


# **100 TROPICAL AFRICAN TIMBER TREES FROM GHANA**

**Tree Description and Wood Identification with  
Notes on Distribution, Ecology, Silviculture,  
Ethnobotany and Wood Uses**

**Andrew A. Oteng-Amoako, Editor**



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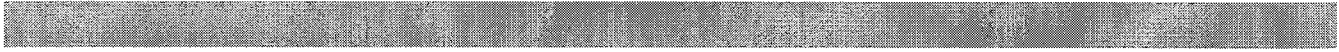
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**Andrew A. Oteng-Amoako, Editor.**



## FOREWORD

Lesser-used species (LUS) and lesser-known species (LKS) are previously less marketed or never marketed timber species which occur in forest in significant volumes, and for which adequate technical information has accrued in recent years to allow them to be promoted and sold in local and international markets. These species may be suitable for the same end-uses as species that are already used commercially and might, therefore, be promoted as substitutes. Increasing the use of LUS and LKS reduces pressure on commercial species, increases volume of species extracted per harvested area and, therefore, makes harvesting more financially viable.

Although most LUS and LKS exist in the tropical forests of Africa, only a few commercial species continue to be harvested, apparently because of problems such as lack of technical information on their uses and popularity in the market-place. Some of these species also exist in low volumes and may be characteristically small in diameter. The yield from such small-sized logs is low using the available wood processing technology in the tropics which is mostly tailored to processing large logs.


The first process in extraction is identification of tree to be harvested and then identification of wood after the tree has been processed at the mill. Unfortunately, the two processes are often inefficiently done and can contribute to deforestation and forest degradation, misidentification of timber trees during extraction, processing and grading. This problem of misidentification will be compounded as more LUS and LKS are supplied to the wood industries in tropical Africa.

The International Tropical Timber Organization (ITTO) has been at the forefront of various interventions to address the problems and challenges of promoting LUS and LKS. In collaboration with governments, non-governmental organizations, and the private sector in many tropical countries, ITTO has implemented projects totaling about 5 million US dollars within the last 20 years aimed at promoting LUS and LKS as alternate timber species for industrial use. The Government of Ghana is committed to promoting LUS and LKS and has committed counterpart funding to this and previous major LUS projects in Ghana funded by ITTO.

This book is the final output of ITTO-funded Project PD 44/98 Rev.2 (I), which started in January 2000. The key objectives of the project were as follows:

- Collect botanical and wood samples of selected LUS and LKS from forests of Ghana to increase herbarium and xylarium collections at the Forestry Research Institute of Ghana.
- Study and compile tree identification features of 100 timber species including some 74 LUS and LKS.
- Study and compile their macroscopic and physical identification features.
- Compile notes on silviculture, ethnobotany, and wood uses.
- Publish a tree and wood identification book with notes on silviculture, ethnobotany, and wood uses.
- Launch the book at a workshop and educate stakeholders on its use.

The book addresses the problem of tree and wood identification as a first step in increasing sustainable use of LUS and LKS. It also presents information on geographical distribution, in



Africa, vegetational distribution in Ghana, ecology and silviculture, ethnobotany, and wood uses. It is hoped and expected that the book will make a useful contribution toward achieving the following ITTO objectives:

- Helping to expand and diversify international trade in tropical timber and improve structural conditions in the market;
- Improving the marketing and distribution of producers' export of tropical timber; and
- Encouraging national policies which aim at the sustainable use and conservation of tropical forests and their genetic resources.

The success of this project was built around strong collaboration between scientists of Switzerland and Ghana, making it an example of north-south cooperation promoted by ITTO.

**Executive Director**

*International Tropical Timber Organization  
Yokohama, Japan*

**The Minister**

*Ministry of Lands, Forestry and Mines  
Republic of Ghana, Accra, Ghana.*

## CHAPTER 1: INTRODUCTION

A. A. Oteng-Amoako, *Forestry Research Institute of Ghana, Kumasi, Ghana*

Many factors have contributed to deforestation of tropical forest which have resulted in a loss of more than 52 million ha of forest cover over the last five decades (FAO, 2002). These factors include but not limited to shifting cultivation, timber exploitation, fuelwood harvesting, wildfires and cattle grazing. This problem becomes more vivid when one looks at the statistics for Ghana. For instance, at the turn of the 20th century, Ghana had about 8.2 million ha of high forest, which was about 34% of the total land area of the country. By 1950, the forest cover had reduced to 4.2 million ha, a third more had gone by 1972 and by 1992, over 75% of the original forest cover had been depleted (Hawthorne & Abu-Juam, 1995). At the same time, productive areas of forest reserves had declined from 1.76 million ha in 1970 to 719,300 ha by 2001. The net loss in forest area is one of the highest in the humid tropics. Unfortunately, reforestation has not kept pace with deforestation, resulting in an average annual net forest loss of about 65,000 ha nationally. Based on current stocking and forest growth dynamics, there was a need 10 years ago, to impose an Annual Allowable Cut (AAC) of 1 million m<sup>3</sup> of timber, although the installed capacity of the wood industry is estimated at 3 to 4 million m<sup>3</sup>. This has resulted in many wood processing mills producing under capacity, with some even closing down. The shortage of timber in the industry has promoted illegal logging and chainsaw fellings estimated at 2.625 million m<sup>3</sup> annually, which is patronised in the local and export market (Birikorang, 2001). The situation in Ghana is not very different from other countries in tropical Africa, especially in Côte d'Ivoire and Nigeria.

### 1.1 CONSEQUENCES OF WRONG IDENTIFICATION

One factor that contributes to depletion of tropical forest and, therefore, timber trees is wrong identification of timbers of commerce. The heterogenous nature of tropical forests of Africa, with many tree species per unit area, has further compounded the problem of the identification. When a timber tree species is wrongly identified and extracted, loggers often return to the forest to extract the required species, while the felled tree species is either left to rot or used for firewood. This practice leads to extraction above approved yield and results in higher damage to residual stands. Trees correctly identified in the forest may be wrongly identified after processing, and during sorting or grading, especially when timber species processed have identical physical wood characteristics such as colour, texture and density. Export of wrongly identified timber has resulted in penalties being imposed to the detriment of the exporter and exporting country. Furthermore, a wrongly identified timber species, when used in an application not intended for, may often lead to a shorter service life; hence, the need to use more timber for a specified service period. On the other hand, a species of high natural durability, when wrongly identified as a non-durable species, may be underutilized in an environment where a non-durable wood could have been used. For timbers of commerce, a highly priced timber is often deliberately misidentified as a low-priced species by the exporter to attract lower export duties. Once exported, it is identified by its correct name in the importing country and sold at a higher price. This practice of transfer-pricing and wrong identification deprive exporting countries the required timber export revenue for a unit volume of timber exported. Thus, wrong identification of tropical timber trees of commerce, with its concomitant effects of underutilization and transfer-pricing, contributes to deforestation and forest degradation through over harvesting.

## 1.2 CONTENT OF THE HANDBOOK

This handbook addresses the problem of tree and wood misidentification by providing tree, stem, bark, and leaf identification features of 100 timber species selected from the forests of Ghana. The species are also commonly found in many countries of tropical Africa. It provides tree, wood macroscopic and physical identification features as well as essential data on distribution of species by geographical regions of tropical Africa. Additionally, it highlights the distribution of the species in vegetational zones of Ghana, extent of their availability in the forest, their utilization and sustainability status. It further provides notes on ecology and silviculture, ethnobotany (mainly phytomedicine), and industrial uses of the wood. The list includes some 74 lesser-used species (LUS) and lesser-known species (LKS), some of which will form a major proportion of industrial timber in future.

## 1.3 DISTRIBUTION WITHIN AND BETWEEN COUNTRIES


In international timber trade, it is of utmost importance for a timber merchant to know the country source of a species, the conservation status, the growing stock, and rate of exploitation and export in the country of origin, as an indication of how long a species can be sustained on the market. The selection of a species for inclusion in this handbook was partly based on the foregone factors, and on its occurrence in the three tropical regions of West, Central and East Africa. However, details of species distribution, growing stock, and rate of exploitation and export from individual countries could not be provided, except for Ghana.

## 1.4 TREE IDENTIFICATION

The general features used to identify a standing tree before felling include the stem, bark, crown, leaf, flowers, and fruits characteristics. These features are described with particular emphasis on tree height and diameter, bole length and form, colour of bark and slash, leaf type, shape, arrangement and venation, as well as colour and morphology of flower and fruit.

## 1.5 WOOD IDENTIFICATION

Most tropical wood species are brown, cream (white), red, or shades of these three colours. They are predominantly species of "medium" density while few are of "low" or "high" density. When many wood species of similar colour, weight and density are processed in a mill, it is possible for even an experienced mill supervisor to wrongly identify and sort them out by their trade and botanical names for marketing. It is not uncommon in Ghana's local timber market, for Awiemfosamina (*Albizia ferruginea*) or Dahoma (*Piptadeniastrum africanum*), both commercial species, to be sold as Odum (*Milicia excelsa*), a well-known premium timber species which sells at higher price. White Ofram (*Terminalia superba*), a species with white or cream heartwood, may often be sold as Emire (*Terminalia ivorensis*), while Black Ofram (*T. ivorensis*), a species with brown-black stripped heartwood, is often sold as African Walnut (*Lovoa trichiloides*) or Hyedua-nini (*Guibourtia ehie*). In international timber trade, there have been many reported cases of logs and sawntimber from the tropics being rejected by importers for being wrongly identified, resulting in payment of penalties by the exporter or exporting country. In Papua New Guinea, for example, wrong identification and transfer-pricing



resulting in underpricing are reported to cost the country over 10.8 million US dollars annually (Oteng-Amoako, 1990). The problem of wrong identification will be compounded when many underutilized LUS and LKS become more prominent in international tropical timber trade.

The book addresses the problem of wrong wood identification of underutilized LUS and LKS by providing their macroscopic identification features enhanced by the use of hand lens. This not too difficult and inexpensive way of identifying a timber species, in spite of its limited accuracy, is more practical and may be preferred to the expensive, difficult and more technical microscopic identification method. The use of macroscopic features, supplemented by physical features like colour, odour, density, and the resulting ash colour after burning a splinter of the wood species, can assist the user to arrive at a definitive identification of an unknown species. Provision of a dichotomous key and a computer-aided identification give efficiency and reduce the identification process.

## **1.6 PROPAGATION AND SILVICULTURE**


Some ecologists and environmentalists have questioned introduction of exotic species as plantation crop at the expense of endemic or indigenous species, and have urged foresters and tree growers to endeavour to "domesticate" the endemic species. As an example, large areas of land in many tropical countries of Africa have been planted with Teak (*Tectona grandis*), the most important and commonest plantation species in the tropics. In Ghana, recent statistics show that about 70% of all plantation species is Teak, which covers an estimated 70,000 ha (Oteng-Amoako & Sarfo, 2003). This has resulted in considerable export of Teak sawntimber mainly to India, and Teak furniture and ceiling panel are now a common wood product on the local market. The success story has, however, contributed to a now common belief that Teak trees usually deplete nutrients in the soil. Local farmers have found it difficult to reclaim land previously used for Teak plantation for food crop production, while wildlife advocates have expressed concern about Teak plantations lacking in flora and fauna. The notes on ecology and silviculture provide background data that can be used to formulate development interventions in natural forest management and to promote indigenous species for plantation establishment.

## **1.7 ETHNOBOTANY**

Ethnobotany, which deals with the study of plants and trees for use as medicine, food and other ritual purposes, has been practised by our forefathers for many hundred years. The use of tropical trees for commercial timber only assumed high prominence in the late 1950s when cash value was placed on selected timber species which were exported to Europe after the two world wars (Foggie & Piasecki, 1962). This initiated felling, creaming and overexploitation, leading to wanton destruction of tropical forests, especially those of Africa. At a time when use of herbal medicine is being promoted by national governments of Africa, it is only timely for ethnobotany, especially phytomedicine, of tropical trees to be compiled and consolidated.

## **1.8 END-USES AND SUBSTITUTES**

The frequently asked question in the midst of scarcity of commercial and premium timber trees is what LUS can be used as a substitute for a premium species. In the local market of Ghana,



Odum (*Milicia excelsa*), a premium species, has long been used as the main construction timber for frames, trusses, joists, flooring and furniture because of its high durability, low shrinkage, medium density and excellent machining properties. However, because of its high export demand and apparent scarcity of the species in the forest, some commercial timber species like Dahoma (*Piptadeniastrum africanum*) and Awiemfosamina (*Albizia ferruginea*), both naturally durable, are used as substitutes for Odum in the local market. This handbook provides a list of 20 end-use classes for the selected 100 timber species (74 LUS and LKS 26 premium and commercial species) and possible use of LUS or LKS as a substitute for commercial species.

## **1.9 USE OF THE HANDBOOK**

The handbook is foremost for use by those who want to know how to identify any standing tree and wood species of the 100 selected species of tropical Africa. It provides information for management of natural forest, enrichment planting and plantation development. It is a handbook for those interested in ethnobotany and industrial uses of the selected timber species. It can serve as a teaching manual and a reference book for lecturers and students of botany, forestry and wood technology. Ethnobotanists, pharmacologists and herbal practitioners may also find it useful. For tree growers, architects, wood merchants and inspectors, carpenters and other wood users, it will serve as a guide for selecting timber species for a range of uses. It is for all those who want to promote sustainable forest management and efficient use of tropical timbers of Africa, especially the LUS and LKS.

## **1.10 LIMITATIONS OF THE HANDBOOK**

The original purpose of the handbook was to compile wood identification features of selected species in Africa to assist in their identification. It was, however, decided to widen the scope by including tree identification features, notes on ecology, silviculture, ethnobotany and uses of the timber species. Data compiled on these specialized areas are not original work, but a review of published and grey literature, which have been duly acknowledged. Data on technological and other wood properties, which will be the subject of the next publication, are not considered in this book. As a general reference book on some aspects of forestry, the handbook may not sufficiently address all the specialized areas dealt with, and readers who require more data on any of the species may consult further references cited in the Bibliography.

## CHAPTER 2: TREE AND WOOD IDENTIFICATION FEATURES

A. A. Oteng-Amoako, *Forestry Research Institute of Ghana, Kumasi, Ghana*, in collaboration with Daniel K. Abbiw, *Botany Department, University of Ghana, Legon, Accra, Ghana* on tree identification, Ernst Zuercher, *HSB-Wood Division, University of Applied Sciences, Biel, Switzerland* on wood identification.

### 2.1 TREE IDENTIFICATION FEATURES

The tree identification features used in describing the 100 timber species include the following tree characteristics: height and size of girth, bole shape and length, crown form and colour, branching arrangement, bark and slash characteristics, leaf type and shape, flower, fruit and seed characteristics. The over 130 tree diagnostic features are listed in 2.1.1, most are defined in the glossary, and a few of them illustrating leaf characteristics are shown in Fig. 2.1. Further references on terms used in describing the timber trees are found in Hall and Swaine (1981), Hawthorne (1990), Irvine (1961), Jane (1970), Keay (1954; 1958), Metcalfe & Chalk (1972), and PROSPECTS (1996, 2000).

#### 2.1.1 List of Tree Identification Features

##### Tree Characteristics

###### Tree size

- 1 Very large over 4.0 m in girth
- 2 Large 3.0 - 3.9 m
- 3 Medium 2.0 - 2.9 m
- 4 Small under 2.0 m

###### Tree bole

- 5 Cylindrical
- 6 Fluted
- 7 Buttressed
- 8 Stilted
- 9 Wedged

###### Crown shape

- 10 Small / narrow
- 11 Rounded

###### Colour of crown

- 12 Green
- 13 Golden brown / pink/ red
- 14 White / silvery

###### Branches arrangement

- 15 Whorled
- 16 Drooping
- 17 Ascending

##### Bark & Slash Characteristics

###### Bark features

- 18 Smooth
- 19 Rough
- 20 Fissured
- 21 Scaly or flaky
- 22 Spiny
- 22 Lenticellate

###### Colour of slash

- 23 Orange / yellow
- 24 Red / brown
- 25 White / cream or latex
- 26 Streaks of colours
- 27 Colourless

###### Surface of slash

- 28 Fibrous
- 29 Granular
- 30 Ripple marks

###### Exudate from slash

- 31 Yellow / orange
- 32 Red
- 33 White
- 34 Colourless (water like)

**Odour of slash**

- 35 Aromatic
- 36 Peppery
- 37 Pungent
- 38 Nauseating

**Taste of exudate**

- 39 Sweet
- 40 Bitter

**Leaf Characteristics****Leaf arrangement types**(see Fig. 1)

- 41 Simple
- 42 Alternate
- 43 Opposite
- 44 Whorled
- 45 Clusters
- 46 Lobbed
- 47 Compound
- 48 Digitate
- 49 Pinnate
- 50 Bipinnate
- 51 Parapinnate
- 52 Imparipinnate
- 53 Trifoliate

**Shapes of leaf** (see Fig. 1)

- 54 Linear
- 55 Lanceolate
- 56 Elliptic
- 57 Oblong
- 58 Oblanceolate
- 59 Ovate
- 60 Obovate
- 61 Spatulate
- 62 Deltoid
- 63 Reniform
- 64 Orbiculate
- 65 Runcinate
- 66 Palmate

**Leaf Colour**

- 67 Green
- 68 Red / pink
- 69 Golden / yellow
- 70 Silvery

**Leaf Surface**

- 71 Glaucous
- 72 Rough
- 73 Glandular
- 74 Spiny
- 75 Spotted
- 76 Hairy (Stellate)
- 77 Scaly

**Leaf Margin** (see Fig. 1)

- 78 Entire
- 79 Serrate / (serrulate=finely serrate)
- 80 Undulate
- 81 Crenate
- 82 Dentate
- 83 Digitate
- 84 Trifoliate

**Leaf Base** (see Fig. 1)

- 85 Cuneate
- 86 Cordate
- 87 Sagitate

**Leaf Tip** (see Fig. 1)

- 88 Acuminate
- 89 Acute
- 90 Obtuse
- 91 Truncate
- 92 Retuse
- 93 Emarginate
- 94 Apiculate
- 95 Mucronate

**Leaf Venation (Upper surface)**

- 96 Conspicuous / prominent
- 97 Fine
- 98 Parallel / lateral
- 99 Reticulate



## Flower, Fruit & Seed Characteristics

### Colour of flower

- 100 Red / pink
- 101 White / cream
- 102 Yellow / orange
- 103 Combination of colours

### Size of flower

- 104 Very small
- 105 Small
- 106 Medium
- 107 Large

### Odour in flower

- 108 Aromatic
- 109 Sweet
- 110 Nauseating /unpleasant
- 111 Pungent

### Fruit type

- 112 Simple
- 113 Dry dehiscent

- 114 Legume / pod
- 115 Follicle
- 116 Capsule
- 117 Dry indehiscent
- 118 Achene
- 119 Samara
- 120 Schizocarp
- 121 Nut

### Berry

- 122 Drupe
- 123 Aggregate
- 124 Multiple

### Seed size

- 125 Minute
- 126 Small
- 127 Large

### Seed colour

- 128 Brown
- 129 Black
- 130 Red
- 131 White / cream

## TYPES



SIMPLE



EVEN-PINNATE



ODD PINNATE



DIGITALELY  
COMPOUND



PALMATE

## MARGINS



DENTATE



CRENATE



ENTIRE



SERRATE



PALMATELY  
LOBED

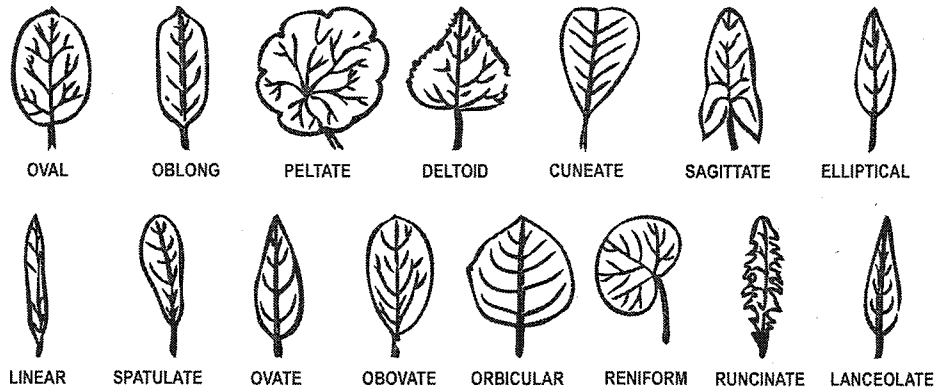


PINNATELY  
LOBED



UNDULATE

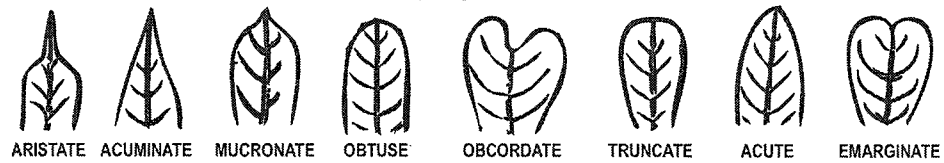
## SHAPES



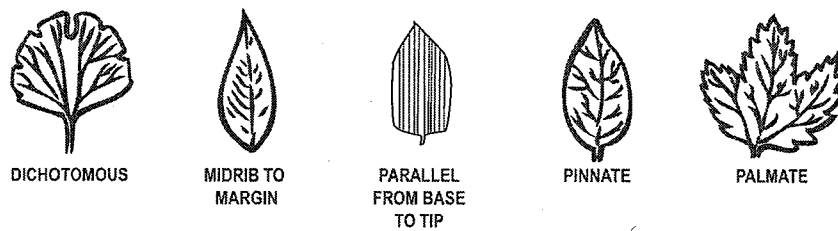
## BASES



## TIPS



## VENATION



## LEAF FORMS

## **2.2. WOOD IDENTIFICATION FEATURES**

### **2.2.1 PREPARING WOOD SAMPLE FOR IDENTIFICATION**

A wood sample to be identified should be prepared and examined according to the following procedure:

1. Make a clean cut on the cross section of the heartwood using a very sharp knife or a razor blade. Hard and high density wood may be softened to ease cutting by soaking a 2-cm cube of the wood in 1:1 glycerin water solution for 2 to 5 days before boiling to soften it. Alternatively, this first step can be done by sanding the samples with progressive sandpapers steps up to grain 600 or higher. The dust can be blown away with air blower and the remaining removed with scotch tape.
2. Examine the cut or sanded surface clearly with a hand lens at 10 x magnification or with your naked eye. The lens should be held close to the eye with both eyes open, and the clearly cut surface of the wood is brought into focus. Examination of features on the cross section is often enhanced by wetting the clearly cut surface and with adequate illumination from light source.
3. Split along the radial and tangential surfaces or make clean cut of the surface with sharp knife or razor blade.
4. Examine the radial surface for marked differences in colour between rays and the background, the tangential surface for ripple marks from storied structures, and for presence of gum canals, latex or tanniferous traces.

## **2.3 EXPLANATORY NOTES FOR MACROSCOPIC WOOD IDENTIFICATION FEATURES**

The 92 macroscopic diagnostic features used in the book are based on structures of the main tissue types, namely vessels or pores, axial parenchyma, ray parenchyma, fibers and other miscellaneous structures. Brunner *et al.* (1994) used a transparent scale grid and a hand lens to quantitatively measure and describe these identification features for timbers of Guyana. Their methods, explanatory notes and classifications have mostly been adopted except in few cases where they have been modified.

### **2.3.1 Vessels**

The vessels or pores are seen as round or oval holes on the cross section. Their diagnostic features include their visibility to the naked eye, size, arrangement, distribution and proportion of solitary to multiple pores, and types of inclusions found in them (Code 1-28 and 81-83).

#### **2.3.1.1 Visibility**

**Goal:** to judge the differentiation of vessels from the surrounding tissue with the naked eye.

**Degree of difficulty:** difficult

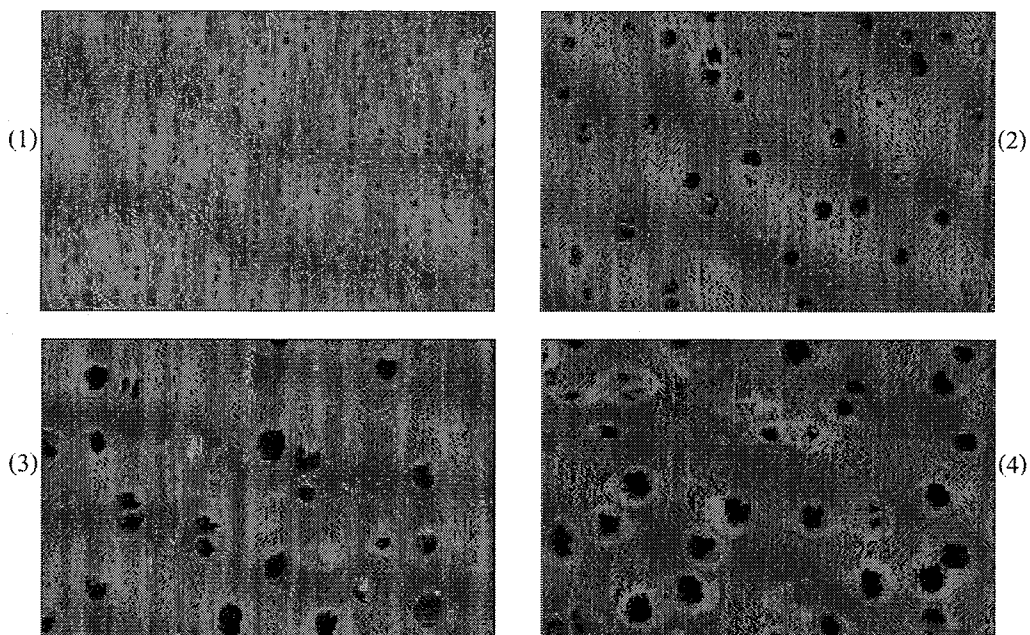
**Tools:** none

**Surface to be examined:** cross section

**Method:** Examine the sample closely. Bright daylight or an adequate source of artificial light is indispensable. Glasses or contact lenses should be worn, if appropriate. The sample can be moved slightly backwards and forwards. The contours of the vessels being examined and their outline must stand out clearly to be classified as “distinct”.

#### Classifications

- 1 distinct to naked eye
- 2 indistinct to naked eye



#### 2.3.1.2 Diameter

**Goal:** to determine the dimension of the largest vessels in mm

**Degree of difficulty:** easy

**Tools:** transparent scale grid, hand lens, illustrations

**Surface to be examined:** cross section

**Measuring method:** Measure the tangential diameter by holding the transparent scale grid parallel to the rays. The five largest vessels (solitary vessels or individual vessels in clusters and multiples) are measured. The average value represents the most frequently occurring diameter class which determines the classification.

#### Classifications

- 3  $\leq 0.1$  mm; small (Fig. 1, shown in bracket against illustration)
- 4  $> 0.1-0.2$  mm; medium (Fig. 2)
- 5  $> 0.2-0.3$  mm; large (Fig. 3)
- 6  $> 0.3$  mm; very large (Fig. 4)

### 2.3.1.3 Arrangement and pattern

**Goal:** to judge the arrangement and pattern of the vessels

**Degree of difficulty:** easy

**Tools:** hand lens, illustrations

**Surface to be examined:** cross section

**Method:** Compare the arrangement of the vessels with the illustrations shown in Fig 5 to 12. The dominant type is classified. More than one classification is possible.

#### Classifications

- 7 exclusively solitary (Fig. 5 )
- 8 solitary and radial multiples or clusters
- 9 exclusively radial multiples or clusters (Fig. 6)
- 10 radial multiples with individual vessels of the same diameter or size (Fig. 7)
- 11 radial multiples with individual vessels of different diameters or sizes (Fig. 8)
- 12 radial multiples of 2-4 vessels (Fig. 9)
- 13 radial multiples of >4 vessels
- 14 clusters of 2-4 vessels
- 15 clusters of >4 vessels (Fig. 10, in late wood, upper part of illustration)
- 16 tangential pattern (Fig. 11)
- 17 diagonal pattern (Fig. 12)

### 2.3.1.4 Vessel and Vessel Group Density

**Goal:** to ascertain the average number of vessels, radial multiples or clusters per  $\text{mm}^2$

**Degree of difficulty:** easy

**Tools:** transparent scale grid, hand lens, illustrations

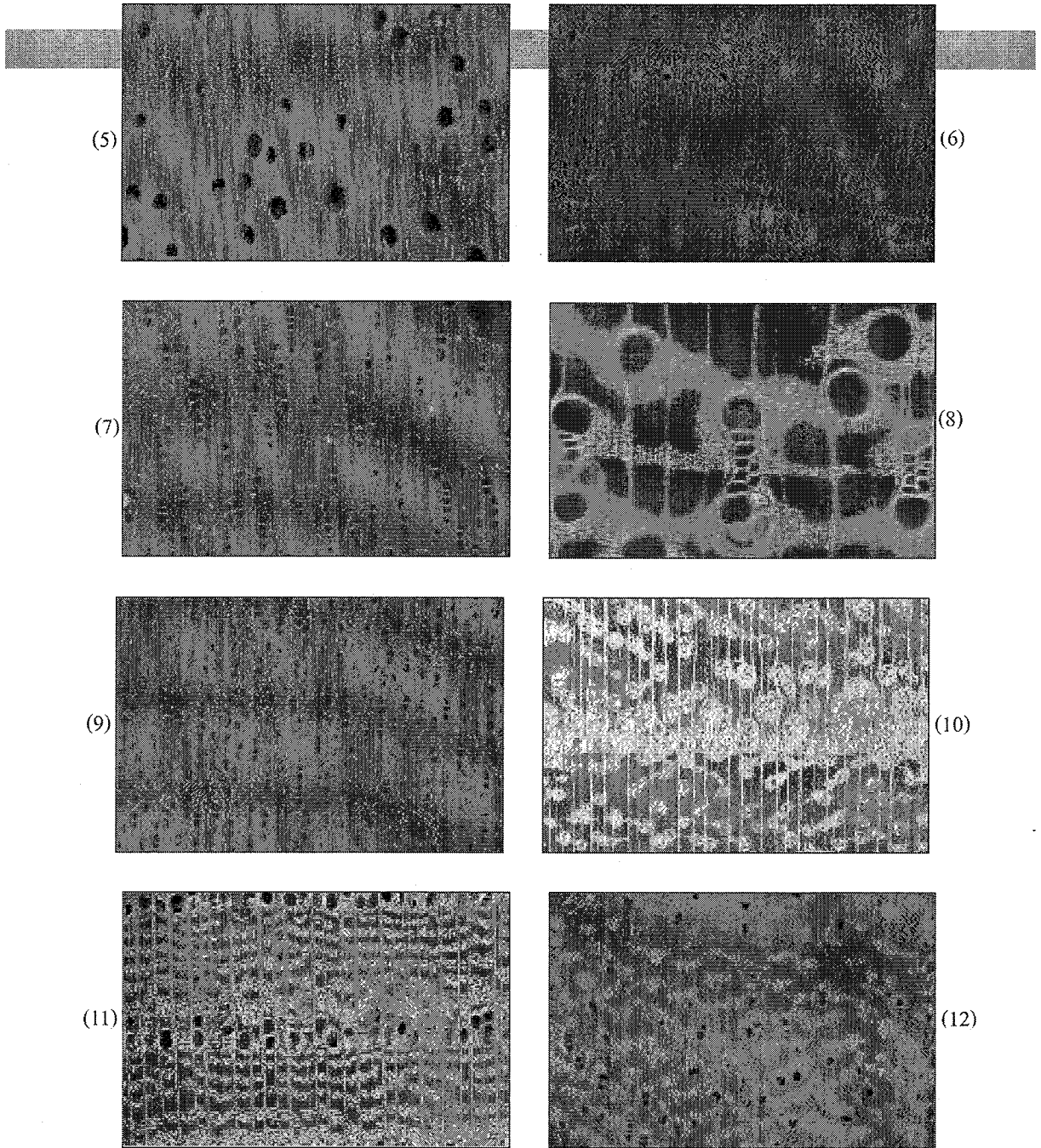
**Surface to be examined:** cross section

**Measuring method:** Count the number of vessels in an area of either 3, 5 or 10  $\text{mm}^2$ . The area chosen should have at least 20 counts. The vessels within the chosen area are counted at five different points. Vessels which are partially within the left-hand or the top boundaries are counted, those partially within the right-hand or bottom boundaries are ignored. To facilitate the counting, radial multiples or clusters are counted as one vessel. The average of five counts corresponds to an area of 1  $\text{mm}^2$ . Fractions should be rounded up to the next whole number and then classified.

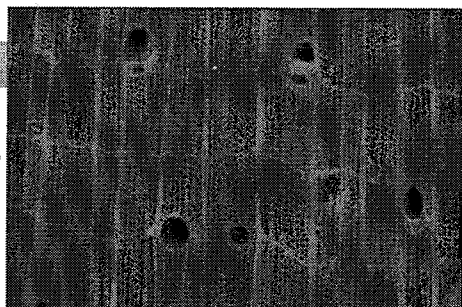
**Note:** To expedite the identification process, it is advisable to count the multiples at the same time ( see proportion of solitary vessels) and to calculate the percentage from the data obtained in both cases.

#### Classifications

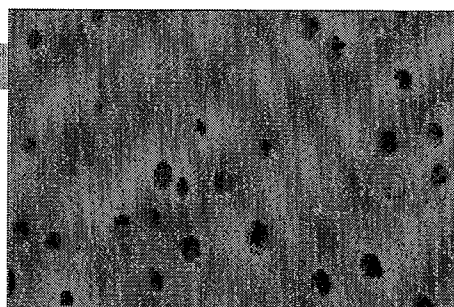
- 18  $<6/\text{mm}^2$ ; low (Fig. 13)
- 19  $6-20/\text{mm}^2$ ; moderate (Fig. 14)
- 20  $21-40/\text{mm}^2$ ; fairly high (Fig. 15)
- 21  $>40/\text{mm}^2$ ; high (Fig. 16)



(13)



(14)



### 2.3.1.5 Proportion of solitary vessels

**Goal:** to determine the ratio between isolated vessels and the total number of vessels in %

**Degree of difficulty:** easy

**Tools:** transparent scale grid, hand lens, illustrations

**Surface to be examined:** cross section

**Measuring method:** The number of vessels in an area of either 3, 5 or 10 mm<sup>2</sup> is counted. The area chosen should have at least 20 vessels or vessel groups. The vessels within the chosen area are counted at five different points. Vessels which are partially within the left-hand or the top boundaries are counted, those partially within the right-hand or bottom boundaries are ignored. The ratio of solitary vessels to the total number of vessels is calculated (%).

The average of five counts is calculated and classified as follows:

#### Classifications

- 22 <33 % solitary vessels; low (Fig. 17)
- 23 33- 66 % solitary vessels; medium
- 24 67-90 % solitary vessels; high
- 25 >90 % solitary vessels; very high, exclusively solitary (Fig. 18)

### 2.3.1.6 Inclusions

**Goal:** to judge the content's of the vessels

**Degree of difficulty:** difficult

**Tools:** hand lens, illustrations

**Surface to be examined:** cross, tangential and radial section

**Method:** Compare the contents of the vessels with the illustrations in Fig. 19 and 20.

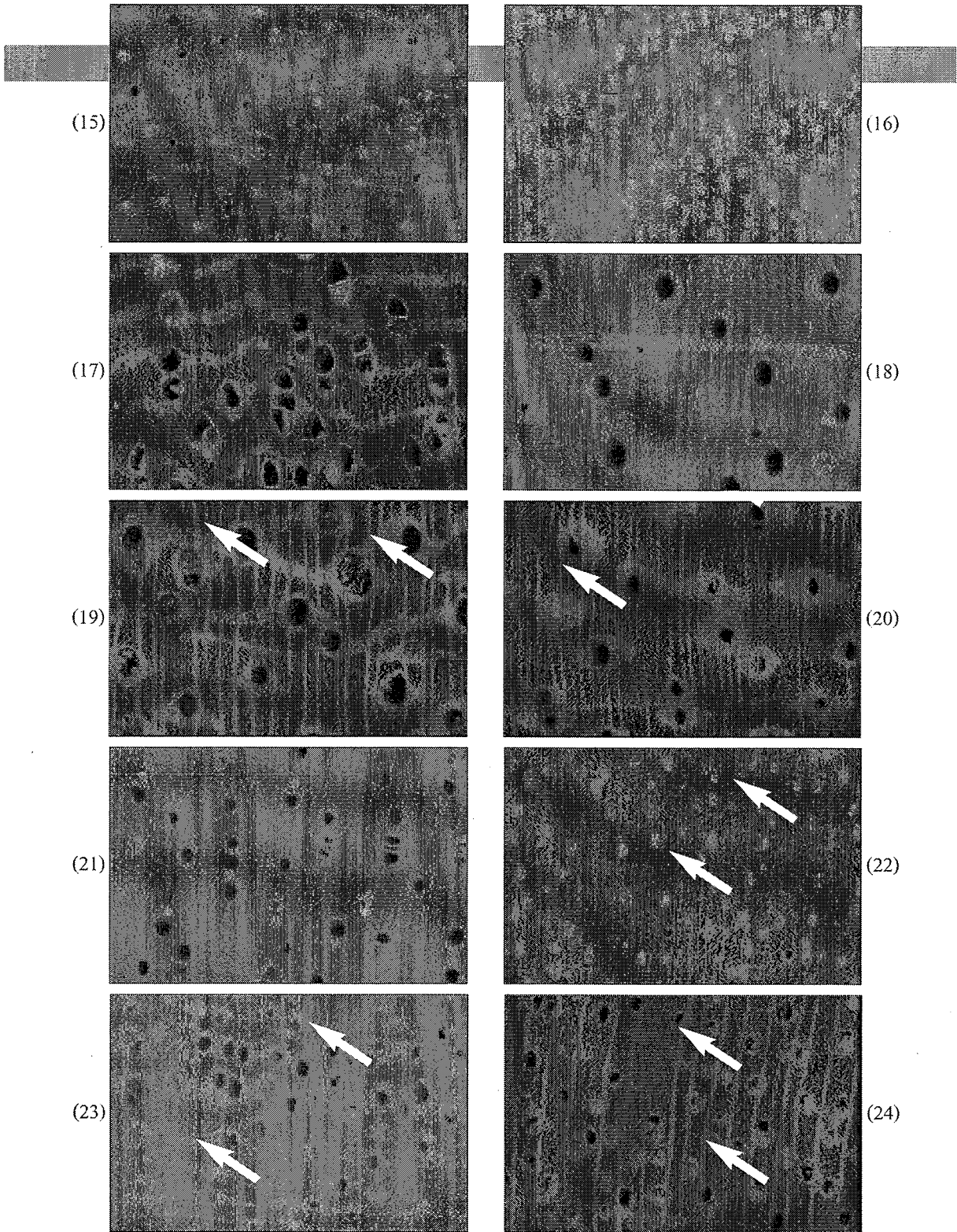
**Explanations:** Tyloses are seen as light, often transparent formation with an appearance of a cracked window-pane or soap bubble. It is only found in heartwood and in non-conducting areas of sapwood.

**Other inclusions:** can be either light or dark. (Warning: in all sections, inclusions and tyloses look very similar and are easy to confuse. Also mode of preparing sample by sanding or fine sawing may leave sawdust in the pores which may look like inclusions). More than one classification is possible.

#### Classifications

- 26 no vessel content
- 27 tyloses present (Fig. 19)
- 28 gum and other organic inclusions present (Fig. 20)







### 2.3.2 Axial parenchyma

Cells of tissue, seen in the cross section under microscope as isodiametric or brick-shaped elements in the cross section, forming light coloured patterns for which diagnostic features include visibility, arrangement and types (Code 29-56). Definitions for various arrangement of parenchyma cells are shown in the Glossary.

#### 2.3.2.1 Visibility

**Goal:** to judge the demarcation of parenchyma from the surrounding tissue with naked eye

**Degree of difficulty:** difficult

**Tools:** none

**Surface to be examined:** cross section

**Method:** Examine the sample closely. Bright day light or an adequate source of artificial light is indispensable. Glasses or contact lenses should be worn, if appropriate. The sample can be moved slightly backwards and forwards. The contours of the parenchyma being examined must stand out clearly to be classified as "distinct".

