B I O D I V E R S I T A S
Volume 5, Nomor 2
Halaman: 61-65

ISSN: 1412-033X
Juli 2004
DOI: 10.13057/biodiv/d050204

Study of *Calamus occidentalis* J.R. Witono & J. Dransf. Species Commercial Values and Possible Utilization

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Received: 12th December 2003. Accepted: 17th May 2004

ABSTRACT

The selection of appropriate rattan for a certain use must be based on adequate information about its potency, anatomical structure, and chemical properties. Standards methods of inventory development by Curtis method was used to obtain data on its density and frequency. To know the anatomical structure of preparation were made according to Schultze method and microtome preparation according to Staining Paraffin Section with Safranin. While to know the chemical component of rattan stem the analyzed by Standard Industry Indonesia procedures. *Calamus occidentalis* is one among other Java rattan species which its distribution is limited in the area of Ujung Kulon National Park, West Java. *C. occidentalis* may be utilized for various purposes based on the following characteristics: species density of 21 cane/ha; and anatomical structure: fiber length of 2204 μm, fiber-wall thickness of 4.26 μm, vascular bundle diameter of 812.5 μm, metaxylem diameter of 293.75 μm, proxylem diameter of 43.5 μm, and phloem diameter of 37.5 μm. Its chemical components are cellulose (49.95%), lignin (22.39%), and air-dry moisture (12.27%). Based on the above information, *C. occidentalis* rattan species possibly can be used as an alternative substitute of *Calamus manan,* an endangered rattan species, because several properties of *C. occidentalis* has similar with that of *C. manan*.

Keywords: commercial-value, possible utilization, *Calamus occidentalis*.

INTRODUCTION

The technology development on the utilization of rattan and on the other hand the increasing demand of "manau" rattan species as raw material caused the attention directed to the utilization of the species which has sufficient potency and prospect in the future. One of the rattan species which can be categorized as a substitute and can be developed as a potential commodity is *Calamus occidentalis*.

C. occidentalis is one among other Java rattan species which its distribution is limited in the area of Ujung Kulon National Park, West Java (Witono and Dransfield, 1998). Belong to Family of Arecaceae, and more recognized as solitary rattan ("rotan tunggal").This rattan species are grown in lowland up to the elevation of 300 m asl (above sea level). If we look at its contribution on human need, almost all part of this rattan species are very beneficial, such as: canes, leaves, fruits and its palm- pith can be utilized.

The properties of *C. occidentalis* stem in relation with the possible utilization has to be known through information on the anatomical aspect, large proportion of fibers are found to be concentrated in the outer portion of the cane with the inside portion composed mostly of parenchyma; and chemical properties. The anatomical structure of *C. occidentalis* rattan cane has similarity to that of *Calamus manan,* so that it can be used as alternative substitute. The utilization of solitary rattan still needs further assessments, such as on: physical-mechanical properties, durability, and its processing method. In line with those mentioned above, this paper present several important information to develop the utilization of *C. occidentalis* a multipurpose plant species.

The role of rattan as export commodity and producer of foreign exchange are still important and significant. The problem faced recently is how to maintain the raw material continuity of this commodity, in order remain as advantageous natural resources. So far *C. occidentalis*, become excellent for people surrounding forest area, because this rattan considered as sacred rattan. Where the activities of people who lives far from the forest area, utilized the natural resources as their livelihood especially as the hunter of this rattan species. This activity has disturbed to Ujung Kulon National park area, since long time ago, and the damage are increasing seriously. Resulting in disappearance of

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the biotic in this ecosystem. The main problem in this matter is the method how to maintain this solitary rattan not disappears.

MATERIAL AND METHOD

Deciding sample plot

To obtain the primary data from *C. occidentalis* species, a thorough exploration and collection of all rattan species material both fertile and sterile were executed. Data collection was conducted during period of August 1997. The forest condition in this area remains good. Continuous plot transect was adopted, 2 transect within 1 km distance. A sample plot of 10m x 10m size was established in each transect and resulting in a total of 200 plots with total areas of 2 ha. Rattan data consisting of species and number of stem were recorded in tally sheet and analyzed using Curtis method (Mueller-Dumbois and Ellenberg, 1974). Each of collected herbarium specimens was processed using alcohol. The identification for scientific name had been conducted in Herbarium Botany of Forest and Nature Conservation Research and Development Center, and Herbarium Bogoriense.

