UNIVERSITI PUTRA MALAYSIA

QUALITY ASSESSMENT OF TWO TIMBER LATEX CLONES OF RUBBERWOOD (HEVEA BRASILIENSIS)

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QUALITY ASSESSMENT OF TWO TIMBER LATEX CLONES OF RUBBERWOOD (*HEVEA BRASILIENSIS*)

By

MOHAMMAD IZHAM BIN YAHAYA

Thesis Submitted in Fulfilment of the Requirement for the Degree of Master of Science in the Faculty of Forestry Universiti Putra Malaysia

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Dedicated to

My Beloved Father and Mother,

Along, Angah and Syu.

Abstract of thesis submitted to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree Master of Science

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Chairman : Assosc. Prof. Dr. Mohd Hamami Bin Sahri
Faculty : Forestry

Understanding wood properties and behavior is important to evaluate the performance of producing high quality end products. A study was conducted to determine the growth performance, anatomical, physical and mechanical properties and chemical constituents of timber latex clones (TLC) and to compared with the common rubberwood. Ten trees, each from two different clones, PB 260 of 11 years old and PB 350 of 5 years old were selected and felled from the Golden Hope Plantation Berhad. Each tree was divided into two portions along the height namely, bottom and upper parts, and 3 radial samples namely outer, middle and inner were chosen for comparative study on the anatomical properties and chemical constituents. For the mechanical and physical study, 1400 samples were randomly selected. Diameter at breast height (dbh) and height of all trees were measured using diameter tape and pole. Physical and mechanical testing were conducted using BS 373 Standard while all chemical experiments was carried out using TAPPI standards.

For DBH and height performances, three clones, namely PB 260 and PB 350 for Timber Latex Clone (TLC) and PB 314 (11 years old) is non-TLC group were measured. The results showed that a PB 260 showed the greatest mean value for height and DBH that is 799 cm and 21.10 cm while PB 350 showed higher mean value for height that is 473 cm if compared to PB 314 that only 470 cm.

The longest fibre for clones PB 260 and PB 350 was from the inner part with 1609 μm and 1383 μm, respectively. For fibre diameter, there is no significant difference either in the portions or the radial parts in both clones. The thickest fibre wall thickness for both clones were in the inner part with 5.83 μm (PB 260) and 5.82 μm (PB 350) respectively, while for lumen diameter, the upper log portion showed the higher value of 25.24 μm for PB 260. In PB 350, lumen diameter showed almost the similar value for all portions and parts. The results also indicate that the vessel frequency in clone PB 260 and PB 350 were between 2 to 3 per sq. mm.

The mean specific gravity value for clone PB 260 and clone PB 350 are 0.55 and 0.51, respectively. In PB 260, tangential shrinkage showed the highest percentage with 1.35 % from air – dried to oven – dried levels. The highest percentage of shrinkage and swelling in clone PB 350 also showed by tangential with 1.37 % and 1.00 %.

The results showed that the Modulus of Elasticity (MOE) mean value for PB 260 is 10363 Mpa while Modulus of Rupture (MOR) is 90.4 Mpa. Compression parallel to grain test indicates the mean value of 44.41 Mpa as mean value. For hardness test, the mean value was 4.87 N while for shear tests the mean value was

13.66 Mpa. The static bending test for PB 350 was 9074 Mpa for MOE and 81.94 Mpa for MOR. Compression parallel to the grain test for clone PB 350 showed the mean value of 38.44 Mpa, while hardness test gives results of 4.49 N and for shear test, the mean value is 13.13 Mpa.

Except for extractives content, the chemical constituents of the bottom and upper portion for clone PB 260 showed almost the same values of alpha - cellulose, hemicellulose, holocellulose and lignin. Significance different was observed in extractives content with 2.51 % and 2.66 % for bottom and upper portion, respectively. For clone PB 350, alpha - cellulose, hemicellulose, holocellulose, lignin and extractives content of bottom and upper portion and also between inner and outer part exhibited almost the similar results, respectively.

The results obtained showed that clones PB 260 and PB 350 have the quality of Timber Latex Clone. The DBH and height of rubber trees from TLC groups growing faster compared to non-TLC trees. Wood yield of PB 260 and PB 350 was considered high with an average of 270 m^3 ha^{-1} and 300 m^3 ha^{-1} harvested at 20 years after planting. These two clones can be commercialised as a plantation crop, which can give latex and timber in a shorter period so the future timber supply can be predicated and soundly managed.