#### Classifications

- 29 distinct to naked eye
- 30 indistinct to naked eye

#### 2.3.2.2 Arrangement

**Goal:** to judge qualitatively the arrangement of parenchyma tissues.

**Degree of difficulty:** easy

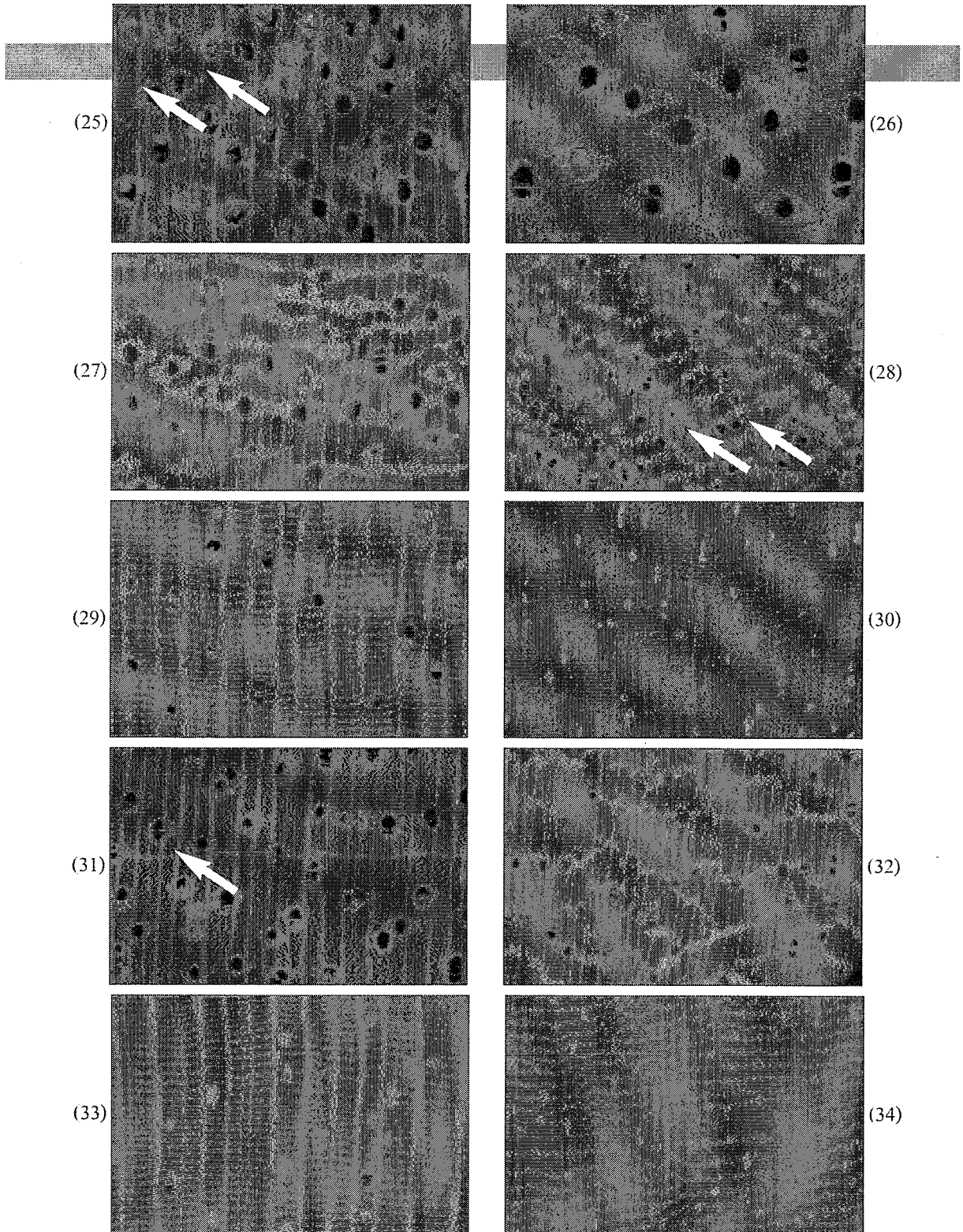
**Tools:** hand lens, illustrations

**Surface to be examined:** cross section

**Method:** Compare the arrangement of the parenchyma with the illustrations shown in Fig. 21-33. The dominant type is classified. More than one classification is possible.

#### Classifications

- 31 absent / not visible with lens (Fig. 21)
- 32 apotracheal parenchyma
- 33 diffuse (Fig. 22)
- 34 diffuse-in-aggregate (Fig. 23)
- 35 paratracheal parenchyma
- 36 scanty (Fig. 24)
- 37 vasicentric (Fig. 25)
- 38 aliform (Fig. 26)
- 39 confluent (Fig. 27)
- 40 unilateral (Fig. 28)
- 41 banded parenchyma
- 42 scalariform (Fig. 29)
- 43 reticulate (Fig. 30)
- 44 marginal (Fig. 31)
- 45 not as above
- 46 wavy-banded (Fig. 32)
- 47 straight-banded (Fig. 33)



### 2.3.2.3 Width of parenchyma bands

**Goal:** to ascertain the average width of the parenchyma bands in mm

**Degree of difficulty:** easy

**Tools:** transparent scale grid, hand lens, illustrations

**Surface to be examined:** cross section

**Measuring method:** Measure the parenchyma band widths in the radial direction by using the transparent scale grid. Measurements are taken at five different points. The mean average width is the determinant.

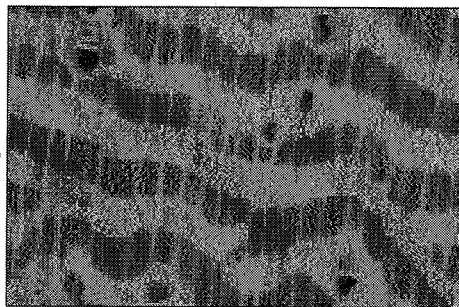
#### Classifications

48 <0.1 mm; very narrow (Fig.33)

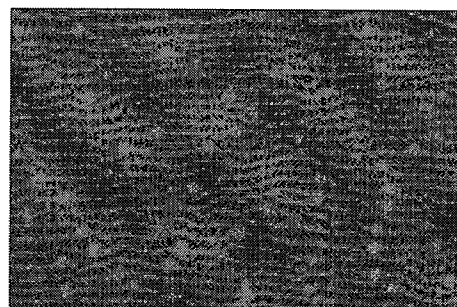
49 0.1-0.2 mm; narrow (Fig. 34)

50 > 0.2 mm; wide (Fig. 35)

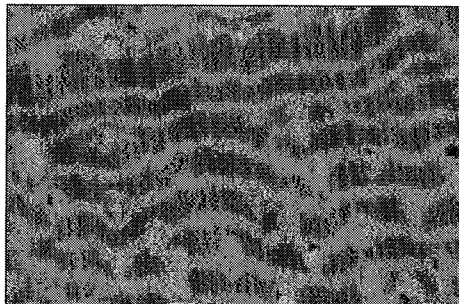
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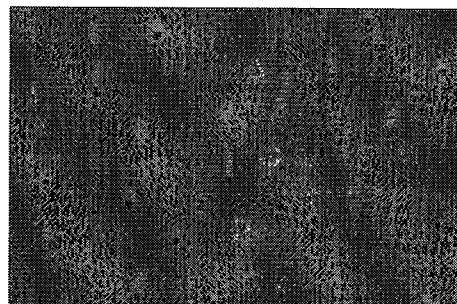
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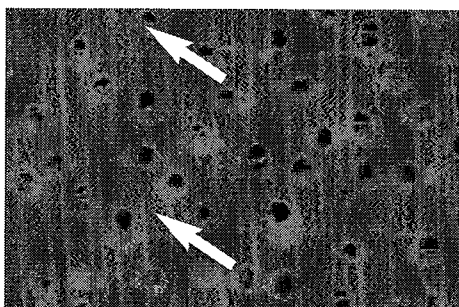
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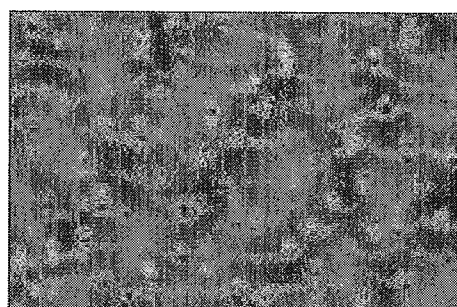
(38)

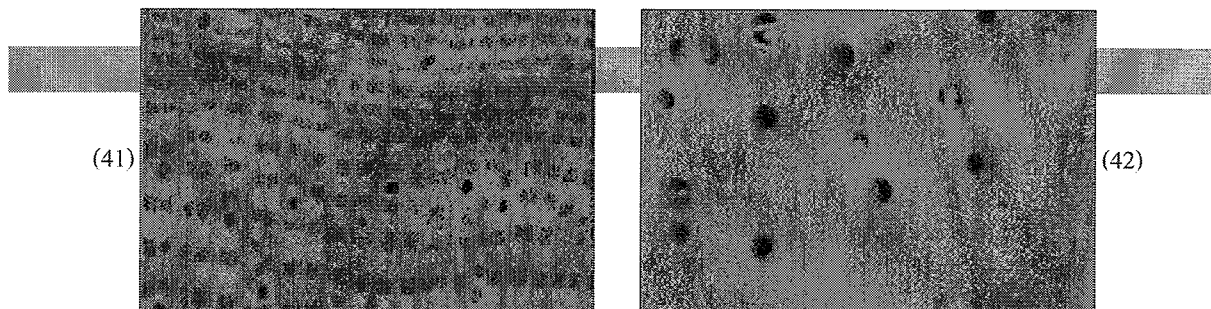


(39)



(40)





#### 2.3.2.4 Type of spacing between parenchyma bands

**Goal:** to ascertain type of spacing between parenchyma bands.

**Degree of difficulty:** easy

**Tools:** illustrations in Fig. 36 and 37

**Surface to be examined:** cross section

**Measuring method:** Compare spacing between parenchyma bands of wood species to Fig. 36 and 37 and classify whether spacing is regularly or irregularly spaced.

- 51 regularly spaced (Fig. 36) if distance between bands is more or less equal or constant
- 52 irregularly spaced (Fig. 37) if distance between bands remarkably changes from band to band

#### 2.3.2.5 Distance between parenchyma bands

**Goal:** to determine average spacing between the parenchyma bands in mm

**Degree of difficulty:** easy

**Tools:** transparent scale grid, hand lens, illustrations

**Surface to be examined:** cross section

**Measuring method:** Measure the spaces between the parenchyma bands by using the transparent scale grid. Measurements are taken at five different points. The calculated mean value of the space is considered.

**Classifications**

- 53  $\leq 0.5$  mm; narrow (Fig. 38)
- 54  $> 0.5$  mm; wide (Fig. 39)

#### 2.3.2.6 Width of bands compared to fibre tissue

**Goal:** to ascertain the ratio between the width of parenchyma bands and the fiber tissue

**Degree of difficulty:** easy

**Tools:** transparent scale grid, hand lens, illustrations

**Surface to be examined:** cross section

**Measuring method:** Measure the widths of parenchyma bands and fibre tissue with the transparent scale grid. Five ratios of band width are determined. The ratio occurring most frequently is the determinant one.

**Classifications**

- 55 smaller than fibre tissue bands (Fig. 40)
- 56 equal to or larger than fibre tissue bands (Fig. 41)

### 2.3.3 Ground tissue fibres

Ground tissue fibres form a dark or light-coloured ground mass, and their diagnostic features are related to their relative proportion to the other three cell types, namely vessels, axial and ray parenchyma (Code 57-60).

#### 2.3.3.1 Proportion

**Goal:** to ascertain the relative proportion of fibre tissue in a complete area to other cell types.

**Degree of difficulty:** usually easy

**Tools:** transparent scale grid, hand lens, illustrations

**Surface to be examined:** cross section

**Measuring method:** Use eyepiece grid with 22 intersection ( $10 \text{ mm}^2$ ) and orientate it over the cross section of a microtomed slide of wood species under microscope as shown in Fig. 43, (Only part of the grid with 8 intersections is shown in Fig. 43). The number of intersections that points to or cover fibre tissues divided by 22 expressed in percentage determines proportion of fibres. The average of five readings at different areas of the cross section gives a good representation. Alternatively, the percent proportion of vessels, rays and axial parenchyma can be estimated and ultimately fibre proportion calculated using the formula: % fibre proportion =  $100 - \% \text{ proportion of vessels, rays and axial parenchyma cells}$ .

#### Classifications

57 <20 %; very low (Fig. 42)

58 20-40 %; low

59 41-60 %; medium

60 >60 %; high (Fig. 43)

### 2.3.4 Rays

Rays, when visible, appear as parallel or near parallel lines of more or less uniform widths running almost at right angle to the growth rings. They have the following diagnostic features: visibility at cross and radial sections, dimensions and distribution and the possible presence of a storied structure (Code 61-80).

#### 2.3.4.1 Visibility

**Goal:** to judge the differentiation of rays from the surrounding tissue with the naked eye

**Degree of difficulty:** difficult

**Tools:** none

**Surface to be examined:** cross and radial sections

**Method:** Examine the sample closely. Bright daylight or an adequate source of artificial light is indispensable. Glasses or contact lenses should be worn, if appropriate. The wood sample should be moved slightly backwards and forwards. The contours of the rays being examined must stand out clearly to be classified as "visible".

#### Classifications

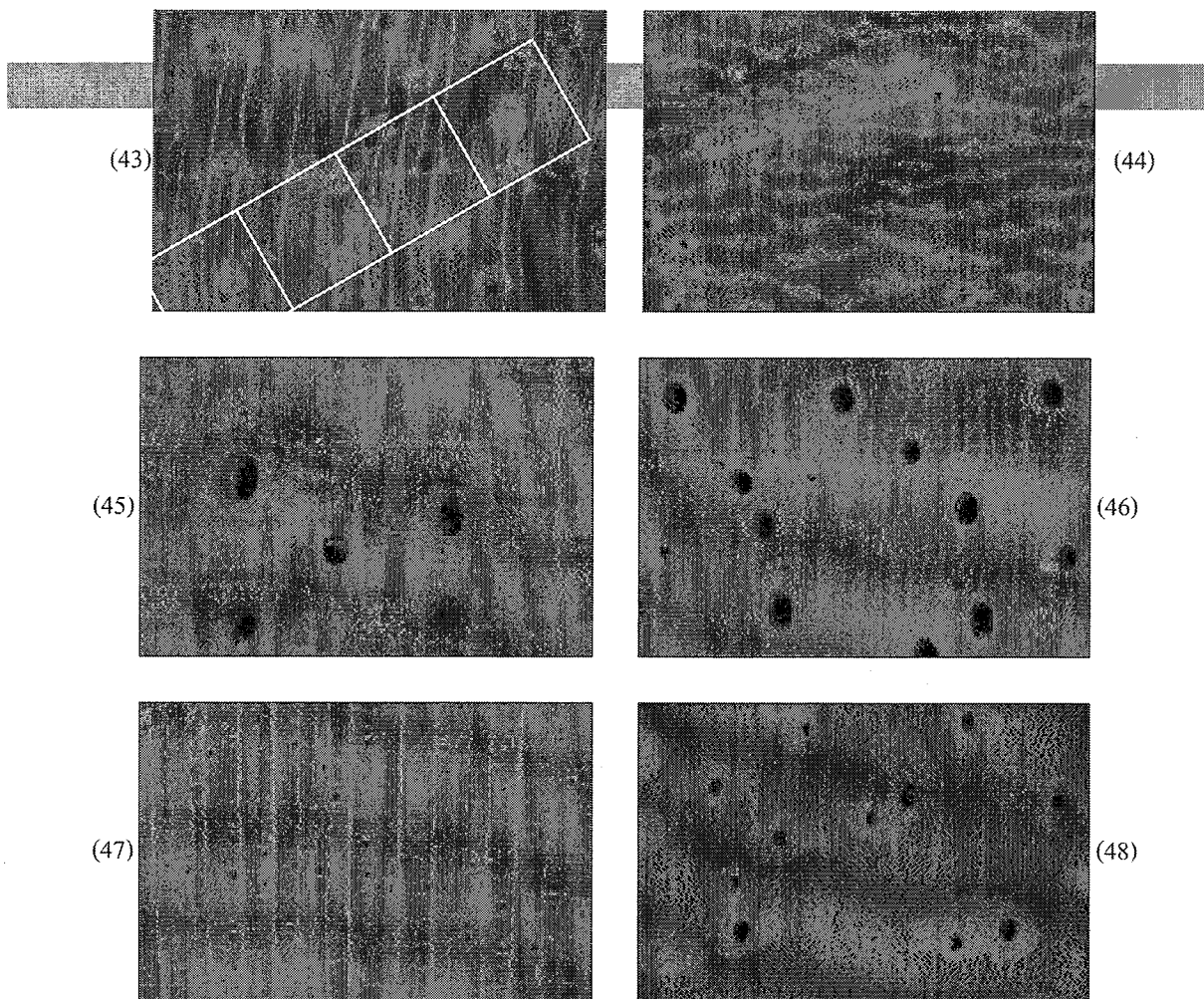
61 distinct to naked eye at cross section (Fig. 43, 45, 46, 47)

62 indistinct to naked eye at cross section (Fig. 44)

63 distinct to naked eye at radial section

64 indistinct to naked eye at radial section





#### 2.3.4.2 Width

**Goal:** to ascertain the maximum width of the rays in mm

**Degree of difficulty:** easy

**Tools:** transparent scale grid, hand lens, illustrations

**Surface to be examined:** cross section

**Method:** Measure the 5 widest rays. The mean width thickness determines the classification.

##### Classifications

65 <0.05 mm; very narrow almost indistinct to the naked eye (Fig. 44)

66 0.05-0.10 mm; narrow (Fig. 43)

67 >0.10 mm; wide (Fig. 45)

68 ray width more or less of equal sizes; uniform (Fig. 46)

69 ray width of two or more different sizes; variable (Fig. 47)

#### 2.3.4.3 Width compared to the vessels

**Goal:** to determine the ratio of ray width to the diameter of the vessels

**Degree of difficulty:** not difficult

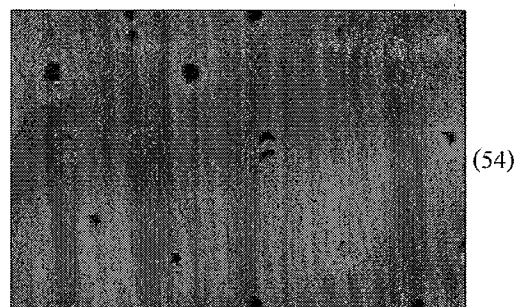
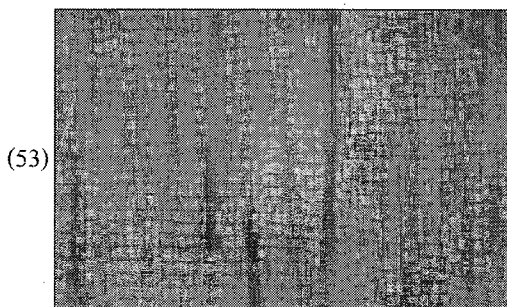
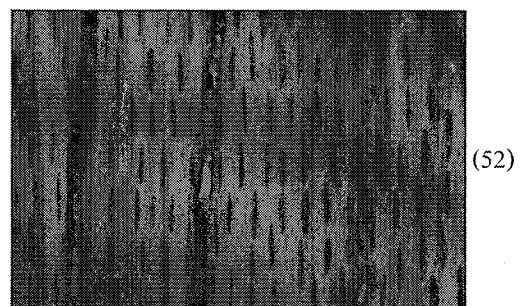
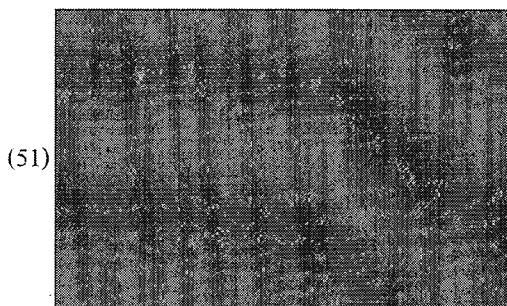
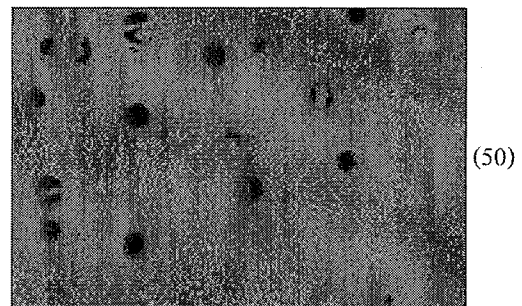
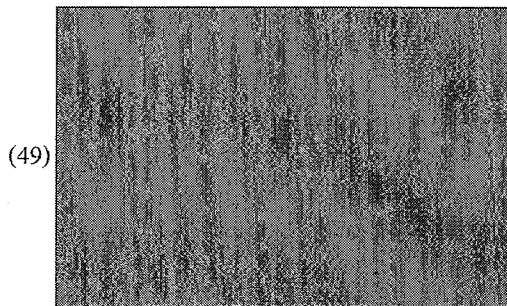
**Tools:** transparent scale grid, hand lens, illustrations

**Surface to be examined:** cross section

**Measuring method:** Evaluate authoritatively the width of rays in relation to vessel diameter. The 5 widest vessels and the widest rays are relevant to the evaluation. The most frequently occurring classification is the relevant one.

**Classifications**

- 70 less than  $\frac{1}{4}$  of vessel diameter (Fig. 48)
- 71 between  $\frac{1}{4}$  and  $\frac{1}{2}$  of vessel diameter (Fig. 46)
- 72 between  $\frac{1}{2}$  and full vessel diameter
- 73 equal to or larger than vessel diameter (Fig. 49)



#### 2.3.4.4 Frequency

**Goal:** to ascertain the number of rays per distance of 5 mm in the tangential direction.

**Degree of difficulty:** easy

**Tools:** transparent scale grid, hand lens, illustrations

**Surface to be examined:** cross section

**Measuring method:** Hold the transparent scale grid at right angle to the rays at (tangential) section. For each measurement, all rays that lie within a distance of 5 mm are counted. The calculated average number is relevant for the classification.

##### Classifications

74 <15/5 mm; low (Fig. 50)

75 15-30/5 mm; moderate (Fig. 50)

76 31-50/5 mm; high (Fig. 47)

77 >50/5 mm; very high (Fig. 51)

#### 2.3.5 Other miscellaneous macroscopic features

Other miscellaneous features include storied structures, porosity, the presence of growth rings and their demarcation (Code 78-89). The section also includes the presence of gum canals, latex or tanniferous traces, included phloem or mucilage cells (Code 90-92).

##### 2.3.5.1 Storied structures

**Goal:** to recognise a repetitive vertical layering of the rays, the parenchyma or the fibres

**Degree of difficulty:** difficult

**Tools:** hand lens, illustrations

**Surface to be examined:** tangential section

**Method:** Compare the structure of the sample with the illustrations in Fig. 52 and 53. The surface being examined should be moved gently backwards and forwards so that the reflection of the light changes. More than one classification is possible.

##### Classifications

78 no storied structures

79 rays storied (Fig. 52)

80 axial parenchyma / fibres storied (Fig. 53)

##### 2.3.5.2 Porosity

**Goal:** to recognise different porous structures (diffuse, semi-ring and ring porous) of wood

**Degree of difficulty:** easy

**Tools:** illustrations

**Surface to be examined:** cross section

**Method:** Compare vessel width at the beginning of growth ring to the vessels in the entire ring and note difference across the entire ring as in Fig. 54, 55 and 56.

##### Classifications

81 diffuse porous: all vessels within a growth ring are about of the same diameter (Fig. 54)

82 semi-ring porous: early wood vessels are slightly larger than late wood vessels (Fig. 55)

83 ring porous: early wood vessels are much larger than late wood vessels (Fig. 56)



### 2.3.5.3 Demarcation of growth ring boundaries

**Goal:** to recognise concentric layer of tissue types (particularly of vessels, but also of parenchyma and fibre tissue)

**Degree of difficulty:** difficult

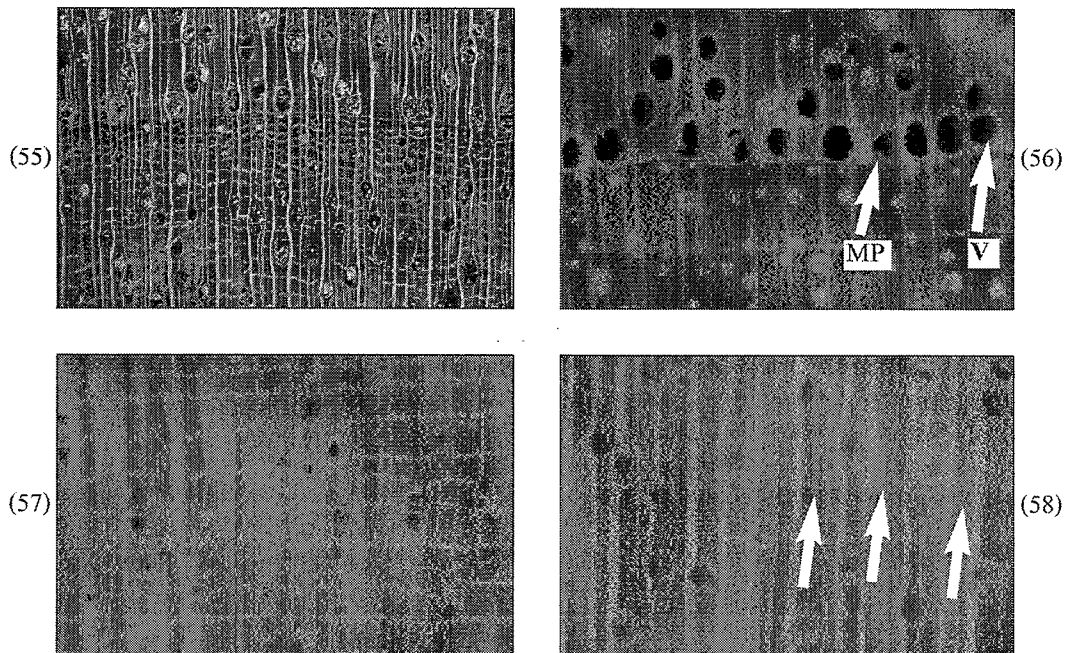
**Tools:** hand lens, illustrations

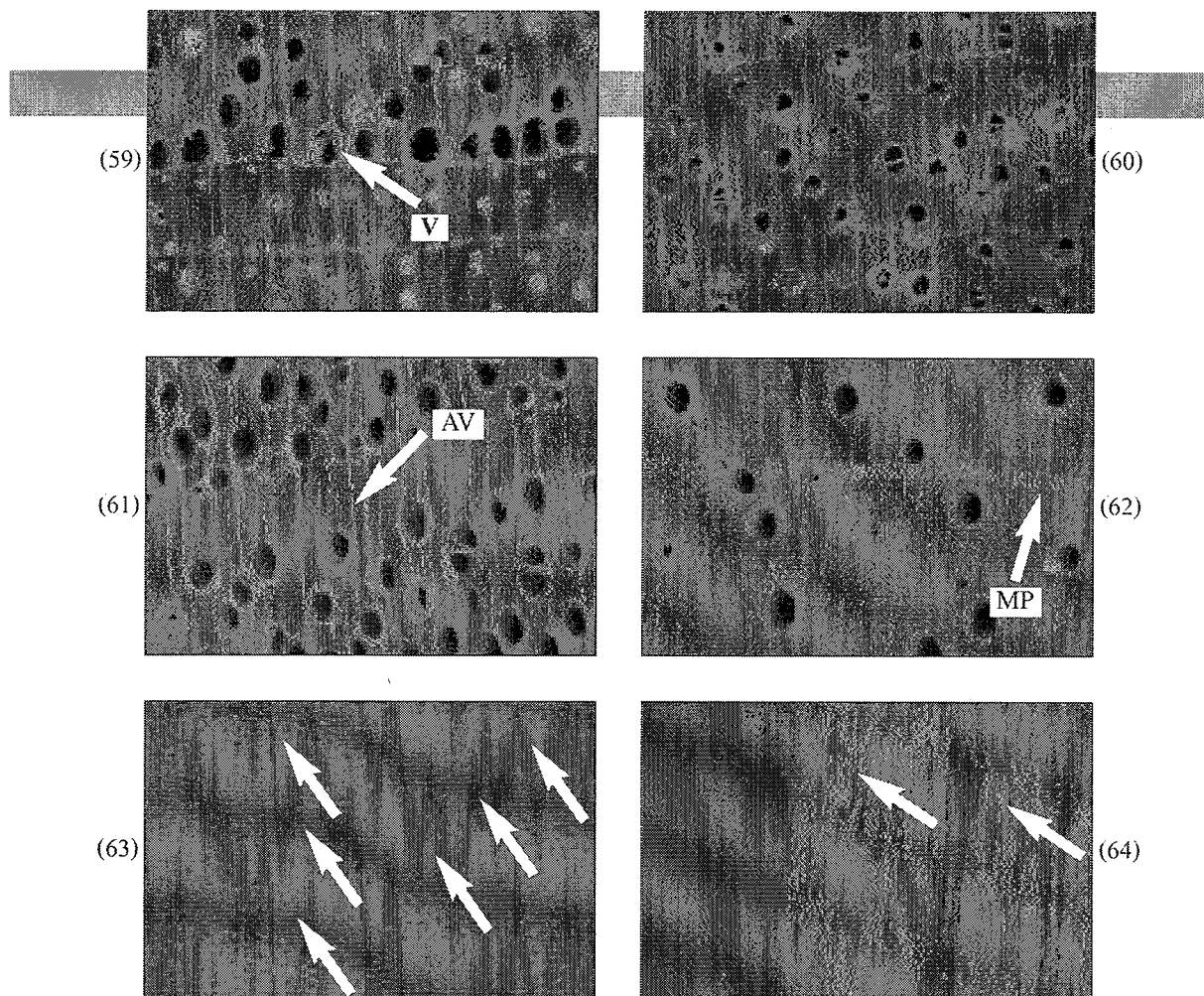
**Surface to be examined:** cross section

**Method:** Compare the structure of the sample with those shown. Note the type of growth ring demarcations: dark ground fibre, differences in vessel diameter, marginal parenchyma and absence of pores.

#### Classifications

- 84 growth ring boundaries indistinct or absent (Fig. 57)
- 85 growth ring boundaries distinct (Fig. 55-56, 58-62)
- 86 demarcated by dark ground fibre tissue (Fig. 58, 62, arrowed)
- 87 demarcated by differences in vessel diameter (Fig. 56, 59, arrowed as V)
- 88 demarcated by marginal (terminal or initial) parenchyma (Fig. 56 and 62 arrowed as MP)
- 89 demarcated by absence of vessels (Fig. 61, arrowed as AV)





#### 2.3.5.4 Canals, included phloem and oil or mucilage cells

**Goal:** to recognise resin or latex-conducting canals, phloem layers included in wood, and to ascertain the presence of secretory cells at the margins of the rays

**Degree of difficulty:** difficult

**Tools:** hand lens, illustrations

**Surface to be examined:** cross section (canals, included phloem), tangential section (mucilage cells)

**Method:** Compare the structure of the sample with the illustrations in Fig. 62, 63 and 64.

##### Classifications

- 90 canals present (Fig. 62)
- 91 included phloem present (Fig. 63, arrowed)
- 92 oil or mucilage cells present (Fig. 64)

## **2.4 EXPLANATORY NOTES FOR PHYSICAL IDENTIFICATION FEATURES**

Physical features of wood like colour, odour and taste are generally less useful as diagnostic features because of their greater variation within a species or a tree. However, they are of use as a supplement to macroscopic and other features for positive identification. The selected diagnostic physical features including heartwood, colour, texture, lustre, odour, density and hardness are used in the handbook.

### **2.4.1 Heartwood colour**

Heartwood colour is mainly due to extractives in the wood and is variable between and within species. Growth conditions including site, soil type and silviculture treatment can modify wood colour. Within a species, the colour of wood is affected by its moisture content, age of the tree, wood specimen and the surface examined. Wet wood appears darker than dry wood, while juvenile wood appears paler than mature wood. Wood surface, when exposed to air, becomes darker. The longitudinal (tangential and radial) surface is normally the surface examined for definition of wood colour. Fungal decay and stain can also alter the original colour of wood to blue, black, green or brown streaks, depending on type or species of fungi. The colours of most species range from cream or white to mostly brown, red or shades of these colours. The nine diagnostic colour codes are listed from 93-101.

**Goal:** to determine colour of heartwood

**Degree of difficulty:** difficult

**Tools:** none

**Surface to be examined:** all sections

**Method:** Examine the freshly-cut surface. More than one classification is possible.

#### **Classifications**

- 93 no difference between heart- and sapwood
- 94 heartwood darker than sapwood
- 95 basically brown or shades of brown
- 96 basically copper-coloured or shades of copper
- 97 basically red or shades of red
- 98 basically yellow or shades of yellow
- 99 basically white to grey
- 100 with streaks
- 101 none of the above

More than one colour classification is possible for a species.

### **2.4.2 Texture**

Texture refers to structural characteristics of wood revealed by reaction to cutting tools which in turn is determined by size and proportional amounts of cells, especially the vessels, in the wood.

**Goal:** to assess the texture of wood

**Degree of difficulty:** easy

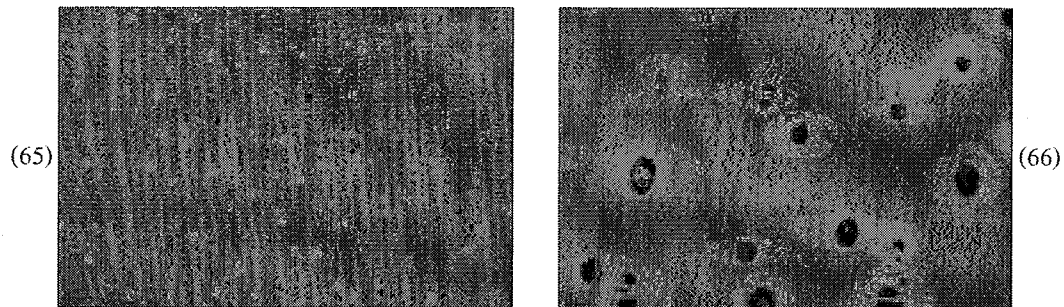
**Tools:** hand lens, transparent scale grid

**Surface to be examined:** cross section

**Method:** Same as for vessel diameter (Code 3-6, Fig. 1-4).

**Classifications**

- 102 diameter of vessels  $\leq 0.1$  mm; fine (Fig. 65)
- 103 diameter of vessels  $> 0.1-0.3$  mm; moderately coarse
- 104 diameter of vessels  $> 0.3$  mm and/or contrasted parenchyma coarse (Fig. 66)



**2.4.3 Lustre**

Lustre is the natural reflective property of wood as seen on radial surface. A dull wood will reflect very little light, while a lustrous wood will visibly reflect light if the sample is moved backwards and forwards under a powerful source of light.

**Goal:** to judge the lustre of the freshly split radial surface

**Degree of difficulty:** difficult

**Tools:** knife, chisel

**Surface to be examined:** radial section

**Method:** Split the sample along the radial direction. Move the freshly split sample backwards and forwards under a powerful source of light.

**Colour Classifications**

- 105 dull
- 106 lustrous

**2.4.4 Odour**

Odour is the smell exhibited by freshly cut heartwood. Old wood sample should be freshly cut, wetted and warmed slightly before it is smelled.

**Goal:** to ascertain possible odour

**Degree of difficulty:** easy

**Tools:** knife, chisel

**Surface to be examined:** whole sample

**Method:** First cut, and then breathe upon the sample. A distinct odour could be nutty, rancid, aromatic, resinous, mouldy, citric, sour, fragrant, foetid, etc.

**Classifications**

- 107 no distinct odour
- 108 distinct odour
- 109 aromatic or fragrant odour (pleasant smell)
- 110 foetid, rancid (unpleasant odour)

### 2.4.5 Density

Density of wood is the weight per unit volume at a given moisture content, usually at 15 % (air dried). It is one of the most important diagnostic physical features, particularly when two samples being compared have identical characteristics. Comparative density between two or more species of same dimensions is made by hefting them.

**Goal:** to assess approximate density of wood in  $\text{g/cm}^3$

**Degree of difficulty:** easy

**Tools:** a container with cold water, illustrations

**Surface to be examined:** whole sample

**Method:** Put the air dried sample, measuring about 5 x 5 x 5 cm on radial or tangential surface, into the water. The position of the sample after about 10 seconds is compared to the illustration (Fig. 67) with explanations below.

#### Classifications

- 111 floats in water ( $<0.25 \text{ g/cm}^3$ ); very low (A)
- 112 floats with 1/4 - 1/2 of wood surface in water ( $0.25\text{-}0.50 \text{ g/cm}^3$ ); low (B)
- 113 floats with 1/2 - 3/4 of wood surface in water ( $0.50\text{-}0.75 \text{ g/cm}^3$ ); medium (C)
- 114 floats almost fully in water ( $0.75\text{-}1.00 \text{ g/cm}^3$ ); high (D)
- 115 sinks instantly in water ( $>1.00 \text{ g/cm}^3$ ); very high (E)

### 2.4.6 Hardness

Hardness of wood at a specified moisture content can be roughly determined by applying pressure with the thumbnail on its longitudinal surface.

**Goal:** to determine hardness of wood

**Degree of difficulty:** easy

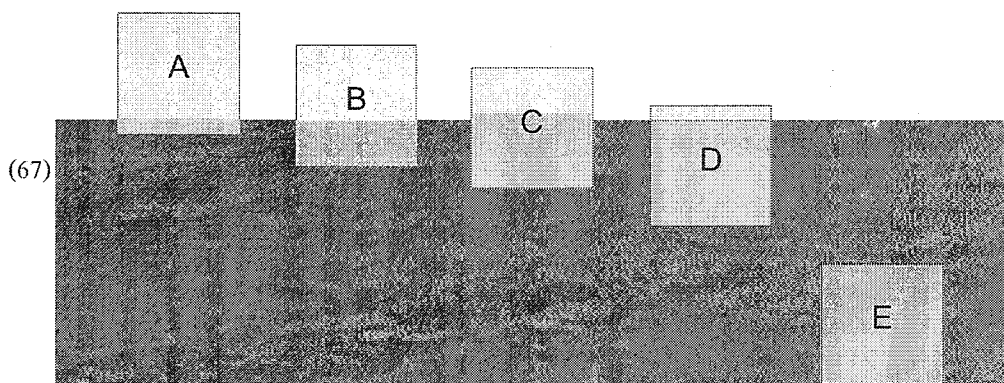
**Tools:** none

**Surface to be examined:** radial or tangential section

**Method:** Use the thumbnail to make a longitudinal indentation on surface of air-dried wood.

#### Classifications

- 116 surface is readily indented; soft
- 117 small indentation on surface; fairly hard
- 118 surface is not indented; hard



## 2.5 SPLINTER BURNING TEST

A splinter of match stick size of the dry heartwood will normally burn in still air from a flame source. The splinter burns in flame and may extinguish after a few seconds or after prolonged seconds, which depends on the species. When the flame extinguishes, it forms various colours of charcoal as residue, or it glows slowly, forming various colours of ash when the glowing stops. Some wood species "spark" or "crackle" while in flame. For others, coloured oil exudates may come out.

**Goal:** to observe burning of a splinter and its residues

**Degree of difficulty:** fairly easy

**Tools:** knife or razor blade, source of flame or candlelight, glass plate

**Surface to be examined:** whole sample

**Method:** Cut a match stick size from the dry wood of a species and hold it in a flame until it just starts to burn. Take it out and allow it to burn in still air over a glass plate to collect the ashes and or charcoal formed. Observe any spark, crackle, or exudates while burning and the colour of ash and charcoal formed as in Code 119-125.

### Classifications

- 119 splinter burns to charcoal
- 120 splinter burns to full bright-white ash
- 121 splinter burns to full yellow-brown ash
- 122 splinter burns to full ash different from above
- 123 splinter burns to partial ash with gritty feeling
- 124 splinter burns to produce crackle or bright sparks
- 125 splinter burns to exude brown / red liquid

## 2.6 LIST OF WOOD IDENTIFICATION FEATURES

(\* denotes key identification feature)

### Macroscopic Anatomical Features

#### Vessel visibility

- 1 Distinct to the naked eye
- \* 2 Indistinct to the naked eye

#### Vessel diameter (mm)

- 3 Small:  $\leq 0.1$
- 4 Medium: 0.1-0.2
- 5 Large: 0.2-0.3
- 6 Very large: Over 0.3

#### Vessel arrangement

- \* 7 Exclusively solitary
- 8 Solitary and radial multiples or clusters
- \* 9 Exclusively radial multiples or clusters
- 10 Radial multiples with individual vessels of the same diameter or size
- 11 Radial multiples with individual vessels of different diameters or sizes
- 12 Radial multiples of 2 to 4 vessels
- \* 13 Radial multiples of more than 4 vessels

- \*14 Clusters of 2 to 4 vessels
- 15 Clusters of more than 4 vessels
- \*16 Tangential pattern
- \*17 Diagonal pattern

**Vessel and vessel group density (per mm<sup>2</sup>)**

- 18 Low: Less than 6 vessels
- 19 Moderate: 6-20 vessels
- 20 Fairly high: 21-40 vessels
- 21 High: Above 40 vessels

**Proportion of solitary vessels (%)**

- 22 Low: Under 33
- 23 Medium: 33-66
- 24 High: 67-90
- 25 Very high: Over 90

**Vessel content**

- 26 No vessel content
- \*27 Tyloses present
- 28 Gum and other inclusions present

**Axial parenchyma visibility (at transverse section)**

- \*29 Distinct to the naked eye
- \*30 Indistinct to the naked eye

**Types of Axial parenchyma pattern**

- \*31 Absent or not visible with hand lens
- 32 Apotracheal
- 33 Apotracheal diffuse
- 34 Apotracheal diffuse-in-aggregate
- 35 Paratracheal
- 36 Scanty paratracheal
- 37 Vasicentric paratracheal
- 38 Aliform paratracheal
- 39 Confluent
- 40 Unilateral
- 41 Banded
- 42 Scalariform
- 43 Reticulate
- 44 Marginal
- 45 Not as above
- \*46 Wavy-band
- 47 Straight-band

**Width of banded parenchyma (mm)**

- 48 Very Narrow: Width of parenchyma band less than 0.1
- 49 Narrow: Width of parenchyma band 0.1 to 0.2
- 50 Wide: Width of parenchyma band over 0.2

**Type of spacing between parenchyma bands**

- 51 Regularly spaced
- 52 Irregularly spaced

**Distance between parenchyma bands (mm)**

- 53 Narrow: Less than 0.5
- 54 Wide: More than 0.5

**Width of parenchyma bands compared to fibre tissue bands**

- 55 Smaller than fibre tissue bands
- \*56 Equal to or larger than fibre tissue bands

**Proportion of fibre tissue (%)**

- 57 Very low: Below 20
- 58 Low: 21-40
- 59 Medium: 41-60
- 60 Very high: Above 60

**Ray visibility (at transverse section)**

- 61 Distinct to the naked eye
- \*62 Indistinct to naked eye

**Ray visibility (on radial section)**

- 63 Distinct to naked eye
- 64 Indistinct to naked eye

**Width of rays**

- \*65 Very narrow: Ray width less than 0.05 mm
- 66 Narrow: Ray width between 0.05 and 0.1 mm
- \*67 Wide: Ray width more than 0.1 mm
- 68 Uniform: Ray width more or less of equal sizes
- 69 Variable: Ray width of two or more different sizes

**Ray width compared to vessels**

- 70 Ray width less than  $\frac{1}{4}$  of vessel diameter
- 71 Ray width between  $\frac{1}{4}$  and  $\frac{1}{2}$  of vessel diameter
- 72 Ray width between  $\frac{1}{2}$  and full vessel diameter
- \*73 Ray width equal to or larger than vessel diameter

**Ray frequency (counts per mm in transverse section)**

- 74 Low: Less than 15
- 75 Moderate: Between 15 and 30
- 76 High: Between 30 and 50
- 77 Very high: Above 50

**Storied structure**

- 78 No storied structure
- \*79 Rays storied
- \*80 Axial parenchyma and or fibres storied



### **Porosity**

- 81 Diffuse porous
- \*82 Semi-ring porous
- \*83 Ring porous

### **Visibility of growth rings**

- 84 Growth ring boundaries indistinct or absent
- \*85 Growth ring boundaries distinct

### **Demarcation of growth ring boundaries**

- 86 Demarcated by dark ground fibre tissues
- 87 Demarcated by differences in vessel diameter
- 88 Demarcated by marginal (terminal or initial) parenchyma
- 89 Demarcated by absence of vessels

### **Other anatomical features**

- \*90 Canals present
- \*91 Included phloem present
- \*92 Oil mucilage cells present

## **Physical Identification Features**

### **Heartwood colour**

- 93 No difference between heartwood and sapwood
- 94 Heartwood darker than sapwood
- 95 Heartwood basically brown or shades of brown
- 96 Heartwood basically copper-coloured or shades of copper
- 97 Heartwood basically red or shades of red
- 98 Heartwood basically yellow or shades of yellow
- 99 Heartwood basically white to grey
- 100 Heartwood with streaks
- 101 Heartwood none of above colours

### **Texture**

- 102 Fine: diameter of vessels less than 0.1 mm
- 103 Moderately coarse: diameter of vessels between 0.1 and 0.3 mm
- 104 Coarse: diameter of vessels more than 0.3 mm

### **Lustre**

- 105 Dull
- 106 Lustrous

### **Odour**

- 107 No distinct odour
- 108 Distinct odour
- 109 Aromatic or fragrant odour
- 110 Foetid or unpleasant odour



### **Density (kg m<sup>-3</sup>)**

- 111 Very low: Up to 399; float with no more than ¼ of sample surface covered with water
- 112 Low: 400-599; floats about ½ to ¾ surface covered
- 113 Medium: 600-799; floats about ½ to ¾ surface covered
- 114 High: 800-1000; floats but fully covered and just under the surface of water
- 115 Very high: Above 1000; sinks instantly in water

### **Hardness**

- 116 Soft: surface is readily indented
- 117 Fairly soft: small indentation on surface
- 118 Hard: surface is not indented

### **Splinter burning test**

- 119 Splinter burns to charcoal
- 120 Splinter burns to full bright-white ash
- \*121 Splinter burns to full yellow-brown ash
- 122 Splinter burns to full ash different from above
- 123 Splinter burns to partial ash with gritty feeling
- 124 Splinter burns to produce crackle or bright sparks
- 125 Splinter burns to exude brown-red liquid

## CHAPTER 3: DATA PRESENTATION

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### 3.1 SELECTION OF SPECIES

The primary objective of the handbook was to examine and compile tree and wood identification features of hitherto commercially unknown or less popular timber species likely to form a major part of future wood supply in tropical Africa. Consequently, about 74 out of the 100 selected species were either LUS or LKS. Twenty six "premium" and "commercial" species selected were those that had dominated the export market for the last 30 years or more. Most botanical and wood samples were collected from standing trees in the arboretum or research plots of the Forestry Research Institute of Ghana (FORIG), and were supplemented by herbarium and xylarium samples from FORIG and Ghana National Herbarium at the University of Ghana, Legon-Accra, Ghana.