All data recorded were tabulated and further analyzed to describe the rattan potency. The formula adopted for the calculation are: (i) Density: number of individual per area unit, (ii) Frequency: the percentage of existing plant in the experimental plots without considering the number of the individual.

Determining the microscopic properties

To know the anatomical structure of *C. occidentalis* species two kinds of preparation were made to determine its microscopic properties. Maserasi preparation was made according to Schultze method and microtome preparation according to "Staining Paraffin Section with Safranin" (Mandang and Rulliyati, 1986). While to know the chemical component of rattan stem the analyzed by Standard Industry Indonesia (SII) procedures (Anon., 1981).

RESULT AND DISCUSSION

To obtain the information on the possible utilization of *C. occidentalis* stem, has to be supported by adequate either data or information. Following are data on:

Morphological characteristics

Calamus occidentalis J.R. Witono & J. Dransf.

Local name: rotan tunggal, rotan keramat (Sundanese)

Description: Solitary high climbing rattan with stems up to 100 m height, looping in lower part of stem. Stem without sheaths 2 - 3 cm in diameter, with sheaths up to 4 - 7 cm in diameter; internodes between 18-30 cm lengths. Leaf sheaths green when fresh, drying brownish green, covered in caduceus brown indumentums, and armed with short black irregularly arranged spines, to 14 mm length by 2 mm width at the base. Knee conspicuous. Ocrea ill-defined. Leaves cirrate to 244 cm length including cirrus; cirrus up to 150 cm length with brown claws; petiole about 2.7 cm length. Leaflets up to on each side rachis, regularly arranged, lanceolate, apex acuminate, base acute, middle longest about 15-34