Abstrak tesis ini dikemukakan kepada Senat Universiti Putra Malaysia untuk memenuhi keperluan ijazah Master Sains

PENILAIAN KUALITI DUA KLON POKOK GETAH (*HEVEA BRASILIENSIS)* UNTUK KAYU DAN LATEKS

Oleh

MOHAMMAD IZHAM BIN YAHAYA

Mei 2001

Penyelia : Prof. Madya Dr. Mohd Hamami bin Sahri
Fakulti : Perhutanan

Pengetahuan tentang ciri – ciri sesuatu kayu merupakan suatu keperluan untuk kita membuat penilaian bagi sesuatu kegunaan seperti untuk penghasilan kayu berkualiti tinggi dan juga untuk menilai potensi kegunaan kayu. Kajian telah dijalankan untuk menilai tumbesaran, anatomi, ciri - ciri fizikal dan mekanikal dan juga kandungan kimia dalam pokok getah dari klon TLC untuk dibandingkan dengan pokok getah biasa. Dua klon yang berlainan, iaitu PB 260 yang berumur 11 tahun dan PB 350 yang berumur 5 tahun telah di pilih daripada ladang Golden Hope Berhad. Sepuluh pokok dari setiap klon ditebang untuk kajian anatomi dan kimia kayu. Setiap pokok dibahagikan kepada dua bahagian mengikut tinggi pokok iaitu bahagian atas dan bahagian bawah dan 3 sampel mengikut jejari iaitu bahagian luar, tengah dan dalam. Untuk ujikaji fizikal dan mekanikal, 1400 sampel telah dipilih secara rawak. Diameter dan tinggi pokok telah diukur menggunakan perepang dan meter tinggi. Ujian fizikal dan mekanikal telah dijalankan menggunakan piawaian BS 373 manakala ujikaji kimia pula dijalankan dengan menggunakan piawaian TAPPI.

Untuk DBH dan tinggi pokok, tiga klon iaitu klon PB 260 dan PB 350 dari kumpulan TLC dan klon PB 314 (11 tahun) untuk kumpulan bukan TLC telah diukur. Klon PB 260 telah menunjukkan nilai min tertinggi untuk DBH dan tinggi pokok iaitu 21.10 cm dan 799 cm manakala klon PB 350 menunjukkan nilai min tinggi pokok yang lebih besar iaitu 473 cm berbanding klon PB 314 yang hanya 470 cm.

Daripada ujikaji, gentian terpanjang untuk klon PB 260 dan klon PB 350 terdapat pada bahagian dalam iaitu masing – masing 1609 μm dan 1383 μm. Untuk garis pusat gentian, kedudukan sampel dalam tidak menunjukkan sebarang perbezaan bererti. Ketebalan dinding gentian bagi kedua – dua klon ialah dari bahagian dalam iaitu 5.83 μm (PB 260) dan 5.82 μm (PB 350) manakala untuk diameter lumen, bahagian atas pokok menunjukkan nilai tertinggi untuk klon PB 260 iaitu 25.24 μm. Bagi klon PB 350, nilai diameter lumen adalah hampir sama untuk semua bahagian. Frekuensi vesel untuk klon PB 260 dan PB 350 adalah berjulat di antara 2 hingga 3 bagi setiap mm persegi. Nilai min tertinggi untuk frekuensi vesel ialah pada balak bawah dan bahagian dalam iaitu 3.26 bagi setiap mm persegi manakala bagi klon PB 350, nilai min tertinggi ialah pada balak atas dan bahagian dalam iaitu 3.79 bagi setiap mm persegi.

Min graviti spesifik untuk klon PB 260 ialah 0.55 manakala min graviti spesifik untuk klon PB 350 ialah 0.51. Pengecutan tangen bagi klon PB 260 menunjukkan nilai peratusan tertinggi iaitu 1.35 % daripada keringan udara ke peringkat keringan oven. Nilai peratusan pengecutan dan penggembongan tertinggi pada klon PB 350 juga berlaku pada arah tangen iaitu masing – masing 1.37 % dan 1.00 %.

Daripada ujikaji mekanikal, keputusan menunjukkan nilai min Modulus Ketegangan (MOE) bagi klon PB 260 ialah 10363 Mpa manakala Modulus Kepecahan (MOR) ialah 90.4 Mpa. Nilai min ujian mampatan selari ira ialah 44.41 Mpa. Untuk ujian kekerasan, nilai min ialah 4.87 N manakala ujian kekuatan ricihan memberikan nilai min 13.66 Mpa. Nilai min MOE dan MOR pada klon PB 350 lebih rendah daripada klon PB 260 iaitu 9074.29 Mpa pada MOE dan 81.94 Mpa pada MOR. Ujian kekerasan memberikan nilai min 4.49 N manakala ujian kekuatan ricihan memberikan nilai min 13.13 Mpa.

Selain dari kandungan ekstraktif, perbandingan antara balak atas dan balak bawah untuk klon PB 260 menunjukkan peratus kandungan alfa - sellulosa, hemisellulosa, holosellulosa dan lignin yang hampir sama. Nilai perbezaan yang ketara untuk kandungan ekstraktif berlaku pada balak bawah dan atas iaitu 2.51 % dan 2.66 %. Untuk klon PB 350, kandungan alfa - sellulosa, hemisellulosa, holosellulosa lignin dan ekstraktif tidak menunjukkan perbezaan yang bererti bagi setiap balak.

