UNIVERSITI PUTRA MALAYSIA

STEM PROPERTIES OF PLANTED CALAMUS SCIPIONUM AND DAEMONOROPS ANGUSTIFOLIA OF DIFFERENT AGES

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STEM PROPERTIES OF PLANTED *CALAMUS SCIPIONUM* AND *DAEMONOROPS ANGUSTIFOLIA* OF DIFFERENT AGES

By
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LIST OF ABBREVIATIONS

FRIM : Forest Research Institute Malaysia

MOE : Modulus of Elasticity

MOR : Modulus of Rupture

MTS : Maximum Tensile Stress

MCS : Maximum Compressive Stress

Sp : Species

Abstract of thesis submitted to the Senate of Universiti Pertanian Malaysia in fulfilment of the requirements for the degree of Master of Science.

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Faculty : Forestry

Knowledge on anatomical, physical, mechanical and machining properties is necessary in assessing the potential use of rattan but little research has been conducted on the commercially important large diameter species. A total of fifty two stems of two species namely *Calamus scipionum* Lour. 'Rotan semambu' and *Daemonorops angustifolia* (Griff.) Mart. 'Rotan getah' from plantation plots were chosen for the study to evaluate the effect of age and height on the properties of rattan.

All the anatomical characteristics studied were significantly correlated to age, portion, part (except fibre length, lumen diameter and cell wall thickness) and segment. In terms of size, distribution, percentage area and fibre length (anatomical properties), *C. scipionum* was bigger than *D. angustifolia*. The fibre length tended

to decrease from basal (1.99 mm) towards the top portion (1.41 mm) and from the peripheral layer (1.67 mm) towards the inner wall (1.56 mm) for both species. The average range of cell wall thickness was from 3.49 to 5.67 μm , fibre diameter; from 20.58 to 24.07 μm and lumen diameter, from 12.63 to 13.61 μm, respectively.

The initial moisture content and specific gravity were significantly correlated with height, maturity of the stem and anatomical properties but not with the part of the specimens for both species. The moisture content of *C. scipionum* ranged from 74 to 331 percent and from 54 to 321 percent in *D. angustifolia* while the specific gravity value ranged from 0.40 to 0.83 and from 0.27 to 0.58, respectively. All the shrinkage values of rattan were significantly correlated with height of the stem. It increased from the basal towards the top portions.

However, the value of mechanical properties of both species increased with age but decreased with height of the stem. In sanding, *C. scipionum* was found to be a stronger cane and exhibited better quality than *D. angustifolia*. The treated samples (boiled with diesel) gave a better result (smoothness and easy to process) than untreated samples.

Abstrak tesis ini di kemukakan kepada Senat Universiti Pertanian Malaysia sebagai memenuhi keperluan untuk mendapatkan Ijazah Master Sains.

SIFAT-SIFAT BATANG BAGI *CALAMUS SCIPIONUM* DAN *DAEMONOROPS ANGUSTIFOLIA* YANG DITANAM PADA TAHAP UMUR YANG BERBEZA

Oleh

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Pengetahuan mengenai sifat-sifat anatomi, fizikal, mekanikal dan pemesinan amat diperlukan di dalam menilai potensi kegunaan spesis-spesis rotan tetapi hanya sedikit sahaja penyelidikan yang telah dijalankan ke atas spesis-spesis komersial yang berdiameter besar. Sejumlah lima puluh dua batang dari spesis *Calamus scipionum* Lour. (Rotan semambu) dan *Daemonorops angustifolia* (Griff.) Mart. (Rotan getah) daripada plot tanaman telah dipilih untuk kajian bagi menilai kesan umur dan ketinggian batang terhadap sifat-sifat rotan berkenaan.

Kesemua sifat-sifat anatomi didapati memberi kesan yang bererti terhadap umur, ketinggian, bahagian (kecuali panjang gentian, diameter lumen dan ketebalan

dinding sel) dan segmen. Di dalam erti kata saiz, taburan dan peratusan kawasan ke atas sifat-sifat anatomi serta panjang gentian, *C. scipionum* mempunyai nilai yang lebih besar berbanding *D. angustifolia*. Penurunan panjang gentian adalah ketara daripada bahagian bawah (1.99 mm) sehingga ke bahagian teratas sekali (1.41 mm) dan daripada lapisan luar (1.67 mm) terus kepada lapisan dalam sekali (1.56 mm) bagi kedua-dua spesis. Ketebalan dinding sel setiap satunya berjulat di antara 3.49 hingga 5.67 μm, diameter gentian di antara 20.58 hingga 24.07 μm dan diameter lumen daripada 12.63 hingga 13.61 μm.

