

Key words: Nursery operation, Seedling, Survival, Growth

LUCINO A. FERNANDES

Germination media for igem (*Podocarpus imbricatus*)
Sylvatrop, Philippine Forest Research Journal, Philippines, 3(4), 251-252, 1978, English

Igem is one of the most common and important Philippine gymnosperms thriving in the province of Bukidnon.

This species is used in the manufacture of fine engineering instruments such as slide rule, T-square, drawing boards, as panel board, surface veneer, pencil slats, table tops, furniture, wood carving, novelties, and other uses requiring light/fine-grained wood. It is a potential source of pulp for paper manufacture because of its relatively long fibers.

Different germination media were tried for Igem: a) forest soil, b) sand; c) ground moss; d) forest soil and sand (1:1); e) forest soil and moss (1:1); f) sand and moss (1:1).

There were significant differences among germination media. Forest soil + sand media gave the highest germination (99%), sand + moss (98%), ground moss (98%), forest soil (96%), sand + moss (92%), and forest soil + moss (88%). The last medium's rate was significantly lower than those of the other treatments.

Key words: Native tree species, Germination, Seed, Sowing

T.W. EARLE & A.S. GARCIA

Hastening the germination of lumbang (*Aleurites moluccana* (L.) Willd) seeds
Sylvatrop, Philippine Forest Research Journal, Philippines, 2(4), 291-295, 1977, English

Lumbang seeds contain a drying oil similar to linseed oil and Chinese wood oil (tung oil). Lumbang oil can be used as a constituent of paints, soap, varnishes and linoleum, for home illumination by burning, and for wood preservation.

The objective of the research was to find a method that would consistently hasten Lambang seed germination to less than 10 days and would elicit a high (around 75%) germination.

All seeds were tested for viability by the water soak (sink/float) method before treatment. Acids were changed after each 15--seed sample was treated thus each replicate of a treatment received the same treatment. All seeds were sown 1 inch deep in a prepared seedbed positioned in full sunlight and watered daily.

Pre-sowing treatments using sulfuric, hydrochloric and nitric acids did not hasten germination of Lambang seeds. Neither did the methods of cracking or hot water soaking. The use of chemicals may be impractical because they are expensive, require careful handling and technical skill.

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

J. B. BRUZON

Fertilization of potted mayapis (*Shorea squamata*) seedlings in Surigao del Sur.

Sylvatrop, Philippine Forest Research Journal, Philippines, 3(3), 201-204,

1978, English

Mayapis, a member of the family Dipterocarpaceae, and known to grow all over the Philippines, has rarely been used to revegetate poorly stocked areas, denuded lands or openlands. For it to be used extensively in reforestation, technology on its production and development should be made available, hence, this study on fertilization was conducted.

Seeds were sown in a moist nursery bed. After one week, when the radicles emerged the seeds were potted and allowed to grow in the open with sunlight averaging 7 hrs. daily. Thirty six days after potting, almost all of the cotyledons had fallen and most of the seedlings had grown to an average height of 25 cm. The seedlings were then gathered and randomly assigned to the treatments, 20 seedlings to each treatment. Fertilization was completely randomized with 3 replications. The fertilizer used was NPK (14-14-14) formulation dissolved in tap water. The treatment levels were from 1 gm. up to 4 gm/seedling. Fertilization was done twice, the first application on 10 January 1978 and the second on 3 February. Analysis of variance was done using Tukey's test.

Height and growth responses were evaluated. The levels of 1 gm. and 2 gm. of fertilizer applied twice on each seedling gave significantly better results than the control.

Key words: Dipterocarps, Seedling, Fertilizer application, Growth

M. UMALI-GARCIA

Effects of pericarp removal on the germination of molave (*Vitex parviflora* Juss.) seeds

Sylvatrop, Philippine Forest Research Journal, Philippines, 5(1), 61-66, 1980,

English

This study was conducted to find a useful, economical and practical way to improve and enhance germination of Molave seeds.

The Molave fruits used were sorted into 2 categories, ripe and matured green. The ripe ones consisted of fruits with purple pericarp and the matured green consisted of matured fruits with plain pericarp (completely free of any purple coloration).

One thousand fruits per category were sown in a mixture of 1 part sand and 1 part garden soil. The seeds, for both categories, were either depulped (pericarp removed) or the pericarp left intact, then were either kept inside a tightly sealed polyethylene bag or kept in an open container under room temperature for 12 h before sowing.

Removal of the pericarp of molave drupes prior to sowing hastened and improved germination. The germination of intact green fruits devoid of pericarp was further enhanced by keeping them sealed in a polyethylene bag for 12 h. The above treatments point to a useful, economical and practical way to germinate molave seeds and help ensure seedling uniformity.

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

C.A. MONDOLA

Depth and position of sowing large-leaf mahogany (*Swietenia macrophylla*) seeds

Sylvatrop, Philippine Forest Research Journal, Philippines, 2(2), 131-137,

1977, English

Large-leaf Mahogany is an excellent species for the manufacture of cabinets and furniture pieces. The species is also used for roadside and park planting and intensive reforestation.

Three hundred seeds of Large-leaf Mahogany were stored at room temperature for 2 weeks before sowing. Depths of from 2 to 6 cm were used. In each row only one depth was used but the 12 seeds were sown in different positions, i.e., 4 seeds each in an upward, downward and flat position. Upward position means the wing of the seed is pointing upward, downward means the narrower long side pointing downward and the embryo upward, and flat position means the wider side lies on the soil.

The 3-cm depth and downward position gave the earliest time of germination. The highest percentage germination was found in the 3-cm depth and flat position. Peak germinative energy and growth rate were observed in the 6-cm depth and downward position. Statistical tests, however, showed no significant differences among treatment means.

Key words: Mahogany, Sowing, Germination, Seed

MAXIMO V. LANTING JR

Germination of talisai (*Terminalia catappa* Linn.) seeds

Sylvatrop, Philippine Forest Research Journal, Philippines, 7(1), 27-32, 1982, English

Talisai seeds were separately subjected to 3 treatments before they were sown in 4 different germination media. Seeds soaked in hot water with initial temperature of 50 degrees centigrade for 2 hours then in tap water for 15 hours germinated significantly faster (21 days) than any of the other treated ones (26.5 days). Likewise, treated seeds had significantly higher germination percentage (55.5%) than the untreated seeds (46.33%) rate. The most suitable germination medium was ordinary garden soil provided moisture was maintained.

Key words: Seed, Pre-sowing treatment, Germination

LEVI V. FLORIDO

Vegetative propagation by cuttings of yemane (*Gmelia arborea* Roxb.) using growth

Sylvatrop, Philippine Forest Research Journal, Philippines, 3(2), 115-122, 1978, English

Cutting as a propagation technique is inexpensive, rapid, simple and does not require as much special technique as stock production from seeds. Between planting stock from seed and from cuttings, the use of the latter is more advantageous in the establishment of seed orchards.

This study was conducted to determine the response of Yemane cuttings to different growth hormones and at different level concentrations.

Indoleacetic acid (IAA), naphthalene acetic acid (NAA) and indolebutyric acid (IBA) in 4 levels: 0 ppm, 250 ppm, 500 ppm, and 750 ppm were tested on Yemane cuttings. NAA induced more formation of roots than IAA and IBA. Higher concentration of the hormones enhanced root initiation and development.

Key words: Vegetative propagation, Cutting, Hormone, Rooting

CESAR A. ORALLO

Height growth and survival of benguet pine (*Pinus insularis* Endl.) grown in various potting media

Sylvatrop, Philippine Forest Research Journal, Philippines, 4(2), 93-96, 1979, English

This exploratory study was initiated to determine growth and survival of pine seedlings grown in various potting media.

Seedlings with an average height of 5.22 cm, were potted in polyethylene bags using different soil media. Seedlings grown in sphagnum moss were taller and more vigorous (18 cm. tall and 89% survival) than those grown in the other media. The 1:1 topsoil-moss mixture and ordinary topsoil produced fairly tall and vigorous seedlings, followed by intermediate growth from the 1:1 topsoil-sawdust, decomposed sawdust and the mixture of 1:1 sawdust and moss potting media. The poorest seedling growth was in the topsoil-sawdust-moss combination. Significant differences in growth were observed. Rates of survival in all the media tested were satisfactory but no significant differences were noted among the treatments.

Key words: Seedling, Pine, Survival, Nursery

ADELAIDA B. COSTALES & V.P. VERACION

Germination of benguet pine (*Pinus kesiya*) seeds at various intervals of watering

Sylvatrop, Philippine Forest Research Journal, Philippines, 3(4), 243-245, 1978, English

An important but obviously neglected nursery operation is the proper spacing of watering. In Benguet forest nurseries, nurserymen are likely to follow their own judgment and do the watering everyday, every other day, or at 3, 4 or 5-day intervals.

Four hundred seeds were sown from a seed lot stored for one year at room temperature. Then the beds were watered with a portable sprinkler at intervals of from 1 to 9 days.

Most satisfactory germination values were attained with everyday watering of Benguet Pine. However, the 2-day watering interval is preferred because germination time is much shorter.

Key words: Seed, Germination, Pine, Nursery, Watering, Seedling

PEPITO R. GARCIA, LIDA CASTILLO-BORBORAN & MACARIO G. BIONGLAY

Germination of naring (*Vatica mangachapoi* Blanco) and red lauan (*Shorea negrosensis* Foxw.) seeds in various media

Sylvatrop, Philippine Forest Research Journal, Philippines, 8(2, 3 & 4), 133-137, 1983, English

Naring and red lauan seeds were sown in different germination media using sand (A), ordinary garden soil (B), sawdust (C), mixtures of AB, AC, BC (1:1 v/v) and ABC (1:1 v/v).

Naring seeds sown in A, C, or their combination (AC) showed better germination (83.3, 78.3 and 74.7 percent Germinative Capacity, respectively) than those sown in B (32.2% Germinative Capacity). Red lauan seeds sown in any of the tested media except in ABC (63.0% Germinative Capacity) yielded a relatively high percentage (from 69.0 to 81.7% Germinative Capacity). However, for practical application, the germination medium that may be best for red lauan is sand or its mixture with ordinary garden soil.

Key words: Dipterocarps, Seed, Germination, Sowing

MAXIMINO I. GENERALAO

Effects of pre-treatment media on the germination of palasan

(*Calamus maximus* Blanco) and limuran (*C. ornatus* Blanco) seeds at Pagbifao, Quezon

Sylvatrop, Philippine Forest Research Journal, Philippines, 2(3), 215-218, 1977, English

Proper seed germination technique is indispensable in stock production especially of plant species left alone to grow in the wilderness like rattan. This study was conducted to determine the germination medium that may enhance the optimum germination percentage of rattan seeds. The germination media used were ordinary garden soil (OGS); OGS and forest soil (1:1); OGS, forest soil and sand (1:1:1); OGS, forest soil and sand (1:2:2). The seed pre-treatment used were: control; tapwater; soaked for 48 hrs., 100° C initial temperature; diluted sulfuric acid (1%) soaked for 2 hrs., seed heated for 20 min., then soaked in tapwater for 24 hrs.; stratification in moist sawdust soaked for 12 days; stratification with cogon mulch soaked for 12 days; seeds mixed with wet wood ash soaked for 12 days.

There was a significant difference in germination among methods of seed pre-treatment but none among germination media. There was no interaction between pre-treatment and germination media.

Stratification in sawdust for 12 days as seed pre-treatment gave the highest germination (27.48%). Six other pre-treatment methods were deleterious and gave germination percentage significantly lower than the control.

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

JEREMIAS B. BRUZON

Fertilization of potted white lauan (*Shorea contorta* Vidal) seedlings in the nursery of the Dipterocarp Forest Research Center, FORI

Sylvatrop, Philippine Forest Research Journal, Philippines, 7(1), 21-25, 1982, English

Three hundred (300) white lauan seeds of uniform sizes were collected on December 1977, a seed year. They were air-dried for 2 days and were sown in prepared pots which were then placed in the open for exposure to sunlight for approximately 7 hr daily. Fertilizer was applied on the seedlings three times after planting.