Several factors including the following were used in selecting the 74 LUS and LKS:

- A relatively good tree form with clear cylindrical bole and a minimum girth of 1.60 m or a diameter of 50 cm;
- Adequate growing stock in the forests of Ghana to sustain prolonged local use and export trade;
- Occurrence of a species in at least two of the three tropical regions of West, Central and East Africa;
- Adequate technological properties, evidence of its natural durability or local use in one or more countries in tropical Africa;
- Occurrence in a timber-deprived area like the Savanna woodland; and
- A demonstrated ethnobotanical or traditional use.

For each species, data were compiled on nomenclature, geographical distribution in tropical Africa, vegetational type and status in Ghana, tree and wood identification features, ecology and silviculture, ethnobotany and wood uses. These areas are further elaborated below.

### 3.2 NOMENCLATURE

In conformity with recent publications on timbers of Ghana, the basic nomenclature of scientific and family names follows that of Hall & Swaine (1981) unless the previous names have been changed.

Each species is identified first by its botanical name (genus and specific name) with the abbreviated name of authority, followed by a related synonym if any, then the family, trade and local names. The botanical names of species are alphabetically arranged. The trade names used by the Timber Industry Development Division of Ghana's Forestry Commission, in most cases, have been adopted. In addition, one or two other trade names derived from PROSPECT (1996, 2001) published by Oxford Forestry Research Institute, International Tropical Timber Wood Database (1997, 2001), or Association Internationale Technique des Bois Tropicaux (1999) have also been used. For the LKS yet to enter the export market, their generic names are invariably recommended as the trade names. However, in few instances, a popular local name in addition to the generic name is used as trade name. In rare instances, a new trade name, for example "Goldenwood" for *Enantia polycarpa*, so called because of its intense yellow colour, has been recommended. For local names of a species, a name or names use

Ghana, and usually one or two other names from an anglophone or francophone country are stated. The abbreviated name of the country where the local name originates is shown in brackets against that name.

### **3.3 DISTRIBUTION**

The distribution of a species by region and country of origin in tropical Africa is described in Chapter 4. Fig. 3.1 shows the distribution of species in the two major forest types of Evergreen and Semi-deciduous forests, and in the Savanna Woodland of Ghana.

### **3.4 VEGETATION TYPES**

Ghana has two main vegetation types: Tropical High Forest and Savanna. The High Forest accounts for about a third or 8 million ha of the land area of 23.85 million ha; the Transition Zone is about 1.1 million ha and 14.7 million ha for the Savanna. The following description on Tropical High Forest of Ghana includes the Transition Zone, and is based on Hall & Swaine (1981).

#### **3.4.1 Tropical High Forest**

The forest vegetation consists of the Evergreen forest in the South-West corner of Ghana with annual precipitation of not less than 1750 mm and covers about 30 % of the original forest land (Fig. 1). This forest is characterized by predominantly evergreen trees growing on acidic leached oxisol soil. The Evergreen forest is floristically very rich, contains few valuable evergreen timber trees usually with heights between 35 and 50 m, and are relatively shorter than trees of Moist Semi-deciduous forest. This forest is further subdivided into Wet and Moist Evergreen forests (Fig. 3.2). The Wet Evergreen at the extreme south-western part of Ghana with annual precipitation of over 2000 mm covers 8.1 % of the original forest land. It is surrounded by the Moist Evergreen which covers 21.9 % of the forest land with annual precipitation between 1750 and 2000 mm. The remaining 70 % of the original forest land is Semi-deciduous forest, characterized by ochrosols soils with annual precipitation range of 1250 to 1750 mm.

The Semi-deciduous forest contains many deciduous tall timber trees of economic importance, and is further subdivided into Moist and Dry Semi-deciduous forests. The Moist Semi-deciduous forest which surrounds the Moist Evergreen forest, covers about 43.4 % of the forest area with precipitation range from 1500 to 1750 mm. This is further divided into South-East and North-West subtypes and has the highest frequency of premium and commercial timber species usually with tree heights exceeding 50 m (Fig. 3.2). The Dry Semi-deciduous forest, which covers about 26.4 % of forest land with annual precipitation range from 1200 to 1500 mm, extends over wider range of environmental conditions with tallest timber trees between 30 and 45 m in height. It forms a peripheral band around the Moist Semi-deciduous forest, and is adjacent in the north to the Savanna Woodland. This forest type is also subdivided into the Fire zone of the North-West and the Inner zone of South-East. Other minor forest types exist, but they contain very few economic trees.

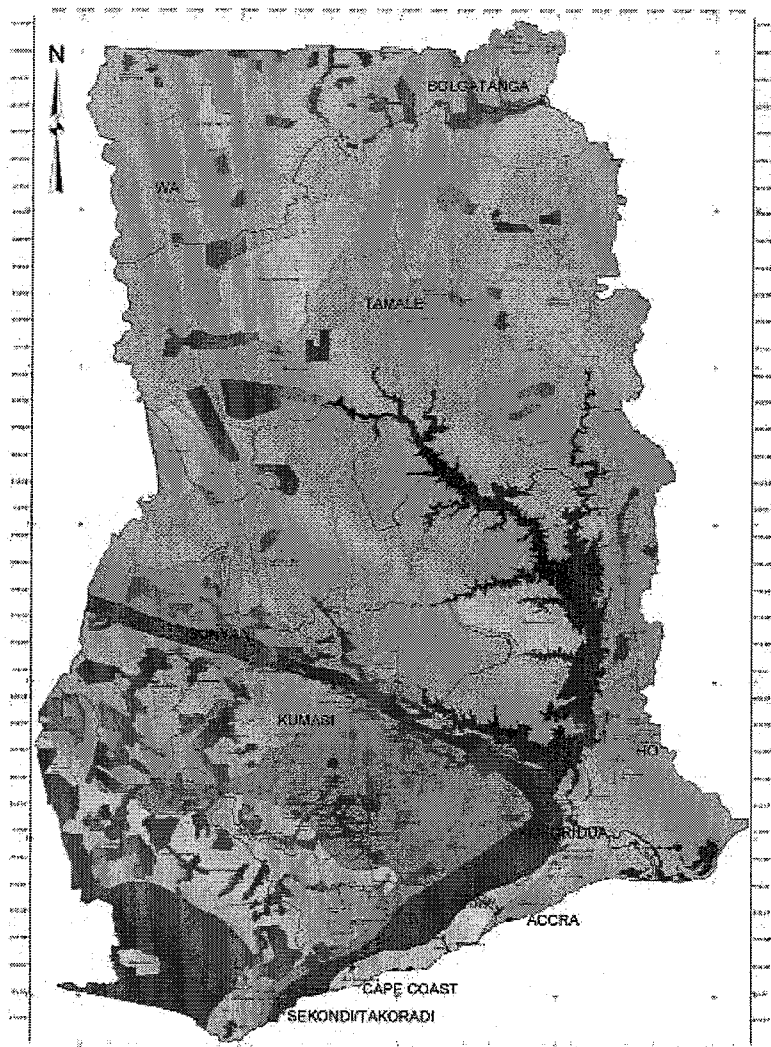


Fig. 3.1. Vegetation Map of Ghana (Source: Cartographic Unit , Forest Commission)

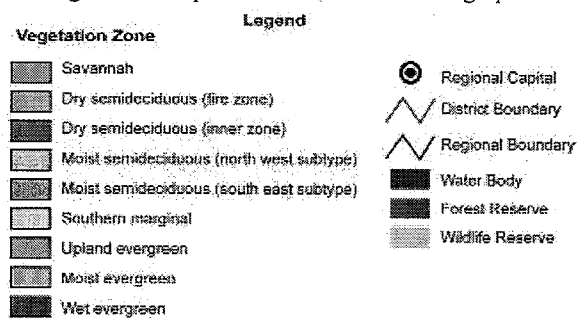




Fig. 3.2 Moist Evergreen Rainforest of Ghana

#### **3.4.2 Savanna**

The remaining 75 % of total land area with annual precipitation of less than 1200 mm consists of Savanna Woodland to the south and Low Grass Savanna to the north. The Savanna zone has virtually no economic timber trees, except in the Savanna Woodland where isolated economic timber trees like *Khaya senegalensis* and *Anogeissus* spp. of relatively short heights are found.

#### **3.5 STATUS**

The utilization status of a species, its growing stock, minimum felling diameter, harvesting intensity, export volume, conservation status, and toxic levels of sawdust emitted during processing are essential information on timber trees. These attributes may differ from species to species and from one country to another. The data were accessed mainly from timber inventory and trade statistics documents of Ghana Forestry Commission, but data on toxicity were sourced from PROSPECT (1996, 2001), ITTO Database (1997, 2001) or ATIBT (1990). The different aspects of status are discussed below.

### 3.5.1 Utilization

All species are grouped into one of the four utilization categories based primarily on how long a species has been exported, its quality, value, and demand on the export market (Table 1). The growing stock of a species, its conservation status, sustainability, and intensity of exploitation influence the utilization status of a timber species (Table 1). The following definitions are offered for the four utilization categories:

**Premium species** have long history (over 50 years) of export, and are of very high value and demand in the international market because of their superior quality. Although very high volumes were exploited and frequently exported in the past, the current growing stock, production and export, may vary from species to species due to in-country conservation measures, regeneration potential and exploitation levels. Some species like *Milicia excelsa* and *Pericopsis elata* have been overexploited due to their very high demand. Most species in this category are either endangered like *Pericopsis elata* or vulnerable, eg. *Milicia excelsa* and are recommended for very strict harvesting controls. This category has 12 species.

**Commercial species** like *Antiaris toxicaria* and *Nauclea diderrichii* have export history of less than 50 years. They are of good quality and value, forest availability is generally abundant to frequent, with very high to moderate extraction and are regularly exported. Few species are vulnerable and some are near threatened. They are recommended for some form of harvesting controls to curtail their overexploitation and ensure their sustainability. Fourteen species belong to this group.

**Lesser-used species** like *Cylicodiscus gabunensis* and *Albizia ferruginea* have short history of export, having been introduced as export timber less than 25 years ago. The species are of acceptable quality and adequate value, but are irregularly exported because of low international market demand. They are of variable occurrence in the forest, and are generally of very low extraction rate. Most are lower risk and only few species are either vulnerable or near threatened and are recommended for harvesting control. This group has 39 species.

**Lesser-known species** are yet to be exported, but are now being promoted or have the potential to be promoted in the local market. Their forest occurrence is variable, usually from frequent to sparse, and data on their technological properties are limited, for example, *Berlinia grandiflora* and *Allanblackia floribunda*. They are mostly lower-risk species which can be exploited under normal forest harvesting practice. Thirty-five lower-risk species are recorded in the group.

The utilization status of a timber species is quite dynamic and is dependent on many factors as shown in Table 1. It may also differ from country to country because of criteria used for the grouping.

**Table 3.1: Criteria for Grouping of Species into a Utilization Status.**

Criteria	Premium	Commercial	LUS	LKS
1. Period of Export (Long (50+yr), Short (<50), Recent (<20), Local)	Long	Short	Recent	Local
2. Quality (Very High, High, Acceptable, Local)	High to Very High	Acceptable to high	Acceptable to High	Usually Acceptable or Local
3. Value of Export Price (Very high, High, Acceptable, Local)	High to Very High	Acceptable to Very High	Acceptable to High	Local
4. Demand for Export (Volume)(Frequent, Regular, Irregular, Occasional, Local)	Regular to Frequent	Regular to Frequent	Occasional to Regular	Local
5. Forest Availability (Growing Stock) (Abundant, Frequent, Sparse, Rare)	Rare to Abundant	Frequent to Abundant	Sparse to Frequent	Rare to Frequent
6. Exploitation (Production Volume) (Very High, High, Moderate, Low, Insignificant)	Low to Very High	Moderate to Very High	Low to High	Insignificant to Low
7. IUCN Conservation Status (Critically Endangered, Endangered, Vulnerable, Lower Risk Near Threatened, Lower Risk Least Concern)	Vulnerable to Endangered	Lower Risk Near Threatened to Vulnerable	Lower Risk Least Concern to Vulnerable	Lower Risk Least Concern to Lower Risk Near Threatened

### 3.5.2 Growing Stock

The Forest Inventory Management Programme (FIMP) of 1995 estimated the Permanent Forest Estate of Ghana to be 2,316,500 ha. The High Forest, which covers 1,620,000 ha, contains 204 forest reserves; and the 62 forest reserves in the Savanna zone covers 600,000 ha (Forest Commission, 2004). The effective area of the High Forest designated for timber production, is only 762,400 ha or 47 % (Forestry Department, 1995). In addition, about 22 % or 352,500 ha of the High Forest zone is partly used for permanent protection, 122,000 ha (or 7 %) rehabilitation; and 127,000 ha or 8 % for conversion. However, the Multi Resource Inventory of 2001 showed that the total timber production area of High forest had dwindled by 5.7 % to about 719,300 ha. From this productive area, the total growing stock of 73 identified timber species above 30 cm dbh was 162.36 ms and 56.43 m<sup>3</sup> ha<sup>-1</sup> for the same species above their minimum felling diameters. This translates to a total of about 116.786 million m<sup>3</sup> for the 73 species above 30 cm dbh, out of which 34.76 % (40.590 million m<sup>3</sup>) for same species were above minimum felling diameter. The total volume for each of the four



utilization classes above their felling limits was as follows: 19.70 % for 13 premium species, 25.9 % for 15 commercial species, 48.80 % for 37 LUS, and 5.6 % for 8 LKS (Table 2). This further emphasizes the need to harvest, promote and use more LUS which is in relative abundance.

In 1997, the off-reserve forest area of 5,001,335 ha was inventoried to have some 122.683 million m<sup>3</sup> or 24.35 m<sup>3</sup> ha<sup>-1</sup> of timber trees above 30 cm dbh out of which 37 % or 45.822 million m<sup>3</sup> or 9.16 m<sup>3</sup> ha<sup>-1</sup> was above their minimum felling diameters (Forestry Department, 1997). Although the off-reserve forest is about seven times the size of productive reserve forest, the latter contains over 6 fold of timber trees per ha than the former.

Individual species composition in the reserve and off-reserve forests may differ between vegetational zones. Wawa (*Triplochiton scleroxylon*) from forest reserve had the highest stock of 39.32 m<sup>3</sup> ha<sup>-1</sup> above 30 cm dbh, followed by *Celtis* (*Celtis mildbraedii*) and Dahoma (*Piptadeniastrum africanum*) with 38.02 and 16.28 m<sup>3</sup> ha<sup>-1</sup>, respectively. *Afromorsia* (*Pericopsis elata*) and Makore (*Tieghemella heckelii*), classified by IUCN (2004) as endangered species, had a growing stock of 0.26 and 1.33 m<sup>3</sup> ha<sup>-1</sup> above 30 cm dbh, respectively.

Apart from the reserve and off-reserve forests, commercial timber trees are also extracted from about 150,000 ha of plantation forest which first started in 1875 (Oteng-Amoako & Safo, 2003). Most planted forests comprise of exotic species including Teak (*Tectona grandis*) which takes about 90 % of all planted species, *Cedrella*, *Eucalyptus*, and *Gmelina*. Some indigenous species like *Ceiba*, *Terminalia*, *Triplochiton*, *Khaya*, and *Milicia* have been planted only recently. Over 50,000 ha out of the 150,000 ha of planted forest have been created between 2000 and 2004 (Agyemang, 2004).

Growing stock of timber species is threatened by forest fires caused by excessive accumulation of logging residues which later become highly inflammable on the forest floor. It is estimated that about 30 % of the forest areas are adversely affected by fire every year. While few trees are able to withstand ravages of fire, most die at especially seedling and sapling stage. The positive side of forest fires is that many species have prolific regeneration after such destructive burning.

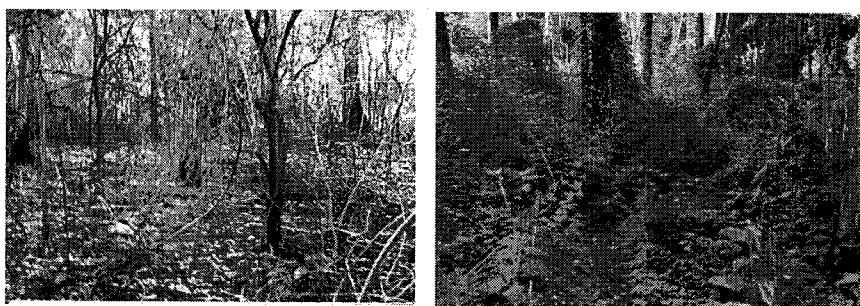


Fig. 3.3 Forest fire (left) affects growing stock but increases regeneration (right)  
(Courtesy: Owusu-Afriyie of FORIG)

The five categories of growing stock of species above 30 cm dbh, based on inventory of reserve forests completed in October 2002, are as follows:

<b>Abundant (A):</b>	1000 m <sup>3</sup> or more km <sup>-2</sup>
<b>Frequent (B):</b>	500 to 999 m <sup>3</sup> km <sup>-2</sup>
<b>Moderate (C):</b>	100 to 499 m <sup>3</sup> km <sup>-2</sup>
<b>Sparse (D):</b>	50 to 99 m <sup>3</sup> km <sup>-2</sup>
<b>Rare (E):</b>	Under 50 m <sup>3</sup> km <sup>-2</sup>

**Table 3.2: Growing Stock of 2001 and Harvested Volume from 2000 to 2003 from Reserve Forests for Premium, commercial Lesser-used and Lesser-known Species.**

Utilization Group	Premium	Commercial	Lesser-used	Lesser-known	Cumulative
Number of Species	13	15	37	8	73
Growing Stock (m <sup>3</sup> ) Above Felling Limit	7,984,230	10,516,166	19,816,715	2,272,988	40,590,099
% of Growing Stock	19.7	25.9	48.8	5.6	100
Harvested Volume (m <sup>3</sup> )	1,350,651	633,191	633,142	4,059	2,624,043
% of National Total Harvest	51.47	24.13	24.24	0.16	100
Harvested vol / Growing stock ×100	16.92 %	6.02	3.20	0.18	6.48

### 3.5.3 Minimum Felling Diameter and Felling Cycle

Minimum felling diameter (MFD) also referred to as minimum felling limit (MFL), and felling cycle (FC) are important regulatory mechanisms to control forest exploitation in Ghana. The MFD is measured at breast height and was first introduced in Ghana in 1907 to protect immature trees, sustain production of commercial timber species and conserve their biodiversity. It was revised in 1910, 1958, 1972, and 1989 (Ghartey, 1992) until the recent one in 1997 by Ofosu-Asiedu and others. The MFD between 50 and 110 cm are now in use for exploiting timber species from reserve and off-reserve forests of Ghana (Table 4). In few instances where species do not have MFD, one has been recommended based on its diameter and conservation status. Few trees above MFD are deliberately left as future seed trees. Felling cycle, on the other hand, defines periodic entries into the reserve forests for logging. Felling cycle of 25 years was used in the 1960s, but a 40-year cycle introduced in 1990 is still in use (Adam, 2003). A yield regulation, determined by a formula, is in place to ensure

retention of 40 % of trees above minimum felling diameter in a felling cycle. Unfortunately, it is often flawed and seldom ensures the required level of retention (Adam, 2003).

### 3.5.4 Annual Allowable Cut and Production Volume

A timber tree can officially be harvested as a commercial timber with a Timber Utilization Contract (TUC) if it has reached its minimum felling diameter which, depending on a species, varies from 50 to 110 cm. In 1994, the old system of awarding forest concession for timber exploitation was replaced with the TUC, which seemingly favours efficiency, transparency, and accountability. The Forest Commission advertises available forest areas and awards TUC to deserving contractors to undertake forest exploitation for timber. To ensure sustainability of all timber species, an annual quota system for harvesting, referred to as Annual Allowable Cut (AAC), is set from year to year. The AAC, in the context of sustainable management, is the annual increment of commercially utilizable species per hectare multiplied by the productive area. The current prescribed AAC for the last 4 years of 1 million m<sup>3</sup> was revised from a previous years' value of 1.25 million m<sup>3</sup>. The AAC of 1 million m<sup>3</sup> is far below industrial annual demand of at least 3 million m<sup>3</sup>. The official volume of timber species extracted from reserve and off-reserve forests by companies issued with timber permits are recorded by the Timber Industry Development Board (TIDD), using Log Measurement Certificate (LMC).

Tree removal statistics available from the Forestry Commission show that between 1900 and 2000, about 95 species were exploited from the forest reserves in Ghana. The first quarter of the 20th century saw exploitation of no more than five species, rising to about 25 species in the 1950s and about 50 in the 1980s. Increased promotion and utilization of LUS and LKS in the last two decades has increased exploitation of all classes of species to a current peak of about 77 species. Despite the high number of harvestable species, the bulk harvest came from a few premium species, notably *Triplochiton scleroxylon*, *Entandrophragma* and *Khaya* spp., and more recently from *Ceiba*, a lesser-used species.

Current data from Resource Management Service Centre (RMSC) of the Forestry Commission (Fig. 2) show that from 2000 to the end of 2003, the mean official annual extraction for 77 timber species was 1,192,614 m<sup>3</sup>, which is 19.26 % more than the currently prescribed AAC of 1 million m<sup>3</sup>. The annual harvested volume of 982,955 m<sup>3</sup> in 2000 was the lowest compared to highest harvested volume of 1,364,392 m<sup>3</sup> for 2002 (Fig. 3). Timber harvested from reserve forests during the last 4 years from 2000 to 2003 has consistently been higher than that from off-reserve forest. The annual mean of 654,156 m<sup>3</sup> (or 55 % of total harvest) came from the forest reserves compared with 535,786 m<sup>3</sup> or 45 % from outside forest reserve. However, because the reserve forest is over six times more productive and much smaller in area than the off-reserve, it is being fast depleted. On the other hand, the large area of off-reserve forest makes policing difficult and are readily subjected to illegal logging.

A comparison of growing stock of 2001 and harvested volume from 2000 to 2003 from the reserve forests shows that 16.92 % of premium species was harvested compared with 6.09, 3.20 and 0.18% for the commercial species, LUS and LKS, respectively (Table 3.2 & Fig. 3.4). This scenario emphasizes the urgent need to control extraction of premium species to

avoid their possible extinction, and promote harvesting and use of LUS and LKS which are in relative abundance. This will make timber harvesting more efficient, increase volume of harvest, and sustain supply to the timber industry. It also indicates that about 6.46 % of all timber species above felling limit was extracted from the reserve forests for this period.

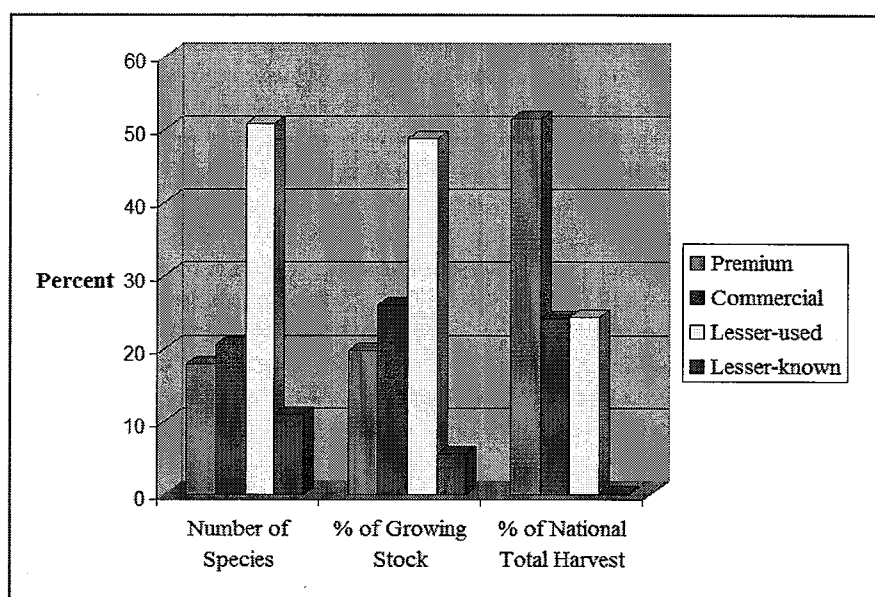


Fig. 3.4 Number (%) of Timber species, Growing stock and Total Harvest (2001 to 2003) from Reserved Forests.

The timber processing industry, which was once very buoyant, is now faced with crisis of inadequate supply of raw material because of restricted AAC of only 1 million m<sup>3</sup> as against minimum required capacity of at least 3 million m<sup>3</sup>. This has resulted in many companies producing below capacity, and some have even stopped production. The shortage of timber encourages illegal logging from mostly off-reserves estimated at about 2.625 million m<sup>3</sup> annually (Birikorang, 2001), and is well patronized in the local market and the wood processing companies. Promotion of industrial use of bamboo, in recent years, is meant to partly address the eminent problem of timber shortage.

Seven levels of classification are offered for exploitation of the 100 timber species. This is based on the annual mean of timber trees extracted from reserve and off-reserve forests as recorded by TIDD from 2000 to 2003. It does not include illegal logs that could not be officially recorded.

<b>Extremely High (A):</b>	More than 100,000 m <sup>3</sup>
<b>Very High (B):</b>	Between 20,000 and 100,000 m <sup>3</sup>
<b>High (C):</b>	Between 5000 and 20, 000 m <sup>3</sup>

<b>Moderate (D):</b>	Between 1000 and 5000 m <sup>3</sup>
<b>Low (E):</b>	Between 500 and 1000 m <sup>3</sup>
<b>Very Low (F):</b>	Between 100 and 500 m <sup>3</sup>
<b>Insignificant (G):</b>	Under 100 m <sup>3</sup>

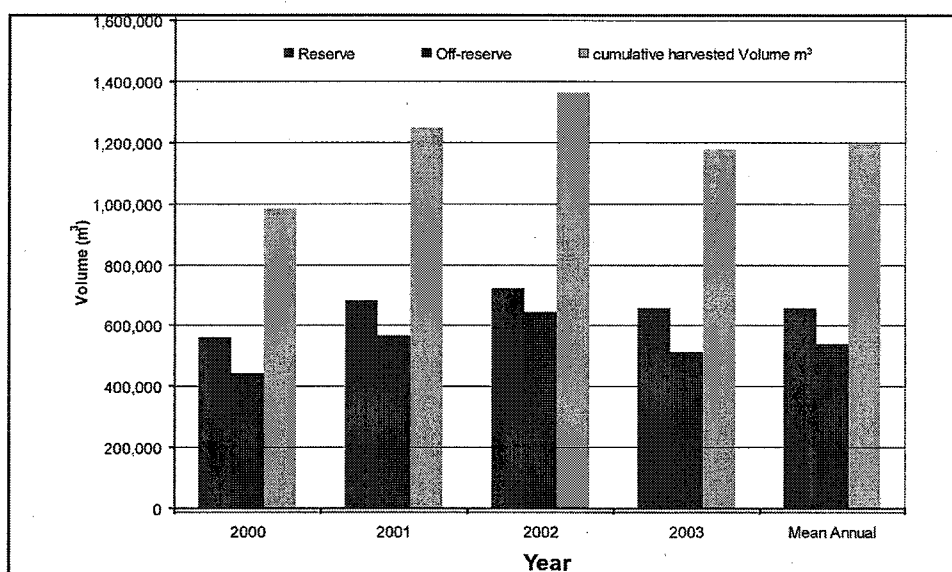


Fig. 3.5: Volume of timber species harvested from reserve and off-reserve forests 2000 to 2003. *Source: Resource Management Service Division, Ghana Forestry Commission (2004)*

### 3.5.5 Export

The Ghana wood industry is made up of about 200 logging companies, 230 sawmills (including some 50 portable mills), 30 ply and veneer mills, and over 300 furniture-processing companies. Most processing companies are small, employing less than 100 people, except for 10 medium-sized saw and plymills which employ over 100 workers per mill. The industry accounts for 4 to 7 % of Gross Domestic Product (GDP), and export of timber and wood products represents 18 % of total export revenue and the fourth foreign exchange earner for Ghana (Overseas Consultancy Services, 1995). Export of logs in any form for all species was banned in 1995, and since then, local processing of log has reached an unprecedented level. The estimated recovery rate of sawntimber earmarked for export is between 20 and 40 % depending on export specification, 40 and 60 % for boules, 30 and 40 % for sliced and rotary veneer, and 10 and 20 % for finished wood products like furniture. The volume of timber used in the domestic market has steadily increased from about 10 % of harvested timber two decades ago to about 40 % or 1 million m<sup>3</sup> in 1995 (Overseas Consultancy Services, 1995) and 1.5 million m<sup>3</sup> in 2004. The extra demand for domestic market is met from re-sawing of residue resulting from processing of export timber and illegal logs which cannot be officially recorded.

Records indicate that as early as the 1890s, Gold Coast now Ghana, was exporting Africa Mahogany (*Khaya spp.*) Analyses of export permits and LMC issued from 1986 to 1996 show that for an average annual timber export of 800,000 m<sup>3</sup>, about 75 % or 600,000 m<sup>3</sup> was from the premium species, 17.5 % was commercial species, with only 7.5 % being LUS and LKS. In spite of that, the growing stock of the premium species is only about 40.3 % of the growing stock for LUS. Therefore, the need to increase export of the LUS and LKS is most urgent to meet demand from the local wood industry, sustain volume of export, and reduce logging of mostly threatened premium species. For the same period, the premium species accounted for 65 % of the total export volume and 80 % of total export revenue of about 200 million Deutsche Marks, or 120 million Euros. The high demand for timber and wood products in the domestic market is partly due to increase in population and industrialization. The Government's policy of encouraging domestic tertiary processing of timber has resulted in considerable reduction in volume, but increase in value of export. The total annual timber and wood products export for the first 4 years of the year 2000 averaged 472,925 m<sup>3</sup> and generated about 178 million Euros (Fig. 3 and Fig. 4).

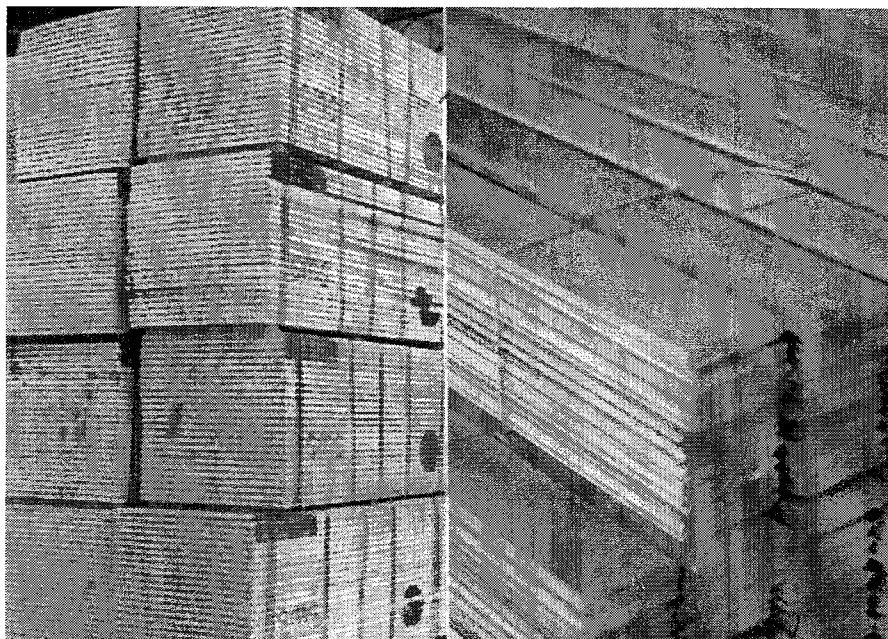


Fig. 3.6 Plywood and profile boards packaged for export

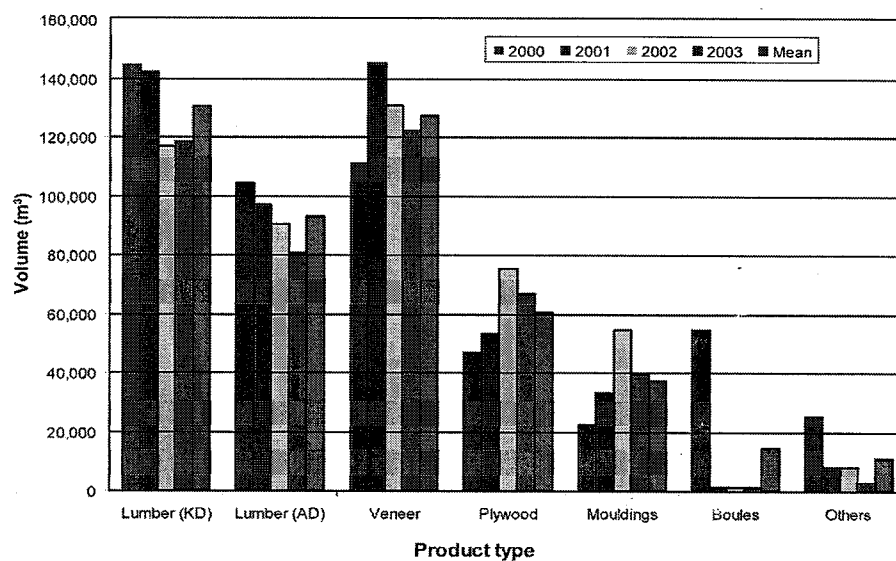
Timber export of Wawa, Koto, Mahogany, Odum, Makore and Sapele accounted for 70 to 80 % of kiln dry timber export, while Ofram, Teak, Danta, Mahogany and Papao accounted for 60 to 70 % of air-dried timber. Levy is imposed on export of air-dried timber of nine important premium species including Wawa, Koto, Mahogany, Odum, Makore and Sapele. Ceiba accounted for 70 to 80 % of rotary veneer and plywood export, Asanfena for 50 to 60 % of

sliced veneer, and Wawa for 70 to 80 % of mouldings. Furniture parts were produced from 20 species of which Odum, Avodire, Papao, Mahogany, and Albizia dominated. Timber export is mainly to European countries including Italy, France, Spain and Germany, but also to USA and India. An insignificant volume of wood and wood products are exported by road to neighbouring African countries like Burkina Faso, Senegal, Togo, and Mali.

The five levels of export volume for the 100 species, based on the mean total annual export for sawntimber, veneer, plywood and other finished products including furniture parts from 2000 to 2003, are as follows:

<b>Frequent (A):</b>	Above 50,000 m <sup>3</sup>
<b>Very Regular (B):</b>	Between 10,000 and 50,000 m <sup>3</sup>
<b>Regular (C):</b>	Between 1,000 and 10,000 m <sup>3</sup>
<b>Irregular (D):</b>	Between 100 and 1,000 m <sup>3</sup>
<b>Occasional (E):</b>	Under 100 m <sup>3</sup>

Any species extracted but not exported is assumed to have been used only in the domestic market.



**Fig. 3.7 Volume (m<sup>3</sup>) of timber and types of wood products export from 2000 to 2003.**  
Source: Timber Industry Development Division, Ghana Forestry Commission (2003)

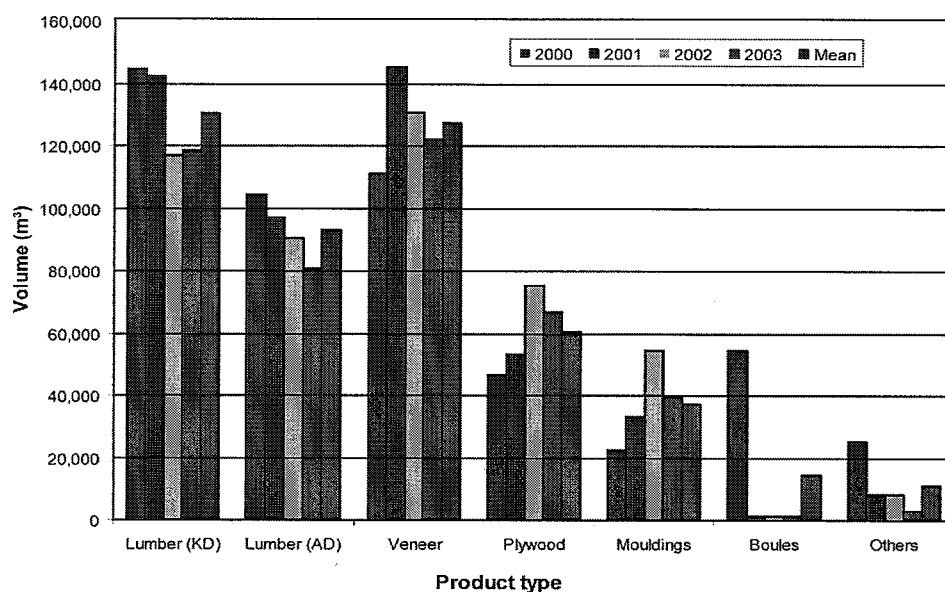


Fig. 3.8 Value (Euro) of timber and wood products export from 2000 to 2003.  
Source: Timber Industry Development Division, Ghana Forestry Commission (2003)

### 3.5.6 Conservation

Hawthorne & Abu-Juam (1995) concluded in their book that timber extraction has destroyed part of the reserve and off-reserve forests such that 40 to 50 % of the reserve forest is considered to be "mostly degraded" while about 25-30 % "has no forest at all". Timber growing stock is affected by forest depletion and Cobbinah *et al.* (2005) estimated the cost of forest depletion to be nearly 323 million US dollars a year including loss of economic timber species. To forestall the problem of forest destruction, control "creaming" of economic timber species, and conserve biodiversity of the remaining timber species, Hawthorne & Abu-Juam (1995) used a "star" conservation grouping to rank plants including over 600 tree species in Ghana's forest. Their rating was based on local and global distribution as well as on ecological, commercial, social and taxonomic considerations. In their classification, 14 "scarlet" species, which include the 12 premium species used in this handbook, were defined as "common species under serious pressure from heavy exploitation which needed vital protection". Some 40 species classified as "red" including "pink" stars, were defined as "common species under pressure from exploitation that needed careful control and protection". This group includes most commercial and few lesser-used species. Over 500 tree species grouped as "green" species had no particular conservation problems. Unfortunately, all the scarlet species including *Milicia excelsa*, *Entandrophragma* and *Khaya* spp. for which Hawthorne & Abu-Juam (1995) recommended for vital protection, are still being logged with special permit from Forestry Commission and according to Timber Resource Management



Regulations (1998). This situation is unlikely to differ from Cote d'Ivoire and some other timber-exporting countries in the region.