Kandungan lembapan dan ketumpatan bandingan didapati amat dipengaruhi oleh ketinggian dan peningkatan umur batang serta sifat-sifat anatomi tetapi tidak dengan bahagian-bahagian sampel bagi kedua-dua spesis. Kandungan lembapan bagi *C. scipionum* berjulat di antara 74 hingga 331 peratus dan dari 54 hingga 321 peratus bagi *D. angustifolia* sementara bagi ketumpatan bandingan, masing-masing berjulat di antara 0.40 hingga 0.83 (*C. scipionum*) dan 0.27 hingga 0.58 (*D. angustifolia*). Kesemua nilai pengecutan rotan amat dipengaruhi oleh ketinggian sampel. Nilainya meningkat daripada bahagian bawah sehingga ke bahagaian teratas batang.

Walau bagaimanapun, sifat-sifat mekanikal kedua-dua spesis didapati meningkat bersama peningkatan umur tetapi menurun dengan ketinggian batang. *C. scipionum* merupakan rotan yang lebih kuat serta menunjukkan kualiti lebih baik berbanding *D. angustifolia* terutamanya di dalam proses pempelasan. Sampel yang dirawat (direbus bersama disel) memberikan permukaan yang lebih baik berbanding dengan sampel yang tidak dirawat.

CHAPTER I

INTRODUCTION

Rattan is one of Malaysia's rich natural and renewable resources. As a native plant of the jungle, it is a source of sustenance and livelihood (Raja Fuziah, 1985). Although categorised as a minor forest product, rattans together with bamboo far outweigh all the minor forest produce in economic terms. Before this, their importance is overshadowed by the forest's primary product, the logs. These nonwood forest products were ignored, destroyed and left to rot during logging operations or were gathered by the local for domestic consumption.

According to Menon (1980), rattans have been exploited and utilised for several centuries and during the last few decades, rattan has emerged as the most sought after raw material for the furniture industry within the country, thus resulting into a multi-million dollar business.

Locally, rattan may be of great social significance in providing a source of income for the poorer communities living near the forest. These people may use wild rattan growing in the forest as a source of income for riding over difficult periods in the agricultural crop cycle.

Dransfield (1979) reported that all rattans of the world may number about 600 species in 13 genera. Aminuddin (1994) further revealed that about 25 out of the 106 species of rattan found in the forest of Peninsular Malaysia are presently collected and utilised commercially (Table 1). This could be due to the inferior quality of some species and in others they produced only very short stems of non-commercial lengths (Manokaran, 1990). Because of these reasons, most of the world's 600 species do not enter the trade.

Background of the Study

In the past, rattan which was regarded as a minor forest product was beyond the scope and interest of forest departments which concentrated on timber extraction and the regeneration of timber stands. Today, rattan is the most important resource after timber. Despite the antiquity of its uses, rattans rarely constitute a managed resource and in spite of their great economic value, they are poorly understood biologically.

According to Darus & Aminah (1985), the economic importance of rattan has been found to be significant mainly because of the rattan furniture industry and handicrafts items which turn into a modern multi-million dollar industry. These products enjoying very high demand domestically as well as internationally. In facts,

Table 1
List of Potential Rattan Species

Species	Vernacular name
Large diameter (>18 mm)	
Calamus manan	Rotan manau
C. tumidus	Rotan tikus
C. palustris	Rotan manau langkawi
C. ornatus	Rotan mantang
C. scipionum	Rotan semambu
C. peregrinus	Rotan jelayan
C. erinaceus	Rotan bakau/air
Daemonorops grandis	Rotan sendang
D. angustifolia	Rotan getah
Korthalsia rigida	Rotan dahan
K. flagellaris	Rotan dahan
K. laciniosa	Rotan dahan/merah
Small diameter (<18 mm)	
C. caesius	Rotan sega
C. axillaris	Rotan sega air
C. speciosissimus	Rotan sega badak
C. insignis	Rotan batu
C. laevigatus	Rotan tunggal
C. densiflorus	Rotan kerai
C. diepenhorstii	Rotan kerai hitam
C. javensis	Rotan lilin/seni
C. exilis	Rotan paku
C. pycnocarpus	Rotan kong
Daemonorops propiqua	Rotan jernang
D. didymophylla	Rotan jernang
D. micrantha	Rotan jernang miang

(Source: Aminuddin, 1993)

its roots still remain firmly embedded in village and small-scale rural cottage-type activities.

The international trade in rattan dates to the mid-nineteen century before the Portuguese brought the material to Europe (Corner, 1966; Whitmore, 1973; Dransfield & Manokaran, 1993). However, village-level utilisation in the Asia region spans many centuries ago. Rattan enters into the world market as rattan sticks, cane core and split canes. Menon (1980) reported that the rattan brings US$50 million into village economies, annually and more than US$1.2 billion in terms of manufactured products. Such a large volume in rattan trade indicates that there is great demand for rattan and rattan products throughout the world.

In recent years, there has been a sharp increase in demand for furniture especially from Japan, Europe and United States of America (USA). Singapore was the clearing-house for practically the entire rattan output of the South-East Asia and the Western Pacific at the turn of the 20th century. Singapore and Hong Kong, without raw rattan resources of their own, have been playing the lucrative role of the middle-man from the beginning of international trade in rattans. They have been importing, processing and then re-exporting of rattan products (Manokaran, 1990).