White lauan (*Pentacme contorta* Vidal) responded best to NPK (14-14-14) fertilizer dissolved in 3 liters of water and applied at 2g/seedlings. Fertilization was done thrice; 38 days after sowing; 22 days after the first application; and 28 days after the second application. Average height, survival and girth were significantly different 83 days after the first application of fertilizer, when compared with the seedlings that were not fertilized.

Two grams of fertilizer mixed in 3 l of tap water seems to be the ideal and recommended treatment for white lauan seedlings potted in sandy-loam soil.

Key words: Dipterocarps, Fertilizer application, Seedling fertilizer

SOMYOS KIJKAR

Coconut husk as a potting medium: hand book

ASEAN-Canada Forest Tree Seed Centre, Saraburi, Thailand, 14, 1991, English

The ASEAN-Canada Forest Tree Seed Centre (ACFTSC) has identified the most cost-effective methods for preparing healthy seedlings; these focus on potting media and fertilizer application. After some years of experimentation, it has been found that coconut husk is the most cost-effective potting medium for producing vigorous forest tree seedlings. The use of coconut husk, in conjunction with the application of Osmocote fertilizer, has many advantages. The material is light weight, porous, and has excellent adhesive and cohesive properties. In addition, its high water-holding capacity reduces watering cost and time, and during wet season it is not damaged by splashing from heavy rain. Other major advantages of coconut husk as potting medium is that seedlings can be lifted bare rooted from the containers and transportation costs are less than when other potting media are used. The most serious disadvantage to the use of coconut husk is the risk of damage by termites.

This handbook describes the preparation of coconut husk for use as a potting medium and documents its cost benefits.

Key words: Nursery, Nursery operation, Seedling, Sowing, Potting media

SOMOYOS KIJKAR

Producing rooted cuttings of *Eucalyptus camaldulensis*: handbook

ASEAN-Canada Forest Tree Seed Centre, Saraburi, Thailand, 25, 1991, English

Conventional *Eucalyptus* plantations, that is, those established from general seedlings, can give low yields. It is estimated, depending on site, that traditional *Eucalyptus camaldulensis* plantation yield approximately 16-22 m³/ha/yr. It is believed that the best way to guarantee adequate yields for commercial operation is to establish clonal plantations.

The low yield of *Eucalyptus* plantation is largely explained by the self-pollination of the species. It is reported that as many as 80% of *Eucalyptus* trees are self breeding. Since only 20% of fertilized seed are suitable for plantation establishment, the self-pollination of the species is a critical issue for plantation establishment.

Rooting cuttings, which has already been used successfully in South America, is the most appropriate method for establishing clonal plantation. Researchers at the ASEAN-Canada Forest Tree Seed Centre in Thailand (ACFTSC) have adapted the rooting cuttings system for use with *E. camaldulensis*. Eighteen months after transplanting two plots of *E. camaldulensis* to an observation area, the yield from one plot increased from the conventional plantations 16-22 m³/ha/yr, to approximately 45 m³/ha/yr with conventional site plantation and maintenance.

The contents of this handbook are based largely on research trials conducted during 1987-1989 at ACFTSC.

Key words: Eucalypt, Cuttings, Growth, Vegetative propagation

A.V. GLORI & D.R. TUMAMBING

Hardening of falcata (*Paraserianthes falcataria* L. Nielsen) seedlings for dry season planting

Sylvatrop, The Technical Journal for Philippine Ecosystems and Natural Resources, DENR, Philippines, 1(1), 63-68, 1991, English

The effect of hardening treatment of falcata (*Paraserianthes falcataria* L. Nielsen) seedling growth in the nursery was determined by subjecting the seedlings to various periods of exposure to direct sunlight.

The study revealed that raising falcata seedlings in the nursery under plastic shed for 24 to 38 days (from date of sowing) and subsequently exposing them in the open for 7 to 21 days resulted in shorter but hardened seedlings.

Seedlings kept under the shed for 24 to 31 days and then exposed in the open for 14 to 21 days gave better field survival and growth rates than unhardened seedlings.

The 14 to 21 day period of hardening in the nursery is therefore recommended for falcata seedlings.

Key words: Seedling, Nursery, Planting stock, Survival, Growth, Sun-shade

VIRGILIO C. RAMILO & A.D. MAGAT

Field performance of growth-retarded falcata (*Paraserianthes falcataria* (L.) Nielsen) and bagras (*Eucalyptus deglupta* Blume) seedlings in Bislig, Surigao del Sur
Sylvatrop, The Technical Journal for Philippine Ecosystems and Natural Resources, DENR, Philippines, 1(1), 47-52, 1991, English

Standard sized plantable falcata and bagras seedlings were arrested of growth rate for two months in the nursery and then immediately outplanted to determine their survival and growth performances in the field.

Three months after outplanting, the mean height and diameter of growth-retarded falcata and bagras seedlings (A and B) did not differ significantly from the standard sized seedlings. Mean survival rate ranged from 82 to 87% for falcata and 85 to 91% for bagras.

Therefore, arresting the growth rate of falcata and bagras seedlings in the nursery for two months when outplanting activity is delayed does not adversely affect subsequent performance of the seedlings in the field. Application of fertilizer during the growth retardation period in the nursery is not necessary.

Key words: Survival, Growth, Eucalypt, Seedling

APICHART KAOSA-ARD

Teak, *Tectona grandis* Linn. f. nursery techniques
Danida forest seed center, Thailand, No. 4A, 42, 1986, English

In Thailand, teak occurs naturally throughout the northern part of the country covering an area of 170,000 km². Due to population pressure, both the stock of teak trees in the forests and the forest area have been depleted rapidly.

Now technological knowledge regarding teak nursery and plantation establishment techniques is highly demanded. Although a large volume of scientific results in this field has been recorded, in various journals and graduate university theses, a manual on teak nursery practice and plantation establishment on a commercial scale is not available.

The present paper aims to give an account of scientific results and techniques currently adopted in teak nurseries in Thailand. These techniques are expected to reduce production cost, improve both qualities and quantities of seedlings and/or stumps and hence increase the value of the plantation.

Key words: Seedling, Nursery, Nursery operation

PIN KUERKOOI.

Nursery production techniques in Thailand
ASEAN-Canada Forest Tree Seed Centre, Thailand, No. 2, 5, 1991, English

This paper describes key stages in nursery production techniques for teak, pine, and eucalypt. The importance of large-scale nursery production in Thailand as a source of rural employment and social welfare is also addressed.

Key words: Nursery, Nursery stock, Pine, Eucalypt

KOWIT PONG--ANANT

Grafting epicormic shoots: a new method of clonal propagation
ASEAN-Canada Forest Tree Seed Centre, Thailand, No. 6, 6,
1991, English

This paper presents the findings of an experiment conducted on differences in grafting rates between conventional seedlings and epicormic shoots derived from the branches of five, 25 year-old *Pterocarpus macrocarpus* trees. There was very little difference in graft survival, the range being 90-100%. Grafting epicormic shoots show considerable promise in establishing clonal seed orchards.

Key words: Grafting, Breeding, Seed orchard

ASEAN-CANADA FOREST TREE SEED CENTER

Planting stock production technology

ASEAN-Canada Forest Tree Seed Centre, Thailand, No. 1, 57,
1991, English

The objectives of the Planting Stock Production Technology Course held at the ASEAN-Canada Forest Tree Seed Centre, Thailand were to upgrade the competence of nursery managers and planting stock producers, orient research towards practical ends, help find ways to produce more vigorous and healthier seedlings within a reasonable period of time at low cost and, of course, transfer the technologies developed in ASEAN to all interested parties.

There were 33 trainees from Brunei-Darussalam, Indonesia, Malaysia, Philippines, and Thailand. They exchanged ideas, discussed mutual problems, and shared the knowledge imparted by lecture and gained from practical exercises.

Key words: Planting stock, Seedling, Nursery operation

2-4 Plantation Establishment

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

M. SAKAI, W. ANAPANURAK, S. BOONPLIAN, S. PHOPINT, C. RUNGSIRI, J. YOSHIOKA

The forest soil in Thailand Part II

Research and Training in Re-forestation Project, RFD-JICA, Thailand,
34, 1991, English

This pamphlet contains 15 soil profiles with color photo and some explanations. The explanations are location, general information of stand, general information of site, surveyor, date of survey, brief description of soil profile, and features of plot.

Key words: Soil profile, Soil type

JIRO YOSHIOKA

The practical procedure of systematic soil survey and an application of their results for an afforestation practice

Research and Training in Re-forestation Project, RFD-JICA, Thailand,
18, 1991, English

This report is explained a concerning information of an obligate procedure on the systematic soil survey and an applying of their results for an afforestation into practice.

This report give a few data in case studies at Thung Seleang Luang, Kanchanaburi, Sakaerat experimental fields and the soil of mass forest on the Mt. Intanon.

Key words: Soil survey, Afforestation

MORIYOSHI ISHIZUKA, PISAL WASUWANICHI

Research activities and achievements of the Silviculture Plantation

Section (Phase II)

**Research and Training in Re-forestation Project, RFD-JICA, Thailand,
126, 1991, English**

This report consists of 5 research subjects and 2 research reports.

The research subjects are as follows: (1) Planting techniques of *Dipterocarpus alatus* using stumps and seedlings; (2) Underplanting of *Hopea odorata* in the plantation of various pioneer tree species; (3) Effect of the different number of row/strips arrangement of *Acacia leptocarpa*, *Eucalyptus camaldulensis*, *E. deglupta* and *Pinus caribaea* on the production of trees/crops under the practice of agro-forestry system; (4) Thinning and coppice growth in *Eucalyptus camaldulensis* plantation; (5) Annual net production rate, seasonal growth and litter fall pattern in six tree species.

The research reports are as follows: (1) Report on light climate analysis in forests; (2) Biomass production and seasonal growth of some broad-leaved tree species in Central Thailand.

Key words: Dipterocarpus, Under planting, Fast growing tree species, Eucalypt, Thinning, Coppice forest

KOICHI KAMO

Research activities and the progress of silviculture section

in the project

**Research and Training in Re-forestation Project, RFD-JICA, Thailand,
133, 1989, English**

Topic 1: Thinning and coppice experiment of fast-growing tree - (*Eucalyptus camaldulensis*) is aimed to establish a suitable management system for fast growing tree species with coppicing capability. Topic 2: Techniques on the production and management of *Xylia Kerrii* seedlings has been selected to obtain information on suitable nursery techniques of native tree species. Topic 3: Comparative study on planting techniques of *Dipterocarpus alatus* by stumps and seedlings usage is being conducted to find an adequate planting season and stump size required for planting and to make sure which *Dipterocarpus alatus* stumps and seedlings are suitable for planting. Topic 4: Underplanting of *Hopea odorata* in the stand of various pioneer tree species is aimed at obtaining quantitative data on a suitable pioneer tree species and favorable light intensity through spacing for the initial establishment of *Hopea odorata* seedlings. Topic 5: Effect of varied quantities of row/strips arrangement of *Eucalyptus camaldulensis*, *Eucalyptus deglupta*, *Acacia leptocarpa*, *Pinus caribaea* on the production of trees/crops under the practice of the agro-forestry system has been chosen as one part of an agro-forestry study to obtain quantitative data on the interaction between the growth of trees and crops. Topic 6: Growth dynamics in some tropical tree stands - annual net production rate and seasonal growth and litter fall pattern of some fast growing tree species and pine species in Thailand.

Key words: Thinning, Fast growing tree species, Silvicultural technique, Dipterocarpus, Seedling, Pine

THAILAND-JAPAN RESEARCH AND TRAINING IN RE-AFFORESTATION PROJECT, RFD

Reforestation planning and technical guidance

**Thailand-Japan Research and Training in Re-forestation Project, RFD-JICA,
Thailand, 127, 1989, English**

This book was written in order to sum up all of activities for 7 years at Sakaerat Field Station and to introduce precious and useful experiences and knowledge to various persons concerned with forestry.

This book is divided into three parts. Part I is described on the background of the Project and basic information on Sakaerat Field Station. Part II and III are main sections of this book, described on all procedure of reforestation activities; planting, controlling and implementing, in the field of nursery practice in Part II, plantation and tending in Part III.