The Convention on International Trade in Endangered Species (CITES, 2003) evaluated 255 timber species worldwide and found 13 of the 100 selected species covered in this book to be threatened. Six of the 13 species belong to the premium species, another six are commercial, and one (*Copaifera salikounda*) is a lesser-used species. The International Union for Conservation of Nature (IUCN), on the other hand, found 26 of the 100 species to be on the IUCN (2004) Red List of Threatened Species.

The conservation status, in relation to growing stock, volume extracted and utilization status, for each of the 100 timber species used in the book is shown in Table 3. The IUCN Red List of Threatened Species groups conservation status of timber species into the following five categories:

**Critically Endangered (CE):** Threatened species which face extremely high risk of extinction or are critically endangered in the wild in the near future. None of the 100 species covered in this book is in this category.

**Endangered (E):** Threatened species which are not critically endangered, but face very high risk of extinction in the wild soon. The species in this group are recommended for complete ban on exploitation to avoid their eminent extinction. Two premium species, *Pericopsis elata* and *Tieghemella heckelii*, belong to this category.

**Vulnerable (V):** Threatened species that are not endangered, but are facing a high risk of extinction in the wild in the medium-term future. They are recommended for strict exploitation controls to avoid overexploitation and ensure their future sustainability. The 24 species in this category include nine each of premium and commercial species, and six LUS.

**Lower Risk Near Threatened (LRNT):** Species are not threatened, but are close to be qualified as vulnerable. They are recommended for some form of exploitation controls to avoid overharvesting which could lead to vulnerable status. The 22 species in the group include one premium, five commercial, 11 lesser-used, and five lesser-known species.

**Lower Risk Least Concern (LRLC):** Species are not in anyway threatened. Exploitation of the species is recommended with no restriction other than the normal sustainable harvesting practice. The 52 species in this group include 22 LUS and 30 LKS.

**Table 3.3: Conservation Status of 100 Timber Species of Ghana in Relation to Growing Stock, Rate of Extraction and Utilization status**

Conservation Status *	Growing Stock	Past or Present Volume of Extraction	Utilization Status
<b>Endangered (E)</b> (2 spp.)	Scarce	Very High	Premium (2)
<b>Vulnerable (V)</b> (24 spp.)	Scarce to Moderate	Moderate to Very High	Premium(9) Commercial (9) and LUS (6)
<b>Lower Risk Near Threatened (LRNT)</b> (22 spp.)	Sparse to Abundant	Low to Very High	Premium (1) Commercial (5) LUS (11) LKS (5)
<b>Lower Risk Least Concern (LRLC)</b> (52 spp.)	Rare to Abundant	Insignificant to Moderate	LUS (22) LKS (30)

\* Figure in brackets denotes the number out of the 100 species classified under the four conservation status.

### 3.5.7 Toxicity

Some wood species contain toxic compounds which render them durable to biodeterioration but which may be injurious to health of workers when their sawdust or shavers are inhaled or come in direct contact with humans during sawing or planing. Any such possible side effects like dermatitis, irritations, allergies and respiratory disorders that a species may have on humans during processing is noted as being toxic. Use of dust exhausters during sawing and further processing, wearing of nose guards and other essential protective clothings are highly recommended. Table 3.4 shows, among others, the 35 species which are reported to have some levels of toxicity in their sawdust.

### 3.6 TREE IDENTIFICATION FEATURES

The 133 major features for identifying trees in the handbook emphasize on tree height and diameter, bole length and form, colour of bark and slash, leaf shape and venation, flower and fruit morphology. These features, some with illustrations, are shown in Chapter 2. For each timber species, an illustration of the leaf, and occasionally the fruit or flower, is presented. The illustrations are drawn from specimens collected from standing trees confirmed with authenticated herbarium samples. Few illustrations were redrawn from Hawthorne (1990), Keay (1989) or Irving (1961) when specimens were difficult to collect from trees. The intention is only to give key tree diagnostic features, and readers interested in other taxonomic and morphological details may have to read appropriate references in the Bibliography.

### **3.7 WOOD IDENTIFICATION FEATURES**

The thrust of the handbook is on wood identification of the selected 100 timber species based on macroscopic, physical and splinter test. This objective is met in four steps:

- Notes on preparing wood samples for macroscopic and physical identification, and for splinter test, as explained in Chapter 2.
- Definitions and notes with some illustrations of 92 macroscopic, 26 physical, and 7 supplementary features on splinter test (Chapter 2).
- Compilation relevant macroscopic and physical identification features, and splinter tests for each species (Chapters 2 and 4).
- A dichotomous and a computer-assisted identification key for all the species based primarily on the 92 macroscopic identification features (Chapter 5).

### **3.8 ECOLOGY AND SILVICULTURE**

The silvicultural and ecological notes emphasize on interactions that enhance natural or artificial regeneration of a species. Data on preferred soil type, topography, altitude, vegetation, precipitation and effect of natural disturbances and hazards such as fire on growth of species are presented. In addition, notes on phenology, methods of propagation, nursery practices and other factors that enhance growth from seedling to mature tree are included. The silviculture of indigenous timber tree species has been least studied and tested, and data source was mainly limited to Hawthorne (1995), Hall & Swaine (1974,1981), Swaine *et al.*(1997), Taylor (1960) and Irving (1961).

### **3.9 USES**

Two categories are presented: ethnobotany and wood uses.

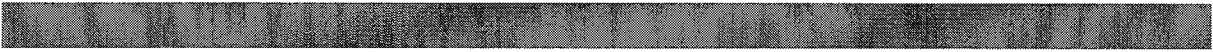
#### **3.9.1 Ethnobotany**

Ethnobotany deals with traditional uses of trees for food, medicine, cloth or for religious rituals by indigenous people. Drugs derived from some trees are used in traditional medicines and have been found to be efficacious in treating many physical and mental illnesses. Ethnobotanical data on 90 out of the 100 selected species are presented.

#### **3.9.2 Wood**

The recognized uses of wood are based on traditional and practical experience, or on scientific tests. These uses are influenced by economic factors such as availability and cost, wood properties, processing technology and conservation status of the species. A list of the main uses, which does not include use of species for pulp, paper or their derivatives, is as follows:

1. Artifacts, carvings and handicrafts
2. Boats, canoes and their components
3. Bridges, sleepers, crossties, deckings, piles and wharfs

- 
4. Boxes, crates, food containers, fruit and packing cases
  5. Claddings (internal or external), panellings and mouldings
  6. Construction (light or heavy)
  7. Flooring (industrial or domestic), steps and stairs
  8. Furniture (decorative or common) and cabinet works
  9. Joinery (external or internal), frames and trims
  10. Match boxes, match splints and pencil holders
  11. Musical instruments
  12. Particle boards, chip boards, flake boards, fibre boards and cement boards
  13. Poles, posts, cross arms and stakes
  14. Roof trusses (domestic or industrial), joists, beams and structures (domestic or industrial)
  15. Shingles, shakes and weatherboards
  16. Sporting goods, tennis rackets, bats, hockey sticks and handles
  17. Tools, turneries and ornaments
  18. Toys and novelties
  19. Vehicle and truck bodies
  20. Veneer (decorative, core or face, sliced or rotary) for internal or external plywood

This list is by no means exhaustive.

### **3.10 BIBLIOGRAPHY**

About 200 general and specific references from published journals and grey literature related to the subject of the handbook have been compiled alphabetically. References in astericks have been directly cited.

### **3.11 GLOSSARY**

The glossary of over 300 technical names and terms is meant to assist readers and users of the book from different professional and educational backgrounds.

**Table 3.4 Names, Distribution and Status of 100 Selected Tropical Timber Tree Species.**

Botanical Name	Trade Name (s)	Distribution			Status						
		WA	CA	EA	UT	GS	PV	MFD (cm)	EXP	TX	CS
1. <i>Afzelia africana</i>	Afzelia; Doussié, Papao	*	*	*	C	E	C	90	C	--	V
2. <i>Albizia adianthifolia</i>	Albizia; latandza	*	*	*	C	D	E	90	D	*	LRNT
3. <i>Albizia ferruginea</i>	Albizia; latandza	*	*	*	C	C	C	90	D	*	V
4. <i>Albizia zygia</i>	Albizia; latandza Tallow tree	*	*	*	C	C	F	90	D	--	LRLC
5. <i>Allanblackia floribunda</i>	Allanblackia; Bundji	*	*	*	D	B	F	70*	--	--	LRLC
6. <i>Alstonia boonei</i>	Alstonia; Emien	*	*	*	C	B	F	110	E	--	LRLC
7. <i>Amphimas pterocarpoides</i>	Amphimas; Lati	*	*	--	C	C	D	90	D	--	LRLC
8. <i>Aningeria altissima</i>	Asanfena; Aningré	*	*	--	B	C	B	90	B	--	LRNT
9. <i>Anogeissus leiocarpus</i>	Anogeissus; Kane **	*	*	*	D	D	--	70*	--	--	LRLC
10. <i>Anopyxis klaineana</i>	Anopyxis; African White Oak	*	*	--	C	D	F	70	E	--	V
11. <i>Antiaris toxicaria</i>	Antiaris; Ako; Chenchen	*	*	*	B	B	B	110	B	*	LRNT
12. <i>Antrocaryon micraster</i>	Antrocaryon; Onzabili	*	*	*	C	C	D	70	E	--	V
13. <i>Berlinia grandiflora</i>	Berlinia; Ebiara **	*	*	--	D	C	F	70	--	--	LRLC
14. <i>Blighia sapida</i>	Blighia; Tsana **	*	*	--	D	C	--	90	--	--	LRLC
15. <i>Bombax buonopozense</i>	Bombax; Kapokier	*	*	--	C	C	D	110*	E	--	LRLC
16. <i>Bussea occidentalis</i>	Bussea; Kotopreppe **	*	--	--	D	C	--	50*	--	--	LRLC
17. <i>Calpocalyx brevibracteatus</i>	Calpocalyx; Atrotre	*	*	--	D	B	--	50*	--	--	LRLC
18. <i>Canarium schweinfurthii</i>	African Canarium; Alélé	*	*	--	C	D	D	110	E	--	LRNT
19. <i>Carapa procera</i>	Carapa; African crabwood	*	*	--	D	B	--	70*-	--	--	LRLC
20. <i>Ceiba pentandra</i>	Ceiba; Fuma; Formager	*	*	*	C	A	A	110	B	--	LRNT
21. <i>Celtis adolphi-friderici</i>	Celtis; Ohia	*	*	*	C	C	C	70	B	*	LRLC
22. <i>Celtis mildbraedii</i>	Celtis; Ohia	*	*		C	A	C	70	B	*	LRLC

Botanical Name	Trade Name (s)	Distribution			Status						
		WA	CA	EA	UT	GS	PV	MFD (cm)	EXP	TX	CS
23. <i>Celtis zenkeri</i>	Celtis; Ohia	*	*	*	C	A	C	70	B	*	LRLC
24. <i>Chrysophyllum albidum</i>	Chrysophyllum; Longhi	*	*	*	C	D	C	70	C	*	LRNT
25. <i>Chrysophyllum perpulchrum</i>	Chrysophyllum; Longhi	*	*	*	C	C	C	70	C	--	LRLC
26. <i>Chrysophyllum subnudum</i>	Chrysophyllum; Longhi	*	*	--	C	D	D	70	C	--	LRLC
27. <i>Cola gigantea</i>	Colawood; Watapuo	*	*	*	C	C	F	90	E	--	LRLC
28. <i>Copaifera salikounda</i>	Bubinga; Etimoe Salikounda	*	*	--	C	E	D	70	E	--	V
29. <i>Cordia millenii</i>	African Cordia, Cordia	*	*	*	C	E	E	70	E	--	LRLC
30. <i>Corynanthe pachyceras</i>	Corynanthe **	*	*	--	D	-	--	50*	--	--	LRLC
31. <i>Cylicodiscus gabunensis</i>	Denya; Okan	*	*	--	C	B	C	70	C	*	LRNT
32. <i>Cynometra ananta</i>	Cynometra; Apome	*	--	--	C	B	F	70	E	--	LRLC
33. <i>Dacryodes klaineana</i>	Dacryodes; Adjouaba **	*	*	--	D	-	--	50*	--	--	LRLC
34. <i>Daniellia ogea</i>	Daniellia; Faro,Ogea	*	*	--	C	E	C	110	D	--	LRNT
35. <i>Dialium aubrevillei</i>	Eyoum	*	*	--	C	C	G	70	E	*	LRLC
36. <i>Diospyros kamerunensis</i>	African Ebony	*	*	--	C	C	E	50	E	*	LRNT
37. <i>Distemonanthus benthamianus</i>	Avan; Movingui, Ayam	*	*	--	C	C	D	90	D	*	LRNT
38. <i>Enantia polycarpa</i>	Enantia; Moambe; Goldenwood **	*	--	--	D	B	--	50*	--	--	LRLC
39. <i>Entandrophragma angolense</i>	Edinam; Tiama	*	*	*	A	C	C	110	B	--	V
40. <i>Entandrophragma candollei</i>	Candollei; Kosipo	*	*	--	B	E	D	110	C	--	V
41. <i>Entandrophragma cylindricum</i>	Sapele, Sapelli	*	*	*	A	C	C	110	C	*	V
42. <i>Entandrophragma utile</i>	Utile; Sipo	*	*	*	A	D	C	110	C	*	V
43. <i>Erythrophleum suaveolens</i>	Potrodom; Tali	*	*	*	C	E	E	70*	E	*	LRNT
44. <i>Gilbertiodendron limba</i>	Tetekon, Limbali	*	*	*	C	D	D	70	E	--	LRLC

Botanical Name	Trade Name(s)	Distribution			Status						
		WA	CA	EA	UT	GS	PV	MFD (cm)	EXP	TX	CS
45. <i>Guarea cedrata</i>	Scented Guarea; Bossé Clair	*	*	*	B	C	D	90	D	*	V
46. <i>Guibourtia ehie</i>	Ovengkol; Hyedua	*	*	--	B	E	D	90	E	--	V
47. <i>Hallea stipulosa</i>	Abura; Bahia; Subaha	*	*	*	B	D	D	100	D	*	V
48. <i>Hannoa klaineana</i>	Hannoa; Effeu; Fotie	*	*	--	C	C	E	70	E	--	LRLC
49. <i>Heritiera utilis</i>	Niangon	*	--	--	A	C	B	70	C	*	V
50. <i>Hexalobus crispiflorus</i>	Hexalobus; Duabaha **	*	*	--	D	C	--	70*	--	--	LRLC
51. <i>Holarrhena floribunda</i>	Holarrhena; Sese	*	*	--	D	D	--	50*	--	--	LRLC
52. <i>Holoptelea grandis</i>	Holoptelea; Kekele **	*	*	*	D	D	--	70*-	--	--	LRLC
53. <i>Homalium longistylum</i>	Homalium **	*	*	*	D	E	--	50*	--	--	LRLC
54. <i>Hymenostegia afzelii</i>	Hymenostegia **	*	*	--	D	B	--	50*	--	--	LRLC
55. <i>Irvingia gabonensis</i>	Irvingia; Andok **	*	*	*	D	D	C	70*	--	--	LRLC
56. <i>Khaya anthotheca</i>	African Mahogany; Acajou	*	*	*	A	E	C	110	B	*	V
57. <i>Khaya ivorensis</i>	African Mahogany; Acajou	*	*	--	A	B	B	110	B	*	V
58. <i>Khaya senegalensis</i>	African Mahogany; Acajou	*	*	*	C	E	E	110*	D	*	V
59. <i>Klainedoxa gabonensis</i>	Klainedoxa; Eveuss; Kroma	*	*	*	C	C	F	90	E	--	LRLC
60. <i>Lannea welwitschii</i>	Lannea; Kumanini; Kumbi	*	*	*	C	C	F	70	E	*	LRLC
61. <i>Lophira alata</i>	Ekki; Kaku; Azobé	*	*	*	B	C	D	110	C	*	V
62. <i>Lovoa trichilioides</i>	African Walnut; Dibétou	*	*	--	A	E	D	90	D	*	V
63. <i>Mammea africana</i>	African Apple; Bompagya; Oboto	*	*	--	C	C	F	70	E	*	LRNT
64. <i>Manilkara obovata</i>	Manilkara; Monghinza	*	*	--	D	E	C	70*	--	*	LRNT
65. <i>Mansonia altissima</i>	Mansonia; Bété	*	*	--	B	C	D	90	D	*	LRNT
66. <i>Milicia excelsa</i>	Iroko; Odum	*	*	*	A	C	B	110	B	*	V
67. <i>Morus mesozygia</i>	Morus; Difou; Wonton	*	*	--	D	E	F	90	--	--	LRNT
68. <i>Nauclea diderrichii</i>	Kusia; Bilinga, Opepe	*	*	*	B	C	C	110	C	*	V
69. <i>Nesogordonia papaverifera</i>	Danta; Kotibe	*	*	--	B	B	D	70	C	--	V

Botanical Name	Trade Name(S)	Distribution			Status						
		WA	CA	EA	UT	G S	PV	MFD (cm)	EXP	TX	CS
70. <i>Octoknema borealis</i>	Octoknema; Wisuboni **	*	--	--	D	C	--	50*	--	--	LRLC
71. <i>Ongokea gore</i>	Ongokea; Angeuk	*	*	--	C	D	C	70*	E	--	LRLC
72. <i>Pachypodanthium staudtii</i>	Pachypo; Kumdwie **	*	*	--	D	C	--	50*-	--	--	LRLC
73. <i>Parinari excelsa</i>	African Greenheart; Sougué; Afam **	*	*	*	D	C	F	90	--	--	LRLC
74. <i>Parkia bicolor</i>	Parkia; Essang **	*	*	--	D	C	F	70	--	--	LRLC
75. <i>Pentaclethra macrophylla</i>	Pentaclethra; Ataa **	*	*	--	D	C	--	110*	--	--	LRLC
76. <i>Pericopsis elata</i>	Afromosia; Kokrodua	*	*	--	A	E	F	110	D	*	E
77. <i>Petersianthus macrocarpus</i>	Petersianthus; Esia	*	*	--	C	A	D	70	E	--	LRLC
78. <i>Piptadeniastrum africanum</i>	Dahoma; Dabema	*	*	*	B	A	B	70	C	*	LRNT
79. <i>Pseudocedrela kotschy</i>	Pseudocedrela; Krubeta	*	--	*	D	D	--	50*-	--	--	LRLC
80. <i>Pterygota macrocarpa</i>	Koto; Pterygota	*	*	--	B	B	B	70	B	--	V
81. <i>Pycnanthus angolensis</i>	Ilomba; Otie	*	*	--	C	B	B	70	C	*	LRNT
82. <i>Ricinodendron heudelotii</i>	Ricinodendron; Erimado **	*	*	*	D	A	G	50*	--	--	LRLC
83. <i>Sacoglottis gabonensis</i>	Sacoglottis; Ozouga; Fawere	*	*	--	D	D	--	90*	--	--	LRNT
84. <i>Samanea dinklagei</i>	Samanea; Abobonkahyire **	*	--	--	D	E	C	50*	--	--	LRNT
85. <i>Scottellia klaineana</i>	Akossika **	*	*	--	D	B	C	70*	--	--	LRLC
86. <i>Sterculia oblonga</i>	Sterculia; Eyong; Ohaa	*	*	*	C	C	E	70	D	--	LRLC
87. <i>Sterculia rhinopetala</i>	Sterculia; Wawabima	*	--	--	C	B	C	70	D	--	LRLC
88. <i>Stereospermum acuminatissimum</i>	Stereospermum **	*	*	--	D	D	--	50*	--	--	LRLC
89. <i>Strephonema pseudocola</i>	Strephonema; Awuruku **	*	--	--	D	C	--	90*	--	--	LRLC
90. <i>Strombosia glaucescens</i>	Strombosia; Afena	*	*	--	C	B	C	50	E	--	LRLC
91. <i>Terminalia ivorensis</i>	Emire; Framiré; Emeri	*	--	--	A	C	C	90	C	*	V
92. <i>Terminalia superba</i>	Limba; Fraké; Ofra	*	*	--	B	A	B	90	B	*	LRNT



Botanical Name	Trade Name(s)	Distribution			Status						
		WA	CA	EA	UT	GS	PV	MFD cm)	EXP	TX	CS
93. <i>Tetrapleura tetraptera</i>	Tetrapleura; Prekese **	*	*	--	D	E	--	50*	--	--	LRNT
94. <i>Tieghemella heckelii</i>	Makore; Baku	*	*	--	A	C	C	110	C	*	E
95. <i>Trichilia monadelpha</i>	Trichilia; Tanuro	*	*	*	D	C	--	50*--	--	--	LRLC
96. <i>Triplochiton scleroxylon</i>	Obeche; Samba; Wawa Ayous	*	*	--	A	A	A	90	A	*	LRNT
97. <i>Turraeanthus africanus</i>	Avodire; Avodine	*	*	*	B	B	D	70	D	*	V
98. <i>Uapaca guineensis</i>	Uapaca; Kontan	*	*	--	D	D	--	50*	--	--	LRLC
99. <i>Xylopia quintasii</i>	Xylopia; Obaa	*	*	--	D	D	--	50*	--	--	LRLC
100. <i>Zanthoxylum gillettii</i>	Zanthoxylum; Okuo	*	*	*	D	D	G	70	--	--	LRLC

\* Denotes species for which MFD has been recommended by the author based on girth diameter.

All trade names listed for LKS (utilization status D) are recommended only.

## LEGENDS OF ABBREVIATIONS

### Regional Abbreviations

WA	West Africa
CA	Central Africa
EA	East Africa
*	Species present in the Tropical Africa region
--	Species absent or data unavailable

### Status

UT	Utilization Status (A=Premium, B=Commercial, C=Lesser-used, D=Lesser-known)
GS	Growing Stock (A=Abundant, B=Frequent, C=Moderate, D=Sparse, E=Rare)
PV	Production Volume (A= Extremely high, B=Very high, C=Moderate, D=Sparse, E=Rare)
EXP	Export volume (A=Frequent, B=Very regular, C=Regular, D=Irregular, E=Occasional)
TX	Toxicity (* denotes presence in species)
MFD	Minimum felling diameter (50-110 cm depending on species)
CS	Conservation Status



### **Conservation Status (based on IUCN)**

CE	Critically Endangered
E	Endangered
V	Vulnerable
LRNT	Lower Risk Near Threatened
LRLC	Lower Risk Least Concern

### **Country Abbreviations**

A	Angola
BF	Burkina Faso
Ca	Cameroon
CAR	Central Africa Republic
CI	Côte d'Ivoire
Co	Congo
E	Ethiopia
EG	Equatorial Guinea
Ga	Gabon
Gh	Ghana
K	Kenya
Ni	Nigeria
S	Senegal
T	Tanzania
U	Uganda
DRC	Democratic Republic of Congo (formerly Zaire)
Za	Zimbabwe

## CHAPTER 4: DESCRIPTION & NOTES ON 100 SPECIES

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### **Content of Chapter is arranged as follows:**

- Nomenclature (Scientific, Family, Trade and Local Names)
- Synonyms (if any)
- Distribution
- Status
- Tree Features
- Wood Macroscopic Features
- Physical Features
- Splinter Test
- Ecology and Silviculture
- Ethnobotany
- (Recommended) Commercial Uses

## ***Afzelia africana* Smith (including *A. bella*)**

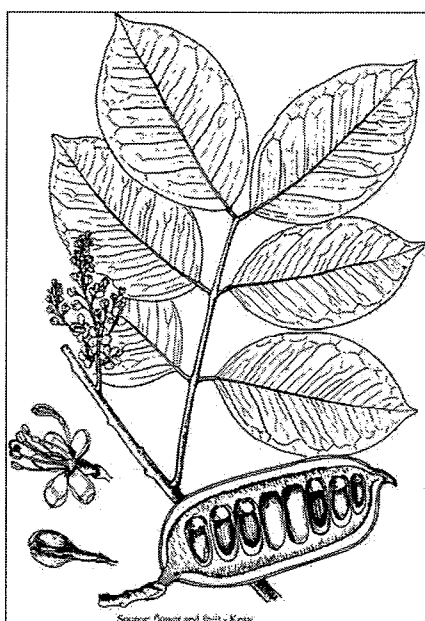
Family Name: **Caesalpiniaceae**  
Trade Names: **Afzelia; Doussie; Papao**  
Local Names: **Papao (Gh); Lingue (CI, S)**

### **Synonyms**

*Intsia africana* (Sm.) Kuntze  
*Afrazelia africana* Pierre

### **Distribution**

West, Central and East Africa, extending from Senegal to Sudan, and south to Uganda and Democratic Republic of Congo (Zaire). Sparsely found in Dry Semi-deciduous forest and Savanna woodland of Ghana.



### **Status**

A **lesser-used species** of sparse forest occurrence with high production for regular export. The prescribed minimum felling diameter is 90 cm. It is usually not distinguished in trade from *Afzelia bella*. It is cited by IUCN (2004) as a vulnerable species

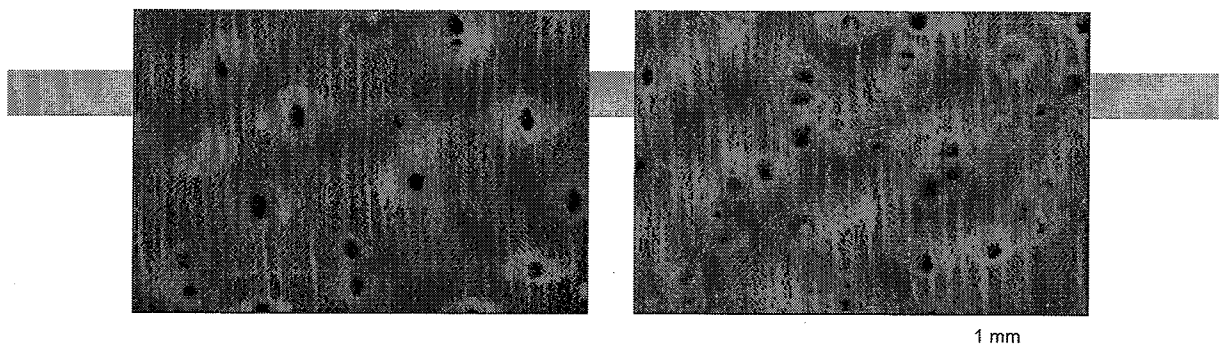
### **Tree Features**

**The tree** is about 26 to 40 m high, but in the Savanna conditions it is usually about 12 m only. It has a girth of up to 3 m, a bole of 10 to 16 m and a wide spreading crown with large branching system. **The bark** is rough-gray to brown and **the slash** is pinkish, granular, fibrous and gritty. **The leaves** are pinnate with a common stalk, 10-30 cm long and swollen at the base. The 3 to 8 pairs of leaflets are 3-15 cm long by 3.5-8.5 cm broad. **The leaflets** are elliptic and rounded at the base. **Flowers** appear from February to April in open panicles 8-20 cm long; inconspicuous and

strongly scented. The fruiting season is from April to July. **The fruits** about 10 to 15 cm long by 10 cm broad, up to 6 cm thick and are borne on stout stalks; very hard and split open explosively. **The seeds** are glossy black with a waxy orange aril, about 6 to 10 in a pod, ellipsoid and 20 to 40 mm long.

### **Wood Macroscopic Features**

**Pores** are medium to large, proportion of solitary pores medium to high with 2 to 4 radial multiples of same or different sizes, clusters rare, diagonal pattern, distribution low with inclusions. **Axial parenchyma** is paratracheal, aliform and confluent, marginal, very narrow straight bands, smaller than fibre tissue bands, irregular and widely spaced. Proportion of **fibre tissue** is low to medium.



**Ray parenchyma** narrow, uniform, less than  $\frac{1}{4}$  of vessel diameter, moderate frequency. Wood is diffuse porous, **growth ring** boundaries are demarcated by marginal parenchyma.

#### Physical Features and Splinter Burning Test

**Heartwood** reddish-brown, differentiated from the pale-yellow **sapwood**, coarse texture, often beautifully figured. Wood is hard and of **high density**.

**Splinter** burns to exude brown-coloured liquid component and forms grey ash.

#### Ecology and Silviculture

*Azelia africana* is a deciduous tree, thrives on voltaian sandstones and granitic soil with low inherent nutrient (Hall & Swaine, 1981). It is propagated by seed and transplants fairly well (Irvine, 1961). Seed germination under shade is epigeal and takes 12 to 24 days with a germination rate of nearly 90 % but growth is slow (Taylor, 1960). Seedlings require light to grow to maturity (Stark, 1986). Roots have ectotrophic mycorrhiza (Jenik & Mensah, 1967). It can be propagated by stump using 2-year-old plant (Taylor, 1960). The tree shows a fair resistance to fire, but is replaced where annual fires become severe. Leaves are susceptible to larvae defoliators of *Achaea catella* (Wagner *et al.*, 1991).

#### Ethnobotany

The leaves are used for treating generalized lumbago (Mshana *et al.*, 2000). The bark decoction is taken for constipation and stomach-ache. It is also said to be an aphrodisiac and mixed with *Tamarindus indica* (Indian tamarind), it is used as a diuretic, febrifuge and an emetic (Irvine, 1961). The root is an ingredient in preparation of arrow-poison, and the decoction is used in treating gonorrhoea (Mshana *et al.*, 2000). The fruit pods are rich in potassium salts, and are burnt to obtain ash which is commonly used to make soap (Irvine, 1961).

#### Commercial Uses

A **durable wood** used for the following:

- Boats, canoes and their components
- Claddings, panellings and mouldings
- Floorings, steps and stairs
- Furniture and cabinet works

## ***Albizia adianthifolia* (K. Schum.) W. Wight**

Family Name: **Mimosaceae**  
 Trade Names: **Albizia; latandza**  
 Local Names: **Pampena (Gh); Bangbaye (CI)**

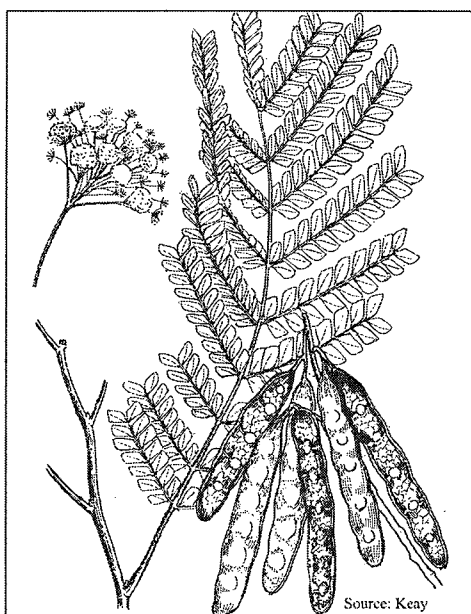
### **Synonyms**

*Albizia fastigiata* (E. Mey.) Oliv.

*Mimosa adianthifolia* K. Schum.

### **Distribution**

West, Central and East Africa, extending from Senegal to Uganda. Sparsely found in all forest zones of Ghana except the Wet Evergreen forest.



### **Status**

A lesser-used species of sparse distribution with low production and irregular export as part of the *Albizia* group. The prescribed minimum felling diameter is 90 cm, and is cited by IUCN (2004) as a lower risk near threatened species. Sawdust may cause some respiratory problems.

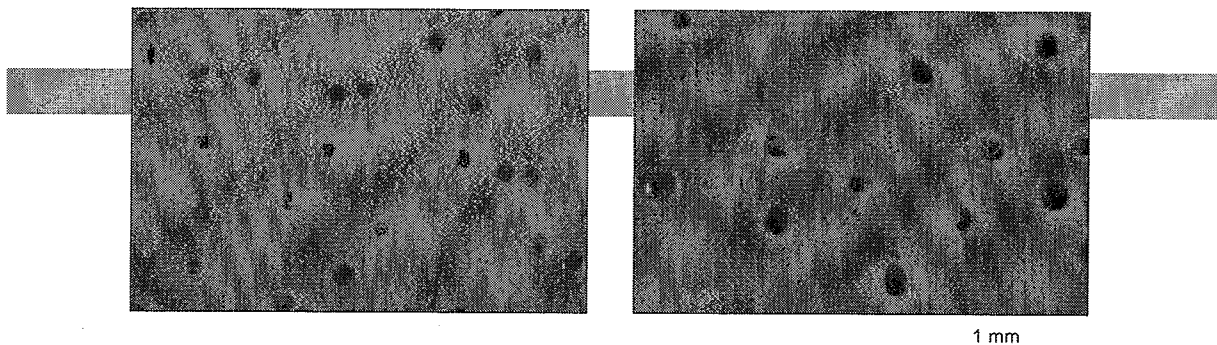
### **Tree Features**

The tree is 28 to 40 m high and 3 to 4 m in girth with a massive branching system and a flat crown. The bole is short without buttresses. The bark is normally smooth but sometimes finely fissured, brown to reddish-brown or dark-gray. The slash is granular, pink, brown or white and exudes clear gum. The twigs and young foliage are short and densely hairy. The leaves are bipinnate, with a hairy common stalk about 8 – 18 cm long,

with 5-8 pairs of equally hairy pinnae 8-10 cm long. There are 8 – 17 pairs of leaflets with glands between the upper pairs. The leaflets are about 6 to 18 mm long by 10 mm broad and are more or less rectangular. The greenish-white flowers, up to 2.5 cm across, are formed from November to April. The fruits mature from December to January, usually pale-brown, hairy, 10-20 cm long by 3 cm broad. They are pods rounded at apex with 4 to 12 seeds.

### **Wood Macroscopic Features**

Pores are medium, proportion of solitary pores is medium to high with 2 to 3 radial multiples of same size, diagonal pattern, distribution low, tyloses present. Axial parenchyma is paratracheal, vasicentric, aliform and confluent. Proportion of fibre tissue is medium to high. Ray parenchyma rarely distinct, very narrow and uniform, less than 1/4 of vessel diameter, moderate to high. Wood diffuse porous, growth ring boundaries demarcated by dark ground fibre tissue, differences in vessel diameter and absence of pores.



### Physical Features

**Heartwood** golden-yellow, demarcated from whitish-yellow **sapwood**, medium to coarse texture with low lustre. Wood is fairly hard and of **medium density**

### Splinter Burning Test

**Splinter** burns to produce crackle or bright sparks and forms partial black ash with gritty feeling.

### Ecology and Silviculture

*Albizia adianthifolia* is characteristic of secondary forests, forest edges, roadsides and abandoned farms. The tree is deciduous and somewhat common on dry infertile soils. Seed is dispersed by wind and propagation is by seed. Germination in shade is epigeal and takes about 13 to 17 days with a germination rate of about 90 % (Taylor, 1960). Seedling is light demanding and rapid growth occurs in gaps (Hall & Swaine, 1981). Taylor (1960) reports an annual diameter growth of 1 to 1.5 cm. It is a nitrogen-fixing species (Western & Hogberg, 1989), and is susceptible to various pests which prey on fruit, flower and seed (Wagner *et al.*, 1991).

### Ethnobotany

Irvine (1961) has summarised the following medicinal uses of the species. The powdered bark is considered haemostatic and antiseptic, and is applied to boils and sores. A decoction of the bark is given to clear the respiratory tract and sinuses from headcolds, headache and sinusitis. The powdered bark is taken with honey as a vermifuge and, when crushed with clay, is rubbed to heal itches. The root infusion is used as eyewash for conjunctivitis and sore eyes. A paste of the young shoot with snake gall is applied to oedema of the legs.

### Commercial Uses

A **non-durable wood** used for the following:

- Artifacts and handicrafts
- Claddings, panellings and mouldings
- Floorings, steps and stairs
- Furniture and cabinet works
- Veneer for plywood
- Tools, ornaments and turneries

### ***Albizia ferruginea* (Guill. & Perr.) Benth.**

Family Name: **Mimosaceae**

Trade Names: **Albizia, latandza**

Local Names: **Awiefosamina (Gh); latandza (CI)**

#### **Synonyms**

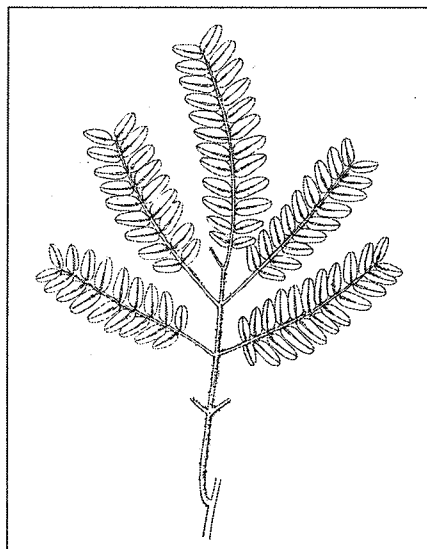
*Albizia macrophylla* (A. Rich) Walp.

*Albizia angolensis* Welw. ex Oliv.

*Inga ferruginea* (Guill. Perr.)

#### **Distribution**

West, Central and East Africa from Senegal to Uganda, and south to Angola. Moderately found in the Moist and Dry Semi-deciduous forests of Ghana.



#### **Status**

A lesser-used species of moderate occurrence, production is low with irregular export as part of the Albizia group of species. The prescribed minimum felling diameter is 90 cm, and is cited by IUCN (2004) as a vulnerable species. Sawdust may have adverse respiratory effects on human.

#### **Tree Features**

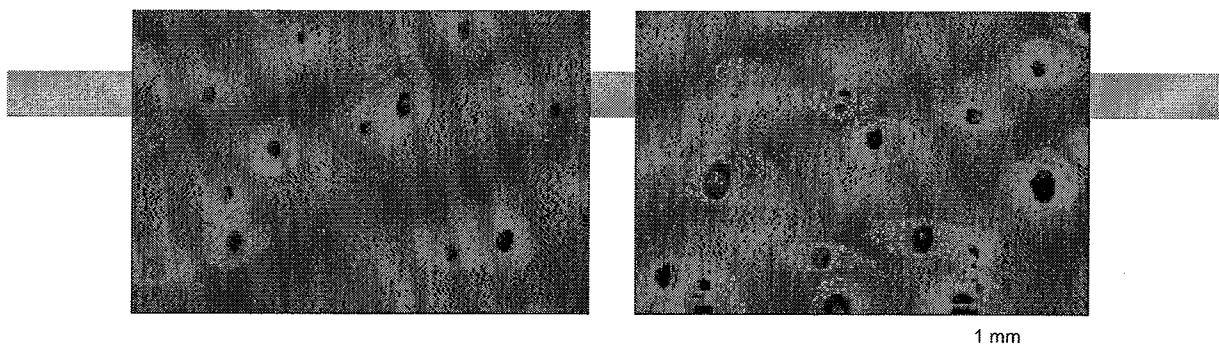
The tree is about 30 to 45 m high and 3 m in girth with a buttress but a clear bole of 20 m. It has a spreading flat-branching system with a domed crown. The bark is normally dark-grey and rough with scales. The slash is yellow, granular, fibrous, and exudes a reddish gum with soapy bitter taste. The leaves are bipinnate with rust-coloured hairs all over, with a common leaf stalk

12-40 cm long. The pinnae are usually 3 to 7 pairs, 6-16 cm long and 8 to 18 pairs of leaflets, 10-26 mm long by 6-10 mm broad. The leaflets are elongated, elliptic, rounded at the apex, and unequally rounded at the base. The greenish-white flowers appear from March to April, and measure 8-12 mm long in the bud with brush inflorescence and very short rusty hairs covering the outside of the calyx and corolla. The fruits are pods formed from December to March, about 10-18 cm long by 3-5 cm broad, bright reddish-brown, very flat, papery, glabrous, and rounded at both ends.

#### **Wood Macroscopic Features**

Pores large, proportion of solitary pores is medium with radial multiples of 2 to 3 different sizes, rarely clusters, moderate distribution. Axial parenchyma is paratracheal, vasicentric, aliform and confluent. Ray parenchyma indistinct at transverse but distinct at radial section, very narrow, uniform, less than 1/4 of vessel diameter, fairly high to high, storied. Wood is diffuse porous, and growth ring boundaries are demarcated by dark ground fibre tissue.





### Physical Features

**Heartwood** dark red-brown, demarcated from pale-yellow **sapwood** with coarse texture. Wood is hard and of **medium density**.

### Splinter Burning Test

**Splinter** burns to produce bright sparks, forms partial ash with gritty feeling.

### Ecology and Silviculture

*Albizia ferruginea* is common in secondary forests where it is found near forest swamps and rivers. It is a deciduous tree and grows on leached oxysols and ochrosols soil (Taylor, 1961). Smaller stems (5-30 cm dbh) are more abundant in undisturbed forests, but larger sizes are common in regenerated forest previously destroyed by fire (Hawthorne, 1994). The mode of propagation is usually by seed dispersed by wind (Hall & Swaine, 1981). Germination under shade is epigeal and occurs within 8-10 days with a germination rate of 88 % (Taylor, 1961). Seedlings are found in shade, but rapid growth occurs in gaps (Hall & Swaine, 1981). Height growth in gaps is 2-3 m in 5 years (Taylor, 1961). It produces epicormic shoots and coppices well (Irvine, 1960). The tree is susceptible to fruit pests and flowers, and to borers and defoliators (Wagner *et al.*, 1991).

### Ethnobotany

The stem-bark is used to treat sickle cell anaemia, gonorrhoea and wounds (Mshana *et al.*, 2000). The bark decoction is taken for dysentery and asthma and to wash sores, bronchial infections and fever pains (Burkill, 1985). A bark macerate or decoction is used for skin eruptions and pimples, while the leaf macerate serves as a mouthwash for toothaches. The young leaves, when dried and beaten to powder, are inhaled as snuff to cure headache, and the powdered root-bark in water with salt is drunk to cure constipation in Nigeria (Irvine, 1961). The leaves lather in water and contain saponin.