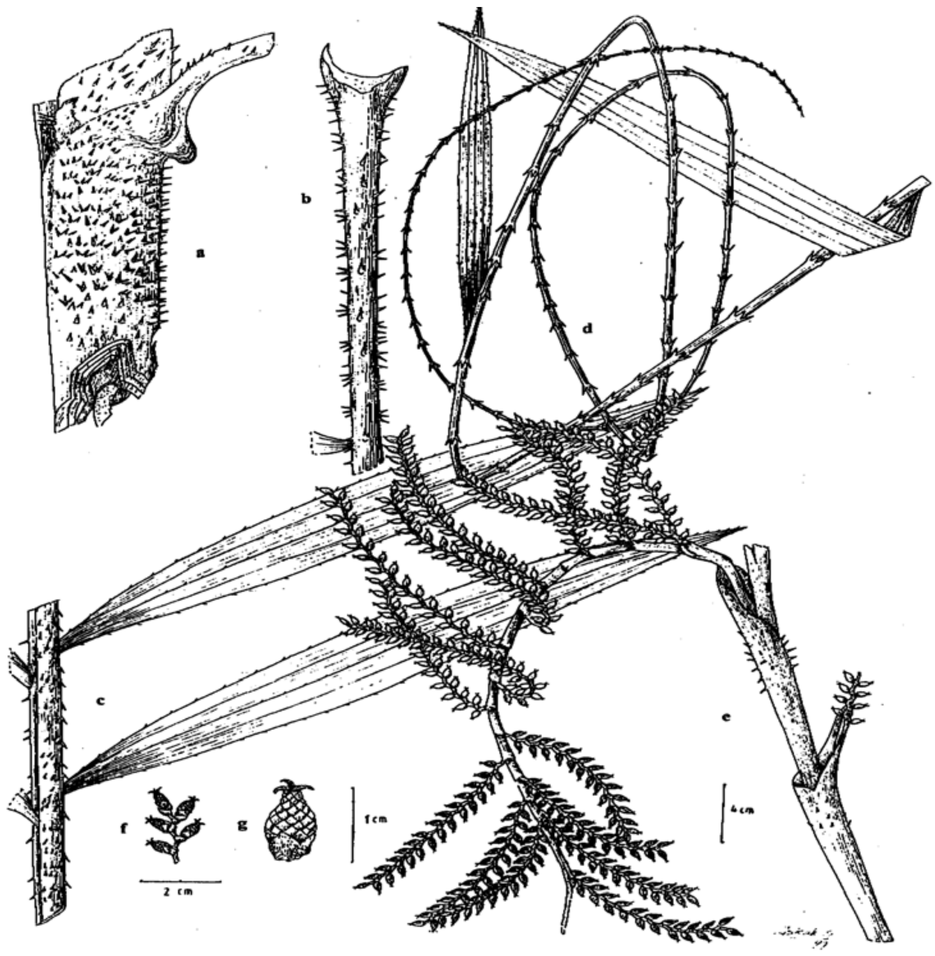

Figure 2. *Calamus occidentalis*. a. leaf sheath, b. petiole, c. portion of rachis with leaflets, d. cirrus, e. first branched of inflorescence, f,g. young fruit (Dransfield 1437 & Kalima 37).

cm length by 3-6 cm width, the surfaces concolours, green when fresh, drying yellowish green, mid and marginal veins on adaxial surface armed with black bristles, secondary parallel veins very thin.

Inflorescence eflagellate, branched to 3 orders, partial inflorescence up to 17, the longest to 62 cm length; rachis branch tightly tubular, to 9 x 1.6 cm, rachillae to 22 mm length, sessile, basally enclosed by the branch, with ca 12-15 flowers on each side; rachilla bracts and bracteoles explanate, with dentate margins and bearing sparse brown scales. Fruit globose-ovoid, 17-19 x 12-15 mm, covered in 15 vertical rows of straw colored scale. Seed ca 10 mm diameter, irregularly pitted and warded; endosperm deeply ruminate, embryo basal.

Habitat: lowland forest, primary and secondary forest, alluvium soil, volcanic soil, rocky, at the altitude of 200 m above sea level.

Distribution: West Java and endemic at Ujung Kulon National Park (Cibandawaoh, Cibunar, Cidaon, and Mount Payung), (Figure 1a, b).

The specimen observed: Ujung Kulon Nature Reserve: J. Dransfield 1437, 1438, 1485, N 1971; 2529, 15, VI (fertile). Ujung Kulon National Park: T. Kalima 37. 11 August 1997 (sterile) (Figure 2).

Research results of Kalima (1999 and 2001) stated that solitary rattan has a good prospect, so it can be expected as structural material, handicraft, etc.

Potency of C. occidentalis *rattan species*

The population density for each species are various while *C. occidentalis* has a relatively low density (20 stem/ha, and 23 stem/ha). This evidence showed that *C occidentalis* existence and distribution in the Park areas are very low or rare (Kalima, 2001).

However, *C. occidentalis* population and its existence in this area are threatened due to human disturbance such as uncontrolled extraction by community. According to recent observation, the solitary rattan species in this Park has a relatively well and good potency among of other things, it is believed as a holy rattan and it has a high economic value. During research study there were a great number of people from far distance areas visiting this holy place, most of them coming by foot to Sanghiang Sirah, which is located near Mount Payung areas. They were not only visiting and praying but also seeking and collecting *C. occidentalis* which is believed as a holy one and has a magical power. This kind of manner is obviously resulted in a continuous and drastically decreases of the respected species due to its intensive extraction. In addition, this kind of rattan considered as a rare one and has limited distribution in this area or else called as an endemic species.

Based on its strength and durability analysis, *C. occidentalis* are closed to *C. manan.* It has a relatively good bending strength properties and powerful as well. This species considered as a potential one and can play a significant role in ethno botanic field of study.

Figure 1a. Young plant of *C. occidentalis*

Figure 1b. Mature plant of *C. occidentalis*

Anatomical structure of rattan

Several results of investigation on anatomical structures of rattan are presented in Table 1.

Metaxylem is a xylem with the biggest diameter, has a function as the duct for mineral nutrient from roots to leaves. Based on the observation results on one vascular bundle there is only one metaxylem.