Key words: Reforestation, Silvicultural technique, Tending, Nursery operation

J.M. MANUBAG

Litter weight and soil compaction under stands of *Anthocephalus chinensis*,

Swietenia-macrophylla, and Mixed Dipterocarps
The Pterocarpus, Philippine Science Journal of Forestry, UP, Philippines,
2(1), 22-25, 1976, English

This study was designed to determine the weight of litter and understory biomass and the degree of soil compaction under stands of *Anthocephalus chinensis*, *Swietenia macrophylla*, and mixed dipterocarp located in Makiling forest, College, Laguna.

The *Anthocephalus* stand yielded the least litter oven-dry (23 g/cm²) compared with *Swietenia* (63.7 g/cm²) and mixed dipterocarp (79.9 g/cm²) stands. Soil compaction was greatest (1.10 kg/cm²) under the *Anthocephalus* stand, followed by mixed dipterocarp (0.88 kg/cm²) then under the *Swietenia* (0.66 kg/cm²) stands. The study failed to show any relation between soil compaction and weight of litter and understory vegetation.

Key words: Litter, Stand, Soil texture, Undergrowth, Biomass

**PHILIPPINE COUNCIL FOR AGRICULTURE, FORESTRY AND NATURAL RESOURCES
RESEARCH AND DEVELOPMENT**

Legume inoculation with rhizobia

Technology, Philippine Council for Agriculture, Forestry and Natural

Resources Research and Development (PCARRD), Philippines, 9(1), 16, 1987, English

Nitrogen fixation by legume-rhizobia symbiosis offers an opportunity for increasing nitrogen supply to crops. The nitrogen gas in the air is converted by the rhizobia into forms which the legume can utilize. On the other hand, host plants or the legumes provide energy for the process. This association has been estimated to fix about 35 million tons of nitrogen per year in agricultural ecosystems.

To maximize the efficiency of the symbiosis, effective strains of rhizobia are introduced through inoculation. The inoculant may be introduced through seed and soil inoculation.

Results of field studies at the University of the Philippines at Los Baños showed that inoculated legumes produced higher yields than plants fertilized with 30 kg nitrogen per hectare. In most instances, however, the benefit derived from inoculation is not an increase in yield but rather a reduction in the use of nitrogen fertilizer.

Key words: Nitrogen fixation, Microorganism, Inoculation

NELLY S. SIABABA & REYNALDO E. DELA CRUZ

How do mycorrhiza and rhizobium inoculation affect the growth of

Ipil-ipil (*Leucaena leucocephala* (Lam.) de Wit) seedlings

NSTA Technology Journal, 31(4), 12-17, 1986, English

The effects of Mycorrhiza and Rhizobium inoculation on height, diameter, dry matter yield, nitrogen and phosphorus contents and uptakes of ipil-ipil seedlings were investigated in pot experiments.

Plants inoculated with Rhizobium had significantly increased nitrogen content at the roots while those inoculated with Mycorrhiza significantly increased in height by 216%, in diameter by 45% and in phosphorus content of roots and shoots. However, significantly greater height growth was observed in plants inoculated with both Mycorrhiza and Rhizobium as compared with those inoculated with either Mycorrhiza or Rhizobium. Combined inoculation also resulted in significantly higher dry matter yield and nitrogen and phosphorus uptakes than those inoculated with Rhizobium and those uninoculated. But this was not significantly different from those inoculated with Mycorrhiza alone. Inoculation with Mycorrhiza plus Rhizobium increased nitrogen and phosphorus uptakes by 223% and 560%, respectively. The increase in nitrogen and phosphorus uptakes consequently resulted in high dry matter yield of ipil-ipil seedlings. These results suggest a possible synergistic interaction between Mycorrhizal fungi and Rhizobium in enhancing growth of ipil-ipil seedlings.

Key words: Mycorrhizal fungi, Fungus, Inoculation, Growth promotion, Root system

**PHILIPPINE COUNCIL FOR AGRICULTURE, FORESTRY AND NATURAL RESOURCES
RESEARCH AND DEVELOPMENT**

The Philippines recommends for mangrove production and harvesting

Philippine Council for Agriculture, Forestry and Natural Resources

Research and Development (PCARRD), Philippines, 96, 1991, English

Mangrove forests are found on tidal flats along seacoasts and are usually associated with thick stands

of medium-sized and even-aged trees, nipa palms and other herbaceous plants. Mangroves grow approximately between latitudes 32° N and 38° S on the eastern border of the continents.

Mangroves offer a wide array of multifarious benefits. However, human activities and interventions within and near mangrove areas usually lead to the degradation of mangroves and the coastal ecosystem as well. The Philippine mangrove areas are converted into fishponds, agriculture, saltponds and other coastal projects. To date, there are only about 139,725 hectares of mangroves left in the Philippine because of unabated deforestation.

To promote mangrove plantation establishment and rehabilitation, this publication provides practical experience on mangrove plantation establishment and management.

Key words: Mangrove, Plantation, Planting, Silvicultural technique

**PHILIPPINE COUNCIL FOR AGRICULTURE, FORESTRY AND NATURAL RESOURCES
RESEARCH AND DEVELOPMENT**

Soil taxonomy: key to effective land use, book series No. 51

Philippine Council for Agriculture, Forestry and Natural Resources

Research and Development (PCARRD), Philippines, 551, 1988, English

Self-sufficiency in food and fiber production can only be made possible with improved and sustained soil productivity. For the transfer of technology to be effective, a common knowledge of the soil resources of the country is necessary. Thus, soil taxonomy, a soil classification system used in more than 60 countries, is very useful for this purpose.

The International Forum on Soil Taxonomy and Agrotechnology transfer was held at PCARRD Headquarters in Los Baños, Laguna, Philippines in 1986. It served as a soil correlation exercise for scientists in the region to establish the basis for a collaborative program leading to the soil map of the ASEAN region.

This publication is a proceedings of the Forum and it contains technical papers that may be helpful to scientists in the region in an exchange of valuable information on soil resources.

Key words: Soil survey, Soil type, Soil management

**RP-JAPAN FORESTRY DEVELOPMENT PROJECT OF THE PANTABANGAN AREA
Silvics**

**RP-Japan Forestry Development Project of the Pantabangan Area, Philippines,
66, 1987, English**

This is a technical report of RP-Japan Project on forestry in the Philippines. It provides information on the silvical characteristics of seven forest tree species used in the Project. These species are *Acacia auriculiformis*, *Anisoptera thurifera*, *Eucalyptus camaldulensis*, *Gmelina arborea*, *Pterocarpus indicus*, *Swietenia macrophylla* and *Vitex parviflora*.

Key words: Tree species, Silvicultural technique

CARLOS C. TOMBOC & ROMEO M. BASADA

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

**Sylvatrop, Philippine Forest Research Journal, Philippines, 3(4), 205-210,
1978, English**

In the management of the dipterocarp forest, manipulating the light conditions of the stand to favor or hinder the growth of certain tree species is one of the most effective methods of influencing the composition of regenerations.

In this experiment of two different treatment plots of white lauan, the survival of seedlings under the forest canopy was 67.8% better than that of seedlings received full light 15 days after sowing, but the height growth and the leaf development were substantially greater in the open.

Key words: Dipterocarps, Survival, Growth, Sowing, Light intensity

ANTINIO V. GLORI, REYNALDO E. DELA CRUZ & IRENEO L. DOMINGO

**Drought resistance of yemane (*Gmelina arborea*) and Kaatoan bangkal
(*Anthocephalus chinensis*)**

Sylvatrop, Philippine Forest Research Journal, Philippines, 3(4), 211-239, 1978, English

One-month old yemane and 3-month old Kaatoan bangkal seedlings were subjected to 4 months of varying soil-moisture levels: 70%, 55%, 40% and 25%. The tests showed that yemane is more resistant to drought than bangkal. This suggests yemane as a better reforestation crop than bangkal especially for dry areas of the country.

Key words: Drought tolerance, Soil moisture, Tree species

ROGELIO A. ZAMORA & ALREDO C. AGPAOA

Months for planting *Gmelina arborea* stumps for different age

Sylvatrop, Philippine Forest Research Journal, Philippines, 1(1), 38-43, 1976, English

Different ages of planting materials and different months of planting were tried to determine the survival percentages in relation to the month of planting and age of stumps that will ensure the establishment of *Gmelina* plantations.

Stumps used were raised to 10 months of age. Seeds were sown monthly. Thirty treatment combinations (6 different ages and 5 planting months) were assigned randomly in each replication.

Stumps 8 to 10 mo old planted during early rainy season, gave the best performance in the field.

Key words: Planting, Seedling, Survival, Planting stock, Fast growing tree species

FELIX F. ORDINARIO & DOMINGO V. JACALNE

The effect of land configuration, site preparation and depth on soil moisture build up in the grasslands of Carranglan, Nueva Ecija

Sylvatrop, Philippine Forest Research Journal, Philippines, 8(2, 3 & 4), 99-118, 1983, English

The scanty rainfall of 127.3 mm, thinly distributed from 1 April to 27 May 1982, on the grasslands of Carranglan, was enough to built up soil moisture at the bottom slope. Slopes of eastern exposure dried up more rapidly than slopes of western exposure.

Site preparation that consisted of digging the hole, pulverizing the soil, returning the mulching the soil, hastened soil moisture build up besides reducing the surface temperature range to a tolerable level. Digging the hole, pulverizing the soil, and returning but not mulching the soil was effective in the build up of soil moisture at the bottom slope but not on the ridge and midslope. In addition, both mulched and dug treatments hastened the build up of soil moisture at 20 cm deep. Scalping was disadvantageous because it induced an extremely high soil surface temperature that desiccated the soil rapidly. Non-removal of grasses induced tolerable range of temperature at the soil surface but kept the soil dry due to interception of rainfall.

Key words: Silvicultural technique, Site preparation, Soil moisture

MARCELINO M. MAUN

Survival and growth of yemane (*Gmelina arborea*) at different spacings

Sylvatrop, Philippine Forest Research Journal, Philippines, 2(4), 287-289, 1977, English

Yemane is one of the major reforestation species in the country. This study was conducted to determine the effect of rectangular and square spacings on the survival and growth of the species.

Yemane seeds were sown in the greenhouse and potted 3 months later. They were set out in the field 5 months after sowing or barely 2 months after potting. Three variables, namely diameter at breast height, total and merchantable heights and survival percentage, were measured.

Yemane trees were planted 1.5 x 1.5 m, 2 x 2 m, 3 x 3 m, 1.5 x 2 m, 2 x 3 m. Spacings had no significant effect on the survival, merchantable length and total height. The 3 x 3 m spacing produced the biggest diameters.

Key words: Fast growing species, Planting, Planting distance, Survival, Growth

V.P. VERACION & LEOPOLDO F. FRIAS

Comparative growth of alnus planted in shaded and open areas

Sylvatrop, Philippine Forest Research Journal, Philippines, 3(4), 247-248, 1978, English

Alnus is one of the reforestation species that have been introduced successfully in Benguet and neighboring areas. The species is suitable for planting on denuded mountain slopes and on banks of water tracks and roads to hold the soil in place. It is also planted for shade and as windbreak. This study was conducted to compare the growth of alnus planted in shaded and open areas.

Shaded Alnus seedlings were grown under a Benguet Piné (*Pinus insularis*), canopy which had about 30% light intensity, while the seedlings in the open were grown under full sunlight. All plantation sites were on a southern exposure at an altitude of about 1626 m. and a slope ranging from 25 to 40%, with generally cool climate and mean annual rainfall of about 4,890 mm. about half of which occurs between July and August.

Diameter growth was more apparent in open areas. On the other hand, total height growth was not significantly different between study sites. This indicates the possibility that the species can be grown fairly well under the shade of Benguet Pine.

Key words: Under planting, Pine, Silvicultural technique

MARCELIÑO V. DAUMACIO & FLORENDO BALANGAN

Direct seeding of *Pinus kesiya* Royle ex Gordon as affected by time of seeding, site preparation and seed coating

Sylvatrop, Philippine Forest Research Journal, Philippines, 1(3), 215-222, 1976, English

Direct-seeding of Benguet Pine is a cheap and fast means of reforestation. To determine the feasibility of direct-seeding Benguet Pine, a study was conducted in a recently burned area in Malaybalay, Bukidnon.