### Commercial Uses

A **durable wood** used for the following:

- Claddings and panellings
- Floorings, steps and stairs
- Decorative furniture, cabinet and doors
- Veneer for plywood
- Turneries, ornaments and coffins

## ***Albizia zygia* (DC.) J.F. Macbr.**

Family Name: **Mimosaceae**

Trade Names: **Albizia; latandza**

Local Names: **Okoro (Gh); Omulera (E, K, T, U); Bangbaye (CI)**

### **Synonyms**

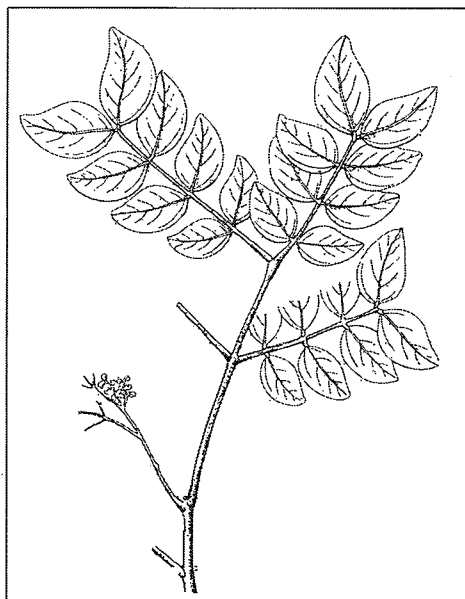
*Albizia brownei* (Walp.) Oliv.

*Inga zygia* DC.

*Zygia brownei* Walp.

### **Distribution**

West, Central and East Africa from Senegal to Angola. Moderately occurs in all forest types of Ghana except the Wet Evergreen.



### **Status**

A **lesser-used species** of moderate occurrence, production is very low with irregular export as part of the *Albizia* group of species. The prescribed minimum felling diameter is 90 cm, and is cited by IUCN (2004) as a lower risk least concern species.

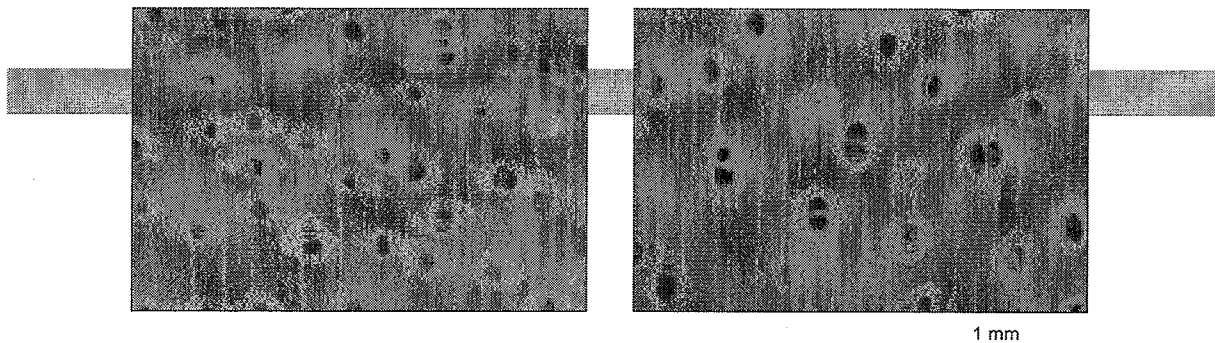
### **Tree Features**

**The tree** is about 20 to 30 m high and 2.5 m in girth. It has widely spread branching system, well-shaped bole, and sometimes well-developed buttresses. **The bark** is usually grey and fairly smooth, but may be slightly fissured. **The slash** is granular, thin and yellowish or orange-brown, exuding a brown gum. **The leaves** are bipinnate on common stout stalk, 6-20 cm long usually with 2-3 pairs of pinnae, 5-10 cm long with 3-4 pairs of leaflets on each pinna. The top pair is very asymmetrical and

larger, but the other leaflets are progressively smaller downwards, more or less like a parallelogram. All the leaflets are glossy and glabrous. **The flowers** appear from February to April, white with red stamen-tube, 10-12 mm long and 12 mm across with brush inflorescence. **The fruits** are flat thin mature pods formed from January to May, glabrous, brown and glossy. Each fruit is 10-20 cm long by 2-3.5 cm broad, containing 9 to 12 medium size seeds per fruit.

### **Wood Macroscopic Features**

**Pores** medium, proportion of solitary pores medium with 2 to 3 radial multiples of same size, distribution low, gum inclusions present. **Axial parenchyma** is paratracheal, vasicentric, aliform and confluent. **Fibre tissue** proportion is medium to high. **Ray parenchyma** very narrow, uniform, ¼ of vessel diameter, moderately distributed. Wood diffuse porous, **growth ring** boundaries demarcated by dark ground **fibre tissue**, differences in vessel diameter and absence of pores.



### Physical Features

**Heartwood** light pinkish-brown or yellow-brown, clearly demarcated from the yellowish-white **sapwood**, coarse texture and slightly lustrous. Wood is fairly hard and of **medium density**.

### Splinter Burning Test

**Splinter** burns to exude coloured liquid and forms grey ash.

### Ecology and Silviculture

*Albizia zygia* is a deciduous tree commonly found in secondary forests, but shows no preference for wet or dry forest, base-poor or base-rich soils. It is common in dry and moist forest, swamps or near rivers (Swaine & Veenendaal, 1994). It is propagated by seed which is dispersed by wind (Hall & Swaine, 1981). Seeds germinate in shade but seedlings grow best in gaps (Hawthorne, 1995). Germination occurs in 4 to 12 days with rapid growth in early stage reaching a height of up to 3 m in 2 years when grown in gaps (Taylor, 1960). Kahn (1982) recorded 80 cm dbh in a 40-year-old tree from secondary forest. All sizes of tree are more abundant in undisturbed forest previously disturbed by fire (Hawthorne, 1994). The fruit, flower and seed are easily attacked by insects, tree borers and defoliators (Wagner *et al.*, 1991).

### Ethnobotany

The sap in the bark is applied on eye diseases (Burkill, 1985). A macerate is given in draught for stomach complaints, and a decoction is taken as a drastic purge to counter female sterility and to expel intestinal worms (Irvine, 1961). The bark is made into vapour baths for chest ailment and to ease fever pains and stiffness. The root powder used in soup is considered a cough remedy. The bark decoction is used for treating stomach-ache by Yorubas of Nigeria (Irvine, 1961).

### Commercial Uses

A **moderately durable wood** used for the following:

- Boat construction
- Floorings, steps and stairs
- Furniture and cabinet works
- Joinery and frames
- Veneer, plywood and particleboard
- Tools and turneries

## ***Allanblackia floribunda* Oliv. A. Chev.**

Family Name: **Guttiferae**

Recommended Trade Names: **Allanblackia; Tallow Tree; Bundji**

Local Names: **Sonkyi (Gh); Ouotera (CI)**

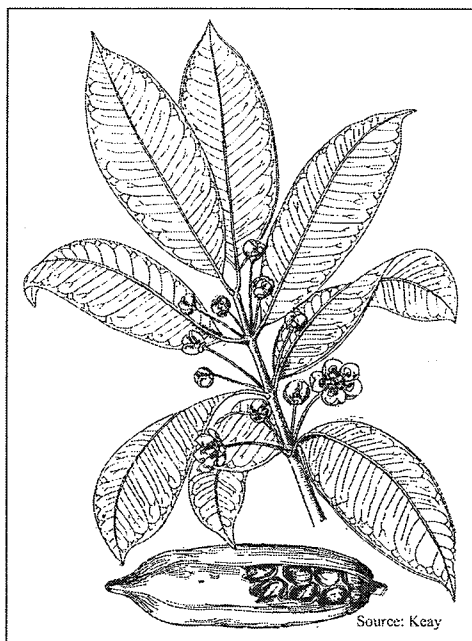
### **Synonyms**

*Allanblackia parviflora* A. Chev

*Allanblackia klainei* Pierre

### **Distribution**

West, Central and East Africa, extending from Sierra Leone to Democratic Republic of Congo (Zaire) and Angola. Frequently found in Evergreen and Moist Semi-deciduous forests of Ghana.



### **Status**

A **lesser-known species** of frequent forest availability, production is low for local use only. No felling diameter has been prescribed, and 70 cm is recommended. It is cited by IUCN (2004) as a lower risk least concern species.

### **Tree Features**

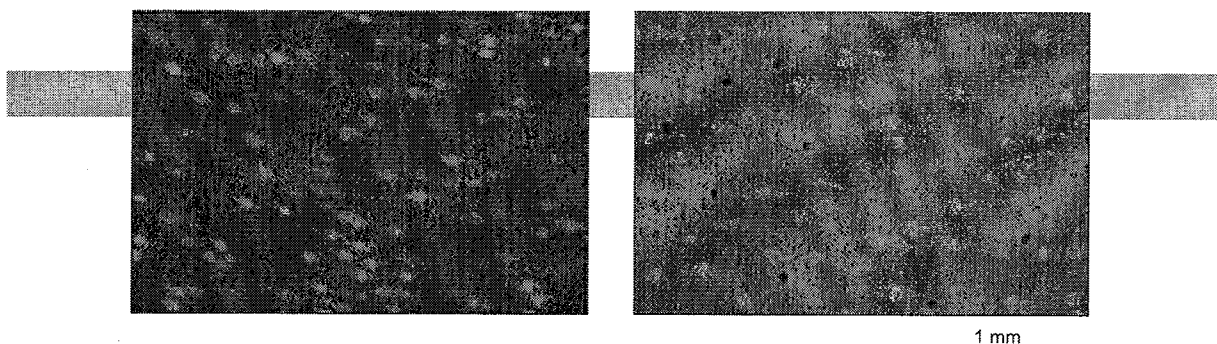
**The tree** is up to 30 m high and rarely above 2.3 m in girth. **The bole** is straight, but occasionally fluted. **The bark** is dark-brown and patchy with small rectangular or circular scales. **The slash** is thin and reddish at the surface but yellowish beneath and exudes sweet sticky yellow juice. **The branches** are conspicuously whorled, slender and drooping. **The leaves** are simple and whorled, 12-24 cm long by 4-8 cm broad. They are elliptic with many pairs of very thin lateral nerves.

**The flowers** are very fragrant, pink or red,

formed from September to February. They are up to 6 cm across with a stout stalk 3-5 cm long. **The fruits** are sausage-shaped, available at most seasons of the year. They are brown and slightly grooved longitudinally, up to 40 cm long, and 16 cm in diameter. **The fruits** taper at each end and hang at the end of a short stalk. Each fruit contains up to 50 large brittle-shelled seeds, about 3 cm long by 20 mm in diameter, embedded in a pinkish gelatinous pulp.

### **Wood Macroscopic Features**

**Pores** small, indistinct to naked eye, exclusively solitary, moderate distribution with gum inclusions. **Axial parenchyma** barely distinct to naked eye, paratracheal, aliform and confluent. Proportion of **fibre tissue** is high. **Ray parenchyma** is indistinct at transverse section but rarely distinct on radial section, very narrow, uniform, less than 1/4 to 1/2 vessel diameter, high frequency. Wood is diffuse porous.



### Physical Features

**Heartwood** pale or yellowish-brown, not clearly demarcated from the **sapwood**. It has fine texture with low lustre. Wood is hard and of medium to **high density**.

### Splinter Burning Test

**Splinter** burns to form full yellow-brown ash.

### Ecology and Silviculture

*Allanblackia floribunda* is an evergreen tree scattered throughout the Semi-deciduous forest and on the slopes of Evergreen forest. It is sometimes found on dry land outside Evergreen forest. The tree does well on soils lower in calcium, potassium and magnesium with a pH of 3.8 to 4.1 (Hall & Swaine, 1981). It is propagated by seed and germination under shade is hypogeal. It is a shade bearer (Hawthorne, 1995).

### Ethnobotany

The pounded resinous bark is used as an analgesic (pain reliever), while the bark decoction is used to relieve pain from toothache, diarrhoea or dysentery (Irvine, 1961; Burkhill, 1995; Mshana *et al.*, 2000). The tree yields resin while the seeds give oil suitable for making soap (Abbiw, 1991; Irvine, 1961). Commercial production of fruits for industrial use has started in Ghana.

### Recommended Commercial Uses

A **non-durable wood** promoted for the following uses:

- Furniture and cabinet
- Tool handles and turneries
- Particleboard and chipboard

***Alstonia boonei* De Wild.**

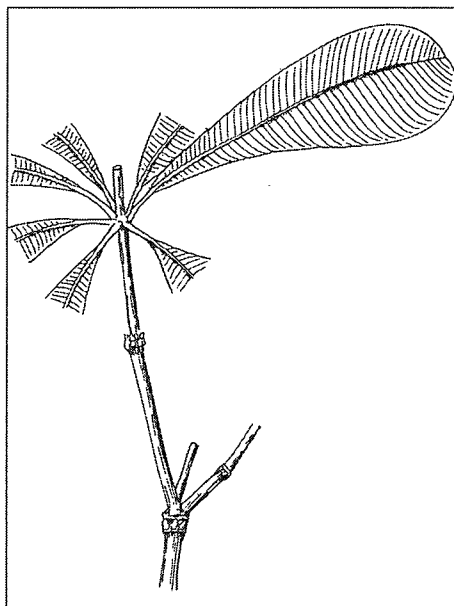
Family Name: **Apocynaceae**  
 Trade Names: **Alstonia; Emien**  
 Local Names: **Sinduro (Gh); Ekuk (Ca); Emien (CI)**

**Synonyms**

*Alstonia congensis*

**Distribution**

West, Central and East Africa, extending from Senegal to Ethiopia, and south to Democratic Republic of Congo (Zaire) and Uganda. Frequently found in all forest types of Ghana except the Wet Evergreen forests.

**Status**

A **lesser-used species** of frequent forest occurrence, very low production for occasional export. The prescribed felling diameter is 110 cm and is cited by IUCN (2004) as a lower risk least concern species.

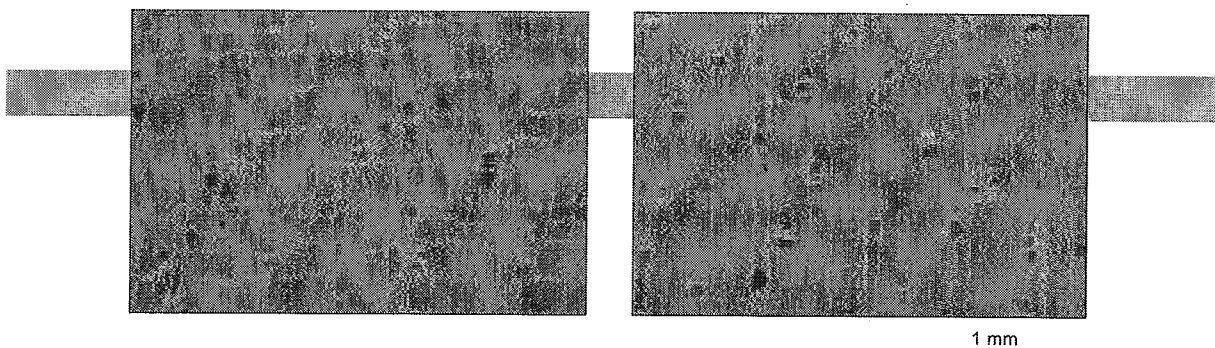
**Tree Features**

**The tree**, with typical pagoda-like branching system, is up to 40 m high and 3.0 m in girth. **The clear bole** is about 25 m, often fluted, sometimes with buttresses. **The bark** is brownish, fairly rough with lenticels. **The slash** is light-brown with white streaks and exudes copious white latex. **The leaves** are simple, in whorls of 5 to 8 on the twig, 12-20 cm long by 6-8 cm broad. They are oblanceolate to obovate, tip-rounded, up to 50 pairs of straight lateral nerves at right angles to the midrib. **The flowers** are small, yellowish-white and in umbel-like

clusters, formed from October to March. **The fruits** mature from December to May and hang down in a pair of follicles up to 60 cm long by 6 mm thick. They are hairy, each contains 3-4 elongated plumose seeds about 6 mm long, with a tuft of long silky hairs at each end dispersed by wind.

**Wood Macroscopic Features**

**Pores** medium, proportion of solitary pores low with 2 to 4 radial multiples of same or different sizes, distribution low to moderate, gum inclusions occasionally present. **Axial parenchyma** indistinct to the naked eye, apotracheal, reticulate, very narrow straight bands smaller than fibre tissue bands, regularly spaced with narrow distance between parenchyma bands. **Fibre tissue** proportion is medium to high. **Ray parenchyma** is very narrow to narrow, uniform, width less than  $\frac{1}{4}$  of vessel diameter, moderate frequency. Wood is diffuse porous.



### Physical Features

**Heartwood** yellowish-white, not differentiated from **sapwood**. Texture is medium with low lustre. Wood is soft and of low to **medium density**.

### Splinter Burning Test

**Splinter** burns to exude coloured liquid and forms white ash.

### Ecology and Silviculture

*Alstonia boonei* is a common deciduous tree found on wetter sites in secondary forests. The tree also grows well in disturbed areas and dry forest hills. It tolerates swampy soils and well-drained sites (Hall & Swaine, 1981). The seedlings are usually grown from seeds which are dispersed by wind, but stripped or stumped planting is possible (Taylor, 1960). It is a pioneer species and the seeds germinate in gaps with epigeal germination that takes 15-25 days (Hall & Swaine, 1981; Taylor, 1960). Germination rate is about 85 % at the end of 6 months. Seedlings grow rapidly in gaps with height increment of 2 m in the 1st year (Taylor, 1960). It coppices readily (Taylor, 1960). Natural regeneration is prolific, and it is more common in forest previously disturbed by fire (Hawthorne, 1995).

### Ethnobotany

The bark and the root are febrifuge used for treating malaria, and as an anthelmintic for jaundice (Burkill, 1985). The bark decoction is applied to sores, ulcers and to snake bites. The most popular use of the bark is to assuage toothache; the Akan name 'sinduro' being a corruption of the local meaning of 'toothache' (Abbiw, 1991). A decoction of the bark is given to promote expulsion after birth (Irvine, 1961), for treatment of boil, malaria and rheumatism (Mshana *et al.*, 2000). The latex is dangerous and can cause blindness, but can be used to treat scabies (Burkill, 1985). The roots, bark and leaves are used externally for rheumatism and as vermifuge and pain killer (Irvine, 1961; Burkill, 1985). The bark alone is used for treatment of jaundice and yellow fever (Burkill, 1985). The latex, bark and root are used as febrifuge; latex and bark as poisonous antidote; and the leaf for dropsy, oedemas, and gout treatment (Burkill, 1985).

### Commercial Uses

A **non-durable wood** used for the following:

- Boxes, crates and light pallets
- Interior joinery, frames and trims
- Match boxes, splints and pencils
- Rotary veneer for plywood

## ***Amphimas pterocarpoides* Harms**

Family Name: **Papilionaceae**  
 Trade Names: **Amphimas; Lati**  
 Local Names: **Yaya (Gh); Edzui (Ga); Lati (CI)**

### **Distribution**

West and Central Africa, extending from Guinea to Democratic Republic of Congo (Zaire). It is moderately found in all major forest types of Ghana, especially the Moist Evergreen forest.

### **Status**

It is a **lesser-used species** of moderate occurrence, with moderate production for irregular export. The prescribed minimum felling limit is 90 cm, and is rated by IUCN (2004) as a lower risk least concern species.



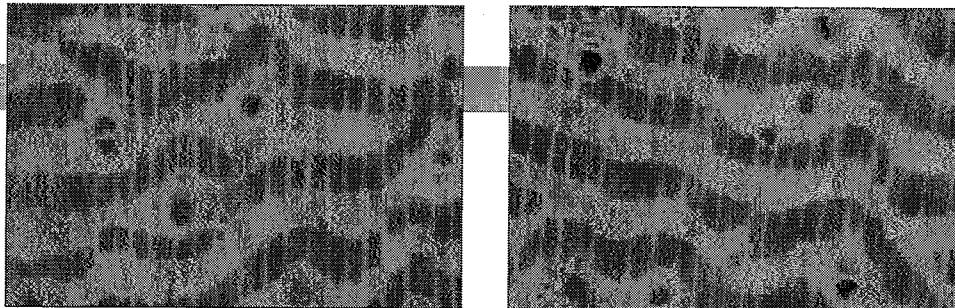
### **Tree Features**

**The tree** has a wide-spreading and flattened crown, and is about 45 to 50 m high and 3 to 4 m in girth. **The bole** is straight and cylindrical, up to about 25 m with small blunt buttresses. **The bark** is dark-grey, rough and normally flakes off in rectangular patches. **The slash** is orange to brown and gummy with red exudates. **The branches** are somewhat whorled and at right angles to the trunk. **The leaves** are pinnate, up to 30 cm long, with a terminal leaflet and 5-10 pairs of opposite or sub-opposite leaflets measuring 6-12 cm long by 2-4 cm broad, variable in size and shape. **It flowers** from September to October, very small, yellowish, mostly appearing in densely crowded racemes when the tree is leafless. **The fruits** mature in February, hanging down conspicuously like leaves. They are 15-20 cm long by 4-6 cm broad, flat and papery pods, elongated-elliptic with a solitary kidney-shaped seed.

### **Wood Macroscopic Features**

**Pores** medium to large, proportion of solitary pores medium with radial multiples of 2 to 3 of same and different sizes, low in distribution. **Axial parenchyma** paratracheal, confluent, wide wavy bands, equal to or greater than fibre tissue bands, regular to irregularly spaced with narrow space between parenchyma bands. Proportion of **fibre tissue** is low to medium. **Ray parenchyma** indistinct at radial surface, very narrow, uniform width less than  $\frac{1}{4}$  of vessel diameter, moderate to high frequency, storied. Wood is diffuse porous.





1 mm

### Physical Features

**Heartwood** yellowish-brown, not clearly demarcated from the yellowish-white **sapwood**. **Texture** is coarse with low lustre. Wood is hard and of **high density**.

### Splinter Burning Test

**Splinter** burns to form full black ash.

### Ecology and Silviculture

*Amphimas pterocarpoides* is a deciduous tree which is less abundant in dry forests, swamp or disturbed forests. Propagation is by seed, dispersed by wind (Hall & Swaine, 1981). Germination in shade is epigeal, takes about 22 days with about 95 % germination rate (Taylor, 1960). Growth is irregular but rapid where open conditions exist. It is more abundant in forest previously disturbed by fire (Hawthorne, 1984).

### Ethnobotany

The exudate of red resin is used to treat dysmenorrhoea, schistosomiasis and blennorrhoea, and as antidote for poison (Irving, 1961). The bark is chewed for coughs, and is added to steam bath for treating yaws, hyperkeratosis, and other sores on the soles of the feet (Abbiw, 1990).

### Commercial Uses

A **moderately durable wood** used for the following:

- Beams and joists
- Sleepers and crossties
- Interior joinery
- Roof trusses and joists
- Floorings, steps and stairs
- Panellings, mouldings and trims
- Common furniture and cabinet works
- Decorative veneer for plywood

## **Aningeria altissima (A. Chev.) Aubrev. & Pellegr.**

Family Name: **Sapotaceae**

Trade Names: **Aningré; Asanfena**

Local Names: **Asanfena (Gh); Mukali (A, Co); Aningré (CI)**

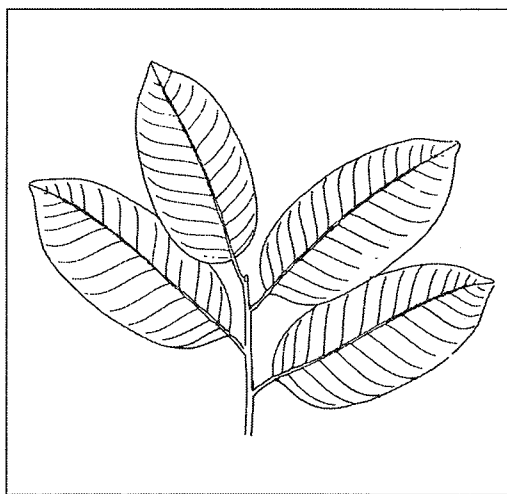
### **Synonyms**

*Hormogyne altissima* A. Chev.

*Pouteria altissima* (A. Chev.) Baehni

### **Distribution**

West, Central and East Africa, from Guinea to Gabon and Uganda. Moderately found in Dry Semi-deciduous forest and sparsely in the Savanna woodland of Ghana



### **Status**

A **lesser-used species** of medium forest occurrence, with very high production and frequent export. It is usually sold as a mixed parcel with other *Aningeria* species. The minimum felling diameter is 90 cm. It is cited by IUCN (2004) as a lower risk near threatened species.

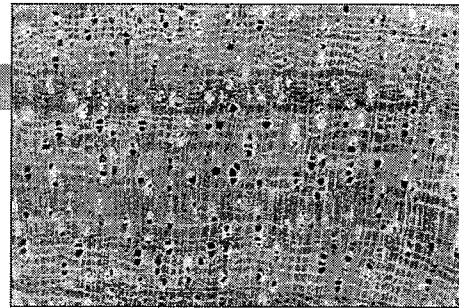
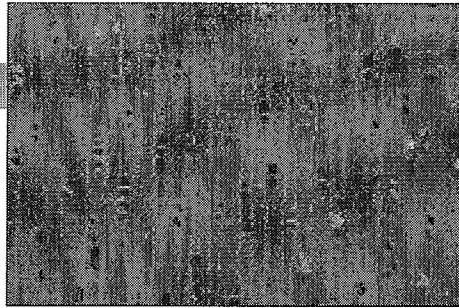
### **Tree Features**

**The tree** is about 35 m high, a girth of 3.4 m with a wide-spreading crown. **The bole** is straight and cylindrical up to 26 m with narrow buttresses. **The bark** is grayish-white, smooth with shallow longitudinal fissures. **The slash** is

brownish outside but whitish with dark-brown streaks inside and exudes white latex. **The leaves** are simple up to 15 cm long by 6 cm broad. They are obovate, acute or acuminate at the apex with inconspicuous hairs on upper surface. The lower surface of the leaf is glaucous, but veins are not very prominent. The 12 to 18 pairs of lateral nerves are connected to each other by prominent veins at the upper surface. **The creamy-white flowers** are formed in January, six in the leaf axil together, and are densely covered with reddish hairs. **The berry fruits** mature in May, bright-red, about 10 mm long, covered with short hairs, and one large seed.

### **Wood Macroscopic Features**

**Pores** are small, barely distinct to naked eye, solitary pores low, radial multiples of 2 to 4 of same size, rarely more than 4, low to moderate distribution, gum inclusions present. **Axial parenchyma** indistinct to the naked eye, apotracheal, straight-banded, reticulate, very narrow width smaller than fibre tissue bands, regularly spaced, narrow distance between bands. **Fibre tissue** proportion is low to medium. **Ray parenchyma** is barely distinct to naked eye, very narrow, uniform width less than ¼ of vessel diameter, high frequency. Wood diffuse porous, **growth ring** boundaries rarely distinct, demarcated by dark ground fibre tissue.



1 mm

### Physical Features

**Heartwood** yellowish-brown or pale-brown, not clearly demarcated from **sapwood**; texture fine and moderately lustrous. Wood is fairly hard and of **medium density**.

### Splinter Burning Test

**Splinter** burns to exude coloured liquid and forms grey ash.

### Ecology and Silviculture

*Aningeria altissima* is a deciduous tree occurring in drier extremes of Semi-deciduous forests, but extends into the riverine forest of the Savanna woodland. It is propagated under shade by seed, dispersed by birds, with hypogeal germination (Hawthorne, 1995). Seedlings grow under forest shade but require light to grow faster. It is believed to suffer from die-back in Uganda when planted near pine plantations (Struhsaker *et al.*, 1989).

### Ethnobotany

Bark is used in Sierra Leone for making bark cloth (Irvine, 1961). The leaf decoction is for treating eye disease, the gum is used as laxative, and the bark for leprosy treatment (Burkill, 1985).

### Commercial Uses

A **moderately durable wood** used for the following:

- Beams and joists
- Frames, trims and interior joinery
- Panellings and mouldings
- Steps and stairs
- Furniture and luxury cabinet works
- Decorative and sliced veneer for plywood

## **Anogeissus leiocarpus (DC.) Guill. & Perr.**

Family Name: **Combretaceae**

Recommended Trade Names: **Anogeissus; Kane**

Local Name: **Sakane (Gh)**

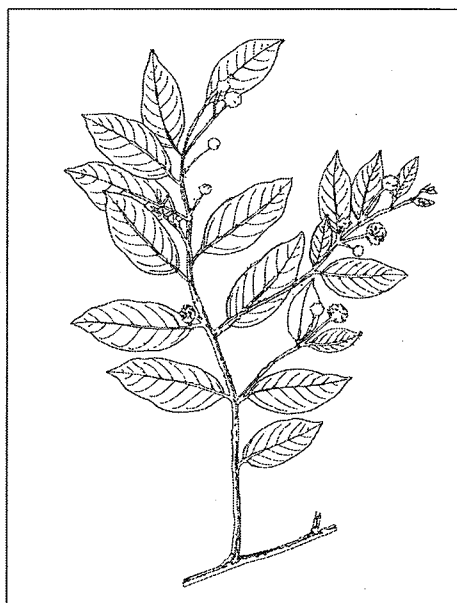
### **Synonyms**

*A. leiocarpa* (DC.) Guill. & Perr.

*A. schimperi* Hochst.ex Hutch. & Dalz

### **Distribution**

West, Central and East Africa, extending from Senegal to Sudan and Ethiopia. It occurs sparsely in Savanna woodland with transitional patches in Dry Semi-deciduous forest of Ghana.



### **Status**

It is a **lesser-known species** with sparse distribution yet to be exploited. No prescribed minimum felling diameter and 70cm is recommended. Cited by IUCN (2004) as a lower risk least concern species.

### **Tree Features**

**The tree** is about 30 m high and 3 m in girth. **The bark** is grey, flaky and darkens with age, peeling off in thin patches. **The slash** is yellow with dark streaks and exudes a brown gum. **The branches** and young foliage are dense, often with silky hairs. **The leaves** are small and simple, 3 – 8 cm long by 15-30 mm broad. They are elliptic to ovate-lanceolate, entire margin, alternately arranged and acute at the tip with the midrib projecting in a short spine.

**The flowers**, formed from July to November,

are greenish-yellow and in compact globose heads on a stalk up to 10 mm long. **The fruits** are samara and scale-like with one kidney-shaped seed.

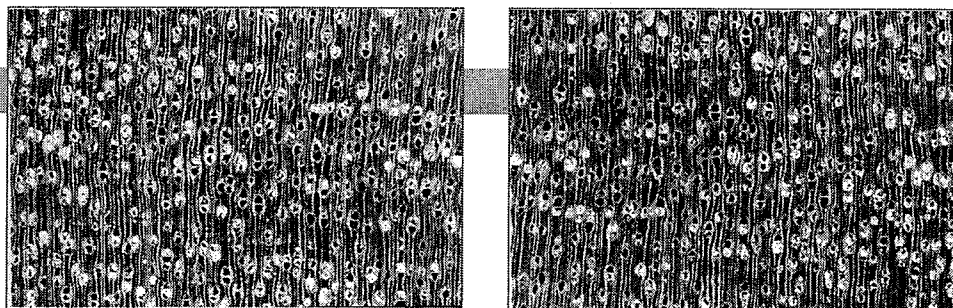
### **Wood Macroscopic Features**

**Pores** indistinct to the naked eye, small, proportion of solitary pores low with 2 to 3 radial multiples of same size, moderate distribution with gum inclusions. **Axial parenchyma** is indistinct and not visible with hand lens. **Fibre tissue** proportion is low to medium.

**Ray parenchyma** is indistinct to the naked eye at transverse but distinct at radial section, very narrow, uniform width less than ¼ of vessel diameter, high frequency. Wood is diffuse porous.

### **Physical Features**

**Heartwood** is dark-brown, demarcated from **sapwood** which is yellowish-grey and fine texture. Wood is very hard and of **high density**.



1 mm

### Splinter Burning Test

**Splinter** burns to produce crackle or bright sparks and forms grey ash.

### Ecology and Silviculture

*Anogeissus leiocarpus* is a deciduous tree common near river banks in the Savanna and dry forests (Hall & Swaine, 1981). It is a colonizer and is known for shading off grass. It is propagated by seed, dispersed by wind, but has poor germination rate of only 5% due to low fertility of fruits (Some, 1990). Seedlings, however, transplant quite well. It is fire resistant and notably abundant around abandoned settlements in the Savanna. Large trees are more abundant in undisturbed forest (Hawthorne, 1995).

### Ethnobotany

The powdered bark with exudating gum is used for treating toothache, and a decoction from the bark of twigs is used to clean syphilitic sores (Irvine, 1961). This decoction, together with red peppers, is taken internally for body and chest pains and as a febrifuge (Irvine, 1961). The plant is useful in preparations for curing stomach pains and for schistosomiasis. The root bark is used as a stimulant and an aphrodisiac (Abbiw, 1990). The leaves are taken with other drugs to treat leprosy (Irvine, 1961). The bark is used for treating chest pain, cough, diarrhoea, syphilitic ulcers, and toothache (Mshana *et al.*, 2000; Burkill, 1985).

### Recommended Commercial Uses

A **durable wood** promoted for the following uses:

Boats, canoes and their components

Heavy construction

Poles, posts and stakes

House framing and joinery

## **Anopyxis klaineana (Pierre) Engl.**

Family Name: **Rhizophoraceae**  
 Trade Names: **Anopyxis; African White Oak**  
 Local Names: **Kokote (Gh); Noudougou (Ca); Bodioa (CI)**

### **Synonyms**

*A. ealaensis* Sprague  
*A. occidentalis* A. Chev.  
*Macarisia ealaensis* (De Wild) Sprague  
*Macarisia klaineana* Pierre  
*Pynaertia elensis* De Wild



### **Distribution**

West and Central Africa, extending from Sierra Leone to Democratic Republic of Congo (Zaire). Sparsely found in all forest zones of Ghana, especially in the Wet Evergreen.

### **Status**

A **lesser-used species** with sparse distribution, very low production for occasional export. Allowable minimum felling diameter is 70 cm, and is cited by IUCN (2004) as a vulnerable species.

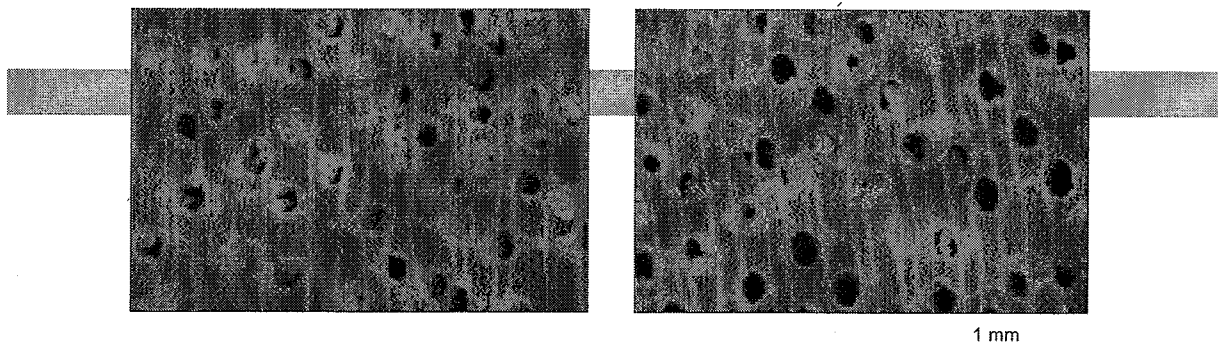
### **Tree Features**

**The tree** is evergreen, 50 m high and about 3.0 m in girth. **The bole** is straight and cylindrical, about 30 m high, without buttresses but swollen base. **The branching system** is regular and topped with a dense dark-green symmetrical crown. **The bark** is scaly and smooth. **The slash** is thick,

granular, pale or orange-pink turning rusty brown. **The leaves** are simple, in whorls of threes or fours, margin recurved, measuring 5-13 cm long by 3-5 cm broad. They are glossy, elliptic with entire margin and 6 to 10 pairs of inconspicuous upcurving lateral nerves. The white flowers are available at most seasons, in small clusters with solitary inflorescence in the leaf axils at the end of the shoots. **The fruits** are capsules, available at most seasons, erect, obovoid, about 3 cm long by 18 mm thick. They are covered with short velvety hairs with a large persistent calyx at the base with up to 10-winged small seeds.

### **Wood Macroscopic Features**

**Pores** large, exclusively solitary, low to moderate distribution, diagonal pattern, gum inclusions present. **Axial parenchyma** indistinct to the naked eye, paratracheal, vasicentric, aliform and confluent. **Fibre tissue** proportion is low to medium. **Ray parenchyma** very narrow to narrow,



variable size, width less than  $\frac{1}{4}$  to  $\frac{1}{2}$  of vessel diameter, moderate frequency. Wood is diffuse porous.

#### Physical Features

**Heartwood** pale-brown or yellow-brown, clearly demarcated from the slightly paler **sapwood** with coarse texture. Wood is very hard and of **high density**.

#### Splinter Burning Test

**Splinter** burns to exude coloured liquid and forms grey ash.

#### Ecology and Silviculture

*Anopyxis klaineana* is an evergreen tree with monotypic genus. It is propagated by seed, dispersed by wind, and germinates in shade with poor viability (Taylor, 1960; Hall & Swaine, 1981). Seedlings grow better in the open or in light shade (Hawthorne, 1995).

#### Ethnobotany

The astringent bark and the leaves are applied to sores and skin infections (Irvine, 1961). The leaves are used to treat wounds while the roots are used for treating constipation (Mshana *et al.*, 2000).

#### Recommended Commercial Uses

A **non-durable wood** used for the following:

- Artifacts and handicrafts
- Heavy construction and structural works
- Industrial roof, trusses, beams and joists
- Industrial floorings, parquets and steps
- Panellings and mouldings
- Vehicle body
- Sleepers, crossties, deckings and piles

***Antiaris toxicaria* Lesch.**

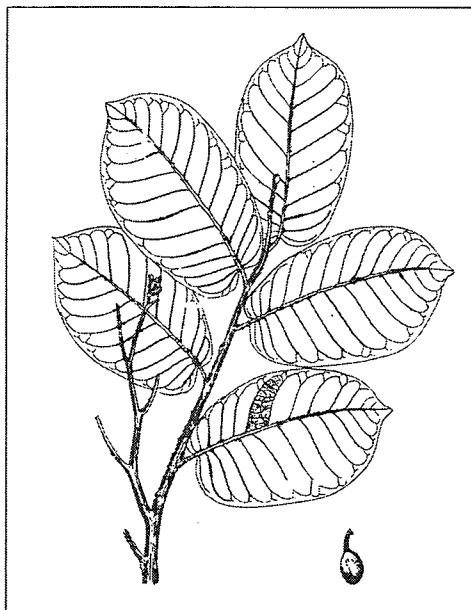
Family Name: **Moraceae**  
 Trade Names: **Antiaris; Ako, Chenchén**  
 Local Names: **Kyenkyen (Gh); Bonkonko (Z); s (CI)**

**Synonyms**

*Antiaris welwitschii* Engl.  
*Antiaris africana* Engl.  
*Antiaris macrophylla* R. Br.

**Distribution**

West, Central and East Africa, extending from Senegal to Democratic Republic of Congo (Zaire), Sudan and Uganda. Found in all forest types and transition zones in Ghana, especially in the Moist Semi-deciduous forest.

**Status**

A **commercial species** of frequent forest occurrence, very high production with very regular export. Prescribed minimum felling diameter is 110 cm, and is cited by IUCN (2004) as a lower risk near threatened species. Sawdust can cause dermatitis and have poisonous effects on humans.

**Tree Features**

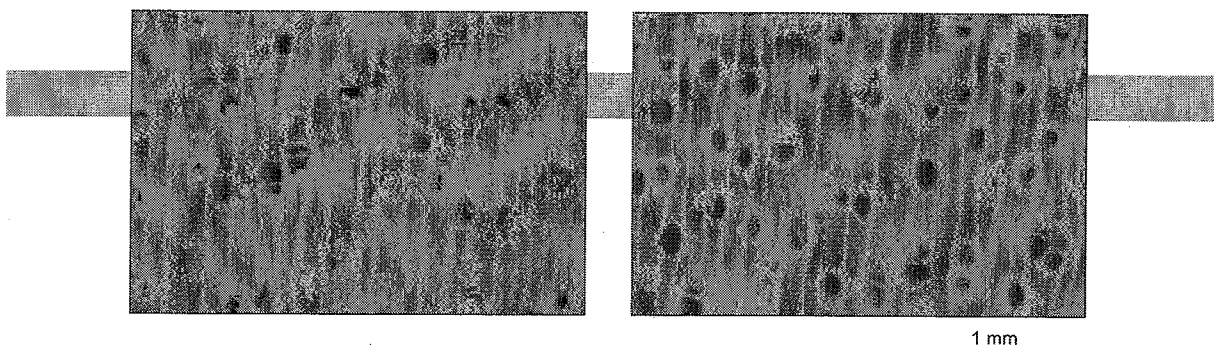
**The tree** is 40 to 50 m high and 4.5 m in girth, with cylindrical bole up to 23 m and rounded buttresses. **The bark** is gray and smooth. **The slash** is fibrous and brown to yellowish-white and exudes watery milky brown latex. **The leaves** are simple, alternate, 10-15 cm long and 4-12 mm broad. They are somewhat asymmetrical, broadly elliptic, thick, and leathery. **The flowers** are

formed from December to January after old leaves fall off. The species is sometimes claimed to be dioecious, but most species examined in Ghana are reported to be monoecious. The male flowers are minute, 15-25 mm across; female flowers are club-shaped, about 6 mm long. **The bright-red fruits** which mature from January to March, are finely velvety and ellipsoid, 14-17 mm long with one seed per fruit.

**Wood Macroscopic Features**

**Pores** large, proportion of solitary pores medium and 2 to 3 radial multiples of different sizes, low to moderate distribution, inclusions present. **Axial parenchyma** is indistinct to the naked eye, paratracheal, vasicentric, aliform and confluent. **Fibre tissue** proportion is low. **Ray parenchyma** very narrow to narrow, variable width between  $\frac{1}{4}$  and  $\frac{1}{2}$  diameter of vessel, moderate frequency.