Daripada keputusan yang diperoleh, klon PB 260 dan PB 350 menunjukkan ciri – ciri klon pokok getah untuk kayu dan lateks (TLC). Ciri – ciri yang dipunyai oleh kedua – dua klon TLC menunjukkan nilai lebih baik daripada pokok getah dari klon bukan TLC. Ukuran diameter dan tinggi pokok didapati meningkat lebih cepat berbanding klon bukan TLC. Isipadu kayu yang dianggarkan untuk klon PB 260 dan PB 350 ialah 270 m^3 ha^{-1} dan 300 m^3 ha^{-1} selepas 20 tahun. Kedua – dua klon ini boleh dikomersialkan sebagai tanaman ladang yang boleh memberikan hasil lateks dan kayu pada masa yang singkat dan oleh itu bekalan kayu balak pada masa depan lebih mudah dianggar dan diuruskan.

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TABLE OF CONTENTS

LIST OF TABLES

Table **Page**

LIST OF FIGURES

Figure **Page**

LIST OF PLATES

LIST OF ABBREVIATIONS

BS	British Standard
MC	Moisture Content
OD	Oven Dry
TLC	Timber Latex Clone
LSD	Least Significant Difference
MOE	Modulus of Elasticity
MOR	Modulus of Rupture
MTIB	Malaysian Timber Industry Board
MDF	Medium Density Fibreboard
PB	Prang Besar
RH	Relative Humidity
RRIM	Rubber Research Institute
TRTTC	Timber Research and Technical Training Centre
FRIM	Forest Research Institute of Malaysia
SG	Specific Gravity
SAS	Statistical Analysis System

CHAPTER I

INTRODUCTION

Timber Latex Clone (TLC) is a clone for rubberwood (*Hevea brasiliensis).* It is classified as a light hardwood. The wood is whitish yellow in colour when freshly cut and dried to a pale cream colour, within a pinkish tinge. The timber is easy to saw, cross cut and machine.

Rubberwood is valuable timber for furniture manufacture on a commercial scale due to its beautiful, light and even coloured texture, comparable strength and easy machining and processing properties (Chew, 1992; Lew and Sim, 1983).

It is necessary to have an appreciation on the structure of wood to understand the wood properties and its behavior. This is particularly so in respect to strength and dimensional changes. According to Shukari (1992), matured trees of rubberwood (generally more than 25 years old) have better physical and mechanical properties than immature trees. With respect to low tensile strength, shorter fibre length and greater longitudinal shrinkage, juvenile wood is known to be lower in quality than mature wood.

The structure of juvenile rubberwood is expected to be different compared to matured rubberwood. Strength properties of juvenile rubberwood are also inferior and less than matured rubberwood. Based on mechanical strength, juvenile rubberwood is suitable for the manufacturing of pulp and paper, solid wood products and medium density fiberboard (MDF) (Roslan, 1998).

Results from the mechanical testing in this study should serve as a guide to produce product based on the strength properties. The finishing, sanding and other process shall be easier to handle because the anatomical properties of these clones have been identified.

Justification

Young rubberwood tends to pose various problems in most manufacturing processes due to the greater occurrence of spiral grain, the lower strength, lower density, shorter fibre length and also greater longitudinal shrinkage. This study is thus important in assessing the suitability of young rubberwood for the manufacture of products as compared to mature rubberwood. Indirectly, it can serve as guidance to the manufacturers in providing additional preliminary information to make correct decision by using these clones as raw materials. The proper understanding and documentation of the properties and processing variability of young rubberwood from various age groups will definitely help towards the production of high quality products as the matured rubberwood.

Objectives

The main objectives of this study were as follows:

1) To determine the diameter at breast height (dbh) and height growth of clone PB 260 (11 years old), PB 350 (5 years old) and PB 314 (11 years old).

2) To investigate the anatomical, physical and mechanical properties and chemical constituents of clones PB 260 and PB 350.

3) To compare these properties with non-Timber Latex Clone rubberwood.

The results from this study can be used to evaluate the performance of the clones for its suitability for new products and fulfilling the objective of producing high quality of timber from timber latex clone.

CHAPTER II

LITERATURE REVIEW

The Rubber Tree

The rubber tree (*Hevea brasilliensis)* is indigenous to the Amazon forests of Brazil. Mature trees rubberwood in the Amazon forest are much larger than the trees that one is so familiar within Malaysia. The mature trees in its native habitat are about 25-30 meters tall with average girth of greater than 1 meter at breast height.

The trees of Malaysian rubber plantations, which are very much smaller, have been bred for the production of latex without taking into account the volume of wood produced (Hong and Sim, 1994). However, with the present scenario of increasing demand for rubberwood the criteria for breeding of rubber trees will include those for the production of wood as well.

Origin of Rubber Plantations In South East Asia

The relatively high price of rubber in the mid-nineteenth century and the British's search for a cash crop for its Eastern colonies then, led to the identification of the rubber tree as one of the potential crops for planting in South East Asia (Hong and Sim, 1994).

Henry Wickham has been credited to be responsible for the introduction of the rubber tree, *Hevea brasilliensis* from the Amazon forests of Brazil to South East Asia.