DDT-coated and control (not coated) Benguet Pine seeds were sown on June 17, July 27 and August 27 on seedspots that were either unprepared, cleared of vegetation by scalping, or cultivated. The seed coating was formulated by dissolving 100 g of DDT into 100 ml of water and mixing the solution thoroughly by stirring. Tenac sticker was then added at the rate of 10% by volume and mixed with the formulation by stirring briefly. To coat 100 g of Benguet Pine seeds, they were placed in a beaker and then 25 ml of the formulation was slowly poured on them, while being stirred.

Germination was very poor, averaging only 4.2%. Sowing on June 27 and August 27 was superior to July 27 sowing while significantly more DDT-coated seeds germinated than the control. Seed losses due to rodent activity could easily account for 90%. No significant effect of seedspot preparation on germination was observed. Survival of seedlings was 37% while the mean height of the more vigorous seedlings was 18.5 cm. Mortality was mainly caused by cutting (most likely by insects), drought, and later by competition.

Key words: Direct seeding, Pine, Land preparation, Germination, Mortality

F. BARANGAN

Spacing of benguet pine (*Pinus kesiya* Royle ex Gordon) in Laparan, Malaybalay, Bukidnon

Sylvatrop, Philippine Forest Research Journal, Philippines, 3(1), 47-50, 1978, English

The various Benguet Pine products are obtained from trees of varying sizes or ages. For instance, Benguet Pine is ideal for Christmas tree when it reaches a height of 2 to 3 m; for pulpwood when it attains a diameter above 35 cm. For these products, one has to consider the maximum number of trees per unit area that gives the grower the maximum profit possible.

The study was conducted to determine the ideal spacing of Benguet Pine in Malaybalay, Bukidnon. Four spacing treatments, namely, 1 x 1 m., 1 x 2 m., 2 x 2 m., 2 x 4 m., were compared to determine mortality rates, height and diameter growths. All the treatments were replicated four times using 25 experimental plants per treatment and with 1 row as buffer or isolation strip around each treatment. Mortality was observed to be greater in closer spacings; height growth was not significantly different in all treatments, while diameter growth was significantly greater with wider spacing and decreased with closer spacing.

Key words: Pine, Planting, Planting distance, Mortality, Survival, Increment

RAQUEL B. MANIT

**Effect of spacing on the growth and development of malapapaya
(*Polyscias nodosa* (Blume) Seem) for match wood
Philippine Lumberman, Philippines, 34(4), 9-11, 1988, English**

Statistical analysis of the data showed spacing had no significant influence on the survival and growth (height and diameter) of Malapapaya. Wider spacings (3 x 3 m and 4 x 4 m) however, tend to produce bigger and taller trees compared to closely spaced trees.

Highly significant effect of spacing was observed on the basal area per hectare. Results indicated that basal area decreases with an increase in spacing interval with 1 x 1 m. spacing attaining the largest basal area of 15.53 m²/ha of 6-year old Malapapaya trees followed by 4.65, 3.90 and 1.82 m²/ha for a 2 x 2, 3 x 3 and 4 x 4 meters of spacing, respectively.

Key words: Planting distance, Planting, Survival, Growth

BASILIO P. MAMANTEO & VICENTE P. VERACION

Coppicing of oak trees

**Sylvatrop, Philippine Forest Research Journal, Philippines, 10(3), 181-186,
1985, English**

Coppicing of oak trees on stumps with diameter classes 5-10, 10-15, 15-20, 20-25, 25-30, 30-35, 35-40 cm was conducted in Palapal, Monamon Sur, Buako, Mt. Province. The highest number of sprouts 54 was obtained in the 20-25 cm diameter class and the lowest, 22 sprouts, was produced in the 35-40 cm diameter class. Sprouts were tallest (138.2 cm) in the 25-30 cm diameter class and shortest (78.2 cm) in the 5-10 cm stump diameter class. However, no significant differences in the number and total height of sprouts were observed among the stump diameter classes. For sprout production, coppicing of oak trees could, therefore, be done regardless of the stump diameter class.

Key words: Coppice forest, Diameter grade, Growth, Stump, Regeneration by sprout

LORETTO V. URI-DELA CRUZ, REYNALDO E. DELA CRUZ et al.

**The effect of nitrogen fertilization and mulching on the growth and
survival of outplanted kaatoan bangkal (*Anthocephalus chinensis*) seedlings
and on some soil properties of an open grassland
The Pterocarpus, UP at Los Baños, College of Forestry, Philippines, 4(1),
62-72, 1978, English**

This research activity tested the effects of three levels of N (0, 0.6 and 1.2 g Urea/plant) and six mulching treatments (no mulch, rice hull, bagasse, Banana (*Musa sapientum*) stalk, Cogon (*Imperata cylindrica*), talahib (*Saccharum spontaneum*) and sawdust) on the survival and growth of Kaatoan Bangkal seedlings outplanted in an open grassland. In addition, other effects of N fertilization and mulching treatments on some soil physical and chemical properties, plant nutrient content and plant uptake were determined four and six months after planting.

Key words: Fertilizer application, Planting, Survival, Growth, Seedling, Mulching, Soil texture

J.M. PERINO

**Rehabilitation of denuded watershed through the introduction of kakawate
(*Gliricidia sepium* Jacq.)
Sylvatrop, Philippine Forest Research Journal, Philippines, 4(2), 49-67,
1979, English**

The study (Phase I) revealed that Kakawate is found in most latitudes in the Philippines from 6° to 19° N and an altitudinal range of from sea level to 900 m in the 4 climatic types (Corona's classification) in the Philippines. Kakawate grows in most adverse sites. It is a drought-resistant species which sheds its leaves during dry season (November to April). Before the onset of the rainy season, its leaves and shoots are again reestablished. It is rarely grazed on by either domesticated or wild animals.

Phase II of the study revealed that the combination of regeneration technique, spacing and length of cutting exposed (upslope planting x 3.75 m² x 15.24 cm), significantly affected the survival rate of cuttings at

1% level. Stepwise regression analysis showed that temperature at 1 m above the ground and the minimum soil temperature at 30.48 cm depth within the experimental area explained 59.26% of the variations in the survival rate of cuttings.

Key words: Afforestation, Degraded land, Planting, Survival, Cutting

L.V. FLORIDO & M.P. LIM SUAN

Survival of seeds and cuttings of yemane (*Gmelina arborea*) under different slope exposures

Sylvatrop, Philippine Forest Research Journal, Philippines, 2(1), 55-58, 1977, English

Yemane of the family Verbenaceae is a fast-growing exotic species that is resistant to drought, wind and fire. It is considered extremely promising for pulpwood production in tropical countries.

A total of 600 Yemane fruits and 600 cuttings were used. The diameters of cuttings measured at the middle, ranged from 3 to 5 cm. The experiment used the Randomized Block Design.

Three 20 x 20 m blocks were laid out in each of the four exposures, i.e., northern, southern, eastern and western. Each block was divided into 2 plots, each 10 x 20 m. Seeds and cuttings were spaced 2 m.

There was no significant difference in the rate of survival of cuttings planted and seeds directly sown under 24 slope exposures. The average rate of survival was 20.8% for cuttings and 18.2% for seeds. Cuttings rooted 2 or 3 days after planting; seeds started germinating 15 days after sowing.

Key words: Fast growing tree species, Planting, Cutting, Direct seeding, Survival, Germination

MAXIMO O. DICHOSO

Drought tolerance of some reforestation species

Sylvatrop, Philippine Forest Research Journal, Philippines, 9(3 & 4), 197-210, 1984, English

The study was conducted to determine the survival performance of five (5) reforestation species when exposed to drought conditions. Results of the study showed that yemane (*Gmelina arborea* (Linn.) Roxb.) and *Acacia auriculiformis* performed better than mahogany (*Swietenia macrophylla* King.), narra (*Pterocarpus indicus* Willd.) and Moluccan sau (*Albizia falcataria* (L.) Back.). Narra, however, performed slightly better than mahogany.

The observed differences of performance among species under moisture stress condition is attributed to differences in the physical and structural features of the species.

Key words: Tree species, Drought, Survival, Drought tolerance

ROGELIO A. ZAMORA & ALFREDO C. AGPAOA

Age of benguet pine (*Pinus kesiya*) seedling and season of planting

Sylvatrop, Philippine Forest Research Journal, Philippines, 1(1), 21-29, 1976, English

The success or failure of establishing forest plantations is dependent upon many factors such as the age of stocks for planting and the season of planting. Following germination in each sowing month, seedlings were potted and hardened. Thirty-five treatment combinations were assigned randomly in each replication (i.e. seven different ages and five planting months).

Results of this study showed that height, diameter and survival percentage of outplanted Benguet Pine seedlings were greatly influenced by the month of planting and age of planting materials. May and June plantings gave the best height and diameter growth of outplanted seedlings while 9 to 12 mos. old planting materials gave the best height and diameter growth. Survival percentage was highest in seedlings 11 to 12 mos. old planted in May.

Key words: Pine, Seedling, Planting, Survival, Growth

SAMUEL R. PENAFIEL

Growth of Japanese alder (*Alnus japonica* Nutt) under two methods of inoculation

Sylvatrop, Philippine Forest Research Journal, Philippines, 10(2), 69-76,

1985, English

Fifteen-day old *Alnus* seedlings transplanted into plastic bag containers were inoculated with the endophyte responsible for root nodulation by two methods: soil collected from *Alnus* stands, and crushed nodule inocula. Four-month observation shows that the seedlings under the soil inocula had significantly better height growth, dry matter production, nitrogen level content and bigger leaves. The crushed nodule inocula was found less effective than the soil inocula. In the absence of pure cultures, soil collected from *Alnus* stands, and mixed with potting soils, could effectively provide the necessary organism for better nitrogen fixation.

Key words: Seedling, Inoculation, Root nodule, Nitrogen fixation

BARTOLOME F. NOBLE

Comparative cost and survival rates of direct seeding, germinant and seedling plantings of benguet pine (*Pinus kesiya* Royle ex Gordon) in denuded areas

Sylvatrop, Philippine Forest Research Journal, Philippines, 10(4), 259-270, 1985, English

Three reforestation techniques: direct-seeding, germinant, and seedling plantings of Benguet pine were studied and compared to determine the cost, survival percentage and total height growth increment. The cost incurred per hectare was lowest under direct-seeding (P338.65), followed by germinant planting (P362.00). The highest cost was in the seedling planting technique (P2,052.00/ha).

However, in mean survival percentage, the planted seedlings gave 70.2% survival or 1,775 seedlings per hectare which was significantly higher than either the direct-seeding with 15.8% (395 seedlings per hectare) or the germinant planting with 26.2% (655 seedlings per hectare). The survival percentage of the germinants was significantly higher than direct-seeding.

Based on seedling survival per hectare after two years, the cost per seedling that survived was: P2.54 for germinants and P4.16 for direct-seeding.

For the total seedling height growth increment, the planted seedlings obtained the highest average height increment with 42.55 cm. per seedling over an 18-month period.

This height growth increment differs significantly from direct-seeding with 30.34 cm. and germinants with 32.72 cm. The germinants, however, failed to show any significant variation from the direct seedlings in height growth increment.

Key words: Pine, Direct seeding, Seedling, Cost analysis, Natural regeneration, Survival, Growth

BARTOLOME F. NOBLE & BASHIO P. MAMANTEO

Trial planting of petroleum nut (*Pittosporum resiniferum* Hemsl.) wildings under Benguet Pine

Sylvatrop, Philippine Forest Research Journal, Philippines, 8(2, 3 & 4), 151-155, 1983, English

Petroleum nut wildings were underplanted in a natural Benguet pine stand to determine survival rates. Six height classes were used in the study. 0.25-0.50 m., 0.51-1.00 m., 1.01-1.50 m., 1.51-2.00 m. and 2.01-3.00.

Height class 3.01-4.0 m. differed significantly from height classes 0.25-0.50 m. and 0.51-1.00 m. in survival percentage. In establishing plantations of petroleum nut, the use of small size wildings (0.25-1.00 m.) is recommended.