Wood is diffuse porous, **growth ring** boundaries demarcated by dark ground **fibre tissue** and differences in vessel diameter.

#### Physical Features and Splinter Burning Test

**Heartwood** yellowish-white or golden-yellow, not clearly demarcated from the **sapwood** with medium to coarse texture and low lustre. Wood is soft with low to **medium density**. Splinter burns to form grey ash.

#### Ecology and Silviculture

*Antiaris toxicaria* is a large deciduous tree common throughout the forest zone and in galleries within the Savanna zone. It is propagated by seed which germinates in shade, with hypogeal germination up to 19 days at a rate of 90 % when seed is fresh. Growth is rapid, about 50 cm per year in exposed conditions (Taylor, 1960). Regeneration is less abundant in forest previously disturbed by fire, and larger tree classes are found in undisturbed forest (Hawthorne, 1994). Sap feeders and insect borers are common pests of the tree while seedlings are prone to aphid attack, causing die-bark of the shoot (Wagner *et al.*, 1991).

#### Ethnobotany

In ancient times the bark was beaten and used as cloth which resulted in the common name 'bark cloth tree' (Abbiw, 1990). The bark is used in enemas during pregnancy confinement to hasten expulsion of the placenta (Irvine, 1961). A decoction is drunk or used as a bath for leprosy and as a gargle for throat troubles, while the latex is used in preparing an arrow poison (Irvine, 1961). The seeds are used for treating headache and the stem-bark for epilepsy (Mishana *et al.*, 2000).

#### Commercial Uses

A **non-durable wood** used for the following:

- Joinery (external or internal), frames and trims
- Claddings, panellings and mouldings
- Core veneer for plywood
- Artifacts, carvings and handicrafts
- Particleboard, cement board, chip board and flake board
- Boxes and crates
- Food containers, fruit and packing cases

**Antrocaryon micraster A. Chev. & Guill.**

Family Name: **Anacardiaceae**

Trade Names: **Antrocaryon; Onzabili**

Local Names: **Aprokuma (Gh); Ngongo (A, Co); Akoua (CI)**

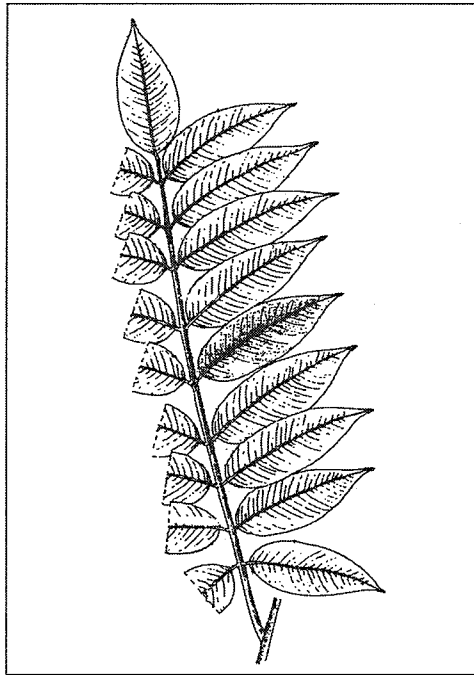
**Synonyms**

*A. nannanii* De Wild

*A. polyneurum* Mildbr.

**Distribution**

West, Central and East Africa, extending from Sierra Leone to Cameroon, Democratic Republic of Congo and Uganda. It is sparsely distributed throughout the Semi-deciduous forests of Ghana.

**Status**

A **lesser-used species** of sparse forest occurrence, moderate production for occasional export. Prescribed minimum felling diameter is 50 cm, and is cited by IUCN (2004) as a vulnerable species.

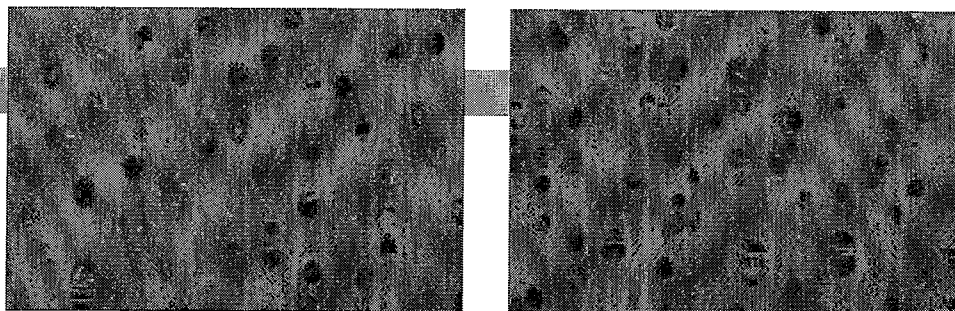
**Tree Features**

A **large tree** up to 50 m high and 3 m in girth, with a spreading crown. **The bole** is up to 30 m in length and slightly buttressed. **The bark** is thick, gummy and fragrant. **The slash** is pink with white streaks and exudes resin. **The leaves** are pinnate, 9-10 pairs of opposite leaflets with terminal leaflet. They are reddish-brown or purplish when young, and are 12 cm long by 6 cm broad. **The leaflets** are entire, acuminate, with many pairs of lateral nerves. **The tiny white flowers** are formed in March, numerous with inflorescence 15 to 20 cm long. **The fruits** mature from April to June, with

strong mango-like smell containing several stony seeds.

**Wood Macroscopic Features**

**Pores** large, proportion of solitary pores high with 2 to 4 radial multiples of same size, moderate distribution, tyloses and other inclusions present. **Axial parenchyma** is indistinct and not visible with hand lens. **Fibre tissue** proportion is medium. **Ray parenchyma** is very narrow to narrow, variable size between  $\frac{1}{4}$  and  $\frac{1}{2}$  of vessel diameter, moderate frequency. Wood is diffuse porous, **growth ring** demarcated by dark ground fibre tissue.



1 mm

### Physical Features

**Heartwood** pale-brown to pinkish-brown, demarcated from yellowish-white **sapwood** with medium texture. Planed surface is lustrous with a silver figure.

Wood is fairly hard and of **medium density**.

### Splinter Burning Test

**Splinter** burns to form **white ash**.

### Ecology and Silviculture

*Antrocaryon micraster* is a deciduous tree which does not compete well against weeds, and so is not common in secondary forest. The fruit is dispersed by primates (Hladik & Hladik, 1960). Seed germination is epigeal and takes about two weeks, but can last up to one year (Taylor, 1960). Seedlings regenerate well in canopy gaps with a height growth of about 0.3 m in a year and 1.6 m in 5 years (Taylor, 1960). It can be propagated using stump and regeneration is more abundant in undisturbed forest (Hawthorne, 1994).

### Ethnobotany

The pericarp is chewed for treatment of stomach-ache and the powdered bark is used for liver complaints (Irvine, 1961). The seeds are used as beads worn for apparent fetish powers, especially by children undergoing spiritual healing. The seed of the fruit produces edible oil (Abbiw, 1990), and the fruit is used for treating naso-pharyngeal diseases (Burkill, 1985). The bark is used for preparing soup in Nigeria (Irvine, 1961).

### Commercial Uses

A **non-durable wood** used for the following:

- Beams, joists and light or domestic structures
- Joinery, frames, mouldings and panellings
- Common furniture and cabinet works
- Core veneer for plywood
- Boxes, crates, light pallets and coffins

Family Name: **Caesalpiniaceae**

Trade Names: **Berlinia; Ebiara**

Local Names: **Kwatafompaboa-nini (Gh); Ebiara (Ga)**

#### **Distribution**

West and Central Africa, extending from Guinea to Gabon and Democratic Republic of Congo (Zaire). Moderately found in all major forest types of Ghana.

#### **Status**

A **lesser-known species** of medium occurrence, with very low production for local use only. The prescribed minimum felling diameter is 70 cm, and is cited by IUCN (2004) as a lower risk least concern species.



#### **Tree Features**

**The tree** is up to 25 m high and about 1.8 m in girth with a dense rounded dark-green crown. **The bark** is dark-gray or brown, flaking in large patches with a pale-brown slash. **The leaves** are pinnate, with a common stalk 8-20 cm long, usually with 3-4 pairs of leaflets. The terminal pair of leaflets is the largest, about 10-20 cm long by 4-8 cm broad. It flowers in panicles from November to March; **the flowers** are large and about the same size as the leaves. **The fruits** are large pods, mature from February to April, velvety, cinnamon-brown, up to 30 cm long by 5 cm broad, split open explosively and release 3 to 5 brown seeds per fruit.

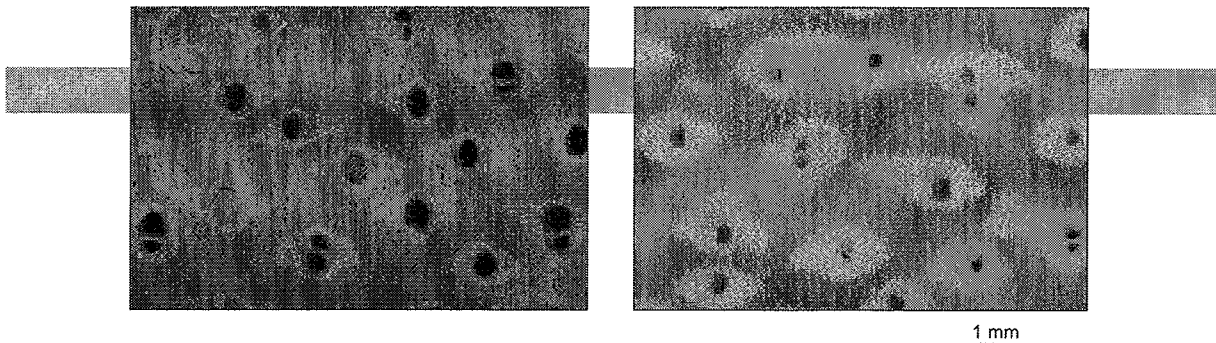
#### **Wood Macroscopic Features**

**Pores** medium, proportion of solitary pores medium to large, 2 to 3 radial multiples of

same size, diagonal pattern, distribution low, white inclusions present. **Axial parenchyma** paratracheal, vasicentric, aliform, confluent, straight narrow bands smaller than fibre tissue bands, irregularly spaced with narrow and wide distance between parenchyma bands. **Fibre tissue** proportion is medium. **Ray parenchyma** is indistinct to the naked eye, very narrow, uniform width, less than  $\frac{1}{4}$  of vessel diameter, very high frequency. Wood is diffuse porous, **growth ring** boundary is distinct and demarcated by dark ground fibre tissue.

#### **Physical Features**

**Heartwood** reddish-brown to dark red-brown with purple streaks, demarcated from pale **sapwood** with fine to moderately coarse texture. Wood is moderately hard and of **medium density**.



### **Splinter Test**

**Splinter** burns to full bright white ash.

### **Ecology and Silviculture**

*Berlinia grandiflora* is an evergreen tree common but scattered in all the forest zones and along rivers in the dry forest. The seeds are dispersed by wind and hypogeal germination takes about 14 days. The tree is supposedly immune to termites, although it is liable to borer attack, making regeneration very difficult (De Koning, 1983).

### **Ethnobotany**

The tree exudes a honey-coloured resin. The bark infusion is used as a purgative (Burkill, 1985; Irving, 1961).

### **Recommended Commercial Uses**

A **moderately durable wood** recommended for the following uses:

- Beams, joists and trusses
- Floorings, steps and stairs
- Panellings, mouldings and claddings
- Decorative veneer for plywood
- Furniture and luxury cabinet works

***Blighia sapida* Koenig**

Family Name: **Sapindaceae**

Recommended Trade Names: **Blighia; Tsana**

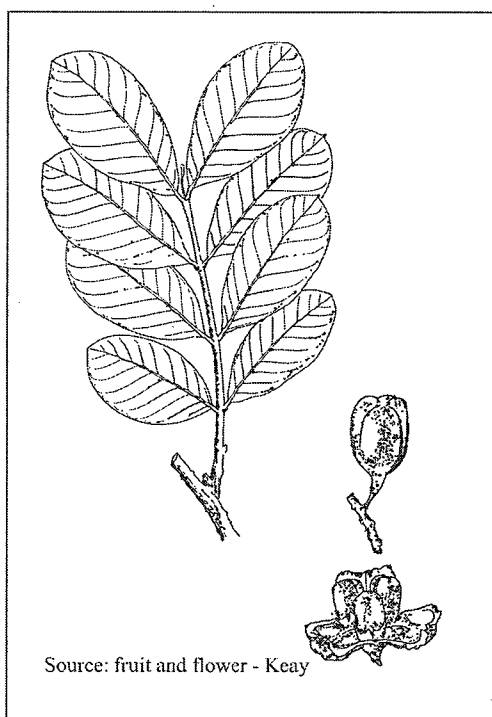
Local Names: **Akye (Gh) Akee (Ca)**

**Distribution**

West and Central Africa, extending from Senegal to Gabon. Moderately distributed in all forest zones and Savanna woodland of Ghana.

**Status**

A lesser-known species of medium occurrence yet to be exploited. Prescribed minimum felling diameter is 90 cm, and is cited by IUCN (2004) as a lower risk least concern species.



Source: fruit and flower - Keay

**Tree Features**

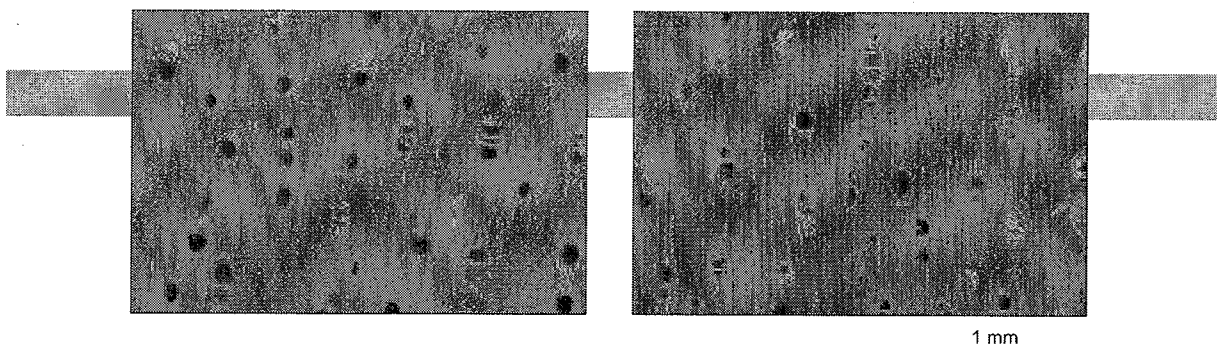
The tree is up to 25 m high, 3 m in girth with a crooked bole of 16 m and heavy crown.

The bark is grey to pale-brown. The slash is granular, pink or orange with gritty streaks. The branchlets have short yellowish hairs.

The leaves are pinnate, up to 5 leaflets, rounded or bluntly acute, acuminate, leathery, dark-green and glabrous. The 8 to 12 pairs of prominent lateral nerves are below. The flowers, as long as the leaves, are formed from October to March and are greenish-white with fragrant odour. Some trees have bisexual flowers, but others have only male flowers. The obovoid capsular fruits mature from March to September, about 4-6 cm long by 3-5 cm in diameter. They are bright-red and yellow, split open on the tree through thick leathery valves to release very large black seeds, each about 3 cm long by 2 cm broad. The aril is pale-yellow or cream. The species at seedling stage cannot be distinguished from *B. welwitschii* (Hawthorne, 1994).

**Wood Macroscopic Features**

Pores medium, proportion of solitary pores low with 2 to 3 radial multiples of same or different sizes, distribution moderate, inclusions present. Axial parenchyma is indistinct even with hand lens. Fibre tissue proportion is medium to high. Ray parenchyma is indistinct, very narrow, uniform, width less than 1/4 of vessel diameter, high frequency. Wood is diffuse porous, growth ring boundaries are demarcated by dark ground fibre tissue and absence of pores.



### Physical Features

**Heartwood** reddish-brown or brown-orange, clearly demarcated from the white **sapwood**; texture moderately coarse with low lustre. Wood is hard and of **medium density**.

### Splinter Burning Test

**Splinter** burns to form white ash.

### Ecology and Silviculture

*Blighia sapida* is evergreen and is widely planted as a shade tree in villages in the forest and Savanna areas. Seeds are dispersed by animals, and hypogeal germination in shade takes about 10 days with a germination rate of 80 % (Taylor, 1960). Seedlings grow better in gaps, with an annual height increment of 0.7 m.

### Ethnobotany

The aril is edible when very ripe. It is a classic ingredient of caribbean dish known as 'Akee Apple' (Abbiw, 1990). The fruit wall lathers and can be used for soap and for fixing colours (Irvine, 1961). The dried husks and seeds are burned and the ashes rich in potash are used in making soap (Irvine, 1961). The leafy twig is used for treating migraine, the leaves and seeds for yaws, and the bark for diarrhoea (Mshana *et al.*, 2000). The bark and gum are used for treating skin diseases (Burkill, 1985).

### Commercial Uses

A **moderately durable wood** used for the following:

Boxes, crates, food containers, and packing cases

Carvings, artifacts, and handicrafts

Light construction

Furniture and cabinet works

Joinery, frames and trims

Turneries and tools

***Bombax buonopozense* P. Beauv.**

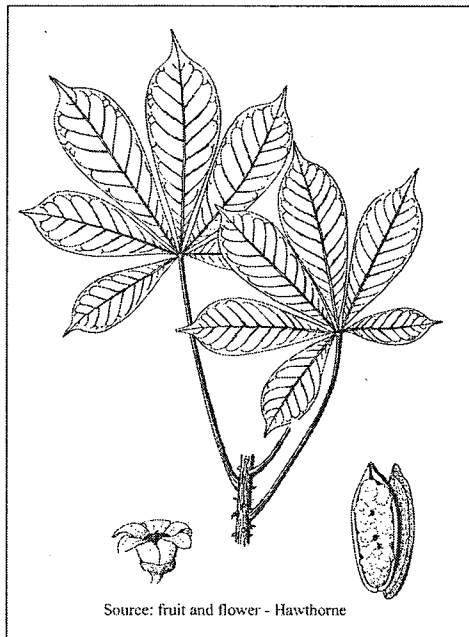
Family Name: **Bombacaceae**  
 Trade Names: **Bombax; Kapokier**  
 Local Names: **Akonkodie (Gh); Bumbum (BF); Kapokier (CI)**

**Synonyms**

*B. angulicarpum* Ulbr.  
*B. buesgenii* Ulbr.  
*B. flameum* Ulbr.

**Distribution**

West and Central Africa, extending from Sierra Leone to Uganda, Democratic Republic of Congo (Zaire), and to Angola. Frequently distributed in Moist and Dry Semi-deciduous forests of Ghana.

**Status**

A **lesser-used species** of frequent occurrence, with moderate production and irregular export. No prescribed minimum felling diameter, but 110 cm is recommended as in *Ceiba* with which it is normally sold and traded. It is cited by IUCN (2004) as a lower risk least concern species.

**Tree Features**

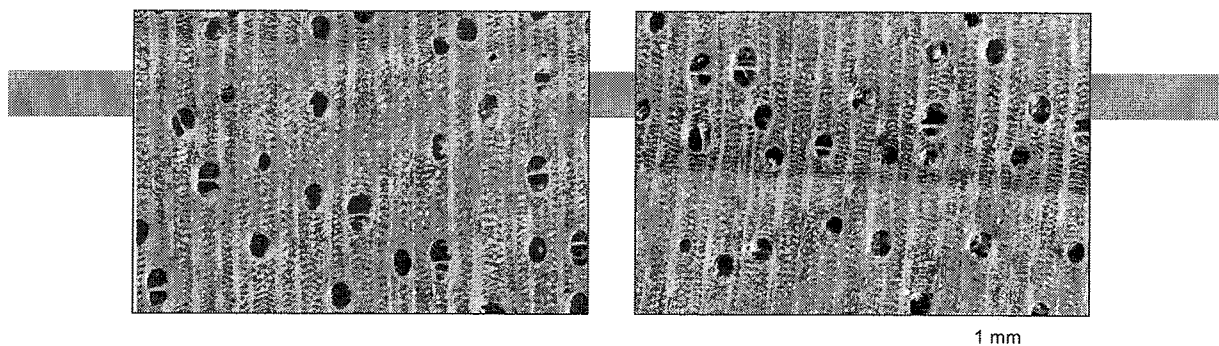
**The tree** is up to 35 m high and 4 m in girth. **The bole** is cylindrical with small rounded buttresses. **The bark** is grey and rough with small tent-shaped black-tipped prickles. **The slash** is red with white streaks, soft and fibrous, but changes rapidly to brown. **The branchlets** are glabrous. **The leaves** are compound, digitate and glabrous, oblanceolate with 5 to 8 leaflets, 6-20 cm long by 3-7 cm broad, broadest close to tip with 15 to 25 pairs of lateral nerves on central leaflets. **The solitary**

**flowers** bloom from December to February and may extend to May. The calyx is yellowish-green, edible, and the petals are deep-pink or red, measuring 6-9 cm long. **The cylindrical dark-brown fruits** mature from February to May and are 10-20 cm long by 4-8 cm broad. They are pentagonal in cross section and contain copious white or greyish kapok, each with numerous black seeds, 8 mm long.

**Wood Macroscopic Features**

**Pores** large to very large, proportion of solitary pores medium with 2 radial multiples of different sizes, distribution low, tyloses present. **Axial parenchyma** is indistinct to naked eye, apotracheal, diffuse-in-aggregate. **Fibre tissue** proportion is very low. **Ray parenchyma** is variable, narrow and wide, width less than  $\frac{1}{4}$  to  $\frac{1}{2}$  of vessel diameter, moderate frequency, storied. Wood is diffuse porous, **growth ring** boundaries demarcated by dark ground **fibre tissue** and absence of pores.





### Physical Features

**Heartwood** pale pinkish-brown, not clearly demarcated from **sapwood**, coarse texture, moderate to high lustre. Wood is soft and of **low density**.

### Splinter Burning Test

**Splinter** burns to exude coloured liquid compounds and forms grey ash.

### Ecology and Silviculture

*Bombax buonopozense* is a deciduous tree common in secondary forest where soil conditions are not too moist. It is a pioneer species and requires strong light to grow. The mode of propagation is by seed, dispersed by wind. Germination is epigeal and takes about 12 days (Taylor, 1960). Height growth is rapid, 3 m in the first 2 years when overhead light is sufficient (Hawthorne, 1995). The species is a suspected alternative host of cocoa virus which causes swollen shoot.

### Ethnobotany

The flowers contain mucilage in the calyxes which is used in soup. The immature fruits, sliced and dried, are used for cooking (Abbiw, 1990). The fresh leaves serve as fodder. A decoction of the leaves is used for treating fever in children (Irvine, 1961). The pounded bark is used for increased lactation. The bark decoction is an effective emmenagogue and, when pulverised and mixed with oil, it forms an ointment used for treating skin diseases such as "crawcraw" (Irvine, 1961). The white kapok of the fruit is used for pillow (Abbiw, 1990). The root bark is used for treating abdominal pain (Mshana *et al.*, 2000). The bark is used as a febrifuge (Burkill, 1985).

### Commercial Uses

A **non-durable wood** used for the following:

- Artifacts and carvings
- Boxes, food containers and crates
- Light joinery, frames and interior trims
- Matches, splints and boxes
- Core veneer for plywood
- Particleboard, pulp and paper

**Bussea occidentalis Hutch.**

Family Name: **Caesalpiniaceae**

Recommended Trade Names: **Bussea; Kotopreppe**

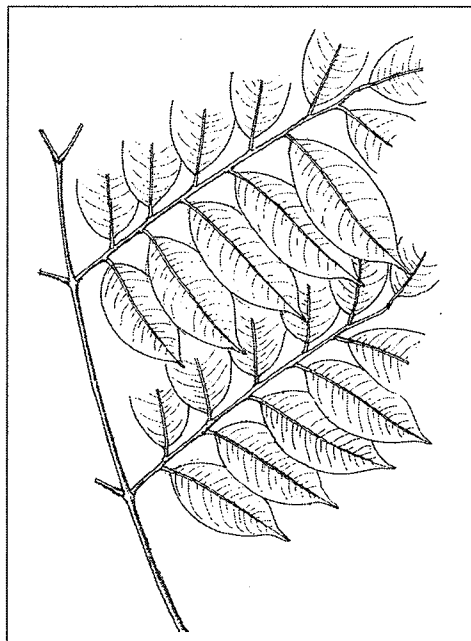
Local Name: **Kotopreppe (Gh)**

**Synonym**

*Peltophorum africanum* Sond.

**Distribution**

West Africa from Sierra Leone to Ghana where it is moderately distributed in all forest types.

**Status**

A **lesser-known species** of moderate forest availability, without prescribed felling diameter, but 50 cm is recommended. It is cited by IUCN (2004) as a lower risk least concern species.

**Tree Features**

**The tree** is about 35 m high and 1.8 m in girth, unbuttressed with smooth bark and lenticels.

**The bole** is crooked, grey and white. **The slash** is thin, orange-brown with watery exudates and ripple marks. The crown is dense and the branchlets are dark-brown and tomentose. **The leaves** are bipinnate, with leaflets measuring 10 cm long and 5 cm broad. The leaflets are alternate, ovate, entire, and glossy above. **The flowers** are formed from April to September; they are yellow, slightly fragrant, conspicuous and crowded with leaves at the ends of branchlets. **The fruits** are pods, maturing from October, velvety-hairy when young, erect and

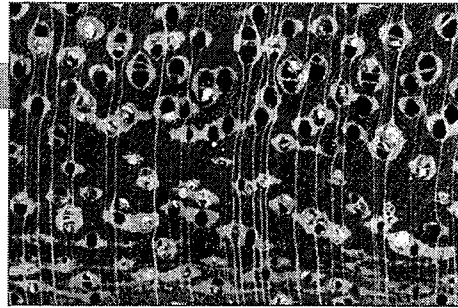
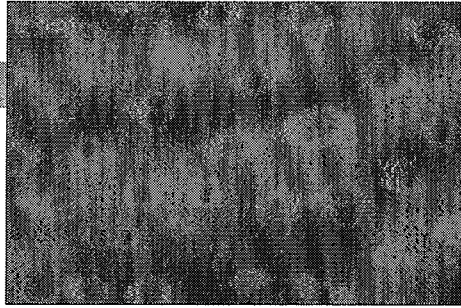
bright-brown, 20 cm by 5 cm with ridges along edges. The dry fruit is woody and explosive, curls upward after dehiscence to release 2 to 4 **large brown seeds**.

**Wood Macroscopic Features**

**Pores** medium, proportion of solitary pores high, with 2 to 3 radial multiples of same size, distribution low, inclusions present. **Axial parenchyma** is paratracheal, vasicentric, aliform and confluent. **Fibre tissue** proportion is medium. **Ray parenchyma** is narrow to very narrow, uniform width less than ¼ to ½ of vessel diameter, moderate frequency. Wood is diffuse porous, **growth ring** boundaries demarcated by dark ground fibre tissue and absence of pores.

**Physical Features**

**Heartwood** is dark-brown or reddish-brown, demarcated from white **sapwood** with moderate to coarse texture. Wood is hard and of **high density**.



1 mm

### **Splinter Test**

**Splinter** burns to produce crackle or bright sparks, exudes coloured liquid and forms yellow-brown ash.

### **Ecology and Silviculture**

*Bussea occidentalis* is an evergreen tree and is most successful in moist rocky areas of Evergreen forests. It is characteristically abundant in undisturbed forests and prefers soils with good drainage. The seeds are dispersed explosively, and epigeal germination lasts for 12-24 days with 90 % germination rate (Taylor, 1960). The tree is a non-pioneer light demander, and the seedlings develop well in gaps, with an annual height increment of 15-35 cm (Taylor, 1960). A 2-year-old stump transplants well. All tree sizes are more abundant in undisturbed forest (Hawthorne, 1994).

### **Ethnobotany**

Pod ashes are used as salt substitute and for making soap (Abbiw, 1990). Irvine (1961) lists the following uses: the bark, mixed with maize, is used to kill monkeys by poisoning. The meat is eaten after discarding the intestines. The leaves are used for fish poison, the bark and the seeds for treating heart ailment.

### **Recommended Commercial Uses**

A **durable wood** promoted for the following uses:

Heavy construction

Industrial floorings

Tools, turneries and ornaments

**Calpocalyx brevibracteatus Harms.**

Family Name: **Mimosaceae**

Recommended Trade Names: **Calpocalyx; Atrotre**

Local Name: **Atrotre** (Gh)

**Synonym**

*C. winkleri* Harms.

**Distribution**

West and Central Africa, extending from Ghana to Cameroon. Frequently found in the Evergreen and Semi-deciduous forests of Ghana.



**Status**

It is a **lesser-known species** of frequent forest availability recommended for promotion in the domestic market. No prescribed minimum felling diameter, but 50 cm is recommended. It is cited by IUCN (2004) as a lower risk least concern species.

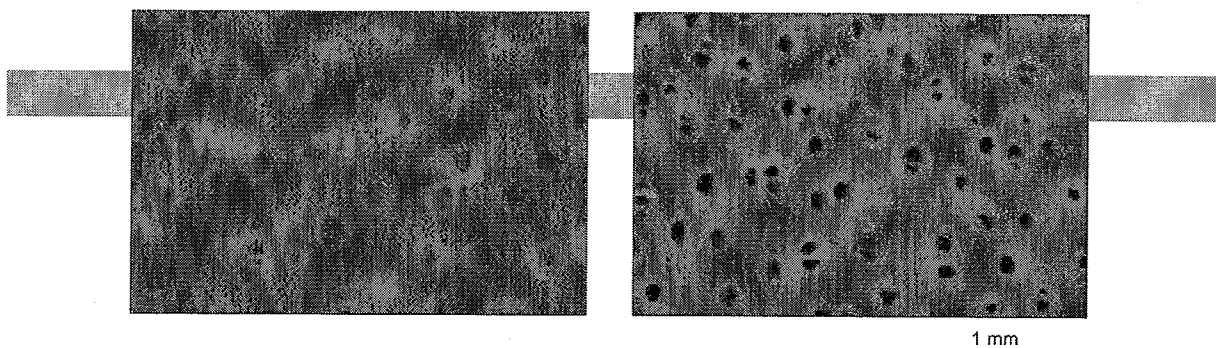
**Tree Features**

The tree is up to 30 m high and 1.8 m in girth, with flute bole and small crown in plumes. The bark is dark, flakes off in old trees, and forms thin lenticels. The slash is red or orange-brown with white streaks. The compound leaves have a stout common stalk 3-14 cm long, and two pinnae 20-45 cm long. The 4 to 8 pairs of opposite leaflets are 5-15 cm long by 3-6 cm broad, elliptic, rounded and slightly unequal at base. It flowers from August to November, reddish or brown-orange and in spikes 7-15 cm long, usually arranged in panicles, 25-45 cm

long. The individual flowers are up to 5 mm long. The woody fruits are formed in February, about 18 cm long and 2-4 cm broad, each containing 6 to 8 shiny brown ovate seeds over 12 cm long.

**Wood Macroscopic Features**

Pores medium, proportions of solitary pores medium with 2 to 4 radial multiples of same size, few clusters of 3 to 4, low to moderate distribution, inclusions present. Axial parenchyma is paratracheal, vasicentric, aliform and confluent, straight-banded and marginal, very narrow width smaller than fibre tissue bands, irregularly spaced with wide distance between bands. Fibre tissue proportion is low to medium. Ray parenchyma is indistinct at transverse but distinct at radial surface, very narrow, uniform width, less than 1/4 of vessel diameter, high frequency. Wood is diffuse porous, growth ring boundaries are demarcated by dark ground fibre tissue and absence of pores.



### Physical Features

**Heartwood** reddish-brown to dark-brown, demarcated from white-grey **sapwood**, texture medium to coarse. Wood is hard and of **medium to high density**.

### Splinter Burning Test

**Splinter** burns to produce crackle or bright sparks, oozes coloured liquid and forms yellow-brown ash.

### Ecology and Silviculture

*Calpocalyx brevibracteatus* is a briefly deciduous tree with a preference for low-lying forests in wetter zones, reaching its peak in Evergreen forests. It is more abundant in disturbed forest (Hawthorne, 1994) and is associated with acidic base poor soils (Hall & Swaine, 1981). It is dispersed by wind and is propagated by seed with epigeal germination. It is a shade bearer and growth is slow with branches developing at a fairly early stage. Swaine *et al.* (1997) have reported fast growth in a Semi-deciduous forest.

### Ethnobotany

The inner bark is used for treating stomach-ache and as a wash for sore mouth. Women apply the pounded roasted seeds with palm oil to ease breast pain (Irvine, 1961). The ashes from the pod are used in making soap and as a salt substitute (Abbiw, 1990), while the ashes from the bark are used for treating naso-pharyngeal diseases (Burkill, 1985).

### Recommended Commercial Uses

A **durable wood** promoted for the following uses:

Heavy construction

Poles, posts, cross arms and stakes

**Canarium schweinfurthii Engl.**

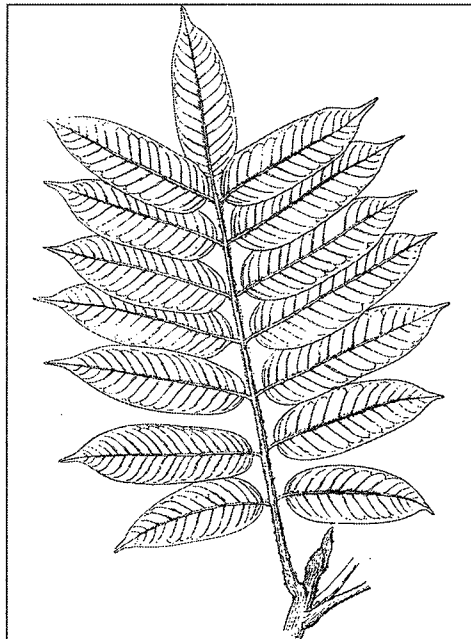
Family Name: **Burseraceae**  
 Trade Names: **African Canarium; Aélé**  
 Local Names: **Bediwonua (Gh) Abel (Ca)**

**Synonyms**

*C. occidentale* A. Chev.  
*C. relutinum* Guill.

**Distribution**

West and Central Africa, extending from Sierra Leone to Angola. Sparsely found in Evergreen and Semi-deciduous forests of Ghana.

**Status**

It is a **lesser-used species** of sparse forest availability, moderate production for occasional export. The prescribed minimum felling diameter is 110 cm, and is cited by IUCN (2004) as a lower risk near threatened species.

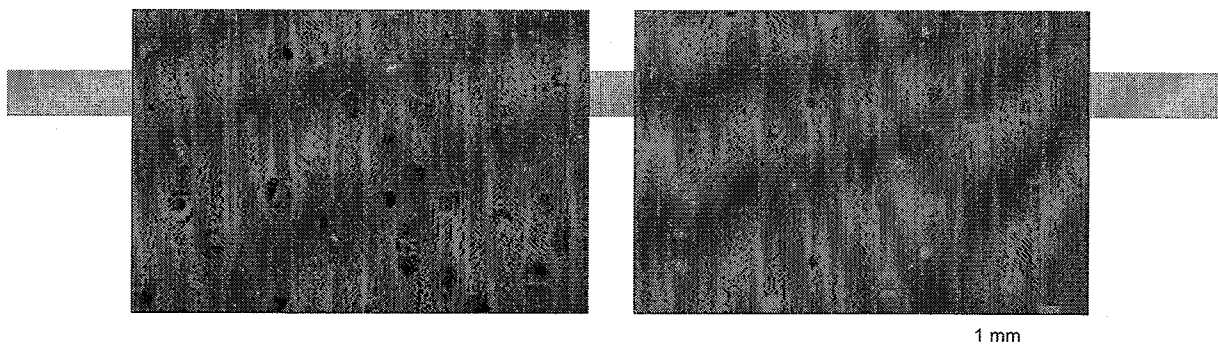
**Tree Features**

**The tree** is up to 48 m high and 3.5 m in girth, a bole of 10 to 30 m with small buttresses and spreading crown with the leaves at the end of the branchlets. **The bark** is grey to brown, rough and fissured. **The slash** is light-brown and exudes a copious yellow to pink fragrant gum that solidifies to form a whitish resin. **The compound leaves** are pinnate, have a stout fine hairy common stalk, 20-65 cm long and 8 to 12 pairs of opposite leaflets, 10 – 20 cm long by 3 – 6 cm broad. They are elliptic, lanceolate, oblong and acuminate. The young foliage is hairy. **The white flowers** are formed from July to August, individual flowers are about 1 cm

long, grouped in narrow panicles 15-30 cm long. **The drupe fruits** mature from February to March, purple and ellipsoid, but slightly 3-angled and 2-4 cm long. They are sharply pointed at the apex with a persistent calyx at the base, each containing 3 **very large seeds**.

**Macroscopic Features**

**Pores** medium, proportion of solitary pores medium to high with 2 to 3 radial multiples of same size, distribution low, tyloses present. **Axial parenchyma** is indistinct to the naked eye even with hand lens. **Fibre tissue** proportion is medium. **Ray parenchyma** is narrow, uniform width, between  $\frac{1}{4}$  and  $\frac{1}{2}$  of vessel diameter, medium frequency, and storied. Wood is diffuse porous.



### Physical Features

**Heartwood** pale-brown to pinkish-brown, demarcated from white to straw **sapwood** with distinct aromatic smell. Wood is hard and of **medium density**.

### Splinter Burning Test

**Splinter** burns to form ash.

### Ecology and Silviculture

*Canarium schweinfurthii* is a deciduous tree which grows well in secondary forest. The seed is dispersed by hornbills (Taylor, 1960) and epigeal germination takes about 21 days to 6 months under shade, with a germination rate of 85 % (Taylor, 1960). Seedlings grow rapidly in gaps up to 1.5 m height in the first year (Hawthorne, 1995). The tree attains 55 cm dbh in 40 years when grown in old secondary forest (Kahn, 1982). Stump and stripped planting are possible using 1-year- old plant (Taylor, 1960). It is more abundant in regenerated logged forest (Hawthorne, 1995).

### Ethnobotany

The fruits are edible, the seed oil is a substitute for shea butter, and the very hard nuts can be carved and used as necklaces (Abbiw, 1990). Archeological evidence suggests that the fruit was formerly used for food and was later replaced with oil palm (Abbiw, 1990). The tree yields a gum copal used as a cosmetic to drive away evil spirits (Burkill, 1985). The fresh bark is sometimes used for treating venereal diseases, haemorrhoids and jaundice, and its decoction is an ingredient in prescriptions for dysentery and treatment of chancre (Irvine, 1961). The root has general medicinal uses, the sap for treating pulmonary disorders, and the bark for stomach troubles and diarrhoea (Burkill, 1985).

### Commercial Uses

A **non-durable wood** used for the following:

- Panellings, mouldings and claddings
- Common furniture and cabinet works
- Frames and interior joinery
- Core, sliced and rotary veneer for plywood

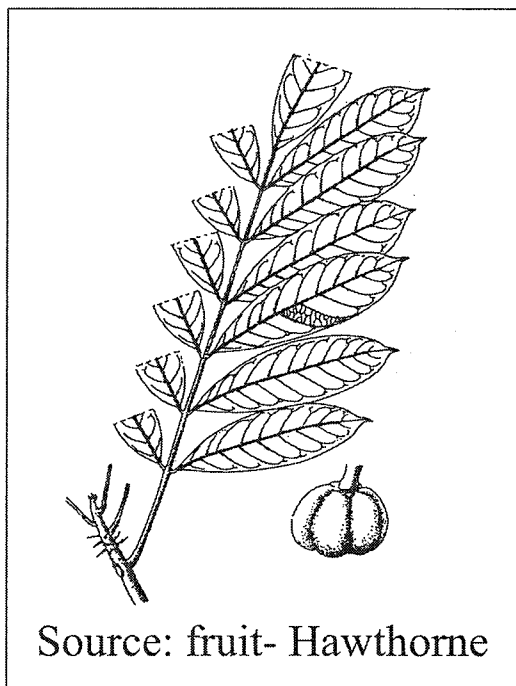
Family Name: **Meliaceae**

Recommended Trade Names: **Carapa; African Crabwood**

Local Name: **Kwakuo-bese** (Gh)

#### **Distribution**

West and Central Africa, extending from Senegal to Uganda and Angola. Frequently occurs in all forest types and Savanna woodland of Ghana.



Source: fruit- Hawthorne

#### **Status**

It is a **lesser-known species** of frequent forest availability, recommended for promotion in local market. No prescribed minimum felling diameter, but 70 cm is recommended. It is cited by IUCN (2004) as a lower risk least concern species.

#### **Tree Features**

**The tree** is about 15 m high and about 2.3 m in girth with a low wide-spreading crown, arching branches, and very large leaves. **The bark** is pale-brown and smooth. **The slash** is pink or red and faintly scented. **The leaves** are pinnate and 1.0 m long. The leaflets are opposite or sub-opposite, with 5 to 21 pairs, brilliantly red when newly flushed. **The flowers** are in long panicles up to 1 m long, formed from January to May. The petals are white and about 6 mm long. **The sub-globose fruits** mature in May, about 15 cm long, each capsule with **at least 10 seeds**, 2.5 cm

broad without a wing or an aril but a thick woody outer covering.