Protoxylem is a xylem which is form firstly in a newly grown internodes, its diameter generally are smaller than metaxylem (Figure 3 a, b). In the radial section one can see that cell wall of protoxylem are spiral form which rolled up densely, this is the factor why rattan generally easy to bend. Phloem are existed in vascular bundle has a similar parenchyma distribution pattern i.e. in one vascular bundle always exist two phloem, in left side and right side of metaxylem (Figure 3 a, b). Anatomical structure of rattan stem which is tightly related with the durability properties of rattan, the size of pores (metaxylem, phloem, and basic parenchyma, if the anatomical structure is big, rattan is less durable because it is easy to attack by insect and laid their eggs, and hatch there, rattan will be attacked by these insect. Research results of Jasni and Supriatna (1999), informing that manau rattan are resistant to the attack of destroying insect, so this rattan is categorized into Resistance Class/Susceptibility I (very resistant). Rattan destroying insect is called *powder post beetle,* the species is *Dinoderus minutus* Farb. Observation showed that the pores or the size of metaxylem, phloem of *C. occidentalis* rattan are almost similar to that of *rotan manau;* this is means that the resistance of *C. occidentalis* is also the same.

The fiber length and fiber-wall thickness are the most important parameter in determining the strength of rattan. The longer the fiber and the thicker the fiber-wall, the higher its strength and the heavier the rattan. Fiber length and fiber-wall thickness are supporting its mechanical properties (Bhat and Thulasidas, 1993; Rachman, 1996). Research results of Rachman (1966) stating that *C. manan* rattan, is the best rattan species and easy to bend, and this species is the most salable in market. But, *C. manan* is rarely now.

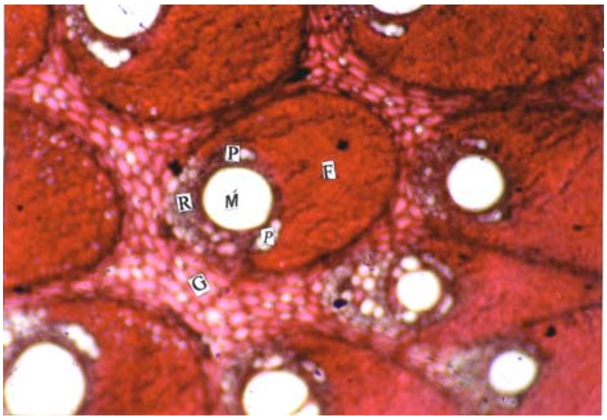

Figure 3a. *C. occidentalis*. Vascular bundles with one two phloem fields (P), one mataxylem vessel (M), protoxylem (R), fiber sheaths (F), and ground parenchyma (G), cross section.

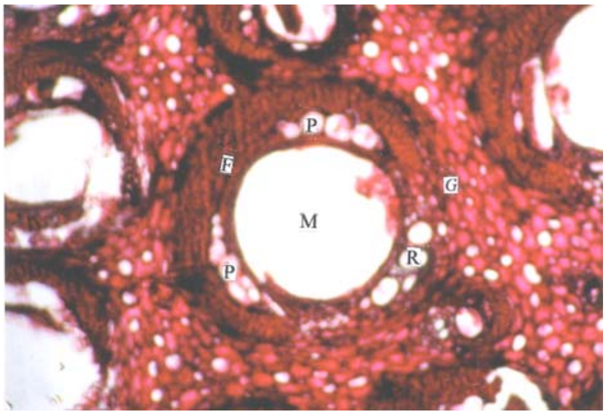

Figure 3b. *C. manan*. Vascular bundles with one two phloem fields (P), one metaxylem vessel (M), protoxylem (R), fiber sheaths (F), and ground parenchyma (G), cross section.

Based on the results mentioned above, where *C. occidentalis* rattan has the fiber length of 2204 μm, longer than that of *C. manan* (1586.7 μm) and fiber-wall thickness of 4.26 μm almost the same as that of *C. manan,* so *C. occidentalis* rattan species probably can be utilized as an alternative to substitute *C. manan* rattan species which rarely found in natural forest (Figure 3a, b).