Key words: Wilding, Survival, Underplanting, Selection of seedling

MARCELINO M. MAUN

Early growth and development of white lauan (*Shorea contorta* Vidal) under different soil covers

Sylvatrop, Philippine Forest Research Journal, Philippines, 6(2), 39-48, 1981, English

The study was carried out in the Magat Experimental Forest Lot B to evaluate the germination, survival, early growth and development of directly-seeded white lauan in five soil covers namely: (1) bare soil, (2) soil

with litter, (3) soil with litter and ground cover, (4) soil with litter and underbrush, and (5) soil with intact vegetation cover.

Germination was observed to be significantly higher in treatments 4 and 5. This indicates the advisability of growing white lauan seedlings under shade or nurse trees as in under brush, although this adversely affected the growth of seedlings as compared to those grown in the open, e.g. bare soil (Treatment 1), soil covered with litter (Treatment 2). Management strategies are suggested to ensure the optimum germination of seeds, survival and growth and development of white lauan seedlings.

Key words: Germination, Dipterocarps, Seed, Direct seeding

**PHILIPPINE COUNCIL FOR AGRICULTURE AND RESOURCES RESEARCH
AND DEVELOPMENT**

State of the art and abstract bibliography of dipterocarp researches,

Forestry Bibliography Series No. 2

Philippine Council for Agriculture and Resources Research and Development
(PCARRD), Philippines, 24, 1986, English

This publication chronicles abstracts of researches and publication on production and utilization of dipterocarps from 1930 to 1980. This is an addendum of the State of the Art, Dipterocarp Research published by PCARRD in 1982.

The major topics discussed in this publication include phenology, nursery techniques and practices, natural and artificial regeneration, management, harvesting and transport, and protection of the dipterocarp species.

Key words: Dipterocarps, Nursery operation, Natural regeneration, Artificial regeneration, Harvesting

**PHILIPPINE COUNCIL FOR AGRICULTURE AND RESOURCES RESEARCH
AND DEVELOPMENT**

The Philippines recommends for dipterocarp production, PCARRD

Technical Bulletin Series No. 58

Philippine Council for Agriculture and Resources Research and Development
(PCARRD), Philippines, 96, 1985, English

Dipterocarps are dominant species of the natural forest in the Philippines and they are mainstays of the Philippine forestry. Ninety percent of the country's remaining forests are of the dipterocarp type. The unregulated cutting of these species, however, has caused the supply of high quality wood to dwindle. There is a need, therefore, to conserve, regenerate, protect, and properly manage dipterocarp forests to ensure a stable supply of timber.

This publication integrates all available information on plantation establishment, harvesting, marketing, and management of natural dipterocarp forest in the Philippines. The technologies included here were generated by various government agencies. Practices observed from various private companies involved in the production of dipterocarps are also integrated.

Key words: Dipterocarps, Silvicultural technique, Natural forest, Under planting, Harvesting

**PHILIPPINE COUNCIL FOR AGRICULTURE AND RESOURCES RESEARCH
AND DEVELOPMENT**

Leucaena research in review, PCARRD Book Series No. 14

Philippine Council for Agriculture and Resources Research and Development
(PCARRD), Philippines, 141, 1984, English

For the past years, induced by changing economic values, a better understanding of the forest resources of the country emerged. This brought about the identification of other products from the forest with economic and ecological importance. Among these is *Leucaena*. Because of its numerous uses and potentials, *Leucaena* has been the subject of research in the Philippines and even in other tropical areas.

This publication is the Proceedings of the National In-House Review on *Leucaena* Research held in 1981. The results of this review explore how *Leucaena* technologies can be made applicable in the field and how the benefits from these generated technologies can be maximized.

Key words: Fast growing tree species, Exotic tree species, Forest utilization

**PHILIPPINE COUNCIL FOR AGRICULTURE AND RESOURCES RESEARCH
AND DEVELOPMENT**

The Philippines recommends for pine, PCARRD Technical Bulletin Series No. 54
Philippine Council for Agriculture and Resources Research and Development
(PCARRD), Philippines, 79, 1984, English

The Philippine pine forest covers an area of about 202,000 ha or 1.67% of total forest area. Despite its limited area, the pine forest plays a vital role in economic and ecological stability as one of the four major forest types of the Philippines. It serves not only as valuable source of timber for construction and mining operations, but also as a protective cover for some of important watershed in the country.

Unless proper measures are resorted to now, however, the pine forest may become extinct in the not too distant future. There are various pressures today that threaten the continuity of the existing pine stands.

This publication is dedicated to the regeneration and perpetuation of the pine forest, and it provides technical information for seed production, nursery practices, plantation establishment and management, harvesting, etc.

Key words: Pine, Silvicultural technique, Seed production, Nursery operation, Planting, Harvesting

REYNALDO E. DELA CRUZ

Status of mycorrhiza research in the Philippines and its implications
to national development

SEARCA technical bulletin 8, SEAMEO Regional Center for Graduate
Study and Research in Agriculture (SEARCA), Philippines, 17, 1987,
English

The term "mycorrhiza" was first used by Frank (1885) in reference to the structure formed by a fungus (*Gr. mykes*) and plant roots (*Gr. rhiza*). This fungus-root association is a form of parasitism whereby a fungal endophyte invades and parasitizes the roots of the host plant. But unlike harmful parasites, the fungus does not damage or kill the host but instead benefits it physically and physiologically.

Herley and Smith (1983) discussed six types of mycorrhiza (i.e., vesicular-arbuscular mycorrhiza or endomycorrhiza, ecto-mycorrhiza, ectendomycorrhiza, ericoid mycorrhiza, arbutoid and monotropoid mycorrhiza, and orchid mycorrhiza). The first two are the most important in reforestation.

In *endomycorrhiza*, infected root are not enlarged. The fungus forms a loose network of hyphae on the root surface and may infect roots through root hairs or directly through epidermal cells. In *ectomycorrhiza*, the infected roots usually enlarged, the outer surface covered with a compact fungal mantle, with fungal mycelia radiating outward into the soil and with the fungus invading the cortical tissues but is confined in between the cell walls. This type occurs in all pines, dipterocarps and eucalypts.

These two important fungi are discussed in more detail.

Key words: Fungus, Mycorrhizal fungi, Inoculation, Growth acceleration

**PHILIPPINE COUNCIL FOR AGRICULTURE AND RESOURCES RESEARCH
AND DEVELOPMENT**

The Philippines recommends for ipil-ipil 1980

Philippine Council for Agriculture and Resources Research and Development
(PCARRD), Philippines, 89, 1980, English

In 1970's, ipil-ipil (*Leucaena leucocephala* (Lam.) de Wit) got the rise in popularity as a plant of multi-
purposeuses in the Philippines and in the rest of the tropics. It had dubbed as "The Wonder Tree" and "The
Supermarvelous Miracle Tree".

This book provides many information on seed production technology, nursery practices, production for
wood, production for foliage and production for other purposes viz. agroforestry, erosion control, greenbreak and
seed production for decorative handicrafts.

It includes many practical information for nursery man, foresters and extension workers.

Key words: Fast growing tree species, Silvicultural technique, Seed production, Nursery operation,
Agro-forestry, Hillside erosion control

**PHILIPPINE COUNCIL FOR AGRICULTURE AND RESOURCES RESEARCH
AND DEVELOPMENT**

**The Philippines recommends for reforestation Vol. 2 upland crops conditions,
Technical bulletin Series No. 49**

**Philippine Council for Agriculture and Resources Research and Development
(PCARRD), Philippines, 149, 1982, English**

Reforestation plays a vital role in the maintenance of a well-balanced ecosystem and environment. This is a publication containing packaged, practicable technology on reforestation that can be adopted to hasten the rate of reforesting the denuded forests and rehabilitate the country's forest resources before it is too late.

The information contained in this volume is based on observations of reforestation operations in the projects of the Bureau of Forest Development (BFD) and those of some big private concessions. Practices identified as worthy of adoption are presented in the contents as the following.

1) Seed Production, 2) Seedling Culture, 3) Sowing, 4) Transplanting, 5) Culture of Wildings as Planting Stock, 6) Vegetative Propagation of Planting Stock, 7) Preparation of Planting Stock for Field Planting, 8) Nursery Establishment, 9) Care and Maintenance in the Nursery, 10) Plantation Establishment, 11) Protection

As appendices, it presents useful information on seed collection period, common pesticides available in the Philippines, seed volume and seed weight of some species etc.

Key words: Reforestation, Silvicultural technique, Nursery operation, Vegetative propagation, Seed production, Agricultural pesticide

RP-JAPAN FORESTRY DEVELOPMENT PROJECT OF THE PANTABANGAN AREA

Technical reports on afforestation

**RP-Japan Forestry development Project of the Pantabangan Area,
Philippines, 322, 1987, English**

This report is the result of the RP-Japan Forestry Development Project, a cooperative undertaking of the governments of the Republic of the Philippines and Japan which started on November, 1976 and ended on July, 1987. This is a comprehensive record of the various techniques which were progressively applied and adopted by the RP-Japan Project in the Pantabangan area, Nueva Ecija.

It includes the experiences and lessons gained in afforestation work in the grassland watersheds of the Pantabangan River, in the training of personnel on erosion control and infrastructure projects, and research on species trial, seed orchard and technology development.

The contents are as followings.

- I. Introduction to the Pantabangan Area
 1. Natural conditions
 2. Social-economic conditions
- II. Technical Achievements
 1. Site classification
 2. Nursery practice
 3. Plantation establishment
 4. Performance as affected by different conditions
 5. Environment changes as affected by reforestation
 6. Trial seed orchard
 7. Control of pests and diseases
 8. Fire protection
 9. Forest road

- III. Socio-economic Effect of Large Scale Afforestation Rural Communities

Key words: Afforestation, Silvicultural technique, Forest fire, Forest road, Forest protection

WEERA PUTTAROON, SAMARN ROUYSUNGNERN

**Changing in soil properties after clearing the logged-over mixed
deciduous forest to shifting cultivation areas**

Watershed Management Div., Royal Forest Department, MAC,

Thailand, 21, 1985, English

The study on the changes of soil properties before and after converted the logged-over deciduous forest to used as a shifting cultivation area for 3 years was carried out at the Chee watershed Research station, Komsarn, Chaiyapoom Province. The result of the study showed the bulk density and porosity of soils changed remarkably in all horizons due to the treatment. However, there was no substantial change on some chemical properties; pH, organic matter, Calcium, Iron, Potassium, Phosphorus, Manganese, and CEC. The reason was because in the logged-over area some remaining trees were cut illegally by the local people, therefore, the less amount of biomass was left in the area and could not change the chemical property of soil after burning and used as shifting cultivation area.

Key words: Logging, Cut-over area, Shifting cultivation

PINTHIP THITIROJANAWAT, PONGSAK WITTAWATCHUTIKUL, et al.
Changes of soil properties under 5 years old Eucalyptus plantation
Watershed Management Div., Royal Forest Department, MAC,
Thailand, 15, 1985, English

The study on chemical and physical properties of soil before and after planting *Eucalyptus teriticornis* at the Highland Watershed Development Project, Unit No. 1, Mae Ta Man, Chiangdiao, Chiangmai was carried out from 1980-1985. The result showed that after planting *Eucalyptus teriticornis* for 5 years, soil density was decreased and increased water holding capacities on both subsoil and topsoil. This phenomenon occurred due to the decomposition of litter from leaves and parts of *Eucalyptus teriticornis* on soil surface under plantation. Furthermore, it was because of the leaching of clay particles and organic matter from soil surface to subsoil. The chemical property of soil such as pH and soil nutrient were increased remarkably, particularly in topsoil. However, the lower density of soil may allow easier movement or leaching of soil nutrient off from the area.

Key words: Soil texture, Plantation, Top soil, Litter layer

WEERA PUTJAROON, SOMPOP CHONGROUYSAB et al.
Changing in soil properties after clearings areas for
reforestation in the mixed deciduous forest and abandoned area
Watershed Management Div., Royal Forest Department, MAC,
Thailand, 25, 1985, English

The study on the changes of soil properties before and after site preparations for reforestation in the Deciduous Forest and shifting cultivation area was carried out at the Chee Watershed Research Station, Komsarn, Chaiyapoom Province. The result of the study showed that soil texture, bulk density, porosity, pH, organic matter and amount of calcium in soils after site preparation did not change remarkably in both the Deciduous Forest and shifting area. However, some chemical properties; Potassium, Phosphorus, and Manganese were found different in the Deciduous Forest more than in shifting area, due to this treatment. The higher changes of iron content in soil under the shifting area was found as compared to soil in the Deciduous Forest.