From 1922 to 1927, Singapore exported from 2750 to 16000 tonnes, mainly to Hong Kong, the United States and France. During the same period, the export from Kalimantan and Sulawesi increased from 9400 to 19300 tonnes and 10300 to 21800 tonnes, respectively. By the 1970's, Indonesia supplied about 90% of raw rattan of the worlds. In 1977, Singapore and Hong Kong which have no commercially harvestable rattan resources, earned more than US$21 million and US$68 million, respectively in export value. By comparison, Indonesia's share only US$15 million of the trade, mainly of unprocessed canes (Manokaran, 1990). Anon (1987) reported that these two non-rattan producing nations in the region have established their processing industries by training a large pool of skilled labour and have developed technologies to treat and utilise a wide variety of lesser known or low quality rattan. Malaysia needs to develop her rattan industry further to overcome this unhealthy situation.

In order to discourage the export of raw rattans, the goverment has imposed a RM 2700/metric tonne export duty recently of any species, size and condition, in an attempt to safeguard the interest of local rattan furniture makers since August 1987. As extension of this, only finished rattan products were allowed to be exported from December 1989 onward. This is to ensure that there is a continuous supply of high quality raw rattan within the country thus conserving its resource base. In fact, these can contribute the industry's ability to meet the Industrial Master Plan export target of US$60 million worth of rattan furniture by 1995 (Manokaran, 1990).

With the increasing demand of rattan products and improvement of processing techniques, the rattan industry is growing up rapidly. More than 642 rattan factories are registered in the country where, 30% is categorised as cottage and small scale and 70% as large scale industries. Of the 642 mills, 24.6% are involved in rattan processing while the remaining 484 mills are engaged in the manufacturing activities (Aminuddin & Abdul Latif, 1992). However, the distribution of these factories are concentrated mainly in the north-west of the Peninsular Malaysia, which is rich in rattan resources.

Malaysia has abundant supply of raw rattan. Abdul Latif (1989) reported that, the total gross value of raw rattans collected could amount to over RM 5 million a month. The value can increase to more than seven to nine times if the manufactures concentrate on downstream processing as in furniture or semi-processed products such as ropes and binds which are traditionally imported from Singapore, Hong Kong, Indonesia and Taiwan. However the supply for commercially importanat large diameter rattan species is getting very scarce. The supply is very difficult to come by and most of the industries have resorted to replace *Calamus manan* (Rotan manau) with other large diameter canes. Rattan has huge potential for industrial development and Malaysia should exploit these resources to the maximum. The supply of these rattan species can be increased through large scale planting on available land ranging from wastelands to forests and rubber estates (Aminuddin & Nur Supardi, 1991).

The potential of these species could partly be realised by understanding its basic characteristics and properties. It is also important to compare its properties to other commercial species in order to obtain rational explanation on its potential usage. In view of this, two planted rattans species were chosen as material for the study in assessing its potential suitabitlity for various end products.

In the light of the increasing emphasis on improved rattan utilisation, the suitability of *Calamus* sp., *Daemonorops* sp., *Korthalsia* sp. and other species for specific end-uses such as handicrafts and furniture has to be studied. This study has been designed to assess the properties of planted rattans viz. *Calamus scipionum* 'Rotan semambu' and *Daemonorops angustifolia* 'Rotan getah' which covers the anatomical, physical, mechanical and machining properties to provide the basic information for their utilisation.

Objectives of the Study

The study emphasised on the followings:-

a. To determine the anatomical features, physical, mechanical and machining properties of two planted rattan species viz. *Calamus scipionum* Lour. and *Daemonorops angustifolia* (Griff.) Mart.

b. To study the variations between and within the parameters studied in relation to age and stem heights.

CHAPTER II

LITERATURE REVIEW

Rattans are mostly trailing or spiny climbing palms with characteristics scaly fruits belonging to the Lepidocaryoid Major Group of the Palm Family (Moore, 1973; Dransfield & Uhld, 1986). It's the most important group of forest species after timber. These palms are abundantly found in low and medium virgin forests. Although there are thirteen recognised genera which comprise about 600 species in the world, rattans are mostly concentrated in tropical and subtropical areas in the Asia Pacific region (10 genera) and West Africa (4 genera). The most commercial genus is *Calamus* while others include *Calospatha*, *Ceratolobus*, *Daemonorops*, *Korthalsia*, *Myrialepis*, *Plectocomia* and *Plectocomiopsis* (Table 2). There is no other rattan growing naturally in other tropical and sub-tropical areas, or in temperate regions (Manokaran, 1990).

According to Whitmore (1973), rattans have their centre in South East Asia and Malaya lies at the very hub (Figure 1). Nine genera, including all the principal ones, occur in this region. In fact, *Calamus* and *Daemonorops* are our two largest palm genera with 72 and 32 species, respectively. Numbers of genera and species fall off sharply in all directions away from the old Sunda shelf countries of Sumatra, Malaya and Borneo. In Malaya out of 220 species of palms, 106 species are rattans and these figures are only provisional.