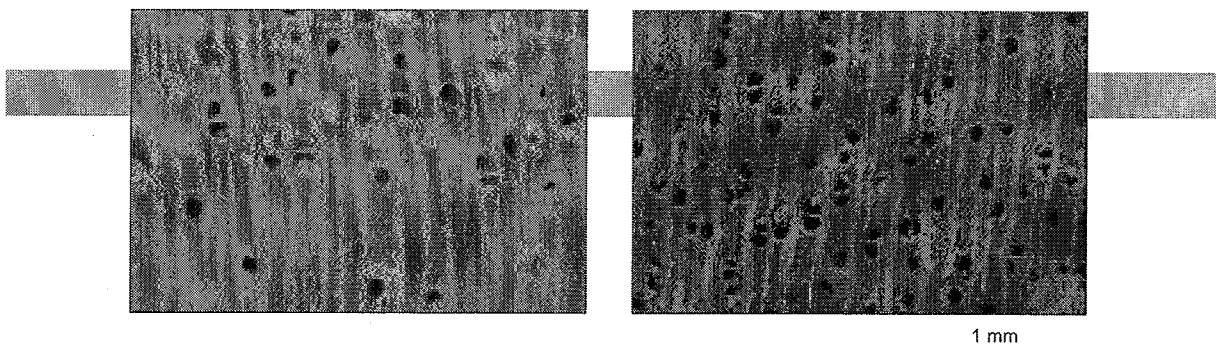
#### **Wood Macroscopic Features**

**Pores** small, proportion of solitary pores high with 2 to 4 radial multiples of same diameter, distribution moderate, gum inclusions and tyloses present. **Axial parenchyma** indistinct, apotracheal diffuse, scanty paratracheal and vasicentric. **Fibre tissue** proportion is low to medium. **Ray parenchyma** is narrow, uniform width, between ½ and full diameter of vessel, high frequency. Wood is diffuse porous.

#### **Physical Features**

**Heartwood** red-brown to dark-brown, demarcated from white with purple-tinged **sapwood**, texture fine to medium. Wood is hard and **density** varies from **medium to high**.





### Splinter Burning Test

**Splinter** burns to form white ash.

### Ecology and Silviculture

*Carapa procera* is an evergreen tree associated with moist situations and extends into fringing forest in the southern part of the Savanna zone. It is most abundant in lower-lying areas, but less common in very dry forest. The tree thrives in swampy condition but is not confined to it. It is a shade-bearer, and mode of propagation is by seed dispersed by water (White, 1983). It is resistant to termites and fire. It is very similar to *C. guianensis* which is widely used as timber in South America. *Hypsipyla robusta* preys on the shoots and flowers (Wagner *et al.*, 1991).

### Ethnobotany

The oil from the seeds was formerly used for candles and in making soap (Abbiw, 1990). It is also used for external application on sores, burns, rheumatic pains, insect bites, eruptions and ringworm. It is used internally as a vermifuge for tapeworms and roundworms (Irvine, 1961). A decoction of the crushed bark is used as an eye wash (Irvine, 1961), but a decoction of the leaf is drunk by children and old people to gain strength. The bark is used for treating cough, asthma and dyspepsia, while seeds are used for treating malaria (Mshana *et al.*, 2000).

### Recommended Commercial Uses

A **moderately durable wood** promoted for the following uses:

- Boats, canoes and their components
- Artifacts, carvings and handicrafts
- Construction, light and heavy
- Floorings and parquets
- Furniture, cabinet, tables, doors and windows
- Joinery, frames and trims.

***Ceiba pentandra* (L.) Gaertn.**

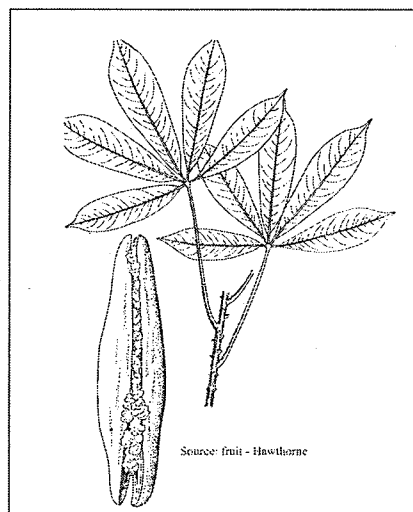
Family Name: **Bombacaceae**  
 Trade Names: **Ceiba, Fermager, Fuma**  
 Local Names: **Onyina** (Gh) *Fuma* (Co, Z)

**Synonyms**

*Bombax pentandrum* Linn.; *C. thoningii* A. Chev.

**Distribution**

West, Central and East Africa, extending from Sierra Leone to Gabon. It is one of the very few African timber tree species also found in Asia and S. America. It is abundant in most forest types and in the Savanna woodland of Ghana, but rare in Wet Evergreen forest.

**Status**

A **lesser-used species** which has developed from a lesser-known status within the last 15 years. It is of abundant occurrence, with extremely high production within the last 20 years for core and face veneer in plywood productin. The prescribed minimum felling diameter is 110 cm. It is cited by IUCN (2004) as a lower risk near threatened species.

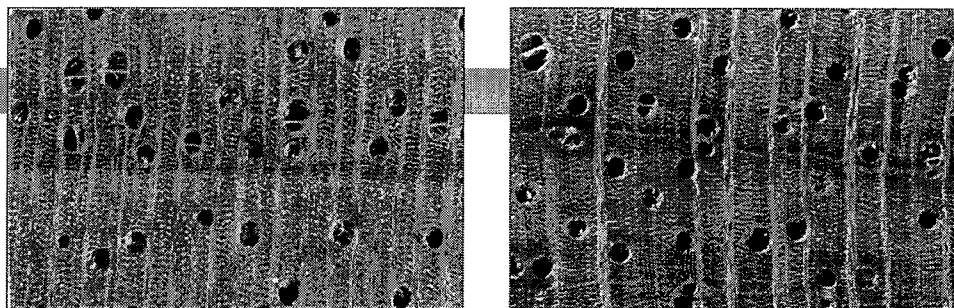
**Tree Features**

**The tree** is up to 60 m high and 6 m in girth, with cylindrical bole up to 20 m with conical thorns and rounded crown. It has **smooth bark** and develops large convex buttresses. **The slash** is hard and fibrous, white with brown spots, which gradually change to brown in older trees. **The branches** are

glabrous; those of younger trees are more or less horizontal, but the older trees are sometimes turned upwards at right angles. **The leaves** are compound digitate, glabrous, with a common leaf stalk, 7 – 20 cm long. The 5 – 10 leaflets are 5 – 18 cm long by 2 – 5 cm broad, oblanceolate, gradually acuminate at the tip and rounded at the base. **The flowers** are in pendulous clusters, formed from December to January. The calyx is cup-shaped, about 12 mm long; the petals are white, 25– 35 mm long, dense and silky outside. **The pale-brown fruits** are shaped like a cucumber, up to 10 – 30 cm long, mature in March and split open into 5 valves on the tree to release kapok with numerous black seeds. The tree is often confused with *Bombax buonopozense* which is smaller and shorter with 5 to 8 leaflets.

**Wood Macroscopic Features**

**Pores** are very large, proportion of solitary pores is high, with 2 to 4 radial multiples of same size, distribution low, tyloses present. **Axial parenchyma** indistinct to the naked eye, apotracheal diffuse and diffuse-in-aggregate, occasionally marginal and straight bands, very narrow width smaller than fibre tissue bands, irregularly spaced, wide distance between bands. **Fibre tissue** proportion is very low. **Ray parenchyma** barely visible, of variable width, narrow and wide, between ½ and full diameter of vessel, low frequency.



1 mm

Wood is diffuse porous, **growth ring** boundaries are demarcated by dark **ground fibre tissue** and marginal parenchyma.

#### Physical Features and Splinter Burning Test

**Heartwood** whitish to pale yellow-brown, not clearly demarcated from **sapwood**. Texture is coarse, sometimes lustrous. Wood is soft and of very **low density**. **Splinter** burns to exude coloured liquid and forms black ash.

#### Ecology and Silviculture

*Ceiba pentandra* is a deciduous tree common in secondary forest and more abundant in disturbed but regenerated forests. It is indifferent to soil conditions and mature trees are highly tolerant of alkalinity (Taylor, 1960). It is a pioneer species which regenerates prolifically in gaps and along roadsides. It is pollinated by bats (Harris & Baker, 1959) and birds (Toledo, 1977), and is propagated by seed dispersed by wind. It is also propagated using stump. Germination in gaps takes about 12 days with fast height growth of about 3 m per year (Taylor, 1960). Although it can germinate in deep shade, seedlings cannot grow well (Kyereh *et al.*, 1999). Regeneration is more common in regenerated forest previously destroyed by fire. (Hawthorne, 1994). Various types of larvae defoliators and tree borers are common on trees of the species (Wagner *et al.*, 1991).

#### Ethnobotany

The fruits yield kapok used in pillows, mattresses and cushions (Abbiw, 1990). The kapok may be a substitute to cotton wool for surgical purposes. The seeds contain 22 to 25 % of oil suitable for soap making and for cooking (Irvine, 1961). The young leaves and fruits are eaten, and for treating oedemas and dropsy (Burkill, 1985). The roots are used for treatment of leprosy while pulverized roots and gum are for treating dysentery (Dalziel, 1932). A bark infusion is used as a mouthwash (Harley, 1941) and as a febrifuge in Nigeria. The gum has laxative properties. The bark is used for treating asthma (Mshana *et al.*, 2000). The bark and root are used for treating leprosy, the leaf and bark for venereal disease and stomach disorders, while the bark alone is for skin and pulmonary diseases (Burkill, 1985).

#### Commercial Uses

A **non-durable wood** used for the following:

Mouldings

Core veneer for plywood

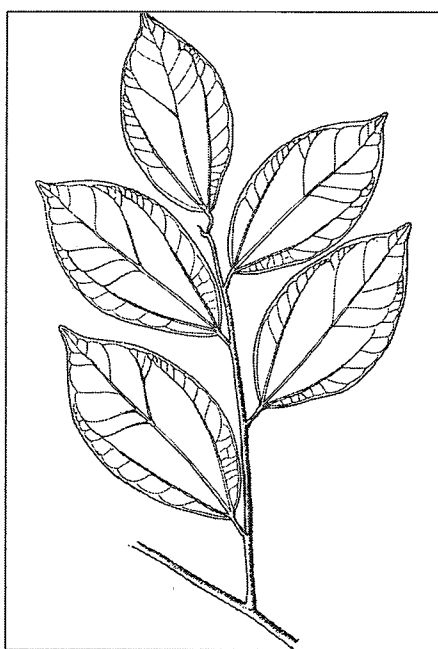
Boxes, crates, packing cases, and food containers

***Celtis adolfi-friderici* Engl.**

Family Name: **Ulmaceae**  
 Trade Names: **Celtis; Ohia**  
 Local Names: **Esakosua (Gh); Lahonfe (CI)**

**Distribution**

West, Central and East Africa, extending from Ivory Coast to Democratic Republic of Congo (Zaire), Uganda, and Sudan. Moderately found in Semi-deciduous forests of Ghana.

**Status**

It is a **lesser-used species** of moderate occurrence, with high production for very regular export. It is sold as part of the *Celtis* group of species. The prescribed minimum felling diameter is 70 cm. It is cited by IUCN (2004) as a lower risk least concern species. Sawdust may have toxic effects on humans.

**Tree Features**

**The tree** measures up to 50 m high and about 2.2 m in girth, with dark-green rounded crown. **The bole** is slender and equipped with wide-spreading crown and sharp buttresses. **The bark** is dark-grey, rough, often with horizontal ridges. **The slash** is granular, crumbly and creamy-yellow with chocolate-brown spots. **The leaves** are entire and very asymmetrical, broadly elliptic with obtusely acuminate tip, 8 – 18 cm long by 5 – 10 cm broad. **The white flowers** are formed in small axillary panicles from July to November, being numerous

and inconspicuous, and in large inflorescence. **The red fruits** are drupes, mature in March, ellipsoid with obscure longitudinal ridges, 15 – 20 mm long, each containing a single large seed.

**Wood Macroscopic Features**

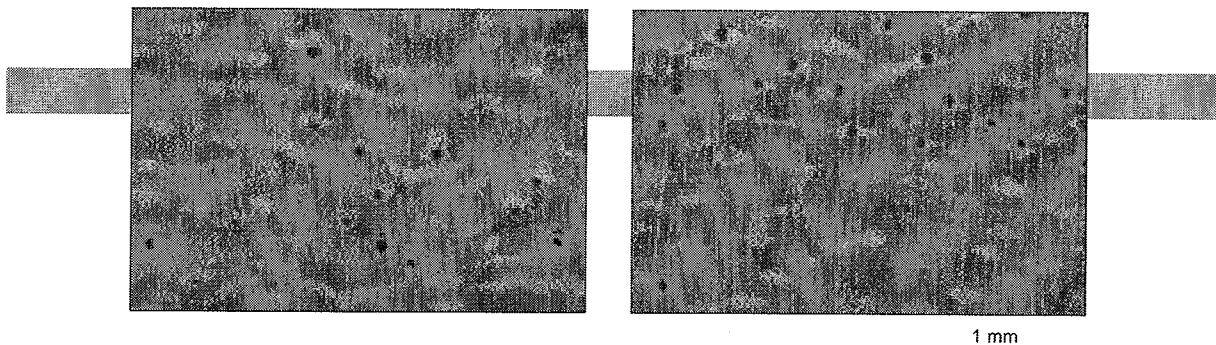
**Pores** medium, proportion of solitary pores medium, with same size radial multiples of 2, distribution moderate, inclusions present.

**Axial parenchyma** paratracheal, aliform and confluent, marginal, straight bands of very narrow width smaller than fibre tissue bands, irregularly spaced with wide distance between bands.

**Fibre tissue** proportion is low. **Ray parenchyma** is very narrow, variable, width less than ¼ to ½ of vessel diameter, high frequency. Wood is diffuse porous, **growth ring** boundaries are demarcated by dark ground fibre tissue and occasionally by marginal parenchyma.

**Physical Features**

**Heartwood** white, cream to grey, not differentiated from **sapwood**, fine texture with low to high luster. Wood is hard and of **medium density**.



### **Splinter Burning Test**

**Splinter** burns to exude coloured liquid compound and forms white ash.

### **Ecology and Silviculture**

*Celtis adolfi-friderici* is a deciduous tree propagated by seed dispersed by birds. Germination is epigeal but erratic, and takes about 33 days with low viability (Taylor, 1960). Soaking or exposure to sun improves seed viability slightly. It is a pioneer tree that is tolerant of shade in early growth, but requires light to grow to about 40 cm per year (Taylor, 1960). Seedlings are less common in regenerated forest previously damaged by fire (Hawthorne, 1994). The tree is preyed on by a polyphagous tree borer (Wagner *et al.*, 1991).

### **Ethnobotany**

The pounded bark is used for treatment of fever, headache and general malaise, while boiled leaves are used for treating sore eyes (Abbiw, 1990).

### **Commercial Uses**

A **non-durable wood** used for the following:

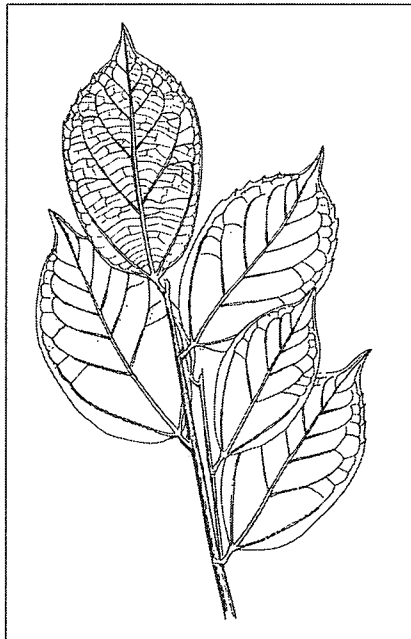
- Handicrafts and artifacts
- Joists and beams
- Floorings, steps and stairs
- Panellings and claddings
- Core veneer for plywood
- Common furniture and cabinet works
- Heavy pallets
- Match boxes and splints

***Celtis mildbraedii* Engl.**

Family Name: **Ulmaceae**  
 Trade Names: **Celtis; Ohia**  
 Local Names: **Esa-fufuo (Gh); Asan (CI)**

**Distribution**

West, Central and East Africa, extending from Ivory Coast to Sudan, and south to Angola and Tanzania. Abundantly distributed in Semi-deciduous forests of Ghana, being more abundant in Moist Semi-deciduous than in Dry Semi-deciduous forest but entirely absent from Wet Evergreen forest.

**Status**

A **lesser-used species** sold as part of the *Celtis* group of species. It is of abundant occurrence with very high production for very regular export. Prescribed minimum felling diameter is 70 cm. It is cited by IUCN (2004) as a lower risk least concern species. Sawdust and shavers may have some toxic effects on humans.

**Tree Features**

Tree is up to 36 m high and 3 m in girth with narrow crown. **The slender bole** is up to 27 m, with thin sharp buttresses up to 3 m with rounded crown and horizontal thin branches. **The bark** is grey, smooth and peels off in thin scales. **The slash** is characterized with alternate layers of cream, yellow and brown concentric rings. **The simple leaves** are 5 – 10 cm long by 3 – 6 cm broad, ovate, acuminate at the tip and slightly unsymmetrical at the base, leathery, glabrous and glossy. **The leaf venation** is not as parallel as in *Celtis zenkeri*. **The small green flowers**

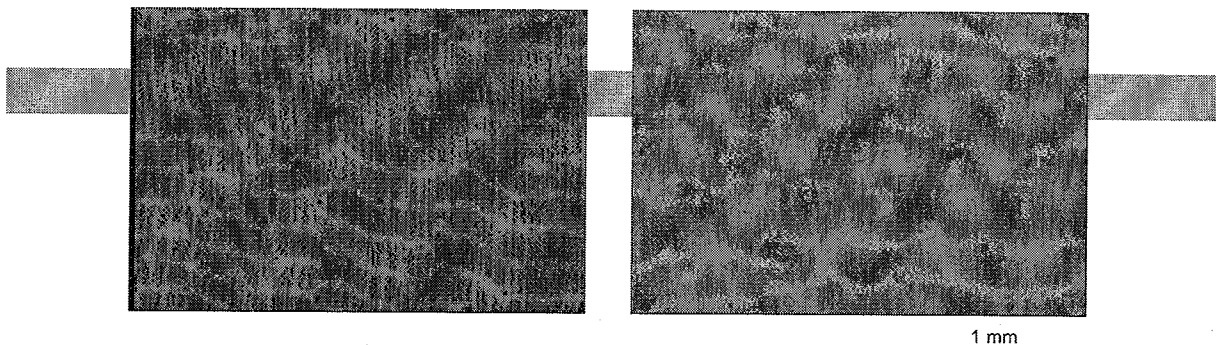
are formed from November to February. The flattened red ovoid **drupe fruits** mature from August, up to 12 mm long by 10 mm broad, with a single medium size seed per fruit.

**Wood Macroscopic Features**

**Pores** indistinct to the naked eye, small, proportion of solitary pores medium with 2 to 4 radial multiples of same size, moderate distribution, black gum inclusions present. **Axial parenchyma** paratracheal, aliform, confluent, wavy, very narrow-banded and reticulate, regularly spaced with narrow distance between parenchyma bands, smaller than **fibre tissue** bands. Proportion of **fibre tissue** is medium. **Ray parenchyma** is very narrow, uniform width between  $\frac{1}{4}$  and  $\frac{1}{2}$  of vessel diameter, very high frequency. Wood is diffuse porous.

**Physical Features**

**Heartwood** cream to yellowish-white or grey, not clearly demarcated from **sapwood**. Texture is fine to medium with light pleasant odour and high lustre. Wood is hard and of **medium density**.



### **Splinter**

**Splinter** burns to exude coloured liquid and forms white ash.

### **Ecology and Silviculture**

*Celtis mildbraedii* is an evergreen tree which regenerates in shade and in open conditions of secondary forest, provided climbers are not too frequent. The tree appears to tolerate a wide variety of soils and drought but avoids swampy places. It is more abundant in undisturbed forest. It is propagated by seeds dispersed by birds and primates (Plumptre *et al.*, 1994). Germination is epigeal, and Kyereh *et al.* (1993) found no difference between germination in light and in dark although germination is depressed in large gaps. It regenerates freely under shade (Hawthorne, 1994), but requires light after seedling stage (Taylor, 1960). Height growth of 1 to 4 m in 4 years has been recorded (Taylor, 1960). It coppices freely when young and is more abundant in undisturbed forest (Hawthorne, 1994).

### **Ethnobotany**

The wood is a first class fuelwood. Pole-size stems are widely used as pestles.

### **Commercial Uses**

A **non-durable wood** used for the following:

- Handicrafts and artifacts
- Floorings and parquets
- Panellings, mouldings and claddings
- Core veneer for plywood
- Match splints and boxes
- Pallets

Family Name: **Ulmaceae**  
 Trade Names: **Celtis; Ohia**  
 Local Names: **Esa-kokoo (Gh); Asan (CI)**

#### **Distribution**

West, Central and East Africa, extending from Guinea to Sudan, and south to Angola. Abundantly found in all forest types and in forest outliers near Savanna woodland, except the Wet Evergreen forest of Ghana.



#### **Status**

A **lesser-used species** sold as part of the *Celtis* group of species. It is of abundant occurrence with high production for very regular export. Prescribed minimum felling diameter is 70 cm, and is cited by IUCN (2004) as a lower risk least concern species. Sawdust and shavers may have unspecified toxic effects on humans.

#### **Tree Features**

**The tree** is up to 40 m high, 3 m in girth, straight bole of 20 m with 3-m high buttress and rounded crown. **The bark** is grey-yellow and thin, much rougher than that of *C. mildbraedii*. **The slash** has alternate layers of yellow and orange concentric rings, thin, brittle and gritty. **The leaves** are simple, 7–15 cm long by 3–6 cm broad, elliptic, acuminate at the tip, with parallel scalariform venation. **The green flowers** appear from February to April, each 2–6 cm long. The male flowers are minute, forming small compact clusters with solitary females at the ends of the branchlets. The inflorescence is densely covered with very short hairs. **The red fruit** is a drupe, matures from March to May, globose, about 6 mm across.

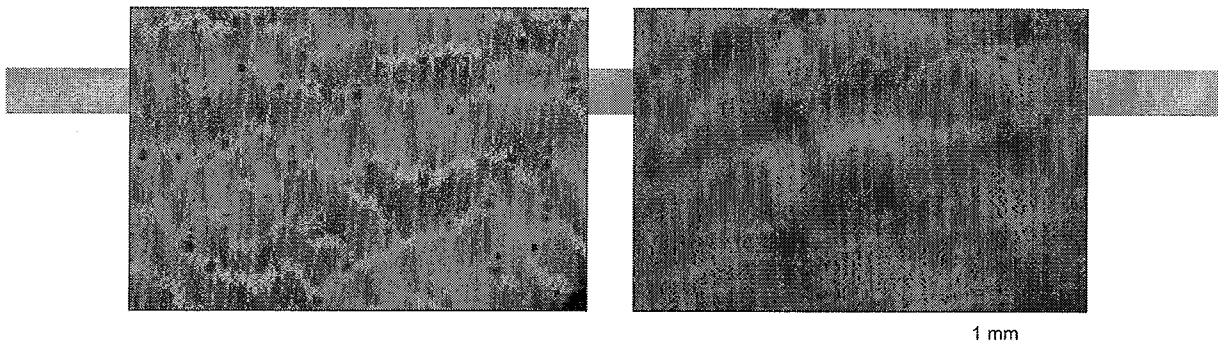
#### **Wood Macroscopic Features**

**Pores** indistinct to naked eye, small, proportion of solitary pores medium with 2 to 3 radial multiples of same size, moderate distribution. **Axial parenchyma** paratracheal, aliform, confluent, banded, wavy, very narrow width, regularly spaced with narrow distance between bands, smaller than fibre tissue bands. Proportion of **fibre tissue** is medium. **Ray parenchyma** is very narrow, very numerous, uniform width between  $\frac{1}{4}$  and  $\frac{1}{2}$  of vessel diameter, very high frequency. Wood is diffuse porous, **growth rings** are demarcated by dark ground fibre tissue.

#### **Physical Features**

**Heartwood** cream to yellowish-white or pale-yellow, not clearly demarcated from the yellowish-white **sapwood**, fine to medium texture with light pleasant odour. Wood is hard and of **medium density**.





### **Splinter Burning Test**

**Splinter** burns to exude coloured liquid compounds and forms white ash.

### **Ecology and Silviculture**

*Celtis zenkeri* is a deciduous tree propagated by seeds dispersed by birds (Taylor, 1960). Germination under shade is epigeal, but requires light to develop and avoids acid soils and swamps (Hall & Swaine, 1981). Trees are more abundant in regenerated forest previously destroyed by fire (Hawthorne, 1994).

### **Ethnobotany**

The wood is a first class fuelwood. Pole-size stems are used as pestles (Abbiw, 1990).

### **Commercial Uses**

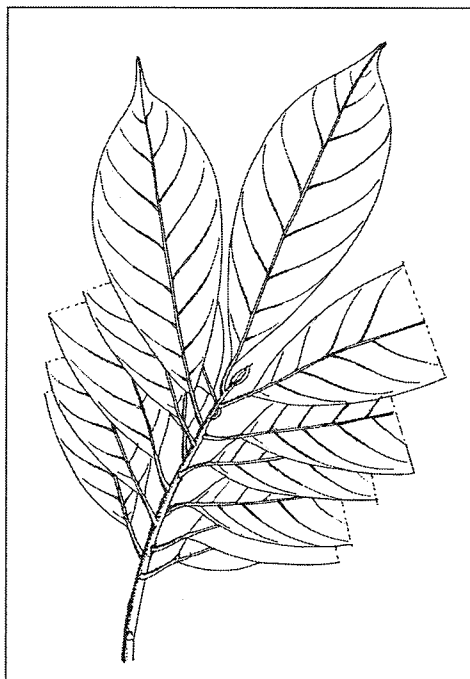
A **non-durable wood** used for the following:

- Handicrafts and artifacts
- Floorings and parquets
- Frames, panellings and mouldings
- Core veneer for plywood
- Match splints and boxes
- Pallets

Family Name: **Sapotaceae**  
 Trade Names: **Chrysophyllum; Longhi**  
 Local Names: **Akasaa (Gh); Akatio (CI)**

#### **Distribution**

West, Central and East Africa. It is an introduced species found sporadically in the Dry Semi-deciduous forests of Ghana (Hall & Swaine, 1981).



#### **Status**

A **lesser-used species** of sparse occurrence sold as part of *Chrysophyllum* group of species, with high production for regular export. Prescribed minimum felling diameter is 70 cm, and is classified by IUCN (2004) as a lower risk near threatened species.

#### **Tree Features**

**The tree** is up to 36 m high and about 2.3 m in girth, with either deeply fluted bole or small buttresses up to 30 cm. **The bark** is pale greyish-brown and slightly fissured. **The slash** is pale-brown and exudes copious white latex. The crown is dark-green with thin and short branches. **The leaves**, up to 30 cm long and 9 cm broad, are oblanceolate with acuminate apex and wedge-shaped base. The lower surface is densely covered with silvery or pale-brown hairs and 8 to 15 pairs of lateral nerves. **The flowers** are formed in clusters in the axil of the leaves from April to June. Sepals about 2.5

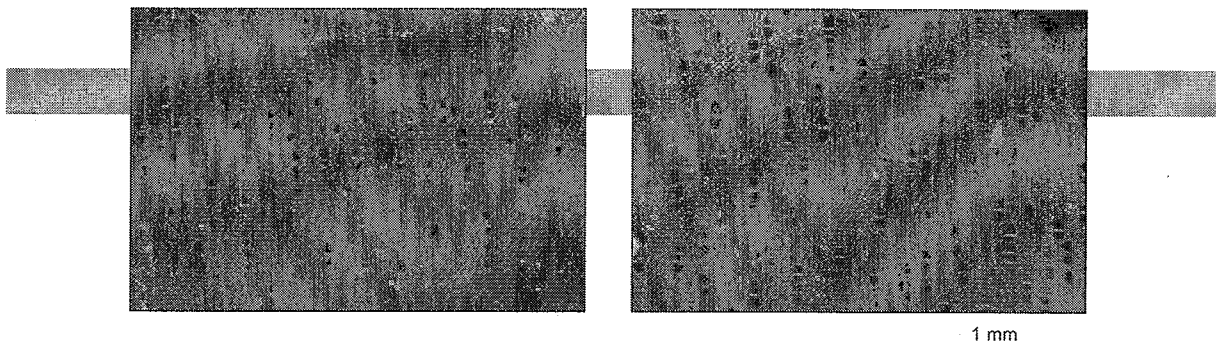
mm long are covered with minute yellowish hairs. **The orange fruits**, mature from January to February, are ovoid to sub-globose with pointed apex, glabrous, up to 6 cm long, each with 5 seeds embedded in an edible pulp.

#### **Wood Macroscopic Features**

**Pores** medium, proportion of solitary pores low with 2 to 4 radial multiples of same size, distribution low, inclusions present. **Axial parenchyma** indistinct to the naked eye, apotracheal, diffuse and reticulate with very narrow regular bands, smaller than fibre tissue bands. **Fibre tissue** proportion is low. **Ray parenchyma** is very narrow to narrow, uniform, width less than  $\frac{1}{4}$  to  $\frac{1}{2}$  of vessel diameter, moderate to high frequency. Wood is diffuse porous, **growth ring** boundaries are demarcated by dark **ground fibre tissue** and absence of pores.

#### **Physical Features**

**Heartwood** pale-brown to cream, not demarcated from **sapwood**, fine texture. Wood is very hard and of **medium to high density**.



### **Splinter Burning Test**

**Splinter** burns to produce crackles or bright sparks, and exudes coloured liquid and forms yellow-brown ash.

### **Ecology and Silviculture**

*Chrysophyllum albidum* is an evergreen tree, sporadic in dry forests and planted in sacred groves. The mode of propagation is by seed which is dispersed by primates (Plumptre *et al.*, 1994) and germinates in shade (Taylor, 1960).

### **Ethnobotany**

**The tree** is planted in sacred groves and also cultivated for edible fruits usually sold in the market (Kingston, 1983; Okafor, 1990). The gummy latex of the bark and fruits is used as birdlime, and the seeds are used as counters and anklets in traditional dancing (Irvine, 1961). **The bark** is used for various medicinal purposes (Burkill, 1985).

### **Commercial Uses**

A **non-durable wood** used for the following:

- Interior joinery, frames and trims
- Light structural works, joists and beams
- Floorings, steps and stairs
- Common utility furniture
- Veneer for plywood
- Tool handles and turneries

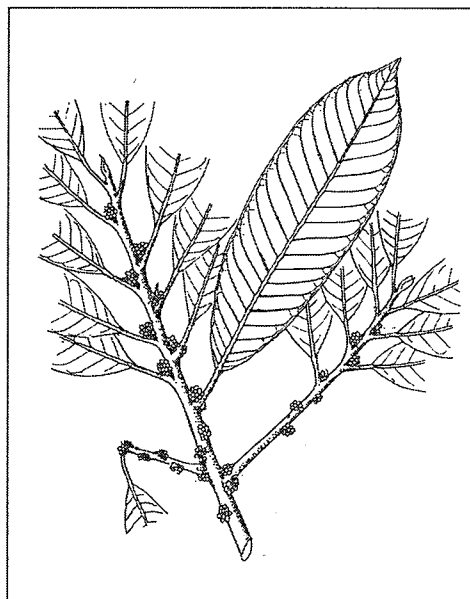
Family Name: **Sapotaceae**  
 Trade Names: **Chrysophyllum; Longhi**  
 Local Names: **Atabene (Gh); Longhi (Co)**

#### **Synonym**

*Gambeya perpulchra* Aubrev. & Pellegr.

#### **Distribution**

West, Central and East Africa, from Liberia to Democratic Republic of Congo (Zaire), Uganda and Tanzania. Moderately found in Dry and Moist Semi-deciduous forests of Ghana but rare in Evergreen forests.



#### **Status**

A lesser-used species of medium forest availability, forms part of the *Chrysophyllum* group of timber. It has high production for regular export with a prescribed minimum felling diameter of 70 cm. It is cited by IUCN (2004) as a lower risk least concern species.

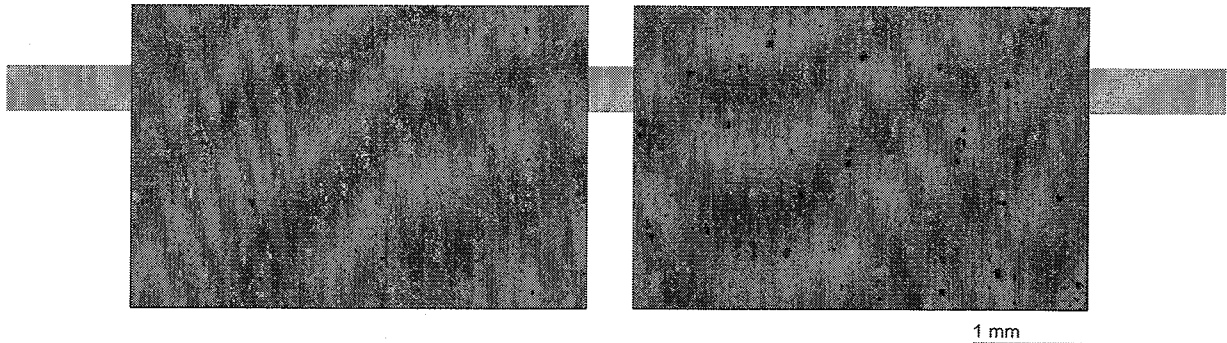
#### **Tree Features**

**The tree** is up to 30 m high, a girth of about 2 m, straight bole, often low-branched, fluted with red crown. **The bark** is pale greyish-brown and slightly fissured. **The slash** is pale-brown, exudes copious white latex. **The leaves** are simple, alternate, up to 30 cm long by 9 cm broad with silky red-brown hairs below giving it a red crown. They are oblanceolate with acuminate apex and wedge-shaped base. The lower surface is covered with dark reddish-

brown hairs with 10 to 15 pairs of lateral nerves. **The small brown flowers** are in clusters in the axil of the leaves, and are formed from April to June. The sepals are about 2.5 mm long covered with minute yellowish hairs. **The orange berry fruits**, mature from January to February, are ovoid to sub-globose and pointed at the apex. **The fruits** are up to 6 cm long, glabrous and edible, 5-ribbed, each containing 5 seeds. **The seed** is broad, flattened, shiny dark-brown with the hilum almost along the whole length of the inner edge.

#### **Wood Macroscopic Features**

**Pores** indistinct to naked eye, small, proportion of solitary pores low with 2 to 4 radial multiples of same size, gum inclusions present. **Axial parenchyma** indistinct to the naked eye, apotracheal, banded, reticulate, wavy, width very narrow, regularly spaced, smaller than fibre tissue bands. Proportion of **fibre tissue** is medium. **Ray parenchyma** indistinct on radial section, very narrow, less than 1/4 of vessel diameter, high frequency. Wood is diffuse porous, **growth rings** demarcated by dark ground fibre tissues and absence of pores.



#### Physical features

**Heartwood** is pale-brown to yellow-white cream, not demarcated from **sapwood**, fine to medium texture, slightly lustrous. Wood is hard and of **medium to high density**.

#### Splinter Burning Test

**Splinter** burns to exude coloured liquid compounds and forms grey ash.

#### Ecology and Silviculture

*Chrysophyllum perpulchrum* is an evergreen tree which is most abundant in dry fire zone forests, and virtually absent from the evergreen forests. It prefers fairly light and well-drained soils. It is propagated by seed with epigeal germination that takes over 18 days (Taylor, 1960). Seedling needs light to grow, being a non-pioneer light demander (Hawthorne, 1994). Striped plants transplant well (Taylor, 1960).

#### Ethnobotany

The fruit is edible, though inferior to that of *C. albidum* (Irvine, 1961). The bark yields gutta-percha (Irvine, 1961). The seeds are used as counters (Abbiw, 1990).

#### Commercial Uses

A **non-durable wood** used for the following:

- Interior joinery, frames and trims
- Light structural works, joists and beams
- Floorings, steps and stairs
- Common utility furniture and cabinet works
- Veneer for plywood

**Chrysophyllum subnudum Bak.**

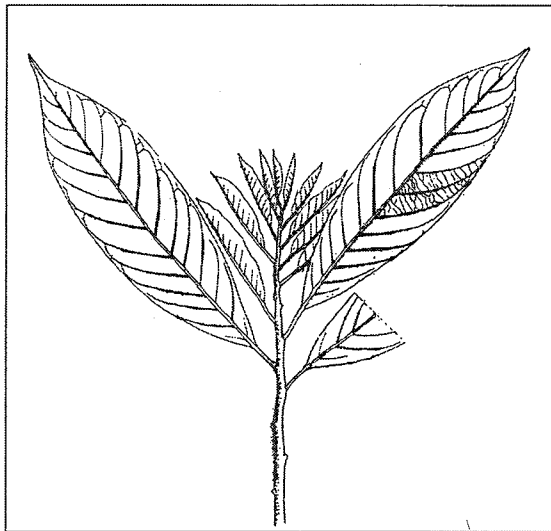
Family Name: **Sapotaceae**  
 Trade Names: **Chrysophyllum; Longhi**  
 Local Names: **Akasa (Gh); Akatio (CI)**

**Synonym**

*Gambeya subnudum* (Bak.); Pierre

**Distribution**

West and Central Africa, extending from Sierra Leone to Democratic Republic of Congo (Zaire). Common in Evergreen forests of Ghana, but lesser occurrence in Semi-deciduous forests.

**Status**

It is a **lesser-used species** of sparse occurrence, moderate production for regular export with other five *Chrysophyllum* species. Prescribed minimum felling diameter is 70 cm, and is cited by IUCN (2004) as a lower risk least concern species.

**Tree Features**

**The tree** is of medium size, about 40 m high and 2.3 m in girth. **The bark** is pale greyish-brown. **The slash** is pale-brown and exudes copious white latex. **The leaves** are up to 30 cm long by 9 cm broad. They are oblanceolate with acuminate apex and wedge-shaped

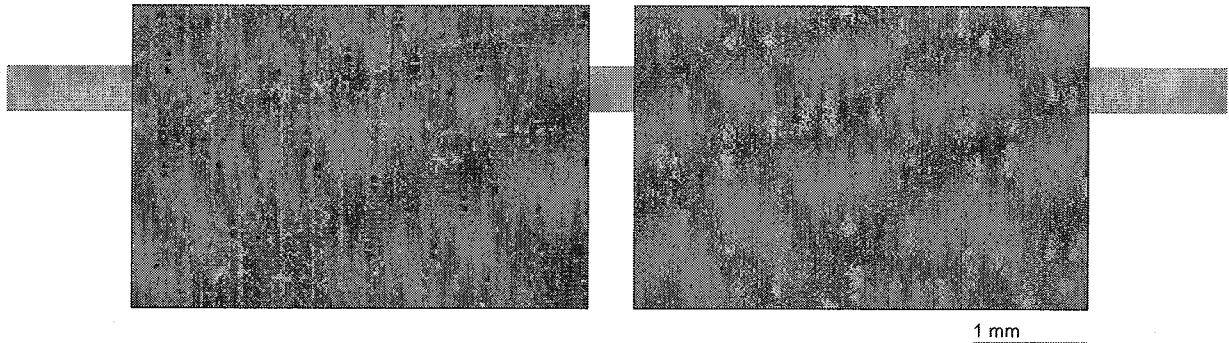
base. The lower surface has a satiny gloss that makes it appear glabrous, but in fact it is covered with very small hairs. Prominent and conspicuous veins are beneath, with 10 to 15 pairs of lateral nerves. It flowers from April to June, being white and in clusters in the axil of the leaves. The sepals are about 2.5 mm long and are covered with minute yellowish hairs. **The orange-red berry fruits** mature from January to February, ovoid to sub-globose, and pointed at the apex up to 6 cm long, glabrous and edible.

**Wood Macroscopic Features**

**Pores** small, proportion of solitary pores low with 2 to 4 radial multiples of same and different sizes, distribution is low. **Axial parenchyma** indistinct to naked eye, very narrow wavy bands, regularly spaced, smaller than fibre tissue band. **Fibre tissue** proportion is medium. **Ray parenchyma** is very narrow to narrow, uniform, width less than  $\frac{1}{4}$  to  $\frac{1}{2}$  of vessel diameter, moderate frequency. Wood is diffuse porous, and **growth ring** boundaries are demarcated by dark ground fibre tissue and absence of pores.

**Physical Features**

**Heartwood** is reddish-brown, demarcated from pale-brown **sapwood** with fine texture. Wood is very hard and of **high density**.



#### **Splinter Test**

**Splinter** burns to produce crackle or bright sparks, exudes coloured liquid compounds, and forms yellow-brown ash.

#### **Ecology and Silviculture**

*Chrysophyllum subnudum* is an evergreen tree and fruits are dispersed by animals including elephants. The seed germinates and grows under shade (Parren, 1991; Hawthorne, 1995).

#### **Ethnobotany**

N/A

#### **Commercial Uses**

A **non-durable wood** used for the following:

- Light construction
- Floorings
- Furniture, cabinets and tables
- Carvings and artifacts

Family Name: **Sterculiaceae**

Trade Names: **Colawood; Watapuo**

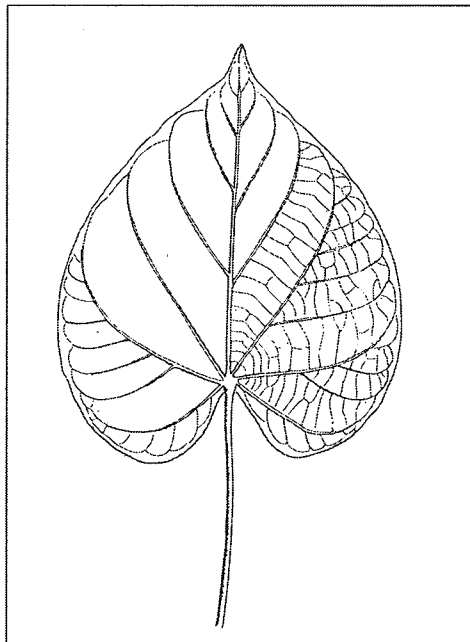
Local Names: **Watapuo, Dodowa** (Gh)

#### **Distribution**

West and Central Africa, extending from Liberia to Democratic Republic of Congo (Zaire), Uganda and Sudan. Frequently found in all major forest types and in the Savanna woodland of Ghana.