Key words: Deciduous tree, Soil texture, Chemical characteristic, Physical characteristic

PONGSAK WITTAWATCHUTIKUL, WARIN JIRASUKTAVEEKUL
Effect of para-rubber plantation on soil water at Taphong Nai,
Rayong, Thailand
Watershed Management Div., Royal Forest Department, MAC,
Thailand, 12, 1989, English

Soil moisture plots and gravimetric method were employed to determine soil moisture fluctuation in 4, 7 and 18-yr plantations of para-rubber and abandoned area at Taphong Nai, Rayong Province, Eastern Thailand during December, 1987 to December, 1988.

The assumption is supported by throughfall study and relative humidity variation measuring including epiphytes observation.

Key words: Soil moisture, Plantation

RP-JAPAN FORESTRY DEVELOPMENT PROJECT OF THE PANTABANGAN AREA
Re-forestation manual for grassland nursery practice
RP-Japan Forestry Development Project of the Pantabangan Area,
Philippines, 50, 1987, English

This manual is one of a series which describe these procedure: 1. Nursery practice manual, 2. Plantation establishment manual and 3. Forest road manual.

Each manual is essentially autonomous, however, it will be helpful to read the others and to relate these to the project's background, achievement and policy as described in the Master plan of the project of the Record of Discussion.

Key words: Nursery operation, Plantation, Forest road, Silvicultural technique

PHILIPPINE COUNCIL FOR AGRICULTURE AND RESOURCES RESEARCH
Philippines recommends for the production of fast growing hardwoods
Philippine Council for Agriculture Resources Research, Philippines,
17, 1978, English

The *Philippines Recommends series for timber products* will come out in four separate issues. This series describes fast growing hardwoods, the primary source of pulpwood, matchwood and fuelwood. The contents of this series are, seed source, seed collection, pre-sowing treatments, sowing, potting, cultural treatment, preparation of outplanting materials, transport of outplanting materials and so on.

Key words: Hardwood, Fast growing tree species, Silvicultural technique, Plantation

PCARRD
State of the art abstract bibliography of forest plantation
researches
Philippine Council for Agriculture and Resources Research and
Development (PCARRD), Philippines, No. 4, 24, 1983, English

This Bibliography is an attempt to present the most complete and updated collection of abstracts of local research in forest plantation researches.

The contents are mature technology, technology for verification, folk technology, technology to be generated and researcher index.

Key words: Planting, Nursery operation, Silvicultural technique

DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
Ecosystems research and development bureau, Annual report 1990
Department of Environment and Natural Resources, Philippines,
75, 1990, English

This publication is an annual report for 1990 of the Ecosystems Research and Development Bureau.

A major project was the rehabilitation of coastal areas through the establishment of plantations on demonstration farms with the involvement of the residents, specifically in the protection and maintenance of the plantations.

Another project implemented 20 studies on the propagation of bamboo, economics, harvesting, pests and diseases and other basic researches.

Key words: Ecosystem, Silvicultural technique, Pest damage, Tree disease, Plant propagation

PCARRD
The Philippines recommends for fast-growing hardwoods
Philippine Council for Agriculture and Resources Research and
Development (PCARRD), Philippines, No. 5-A, 72, 1986, English

This volume integrates available information and technologies on the plantation establishment, management, and utilization of fast-growing hardwoods in the Philippines.

Fast-growing hardwood species described in this volume are Bagias, Gubas, Kaatoan bangal, Moluccan

Sau and Yemane.

In respect of protection, this volume deals with insect pest and diseases of seedling, plantations. As utilization plywood manufacture, particleboard manufacture, particleboard production process and product testing are described.

Key words: Hardwood, Fast growing tree species, Silvicultural technique, Plywood, Particleboard

**ADVISORY COMMITTEE ON TECHNOLOGY INNOVATION, NATIONAL
RESEARCH COUNCIL**

Sowing forests from the air

National Academy Press, Washington D.C., U.S.A.

63, 1981, English

Aerial seedings of forests is largely unappreciated, even by most foresters; it now seems worthy of increased testing and research.

When conditions and species are right, and seed supplies sufficient, aerial seeding could be an important technique for reforesting large areas. It is easy to organize and seems well suited for reforesting sites that have rough terrain, debris, or difficult access. If it can be developed for sites and objectives in developing countries, aerial seedings could offer opportunities for vastly accelerating their reforestation programs.

Aerial reforestation is not a replacement for planting seedlings by traditional methods. It is best considered as a potential complement to conventional planting and to natural seedling, an additional tool for foresters to use when the needs, sites, and species are appropriate.

Today aerial seeding is already regarded as a practical reforestation technique in a few countries. This volume introduces the experiences in America, Canada, Australia, New Zealand, and some tropical countries.

Key words: Reforestation, Direct seeding

**ANIWAT CHALERMPONGSE, SOMKID SIRIPATANADILOK,
SUVIT SANGTHONGPRAO**

**Role and activities of fungi associated with agarwood and
Kritsana tree in Thailand**

Thai Journal of forestry, Thailand, 9(3), 163-171, 1990,

English

Survey and experiments to determine the roles and activities of fungi in the formation of incense aboes-wood or agarwood on kritsana tree (*Aquilaria crassna* Pierr ex H. Lec.) were carried out at Khaoyai National Park, Nakhon Ratchasima, and other provinces. Open wounding and controlled infection of fungi were studied. Many fungi infected in the artificial woundings, fungi colonized on naturally kritsana trees, wood-rotting fungi, seed-borne and seedling diseases and mycorrhizal association with kritsana or agarwood trees were isolated and identified. Results revealed that kritsana or agar (oleoresin deposit) formation did not correlate with the roles or activities of specific fungi, as was previously believed, but it was obviously formed by the interaction of the tree host through injuries or woundings which might be derived from the mechanical, physical, chemical or biological process. However, the result of a protective reaction of the tree host to injuries, woundings or biological invasions to form oleoresin deposits in kritsana trees was expected as the main causes, the fungal infection in agarwood would be degraded to the quality and reduced in weight of agar or kritsana.

Key words: Fungus, Seedling, Tree disease, Fungi damage, Seed

NIT KOMASTIT, PISAL WASUWANICH, SUDARATH NGAMKHUATORNWIWAT

**Effects of fertilizer application, manual weeding, and spacings
on seed production of *Leucaena leucocephala***

Thai Journal of Forestry, Thailand, 7(1), 18-27, 1988, English

Field investigation was carried out at the ASEAN-Canada Forest Tree Seed Centre Field Station, aiming to find out the effects of fertilization, weeding, and stand density on seed production of *Leucaena leucocephala*.

The results showed the highly significant difference of fertilizer - spacing interactions on seed production, while weeding had no effect. The amounts of seeds gained were found to be increased with increasing spacings, ranking from 2,781 to 3,043, 4,580 and 5,325 seeds per tree of non-fertilization plots of 2x2m, 2x4m, 3x3m and 4x4m spacings, respectively. Seeds collected from fertilization plot was 1.3 times over

those from the control at 2x2m spacing. Such multiplying figures were of 1.8, 1.6 and 2.8 for 2x4m, 3x3m and 4x4m spacing, respectively.

Key words: Seed production, Weeding, Fertilization, Planting distance

2--5 Tending

-- weeding, pruning, thinning, fertilizing etc.--

ERNESTO C. BUMATAY & REYNALDO E. DELA CRUZ

Growth and survival of Agoho, Ipil-ipil seedlings

Philippine Lumberman, Philippines, 34(8), 26-28 & 37, 1988, English

The effects of different levels of N and P fertilizer combinations on the growth and survival of agoho and giant ipil-ipil seedlings outplanted in a grassland dominated by *Imperata cylindrica* were studied during a six-month period.

Significant differences were recorded in survival of seedlings. The survival of agoho was much higher than that of giant ipil-ipil. Dry weights at harvest were significantly different between the two species. Height growth of agoho seedlings was significantly higher than that of giant ipil-ipil seedlings during the first six months. Height growth of agoho seedlings averaged 44.15 centimeters as compared to 14.81 centimeters for giant ipil-ipil seedlings. Diameter growth of ipil-ipil seedlings was significantly bigger than that of agoho seedlings during the first month. However, no significant difference of diameter growth between the two seedlings was observed at harvest.

Key words: Fertilization, Planting, Survival, Growth, Seedling

MARCELINO M. MAUN

Survival and growth of four reforestation species applied with slow-release tablet fertilizer

Sylvatrop, Philippine Forest Research Journal, Philippines, 2(3), 219-222, 1977, English

This study was designed to determine the effect of Agriform, a slow-release tablet fertilizer, on survival and growth of reforestation species, namely Yemane (*Gmelina arborea*), *Acacia auriculaeformis*, Teak (*Tectona grandis*) and Benguet Pine (*Pinus kesiya* (Royle) ex Gordon).

One Agriform slow-release tablet fertilizer (18-8-6) was simply dropped into the bottom of the previously prepared hole and was covered with soil about 13 mm thick. Then the seedling was set in the hole which was backfilled with soil up to the ground level. The seedlings were laid out in the experimental site in paired plots; consisting of fertilized and unfertilized plots. Measurements of height and survival count were conducted yearly for 3 yr.

Agriform slow-release tablet fertilizer (18-8-6) had no significant effect on the survival of Yemane, *Acacia*, Teak and Benguet Pine. However, the fertilizer significantly increased the height growth of Yemane and *Acacia* but not of Teak and Benguet Pine.

Key words: Fertilizer application, Planting, Seedling, Survival, Growth

ALFREDO C. AGPADA & ROGELIO A. ZAMORA

Agriform slow-release tablet fertilizer effects on the growth and survival of benguet pine (*Pinus kesiya*), yemane (*Gmelina arborea*) and kalantas (*Toona calantas*) seedlings

Sylvatrop, Philippine Forest Research Journal, Philippines, 1(2), 135-137, 1976, English

This study investigated the effects of fertilization on seedlings of Benguet Pine, Yemane and Kalantas, relatively fast-growing species of commercial value which are commonly used in reforestation projects.

Agriform slow-release tablet fertilizer was applied on the seedlings of these species to compare their field survival percentages and rates of growth with those of the control or unfertilized seedlings.

The fertilizers were placed on the upper slope of the holes and covered with a thin layer of soil before

the seedlings were planted. Fertilizer application was simultaneous with planting.

Uniform seedlings of the 3 species were selected and outplanted. Fertilized seedlings and control seedlings were paired randomly and assigned to each plot.

Agriform slow-release table fertilizer significantly increased the survival percentage as well as height and diameter increment of Yemane seedlings. However, the fertilizer did not have much effect on Benguet Pine and kalantas seedlings. It is recommended to use Agriform for Yemane seedlings during the first 2 yr of establishment.

Key words: Planting, Fertilization, Seedling, Survival, Growth promotion/acceleration

RAFAEL T. GADIZ & REMILIO C. ATABAY

**Fertilization of *Pinus caribaea*, *P. elliotti* and *P. oocarpa*
nursery seedlings**

**Sylvatrop, Philippine Forest Research Journal, Philippines, 4(2), 81-85,
1979, English**

This study was initiated to determine the response of *Pinus caribaea*, *P. elliotti* and *P. oocarpa* to frequency of application of nitrogen, phosphorous, potassium and combinations thereof designed to give optimum growth and survival.

Seeds were sown directly in polyethylene pots filled with top soil and sand (2:1). Fertilizers were applied when the seedlings were about 3 to 4 cm. high, approximately 3 mos. after sowing. Fertilizer was buried 2 cm. deep in two corners around the base of the seedlings. After fertilization, seedlings were shaded with cogon from 9:00 a.m. up to 3:00 p.m. for two weeks to minimize evaporation of nutrients and excessive drying of potting soil. Watering was done once a day after the fertilizer was applied.

Among the tested inorganic fertilizer, phosphorous at two times application (0.6 gm/seedling) to *P. caribaea* seedlings and one time to *P. elliotti* and *P. oocarpa* produced significant and superior responses in height growth increment. Average growth rates of 93%, 61% and 107%, respectively, were recorded as compared to the unfertilized seedlings. Fertilization produced vigorous planting stock that is most desirable for transplanting. Survival was not significantly affected by fertilization.