Table 1. Anatomical structure of two rattan species

Scientific name	Metoxylem diameter (μm)	Proxylem diameter (μm)	Phloem diameter (μm)	Fiber	
				Length (μm)	Thickness (μm)
C. occidentalis	293.75	43.5	37.5	2204	4.26
C. manan	228.2	37.5	40.2	1586.7	5.4

Table 2. Cellulose, lignin and air-dry moisture content (%) of two rattan species.

Scientific name	Cellulose (%)	Lignin (%)	Air-dry moisture content (%)
C. occidentalis	49.95	22.39	12.27
C. manan	39.05	22.22	13.92

Chemical composition of rattan

Other than anatomical structure of *C. occidentalis* rattan stem, chemical composition of rattan is also important in determining the strength of rattan. Chemical content of investigated rattan and chemical content of *C. manan* as comparison are presented in Table 2. Based on Table 2, the chemical component content of *C. occidentalis* rattan are also almost the same as that of *C. manan*. Cellulose, a long chain, linear molecule of sugar is belonging to holocellulose. Cellulose and lignin content can correlate significantly with rattan strength. In this regard, cellulose can contribute to the tensile strength of rattan due to presence of strong covalent bonds in the pyranose rings and between glucose units of the cellulose polymer chain. Consequently, the higher the cellulose content the stronger the modulus of rupture of rattan. Almost similar to cellulose content, lignin can also provide significant strength of the rattan. Likewise, the greater the lignin content, the stronger the bonds between fibers in rattan (Rachman, 1996).

Based on those mentioned above, cellulose and lignin content of *C. occidentalis* rattan species are a bit higher (49.95% and 22.39%) than that of *C. manan* rattan species, so this *C. occidentalis* rattan species can be utilized. From the anatomical and chemical content point of view, *C. occidentalis* rattan species, can also utilized as an alternative to substitute *C. manan* rattan.

Problem solving alternative

From the results mentioned before, it can be showed that *C. occidentalis* rattan species can be utilized for various requirements if supported by basic properties of existing rattan species. If observed, the problems and challenges are revolving on raw material, and development plan of rattan species. From the results mentioned before can be showed that *C. occidentalis* rattan species make possible to be utilized as an alternative to substitute *C. manan.*

In providing raw material, the required efforts to be done are how to select the substitute rattan species, so the quality tend to increase and relatively guaranteed. In these matters, two methods have to do. First, through the potency of existing substitute rattan species. Second, through its several basic properties, it is that *C. occidentalis* rattan species is made possible to be utilized as an alternative for substituting *C. manan* rattan. Third, through direction of the development.

According to first method, based on the research results on *C. occidentalis* rattan species from the discussion before has a good prospect as the substitute. Therefore, in the effort to increase the potency of this rattan species, the development of cultivation on the plant species becomes a determinant matter.

In case of basic properties, the mentioned *C. occidentalis* rattan species has supported the main function of as further mechanical technology development. In relation with the development direction of *C. occidentalis* rattan species, become a good opportunity for researchers, related entrepreneur or NGO (non government organization). This has to be done in the effort to prevent extinction of the species, to maintain the species and stabilizing in controlling the rattan species. To maintain the continuity of raw material without decreasing its function and role as advantageous raw material, the enhancement of sustainability are required either in-situ or ex-situ and also the cultivation of *C. occidentalis* rattan species. Those efforts are involving the community even institution to decide the management system becomes a positive action which has to be enhanced. Not less important, research has to be enhanced continuously from species inventory up to technology engineering on the processing method in order to make easier in enhancing its quality.

CONCLUSION AND RECOMMENDATION

C. occidentalis rattan species as one of species which has a good potency to be developed as substitute of manau rattan species. From data of anatomical structure, and chemical contents, the stem of *C. occidentalis* can be used for various possible utilization. Fiber cell proportion, fiber length which is relatively long, high cellulose lignin content, it make possible and fulfill condition as an alternative material.

In line with the development of the *C. occidentalis* rattan species, the physical properties, mechanical properties, etc. of known rattan species has reinvestigated as a substitute species.

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