Key words: Fertilizer application, Pine, Planting, Seedling, Survival, Growth

CALIXTO E. YAO

**Survival and growth of mahogany (*Swietenia macrophylla* King.)
seedlings under fertilized grassland condition**

**Sylvatrop, Philippine Forest Research Journal, Philippines, 6(4), 203-217,
1981, English**

Survival and growth responses of 1-yr old mahogany seedlings outplanted under grassland condition (in Pating Lupa, Calamba, Laguna) to 3 levels of N (1.8 g, 3.6 g, and 5.4 g), 2 levels of P (0 and 2.4 g), and a fixed level of K (3.6 g) were analyzed 6 months after fertilizer application. The possible effects of some soil properties and climatic factors on growth were assessed.

Survival and nutrient concentration were not significantly affected by fertilizer treatments. The application of N₂PK (3.6-2.4-3.6 g N₂-O₅-K₂O/tree) significantly increased height, diameter, dry weight and nutrient uptake by 196, 211, 258, and 192% respectively. Treatment N₁K increased growth but not to a point which was significantly higher than the growth attained by the seedlings in the control. Rates of N greater than 1.8 g/tree in combination with K had a depressing effect on growth and nutrient uptake.

Regression analysis showed a quadratic response of height, diameter, and dry weight, with increasing levels of N when combined with P and K.

Best height and diameter growth and nutrient uptake were attained with N₂PK fertilizer treatment.

Key words: Mahogany, Fertilizer application, Survival, Growth, Tending

VALERIO B. MENDOSA & ANTONIO V. GLORI

**Fertilization of yemane (*Gmelina arborea*) in Carranglan, Nueva Ecija
Sylvatrop, Philippine Forest Research Journal, Philippines, 1(2), 138-141,
1976, English**

This study was conducted to determine the effects of varying levels of commercial fertilizer (14-14-14)

on the growth of outplanted Yemane seedlings.

Bare-root, 6-mo old Yemane seedlings were set out, following a randomized complete block design, in an area previously cleared of all existing vegetation. The treatments were 0 (control), 50 kg/ha, 100 kg/ha, and 150 kg/ha. The first application was done by ring application with no soil cover placed on the fertilizer. The second fertilizer application was made 1 yr after. Grasses and other weeds were clear-brushed every four months. Height and diameter measurements as well as survival were obtained every 6 mo.

Application of fifty kilograms per hectare of commercial 14-14-14 fertilizer one after planting, and 50 kg a year after, did not improve the diameter and height growths of the seedlings. At 100 kg/ha, significant improvements in diameter, height growth, and survival were obtained. Seedling diameter increased by 109%, and height, 80%. Increasing the rate to 150 kg/ha did not produce significant beneficial effects compared with the application of 100 kg/ha. Slight increase by 3 to 4% in survival was observed among the fertilized seedlings, whose survival was 99 to 100% as compared to 96% for the unfertilized ones.

Key words: Fertilizer application, Seedling, Planting, Survival, Growth, Fast growing tree species

VALERIO B. MENDOZA

Fertilizer trial of cashew (*Anacardium occidentale* Linn.) in

Carranglan, Nueva Ecija

Sylvatrop, Philippine Forest Research Journal, Philippines, 1(1), 30-33,

1976, English

This study was conducted because of the increasing demand for information on the propagation of cashew from both the public and private sectors. Besides the nut being used for food, the fleshy portion could be eaten raw or made into wine through fermentation. Cashew is a good soil cover crop.

Six hundred selected seeds of cashew were directly sown in 4 x 4 inch polyethylene pots. Seedlings were outplanted six months after the seeds germinated. There were 6 treatments and 4 replicates.

Fertilization of cashew once a year for 2 years resulted in an increase in diameter and height growth by as much as 51 and 73% respectively. Diameter measurements were made at a point 2 inches above ground. Height was the distance from the ground level up to the terminal bud of the leader. Comparison of treatment means was done using the Duncan's Multiple Range Test at 5% level of significance.

The application of 100 to 150 kg/ha of complete (14-14-14) commercial fertilizer was sufficient to significantly increase diameter and height growth after 3 years. First fertilizer application was done 1 month after outplanting and the second or last was done 1 year after. Although survival was high for the fertilized plants, it was not significantly higher than that of the control.

Key words: Fertilizer application, Seedling, Planting, Survival, Growth, Fruit tree

M.M. MAUN

Effects of stump-planting and fertilization on growth and survival of narra (*Pterocarpus vidalianus* Rolfe)

Sylvatrop, Philippine Forest Research Journal, Philippines, 5(1), 67-72,

1980, English

This study aimed to determine the effects of fertilization and stump-planting on the survival and growth of Narra.

At time of planting the bare-root stump seedlings were each fertilized with 50 gms. ammonium sulphate using the pit method. After 6 months the surviving seedlings were again fertilized at the rate of 100 gm ammonium sulphate per seedling using the dibbling method. At 1 yr and 2 yr, surviving seedlings were fertilized with 100 g of commercial fertilizer (14-14-14). At the same ages, samplings were applied with 150 gms. of the same fertilizer. Both applications were by dibbling.

Fertilization did not improve the survival and diameter height growth of Narra seedlings. Stump-planting significantly increased its diameter and height growths.

Key words: Fertilization, Stump-planting, Survival, Growth, Planting

MARCELINO M. MAUN

Effect of tending operation on the survival and growth of acacia

(*Samanea saman*)

Sylvatrop, Philippine Forest Research Journal, Philippines, 3(4), 249-250,

1978, English

Acacia wood is used for construction work, carpentry, and furniture manufacture. It has also been particularly preferred by the wood carving industry.

The randomized complete block design was used. One hundred Acacia seedlings were planted in round holes 2 m apart in each row and between rows. Ring-brushing, strip-brushing and cultivation of the seedlings were conducted at monthly intervals during the first year and at 3-mo intervals thereafter.

Strip-brushing and ring-brushing significantly increased survival and significantly improved the total height growth of Acacia. The control and cultivated seedlings did not differ significantly in terms of survival.

Key words: Tending, Weeding, Survival, Growth

CESAR A. ORALLO

Thinning in natural sapling stand of benguet pine (*Pinus kesiya* Royle ex Gordon)

Sylvatrop, Philippine Forest Research Journal, Philippines, 10(1), 1-8, 1985, English

The influence of different levels of thinning (0, 30, 50, 70% of total basal area) on the growth of 5 to 8-year old Benguet pine regenerations at Bohok, Bokod, Benguet was determined. The diameter, height and basal area growth increments were measured for 3 years.

Results showed that removing 50% and/or 70% total basal area had significantly increased the diameter and height growth of trees in 3 years when compared with those in the unthinned plots.

Results indicate that in the 5 to 8 year old B. pine stand with a density of 5,600-7,000 trees/ha. (40.778 m². basal area), removing 70% of the basal area increased the diameter growth of the stand 153%, while 50% thinning increased it to 128% in three years. Moreover, when compared with control plots, heavy thinning increased height growth increment by 147% while height growth in medium and light thinned plots increased by 48% and 38%, respectively.

Removing 70% of the total basal area significantly increased the basal area growth increment by as much as 30% to 50% in three years. Cutting 30% or 50% of the total area did not markedly increase basal area growth, compared with the control plots.

Key words: Pine, Natural forest, Regeneration, Thinning, Height growth, Diameter growth

RODRIGO B. BALMOCENA & EYA P. CASA

Growth and development of established toog (*Petersianthus quadrialata* Merr.) plantation under four different weeding methods

Sylvatrop, Philippine Forest Research Journal, Philippines, 11(1 & 2), 55-60, 1986, English

Four weeding methods (ring, strip, blanket and control/no weeding) were tested to determine their effects on growth and development of a 2-year old plantation of toog in the experimental area of the Eastern Mindanao Forest Research Center, Bislig, Surigao del Sur. No significant differences were observed on the effects of the treatments on height growth. This can be attributed to constant shoot attack by still unidentified piercing/sucking insects on the outplanted seedlings. However, highly significant differences in diameter growth were observed among the treatments. Mean diameter after two years was 2.99 cm. for ring-weeded plants, 1.37 cm. for strip-weeded plants, 1.17 cm for blanket weeded plants and 0.74 cm. for control plots (no weeding).

No mortalities occurred on treated plots but 11.5% mortality was observed on the control plots. Mortalities were attributed to grasses and vines covering and/or overtopping the planted seedlings.

Key words: Plantation, Silvicultural technique, Weeding, Tending

MONTON JAMROENPRUCKSA

Effect of thinning on growth of different ages of *Eucalyptus camaldulensis* Dehn. plantation

Thai Journal of Forestry, Thailand, 8(3), 203-215, 1989, English

The role of thinning in Thailand's forest village plantations, Somdet, Kalasin Province, was assessed. Specifically, the study sought to investigate the post-thinning situation in 4-year-old and 7-year-old *Eucalyptus*

camaldulensis plantations, particularly the response of the tree stands. In this case, tree stands with an initial spacing of 2mx8m were thinned to three spacing levels: 4mx8m, 2mx16m and 8mx8m.

Application of thinning affected tree growth. Based on the growth parameters: relative growth rate (RGR), net assimilation rate (NAR), leaf area index (LAI), and crop growth rate (CGR), thinning of stands with an original spacing of 2mx8m (S_0) to 4mx8m (S_1), 2mx16m (S_2) and 8mx8m (S_3) showed better growth in both the 4-year-old and the 7-year-old plantation. However, trees in the 7-year-old plantation were found to be more sensitive to thinning than those in the 4-year-old plantation. The trees in the 4-year-old plantation showed significant difference only between the highly thinned stand (S_3) and the unthinned stand (S_0), but trees in the 7-year-old plantation showed significant differences between the thinned group (S_1, S_2, S_3) and the unthinned stand (S_0).

Key words: Thinning, Growth rate, Stand density, Eucalypt, Plantation

2-6 Tree Breeding

NENITA M. CALINAWAN & SATURNINA C. HAIOS

Shoot development, callus production and root induction of narra (*Pterocarpus indicus* Willd.) as affected by culture medium and irradiation

Sylvatrop, Philippine Forest Research Journal, Philippines, 6(4), 165-179, 1981, English

Narra (*Pterocarpus indicus* Willd.), the national tree of the Philippines, is the most popular source of wood for making furniture and fancy boards.

Tissues of narra obtained from shoots of 6-mo to 3-yr old saplings started to produce calli from 7 to 11 days in 4 culture media, namely: Murashige and Skoog (MS), 1968; Harvey and Grasham (HG), 1977; White (W), 1963; and Shenek and Hildebrandt (SH), 1976. Calli in the MS and W media gained weight faster than those in the other 2 media. The addition of 20% coconut water and 1 mg/l, IAA (Indole acetic acid) or 4 mg/l, 2, 4-D to MS medium initiated callus production earlier (3 to 4 dys) but the callus gained weight more slowly. The W, SH and HG media induced callus to differentiate into roots 21-48 days after transplanting. Irradiation of MS and SH media at 10-60 kr-respectively, induced dormant buds in nodes of cultured narra stems to develop into shoots.

Key words: Tissue culture, Callus, Breeding

APICHART KAOSA-ARD

Teak improvement programme in Thailand

Technical Paper No. 32, Teak Improvement Centre, Ngao Lampang, Thailand, 13, 1988, English

Teak (*Tectona grandis* Linn. f.) occurs naturally throughout the northern part of the country. The species is mainly found in the "mixed deciduous forest" type and its distribution pattern is discontinuous. The teak tree in the forests may be found scattering individually or may be found in group forming pure stands. In Thailand, the remaining teak forests (in 1982) is 25,000 km² or about 16 percent of the total forest areas.

The objectives of the Teak Improvement Programme in Thailand are: 1) to improve yield and qualities of the species especially through the breeding programme; 2) to produce genetically improved seed and clones through seed orchards and clone banks for a large scale teak planting programme; 3) to conduct research and development of techniques applied for the improvement, seed procurement, nursery production and plantation establishment programmes.

The centre of operation, the "Teak Improvement Centre" (TIC) is located in the Mae Huad teak plantation, Ngao, Lampang (675 km north of Bangkok) and is under the Division of silviculture, Royal Forest Department.

Key words: Teak, Commercial tree species, Breeding, Seed orchard, Seed production

K.G. ELDRIDGE

An annotated bibliography of genetic variation in *Eucalyptus camaldulensis*

Commonwealth Forestry Institute, University of Oxford, U.K., No. 8, 59, 1975, English

The aim of this bibliography is to provide access to and to review information on the genetic resources of *Eucalyptus camaldulensis* Dehnh., a tree of great importance in Mediterranean, subtropical and tropical countries. It is particularly important for the production of domestic products, such as poles, posts and timber, but above all, and increasingly, fuelwood.

The references are confined to natural distribution, genetic variation, reproductive biology, tree breeding, seed supply and the related subjects.

Key words: Eucalypt, Genetic resources, Breeding

RAPA

Expert consultation on use of tissue culture in plant quarantine for exchange of germplasm and planting materials

FAO Regional Office for Asia and Pacific (RAPA), Thailand, 21, 1987, English

The expert consultation on Use of Tissue Culture in Plant Quarantine for Exchange of Germplasm and Planting Materials, co-sponsored by FAO and the Indian Council of Agricultural Research (ICAR) through its National Bureau of Plant Genetic Resources (NBPGR), was held at the Nuclear Research Laboratory of the India Agricultural Research Institute and at Committee Room of United Nations Development Programme, New Delhi, from 26 February to 2 March 1987. Fifty experts from 10 countries, namely, Bangladesh, Bhutan, China, Fiji, India, Malaysia, Nepal, Philippines, Sri Lanka, and Thailand participated in the Consultation, including 35 experts from the host country.

This publication is a proceedings of the meeting.

Key words: Tissue culture, Breeding, Research and development

ISARA VONGKAIUANG

Role of tissue culture in forestry

Thai Journal of Forestry, Faculty of Forestry, Kasetsart University, Thailand, 2(4), 287-295, 1983, English

Re-afforestation is very necessary to be done in tropical countries, specially in Thailand. Using tissue culture techniques in forestry, then, should be under consideration. Forest tree tissue culture technique in many countries have been developing for a long time, but they have only recently started in Thailand. Tissue culture is also useful for conservation of gene resources. There are both advantages and disadvantages to the use of tissue culture which certainly affect forestry operations.

Key words: Breeding, Tissue culture

2-7 Natural Regeneration

K. UEBELHÖR

Impacts of selective logging on dipterocarp forests in Mindanao

Technical Report No. 2, RP-German Dipterocarp Forest Management Project, Philippines, 45, 1989, English

The impact of selective logging on dipterocarp forests of Mindanao was investigated on 10 set-ups yarded with the high-lead system and 4 set-ups yarded with the tractor system from 1980-1984. Results were based on the inventory of these set-ups before and after the different harvesting operations.

This report, the second of a series of technical publication produced during the course of the RP-German Dipterocarp Forest Management Project analyses the impact of selective logging on dipterocarp forests

in Mindanao. The original goal of the study was to find ways and means to increase the yield in old growth forest exploitation. This cannot be a priority anymore since the results of the Forest Resources Inventory (FRI) Project revealed that the remaining dipterocarp old growth forest will be logged over within the next few years. The results of this study, however, will still be valuable to increase our knowledge about the prospects and difficulties of managing the residual forests left after the kind of exploitation which is analyzed in this report.

Key words: Dipterocarps, Selective cutting, Stand condition, Forest inventory

B VON DER HEYDE, A Z. HERNANDEZ et al.

TSI field manual

**RP-German TSI Project, Forest Management Bureau (DENR) and GTZ,
Philippines, 127, 1988, English**

Damaged by uncontrolled human encroachment, the forest resource base in the Philippines is yet to provide timber and timber products for a rapidly growing population. Timber stand improvement (TSI) is considered an appropriate means for upgrading the growing stock in logged-over dipterocarp forests encompassing some 3.3 million ha of timber land. The manual at hand summarizes some basic techniques for TSI-compatible harvesting operations at the field level and is, thus, complementary to the existing publication on the subject.

The contents of the manual are based largely on the new techniques developed by the RP-German TSI Project during the past 10 years or so.

Key words: Dipterocarps, Regeneration, Artificial regeneration, Silvicultural technique, Improvement cutting

REYNALDO S. DIMLA

A dose of TSI for our dwindling dipterocarp forest

**MONITOR, Philippine Council for Agriculture and Resources Development
(PCARRD), Philippines, 14(4), 4-5, 1986, English**

Timber Stand Improvement or TSI is a silvicultural treatment directed towards the correction and improvement of dipterocarp residual stand. TSI is also designed to provide optimum growing conditions for potential crop trees. The criteria to be considered in TSI program for logged areas include the following:

- . Accessibility to roads and trails,
- . Adequate number of potential crop trees - it must not be less than 40 percent,
- . Favorable topography -- the slope must not exceed 60 percent,
- . Free from threats posed by kaingin practices,
- . Elevation should not exceed more than 1,000.

This publication presents more detailed information concerning TSI procedures.

Key words: Dipterocarps, Regeneration, Silvicultural technique, Improvement cutting, Artificial regeneration

RIO P. BOTE

**Financial feasibility of selective logging as a harvesting method in a
virgin forest: The Taggat case**

**Sylvatrop, Philippine Forest Research Journal, Philippines, 8(1), 47-60,
1983, English**

This study was conducted to analyze the financial feasibility of selective logging in a virgin dipterocarp forest at the concession area of Taggat Industries, Inc., in Kalinga-Apayao. This analysis, however, was intended for the first cutting cycle only. Two supervised logging set-ups with an average area of 6.5 ha were selected. Results showed a 317% and 257% return on investment (ROI) for set-ups 21 B8R and 21 C8R, respectively, with respective production cost of ₱189.00/m³ and ₱232.57/m³. Number of healthy residuals left after logging were more than the minimum number of residuals required in the supervised set-ups, lending support to the contention that supervision of logging operation may be needed to save the required residuals thereby attaining the long-term sustained-yield objective of the selective cutting system.

The 4 input categories included in the analysis were: direct labor cost, operating expenses, equipment cost and administrative cost. The Administrative cost had the biggest share of the total cost, averaging 60.1%

for the 2 set-ups. This was followed by equipment cost with an average of 26.25%, operating cost with 8.15% and the direct labor cost with 5.5% of the total. Since both direct labor and administrative costs involve the human factor, these may be summed up to represent the labor component (65.6%) with only around 3.4% cost on equipment and materials. The system is therefore labor-intensive rather than capital-intensive based on the above classification.

Key words: Selective cutting, Dipterocarps, Virgin forest, Cost analysis

ANTONIO C. MANILA

Changes in some site factors of residual dipterocarp forest with TSI treatments

Philippine Lumberman, Philippines, 31-35 & 38, 1990, English

The site factors were higher in quantities or amounts in the treated plots (with TSI treatments) than in the control plots among the study areas. There was no significant difference in site factors between plots among locations, but comparison of the difference in light intensity, soil depth, organic matter and available phosphorus were significantly different between plots of SUDECOR and GPTDC. The topsoil pH and available phosphorus were significant between plots of Taggat. Positive correlations between site factors and parameters of growth were obtained in the treated plots of GPTDC and SUDECOR while negative correlations were shown in the control plots of Aeaje and Taggat sites. The positive correlations indicate favorable influence on the growth of stands with increasing amounts or quantities of the site factors while negative correlations adversely affect the growth beyond tolerable limits.

Key words: Dipterocarps, Site condition, Artificial regeneration, Growth, Soil texture

JUSTO P. ROJO

Notes on the natural regeneration of toog (*Petersianthus quadrialatus* Merr.)

Sylvatrop, Philippine Forest Research Journal, Philippines, 2(4), 277-286, 1977, English

In recent years, Toog has been found suitable as raw material for the manufacture of face veneers for high-grade fancy plywood. But as it steadily gained acceptance, depletion of supply followed.

The natural regeneration of Toog is discussed for the first time. The species is a prolific seeder and, if given the right niche to germinate, natural regeneration would attain high percentage of survival.

The purpose of this study was to ascertain the casual observation that there are no young regeneration (wildings and saplings) of Toog and to determine the factors that bring about the absence of regeneration, if any, underneath and near giant mother trees.

Of 15 mother trees observed in 3 logging areas, only 5 trees were negative for regeneration, i.e., not a single seedling or sapling was noted. Natural regeneration of Toog could be successful if seeds fall directly on bare ground.

Regeneration in virgin forests and cultivated lands (under coconut trees) is discussed. Factors which affect natural regeneration of Toog are described. Favorable situations for germination and growth are discussed. Phenology is described.

Key words: Natural regeneration, Natural forest, Mother tree, Seed, Germination

DOMINADOR M. FAUSTINO JR. & EMMANUEL M. BASCUG

Timber stand improvement of binuang (*Octomeles sumatrana*) in natural stands

Sylvatrop, Philippine Forest Research Journal, Philippines, 2(2), 111-116, 1977, English

This reports the progress of the first of a series of studies being undertaken on timber stand improvement of Binuang, a highly promising raw material source for pulp and papermaking.

This study area is largely dominated by young naturally regenerated Binuang trees interspersed with a few other fast-growing pioneer species. Four experiment blocks were established at random within the area. A block was composed of 2 adjacent main plots, each with an area of 0.1 ha (40 x 25 m) and separated only by a 10-m buffer zone to eliminate border effects. The most important criteria used in applying improvement cutting were the following:

1. Crop trees must compose the healthiest and thickest trees in the stand. Preference was therefore given to trees in the dominant and co-dominant crown levels.
2. Selected crop trees must be spaced at about 6 x 6 m to give adequate allowance for crown development.
3. All plants that overtopped, threatened to overtop, or were likely to offer undesirable competition to selected crop trees, must be either felled or girdled.

A two-year improvement cutting of a four-year old natural Binaang stand significantly increased diameter, height and volume growth per tree by as much as 54%, 59% and 96%, respectively. Based on wood yields in both treated and untreated stands, the average volume increment was 41.13 m³/ha/year. Economic benefits derived are shown to override the cost of stand improvement operations. It is estimated that TSI work in suitable sites (where pulpwood species in sufficient quantities have emerged) is 10 times cheaper than plantation establishment.

Key words: Natural regeneration, Girdling, Improvement cutting

J. H. WEIGELT, LEO V. YAMBAO & B. VON DER HEYDE

The cost of TSI-compatible timber harvesting in second-growth dipterocarp stands: a preliminary approach

Philippine Lumberman, RP-German TSI Project, Philippines, 33(11), 9-15 & 37, 1987, English

Intermediate timber harvests in second-growth dipterocarp forests are time-consuming and costly due to the high silvicultural demands.

Intermediate silvicultural operations such as TSI are nevertheless indispensable if logged-over dipterocarp forests are to be managed for sustained use and quality timber.

The system tested here relies on the principles of pole-wood harvesting as developed in Central Europe and employs a mobile skyline yarder for logging.

The performance and cost of the method employed are acceptable whereas the timber prices do not yet meet all aspirations.

It is hoped that adequate steps can be taken with a view to develop the pole-timber market in order to meet a growing domestic demand.

The figures in this study are, however, preliminary in character and should hence be amplified as soon as more data is made available from further trials.

Key words: Dipterocarps, Secondary forest, Silvicultural technique, Cost analysis, Improvement cutting

MONINA T. URIARTE & FELIZARDO D. VIRTUCIO

Reproductions in logged-over dipterocarp forests following selective logging in four climatic types

Occasional Paper, Ecosystems Research and Development Bureau-DENR, Philippines, No. 4, 22, 1988, English

The occurrence of reproduction in a selectively-logged dipterocarp forest was studied five years after plot establishment. A total of 149 plots of 0.10 ha. with 596 reproduction plots in four climatic regions in the country were analyzed as to species composition, size and distribution of reproduction, growth and mortality. The reproductions were further classified into four: (1) small seedlings, (2) large seedlings, (3) small poles, and (4) large poles.

Analysis reveals the presence of 19 dipterocarp species, 54 non-dipterocarp species and several unidentified species. Other aspects of reproductions were compared for the four climatic types.

Key words: Dipterocarps, Selective cutting, Cut-over area, Regeneration