#### **Status**

A **lesser-used species** of frequent forest availability, very low exploitation with occasional export. Prescribed minimum felling diameter is 90 cm, and IUCN (2004) rates the species as a lower risk least concern.



#### **Tree Features**

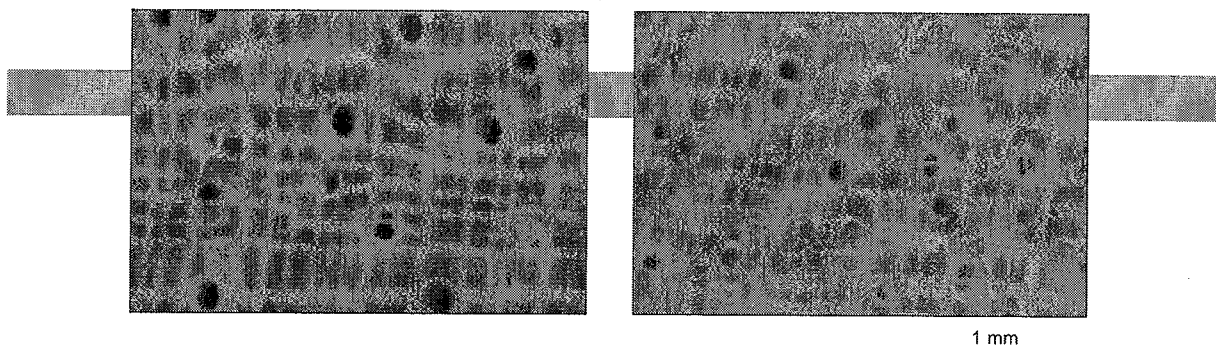
**The tree** is up to 50 m high and 5 m in girth, straight bole with narrow buttresses and rounded crown. **The bark** is grey with longitudinal fissures. **The slash** is pinkish-red with fine whitish 'flame' marks. **The leaves** are simple, 17-45 cm long and 14-32 cm broad, ovate in shape but sometimes slightly 3-lobed, deeply cordate at base and rounded or obtuse at apex. It **flowers** from October to January in axillary inflorescences covered with rusty-brown stellate hairs. The calyx is cup-shaped, about 5 mm long. It is dark creamy-white inside and dark yellowish-red outside changing to orange, pink or red. **The fruit**, follicle or berry matures from February to April, composed of 4-5 boat-shaped carpels up to 15 cm long. The ripe carpels are light-brown and densely felted outside, but cream or pinkish and smooth inside. **The seeds** are about 8 in a fruit, each 3 cm by 1.5 cm, enclosed in a bright-pink fleshy

aril. The sapling is easily confused with *C. lateritia*, but is easily differentiated in adult trees (Hawthorne, 1995).

#### **Wood Macroscopic Features**

**Pores** medium, proportion of solitary pores medium to high with 2 to 4 radial multiples of same and different sizes, distribution low. **Axial parenchyma** is paratracheal, vasicentric, confluent, narrow irregular straight bands, smaller than fibre tissue bands with narrow distance between them. Proportion of **fibre tissue** is low to medium. **Ray parenchyma** variable, narrow and broad, width less than ¼ to full vessel diameter, moderate frequency. Wood is diffuse porous.





### Physical Features

**Heartwood** is grey-brown, demarcated from whitish-yellow **sapwood**, coarse texture and lustrous. Wood is fairly soft and of **medium density**.

### Splinter Burning Test

**Splinter** burns to produce crackle or bright sparks, exudes coloured liquid compounds, and forms grey ash.

### Ecology and Silviculture

*Cola gigantea* is a deciduous tree that thrives in dry sandy sites and on fairly heavy soil (Taylor, 1960). It is propagated by seed but strips and stumps can be transplanted. Germination under shade is epigeal over 16 to 40 days with a germination rate of 78 % (Taylor, 1960). Saplings grow vigorously in gaps up to 0.7 m height in a year (Taylor, 1960). It regenerates in shade, but is severely hindered by fires, although adult trees appear resistant to fire damage because of their thick fibrous bark (Hawthorne, 1995). Regeneration is more abundant in forest not disturbed by fire (Hawthorne, 1994). A fruit weevil attacks the seeds (Wagner *et al.*, 1991).

### Ethnobotany

The broad leaves are used as thatch and food wrappers, while fermented leaf extract is used as a bath for leprosy (Abbiw, 1990). The young taproot is chewed as an aphrodisiac, the powdered bark is applied to ulcers and sores, and a decoction is taken as a remedy for piles (Irvine, 1961). The bark decoction is also used to treat headaches, intestinal and lumbar pains, and the juice from the petiole for sore eyes (Irvine, 1961). The bark is used to treat yaws (Mshana *et al.*, 2000).

### Commercial Uses

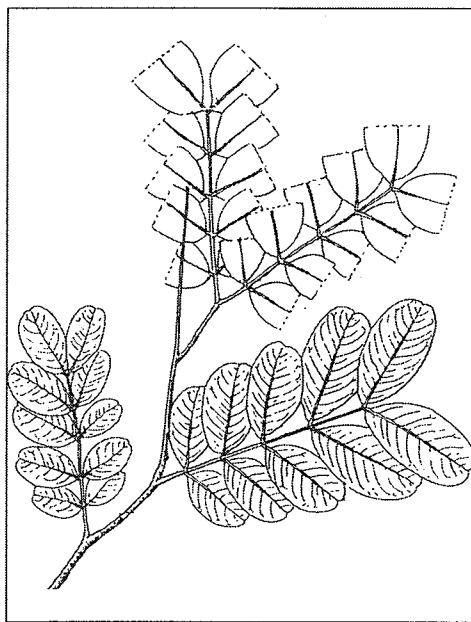
A **non-durable wood** promoted for the following uses:  
Boxes, crates, food containers, packing cases and pallets  
Artifacts, carvings and handicrafts  
Light construction  
Furniture and cabinet works

***Copaifera salikounda* Heck.**

Family Name: **Caesalpinaceae**  
 Trade Names: **Salikounda, Etimoé**  
 Local Names: **Entedua (Gh) Etimoe (CI)**

**Distribution**

West and Central Africa, extending from Guinea to Central Africa Republic. Sparsely distributed in the Evergreen and Moist Semi-deciduous forests of Ghana.

**Status**

A **lesser-used species** of sparse distribution, moderate exploitation with occasional export. Prescribed minimum felling diameter is 70 cm, and is categorized by IUCN (2004) as a vulnerable species.

**Tree Features**

**The tree** is up to 50 m high and 3 m in girth with clear unbuttressed cylindrical bole, and ascending branches with dense crown. **The bark** is fibrous and rugose (wrinkled). **The slash** is orange to pinkish-brown, hard and fibrous with sweet almond scent. **The crown** is fairly large but not dense. **The leaves** are pinnate with 12 to 14 opposite leaflets, elliptic and emarginate at tip, shining and unequal-sided with numerous conspicuous lateral nerves. **The flowers** are white, sessile, small, and in simple-branched panicles with

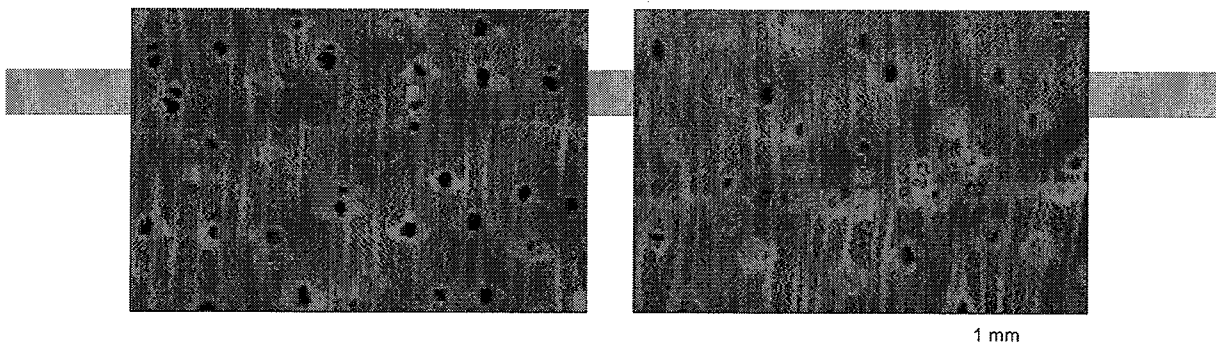
puberulous rachis; they are formed from September to October. **The fruits** are brownish woody pods, flat and oval-shaped, and mature from November to December, each fruit with a single black seed in red aril.

**Wood Macroscopic Features**

**Pores** medium, proportion of solitary pores medium with of 2 to 3 radial multiples, of same diameter, distribution low, tyloses present. **Axial parenchyma** paratracheal, vasicentric, aliform and confluent, marginal with straight narrow bands smaller than fibre tissue bands, irregularly spaced with wide space between bands. Proportion of **fibre tissue** is to low to medium. **Ray parenchyma** is narrow, uniform, between  $\frac{1}{4}$  and  $\frac{1}{2}$  of vessel diameter, moderate distribution. Wood is diffuse porous, and **growth ring** boundaries are demarcated by differences in vessel diameter and marginal parenchyma.

**Physical Features**

**Heartwood** reddish-brown with pink or red stripes, not clearly demarcated from the paler **sapwood**, texture medium, low lustre with pleasant odour. Wood is hard and of **medium density**.



### **Splinter Test**

Splinter burns to exude coloured liquid compounds and forms white ash.

### **Ecology and Silviculture**

*Copaifera salikounda* is a deciduous tree, seed dispersed by wind and propagated by seed with epigeal germination under shade. The sapling requires light to grow. Regeneration is very prolific around mother trees, and is reported by Taylor (1960) to be a long-lived tree.

### **Ethnobotany**

The tree yields resin that is used as a perfume, while an aromatic substance called coumarin in the seed is used for scented body pomade (Irvine, 1961). The powdered dried leaves and bark are applied to ulcers and sores. A cold infusion of the seed is drunk as a remedy for vertigo (Irvine, 1961). The seed is used for treating skin disease (Burkill, 1985).

### **Commercial Uses**

A **moderately durable wood** used for the following:

- Decorative furniture and cabinet works
- Joints and beams
- Floorings, parquets, steps and stairs
- Decorative sliced veneer for face plywood
- Tool handles and turneries
- Shingles and shakes
- Panellings, mouldings and trims

***Cordia millenii* Bak.**

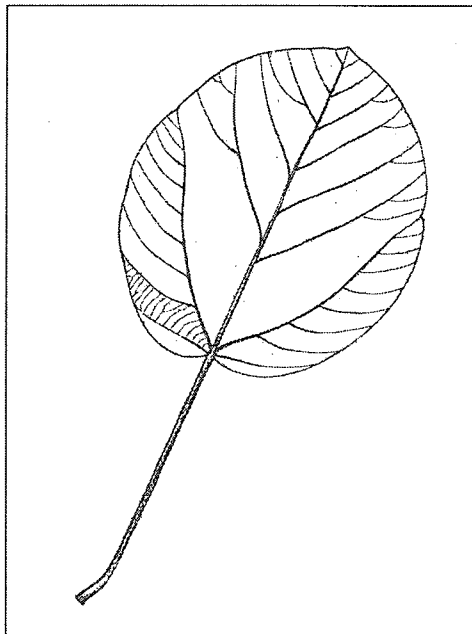
Family Name: **Boraginaceae**  
 Trade Names: **African Cordia; Cordia**  
 Local Names: **Tweneboa (Gh); Mukebu (U); Bon (CI)**

**Synonyms**

*C. chrysocarpa* Bak.  
*C. platythyrsa* Bak.

**Distribution**

West, Central and East Africa from Sierra Leone to Cameroon, Kenya and Uganda. Sparsely found in Evergreen and Moist Semi-deciduous forests of Ghana.

**Status**

It is a **lesser-used species** of scarce occurrence, with low production for occasional export. The prescribed minimum felling diameter is 70 cm, and is cited by IUCN (2004) as a lower risk least concern species.

**Tree Features**

**The tree** is up to 30 m high and about 2.5 m in girth with short bole, low buttresses and wide spreading branches. **The bark** is grey to pale-brown, smooth or finely scaly. **The slash** is yellowish, turning darker with brown watery exudates. **The crown** is spreading and flattened. **The leaves** are 10-15 cm long by 6-12 cm broad, elliptic, shortly acuminate, rounded at base with slender stalk, 5-10 cm long. **The flowers** are formed from May to July, and in spreading panicles. The strongly **scented narrow fruits**, formed from July to September, are ellipsoid drupes, 4 cm long with

4 nutlets. The species is easily confused with *C. platythyrsa*.

**Wood Macroscopic Features**

**Pores** large, proportion of solitary pores high with 2 to 3 radial multiples of same size, clusters of 2 to 3, distribution low, tyloses present. **Axial parenchyma** apotracheal, straight bands, scalariform, very narrow to large, smaller than **fibre tissue** bands, regularly spaced with narrow distance between bands. **Fibre tissue** proportion is very low. **Ray parenchyma** is variable, narrow to wide, width between  $\frac{1}{4}$  and  $\frac{1}{2}$  of vessel diameter, frequency low. Wood is diffuse porous, **growth ring** boundaries demarcated by dark ground fibre tissue and marginal parenchyma.

**Physical Features**

**Heartwood** golden-yellow or orange-brown, demarcated from **sapwood**; coarse texture and lustrous. Wood is soft and of **low density**.



1 mm

### Splinter Burning Test

**Splinter** burns to exude coloured liquid and forms black ash.

### Ecology and Silviculture

*Cordia millenii* is a deciduous tree with seeds possibly dispersed by elephants and other primates (Plumptre, 1967). Seed germination is slow and epigeal, with 77 % germination rate after 17 to 32 days (Taylor, 1960). It is a light demander (Philip, 1967), and seedlings and saplings require light for an annual girth increment of 4 to 6 cm as in Sierra Leone (Savill & Fox, 1967). Seedlings and saplings are more abundant in disturbed forests (Hawthorne, 1994). Natural regeneration is uncommon (Taylor, 1960).

### Ethnobotany

It is traditionally well known for making musical instruments, especially drums (Abbiw, 1990). Leaves are boiled and the resulting liquid is used for treatment of roundworms, asthma, colds, and cough (Irvine, 1961). The pulverized seeds with palm oil are used for treating ringworms and itches. The leaves are used for treatment of headache, constipation in children and fracture, while the leaves and roots are used for treating dysentery and tetanus (Mshana *et al.*, 2000). The leaves are also used for treating pulmonary disorders (Burkill, 1985).

### Commercial Uses

A **durable species** used for the following:

Boats, canoes and their components

Shingles, shakes and weatherboards

Musical instruments, including drums and local xylophones

Furniture, cabinets, tables, doors and windows

Joineries

Family Name: **Rubiaceae**  
 Recommended Trade Name: **Corynanthe**  
 Local Names: **Pamprama** (Gh); **Gaovo** (CI)

#### **Distribution**

West and Central Africa, extending from Sierra Leone to Democratic Republic of Congo (Zaire). Sparsely found in all major forest types of Ghana.



#### **Status**

A lesser-known species cited by IUCN (2004) as a lower risk least concern species. No prescribed minimum felling diameter, but 50 cm is recommended.

#### **Tree Features**

The tree is up to 30 m high and about 2.0 m in girth with a dense crown. The bole is short, crooked, and often markedly fluted with horizontal branches low down the stem. The bark is brown with patches of grey. The slash is cream at first but rapidly turns brown. The leaves are simple, opposite, 12-20 cm long by 4-8 cm broad, elliptic to oblanceolate, with an abruptly acuminate tip and a cuneate base. The white flowers appear from October to December and from May to July, in umbel-like clusters about 2 cm across at the end of the branches and sweetly scented. The individual flowers are stalkless, narrow, up to 6 mm long.

The red fruits, which mature from January to March and in October, are spindle-shaped up to 1 cm long with numerous flat seeds and a long membranous tail.

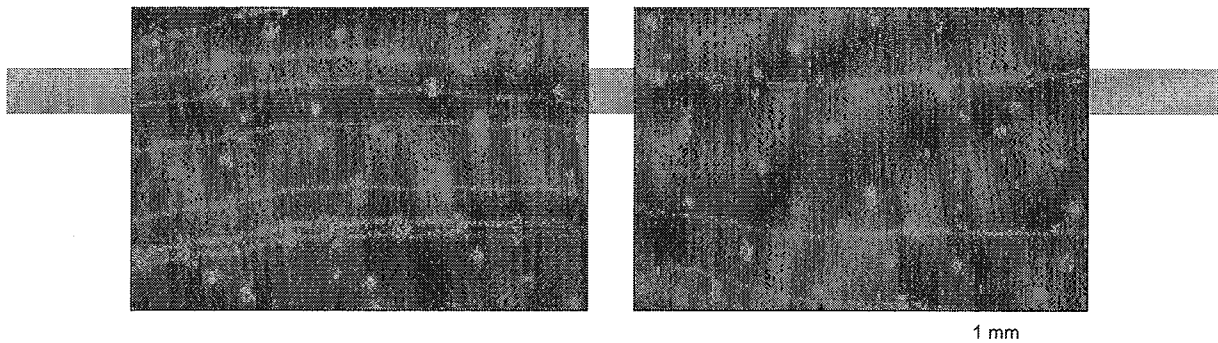
#### **Wood Macroscopic Features**

Pores small, proportion of solitary pores medium to high with 2 to 4 radial multiples of same size, moderate distribution, inclusions present. Axial parenchyma is barely distinct, marginal, straight-banded, very narrow, smaller than fibre tissue bands with wide distance between bands.

Proportion of fibre tissue is medium to high. Ray parenchyma is indistinct to the naked eye at transverse but distinct at radial, narrow, uniform, between  $\frac{1}{4}$  and  $\frac{1}{2}$  of vessel diameter, high frequency. Wood is diffuse porous, and growth ring boundaries are demarcated by marginal parenchyma.

#### **Physical Properties**

Heartwood is pale-pink with yellow tinge, turning yellow-brown, not differentiated from sapwood, fine texture with ribbon-like figure. Wood is hard and of medium density.



### **Splinter Burning Test**

**Splinter** burns to form yellow-brown ash.

### **Ecology and Silviculture**

*Corynanthe pachyceras* is an evergreen understorey tree which is more abundant in disturbed forest where it is gregarious. It regenerates in shade but saplings require light to grow (Hawthorne, 1995). All tree sizes are more abundant in undisturbed forest (Hawthorne, 1994).

### **Ethnobotany**

The bark contains various crystallized alkaloids used as an aphrodisiac, either as a decoction or a tincture (Irving, 1961). The decoction is also used for treatment of leprosy and drunk as cough and fever remedy (Burkill, 1985). The bark is also used to strengthen fermented drinks. The stem-bark is used for treating male sexual impotence and headache (Mshana *et al.*, 2000).

### **Recommended Commercial Uses**

A **moderately durable wood** promoted for the following uses:

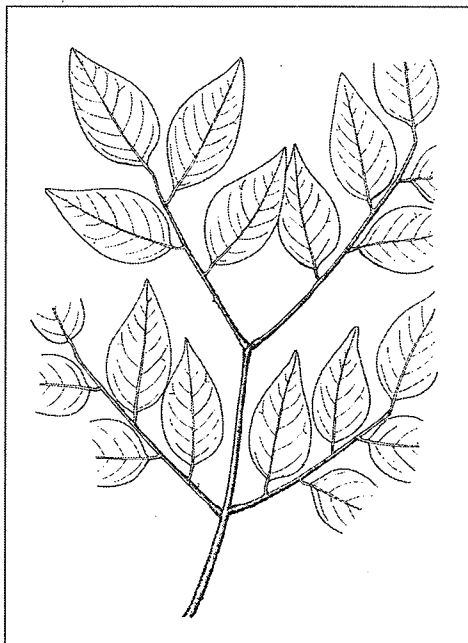
- Handicrafts
- Poles, posts and stakes
- Floorings and parquets
- Cabinet works and furniture
- Tool handles and turneries
- Boats
- Musical instruments

***Cylicodiscus gabunensis* Harms**

Family Name: **Mimosaceae**  
 Trade Names: **Denya; Okan**  
 Local Names: **Denya** (Gh); **Aduom** (Ca); **Bouemon** (CI)

**Distribution**

West and Central Africa, extending from Ivory Coast to Gabon. Frequently distributed in the Moist Evergreen and the Moist and Dry Semi-deciduous forests of Ghana.

**Status**

A **lesser-used species** of frequent forest availability, with high production for regular export. The prescribed minimum felling diameter is 70 cm, and is cited by IUCN (2004) as a lower risk near threatened species. Inhaled sawdust may cause respiratory problems in humans.

**Tree Features**

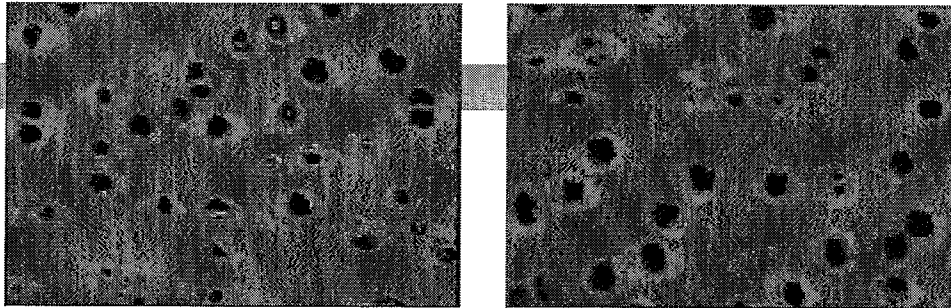
**The tree** is up to 60 m high and 10 m in girth with a wide-spreading and fairly open crown. **The bole** is straight with very short buttresses. **The bark** is brown, thin, flaking off in patches in mature trees; with brown thorns in young trees and a yellow slash. **The flowers** are of strong smell and exude a sticky gum. **The leaves** are bipinnate on common stalk about 2.5 cm long, terminating in a pair of pinnae, each 5-13 cm long. Each pinna has 5 to 10 leaflets, 5-10 cm long by 2.5-5 cm broad, ovate with a

sharp narrow tip, slightly unsymmetrical and cuneate at base. **It flowers** from February to April, yellowish, about 6 mm long, densely crowded in spikes, 7-20 cm long. **It fruits** from November to March, each **fruit reddish-brown**, 90 cm long by 5 cm broad with thick parallel margins, hangs conspicuously from the branches and splits open along the upper margin only. **Seeds** are numerous, flat, surrounded by an elongated papery wing sometimes over 7.5 cm long. Hawthorne (1995) describes it as "an extremely massive hulk of a tree with an immense spreading crown of massive bough".

**Wood Macroscopic Features**

**Pores** medium to large, exclusively solitary, diagonal pattern, low to moderate distribution, gum inclusions present. **Axial parenchyma** barely distinct with naked eye, paratracheal, vasicentric, aliform, confluent and marginal. **Ray parenchyma** is variable, very narrow and narrow, less than  $\frac{1}{4}$  to  $\frac{1}{2}$  of vessel diameter, frequency low to moderate. Proportion of **fibre tissue** is medium to high. Wood is diffuse porous, and **growth ring** boundaries are demarcated by marginal parenchyma and absence of pores.





1 mm

### Physical Features

**Heartwood** yellow-brown to yellowish-red, clearly demarcated from the grayish-pink **sapwood**, with coarse texture, fine silver figure and lustrous. Wood is hard and of **high density**.

### Splinter Burning Test

**Splinter** burns to form white ash.

### Ecology and Silviculture

*Cylicodiscus gabunensis* is a deciduous tree with stand **density** of mature trees reaching their peak in well-drained sites. It is propagated by seed and dispersed by wind, and germinates in shade with epigeal germination (Taylor, 1960). It is a shade bearer with sparse regeneration, but a long-lived tree (Hawthorne, 1995).

### Ethnobotany

A decoction from the bark is used in enemas for treating stomach pains; as a lotion for rheumatism, while the steeped leaves is used to treat migraine (Irvine, 1961).

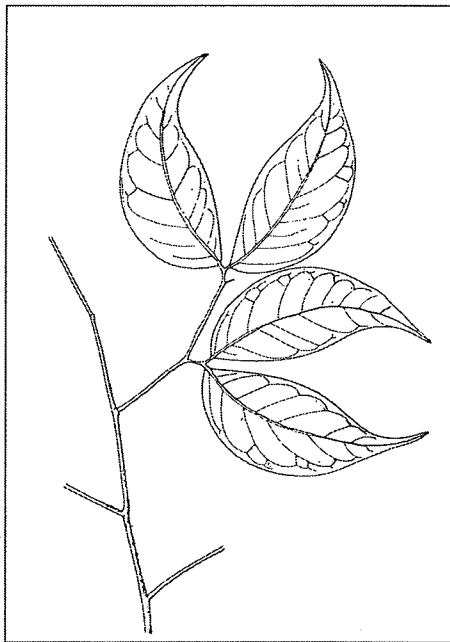
### Commercial Uses

A **durable wood** used for the following:  
 Industrial beams, joists, frames and trusses  
 Industrial floorings, steps and stairs  
 Sleepers, bridges, piles and deckings  
 Ship, boat building and truck bodies

Family Name: **Caesalpiniaceae**  
 Trade Names: **Cynometra; Apome**  
 Local Names: **Ananta (Gh) Apome (CI)**

#### **Distribution**

West Africa, limited to Liberia and Ghana. Frequently found in the Wet and Moist Evergreen forests of Ghana.



#### **Status**

A lesser-used timber species of frequent occurrence, with very low production and occasional export. The prescribed minimum felling diameter is 70 cm, and is categorized by IUCN (2004) as a lower risk least concern species.

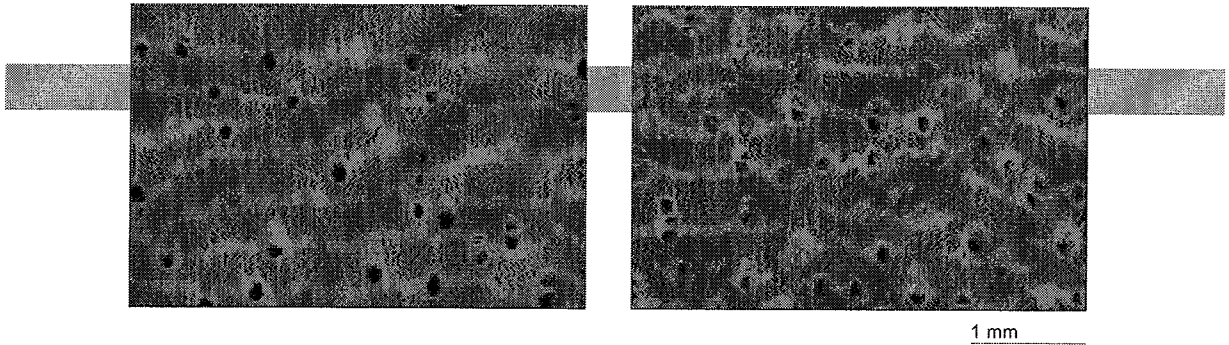
#### **Tree Features**

The tree is up to 35 m high and 3 m in girth, with straight bole and thin creeping buttresses similar to the buttress system in *Piptadeniastrum africanum* (Dahoma). The scales of the grey bark slough off, leaving mustard-coloured marks. The slash is hard and dull, reddish-brown, but darkens quickly on exposure, exudating greenish-grey gum. The leaf consists of one pair of sickle-shaped leaflets (rarely two pairs) that are acuminate at the tip and glabrous, red when newly flushed.

The crown is covered with numerous grey or white small flowers which are formed in November. The fruit pods mature in June, broadly oblong, 10 cm by 5 cm, pointed and nearly erect with a single brown flat large seed. The tree is often confused with *Guibourtia ehie* from which it is differentiated by its central midrib, absence of stipules, with the first two primary leaves being opposite (Taylor, 1960). The pod of *Cynometra* is differentiated from that of *Daniellia* which has the seed placed at central position in the pod.

#### **Wood Macroscopic Features**

Pores medium, proportion of solitary pores medium with 2 to 4 radial multiples of same size, distribution is low, inclusions present. Axial parenchyma is paratracheal, aliform, confluent and wavy bands, narrow width smaller than fibre tissue bands, regularly spaced with narrow distance between bands. Proportion of fibre tissue is low to medium. Ray parenchyma indistinct at transverse, distinct at radial, very narrow, uniform width less than 1/4 of vessel diameter, high frequency and storied. Wood is diffuse porous.



### Physical Features

Heartwood dark-red with darker streaks, clearly demarcated from the pink-brown sapwood with moderate coarse texture. Wood is hard and of **high density**.

### Splinter Burning Test

Splinter burns to form white ash.

### Ecology and Silviculture

*Cynometra ananta* is an evergreen tree characteristic of Evergreen forest where it is occasionally gregarious. It is a shade bearer propagated by seed dispersed by wind with epigeal germination. According to Taylor (1960), the seedling prefers some light to grow but Hawthorne (1995) describes it as a strong shade bearer.

### Ethnobotany

N/A

### Commercial Uses

A **durable wood** used for the following:

- Handicrafts and artifacts
- Beams, joists and other structural works
- Industrial floorings and parquets
- Decorative cabinet and furniture
- Exterior joinery, frames and mouldings
- Poles, posts and sleepers
- Vehicle and wagon bodies

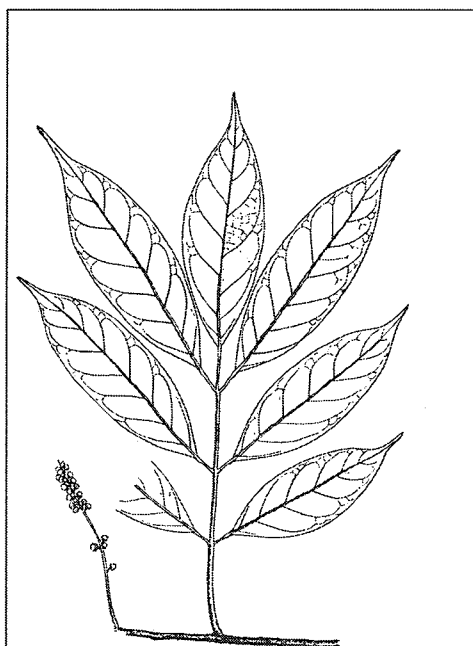
Family Name: **Burseraceae**

Recommended Trade Names: **Dacryodes; Adjouba**

Local Names: **Adwea** (Gh); **Adjouaba** (Ca; Cl)

#### **Distribution**

West and Central Africa, extending from Sierra Leone to Gabon, and found in all major forest types of Ghana.



#### **Status**

A **lesser-known species** categorised by IUCN (2004) as a lower risk least concern species. No prescribed minimum felling diameter, but 50 cm is recommended.

#### **Tree Features**

**The tree** is up to 25 m high and 1.6 m in girth, bole is short, usually without buttresses but slightly irregular. **The bark** is smooth and greyish with small scales. **The slash** is thin, pink-brown with a slight gummy exudate and a characteristic sweet scent. **The branchlets** are scurfy with the leaves in tufts at the ends. **The new leaves** are red, 15 to 45 cm long, and have swollen petiole at the tip. The 3 pairs of leaflets plus a terminal one are oblong-elliptic to oblong, very obliquely cuneate or obtuse at base, shortly acuminate at the tip, up to 20 cm long and 9 cm broad, with 9 to 12 main lateral nerves. **The pale-**

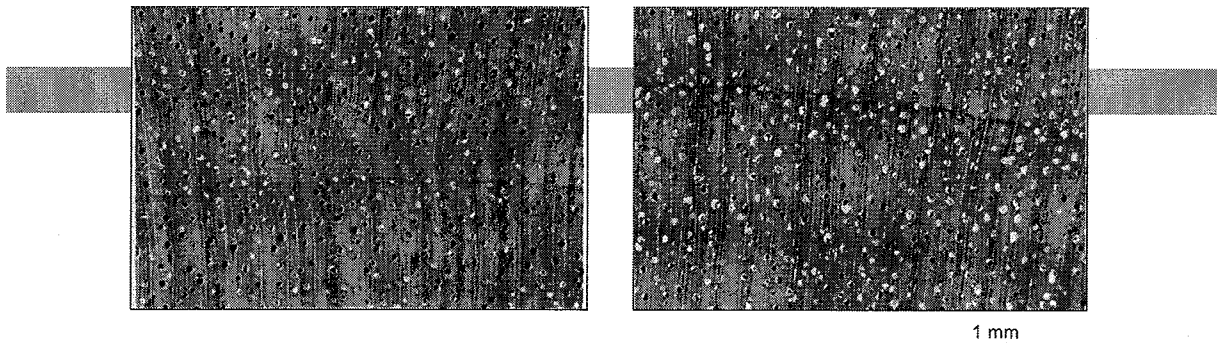
**yellow flowers** are formed from February to March and in panicle inflorescence. The rachis is slightly grooved and the petals are rusty-stellate, scaly and puberulous. The female or hermaphrodite flowers are borne separately, but the male flowers are in small fascicles. **The fruits**, formed in November, are oblong-ellipsoid or subglobose, 2-3 cm long, 1.5-2 cm in diameter, sweet-scented and edible.

#### **Wood Macroscopic Features**

**Pores** indistinct to naked eye, exclusively solitary, moderate to high distribution, inclusions present. **Axial parenchyma** is indistinct to naked eye and with hand lens. **Fibre tissue** proportion is medium to high. **Ray parenchyma** barely distinct, uniform, very narrow between  $\frac{1}{4}$  and  $\frac{1}{2}$  of vessel diameter, high frequency. Wood is diffuse porous.

#### **Physical Features**

**Heartwood** grey or pink, clearly demarcated from the **cream sapwood** with low luster and fine texture. Wood is hard and of **high density**.



#### **Splinter Burning Test**

Splinter burns to exude coloured liquid compounds and forms grey ash.

#### **Ecology and Silviculture**

*Dacryodes klaineana* is an evergreen tree with distribution strongly correlated with rainfall and absent from the very dry forests. It is a shade bearer that is associated with base-poor, acidic soils. The mode of propagation is by seed and germination under shade is epigeal. Trees are more abundant in undisturbed forest (Hawthorne, 1994).

#### **Ethnobotany**

The fruit is edible and often sold in the market (Abbiw, 1990). The tree yields resin used for treatment of skin diseases, leaf decoction is for ear treatment, and the bark for menstrual complications, naso-pharyngeal diseases and diarrhoea (Burkill, 1985).

#### **Recommended Commercial Uses**

A **moderately durable wood** promoted for the following uses:

- Crossties and sleepers
- Poles, posts and stakes
- Floorings, steps and stairs
- Furniture and cabinet works
- Plywood and veneer
- Sporting goods and handles
- Vehicle bodies

***Daniellia ogea* (Harms) Holland (including *D. thurifera* Benn)**

Family Name: **Caesalpiniaceae**  
 Trade Names: **Ogea, Faro, Daniellia**  
 Local Names: **Hyedua (Gh); Faro (CI)**

**Distribution**

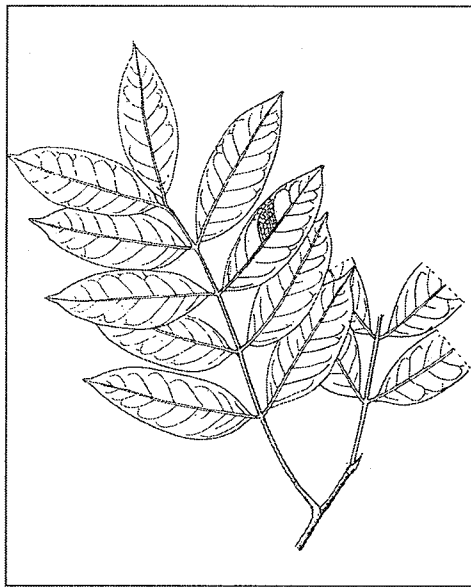
West and Central Africa, extending from Senegal to Gabon. Sparsely found in all Evergreen and Moist Semi-deciduous (South-East type) forests of Ghana.

**Status**

It is a **lesser-used species** of sparse occurrence, a high volume production with irregular export. The prescribed minimum felling diameter is 110 cm. It is not distinguished in trade from *D. thurifera* and is categorised by IUCN (2004) as a lower risk near threatened species.

**Tree Features**

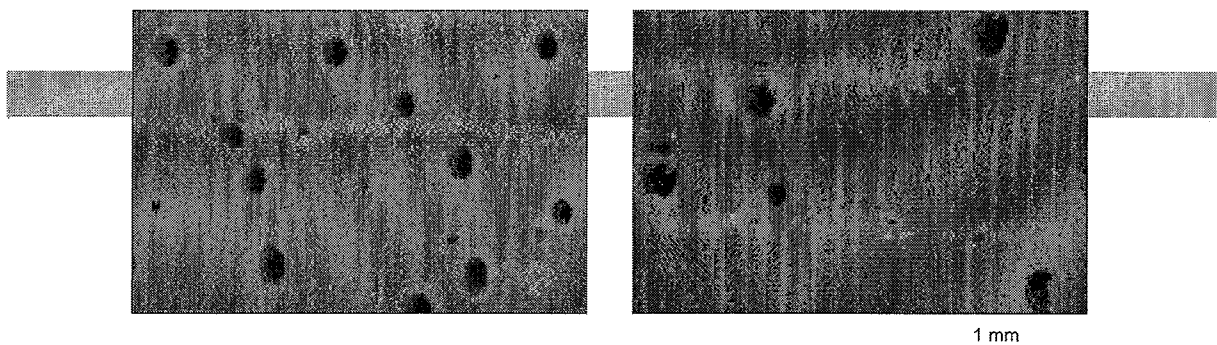
The tree is up to 35 m high and 4 m in girth; bole is straight, cylindrical and unbuttressed, up to 20 m to the first branch. The **branching system** is short and ascending. The young tree has a thin, compact and rounded crown, but flat-topped in older trees. The **bark** is grey, smooth with characteristic rings. The **slash** is brittle and pale-green on the outer layer, but brownish-yellow with ripple marks beneath. The **leaves** are pinnate with a common stalk 15-45 cm, bright-red when in flush. The



**leaflets** are 5 to 9 pairs, 7.5-12.5 cm broad. They are elongated elliptic, abruptly acuminate at the tip, base rounded at one side and cuneate on the other. The **flowers** are formed from November to January, bluish to violet, and in terminal panicles. The whole inflorescence is very finely velvety. The **fruits** mature from March to April. They are flat leathery pods, 5-9 cm long by 2.5-5 cm broad. They are pale-brown, glabrous, more or less elliptic, with a thickened upper edge that splits open along the lower edge. The **single seed** is flattened, elliptic, about 3 cm long by 18 mm broad, and is blown away when the fruit splits open. *Daniellia ogea* is very similar to *D. thurifera* also found in Ghana from which it is distinguished by the former's less scaly bark with more rings on the bole (Taylor, 1960).

**Wood Macroscopic Features**

**Pores** very large to large, proportion of solitary pores medium with 2 to 3 radial multiples of same size, distribution low, inclusions present. **Axial parenchyma** paratracheal, vasicentric, straight-banded, irregularly spaced, marginal, narrow width, smaller than fibre tissue bands, wide distance between bands. Proportion of **fibre tissue** is medium. **Ray parenchyma** narrow, uniform width, less than 1/4 of vessel diameter, moderate to high frequency, storied, gum canals present. Wood is diffuse porous, and **growth ring** boundaries are demarcated by marginal parenchyma and differences in vessel diameter.



### Physical Features

**Heartwood** is pinkish-brown to reddish-brown with darker streaks, clearly demarcated from the white to yellow **sapwood**. Texture is medium to coarse with high lustre. Wood is fairly soft and of **low density**.

### Splinter Burning Test

**Splinter** burns to produce crackle or bright sparks, exudes coloured liquid, and forms white ash.

### Ecology and Silviculture

*Daniellia ogea* is a deciduous tree which is never found in large quantities, and rarely in secondary forests. It is a pioneer tree propagated by seed with epigeal germination (Hawthorne, 1995). Mean annual girth increment of 2 to 4 cm has been recorded in Sierra Leone (Savil & Fox, 1967). All sizes of tree are more abundant in undisturbed forest (Hawthorne, 1994). *Daniellia ogea* does not occur in wettest and swamp forest as *D. thurifera* (Taylor, 1960).

### Ethnobotany

The tree yields gum copal, an ingredient used for treating snake-bite (Abbiw, 1990). Water decoction of the root and bark is used for gonorrhoea (Irvine, 1961). The powdered gum in water is used to treat cough and asthma (Mshana *et al.*, 2000).

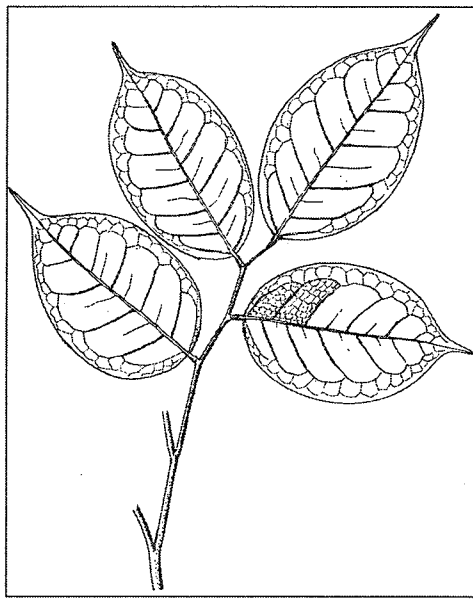
### Commercial Uses

A **non-durable wood** used for the following:

- Claddings, panellings and mouldings
- Interior joinery and frames
- Core veneer and plywood
- Furniture and cabinet works

Family Name: **Caesalpiniacea**Trade Name: **Eyoum**Local Names: **Duabankye (Gh); Eyoum (Ca); Afanbeou (CI)****Distribution**

West and Central Africa, extending from Guinea to Gabon and Democratic Republic of Congo (Zaire). Moderately found in Ghana from Wet and Moist Evergreen, and Moist Semi-deciduous (South-East subtype) forests.

**Status**

It is a **lesser-used species** of moderate occurrence with insignificant production for occasional export. The prescribed minimum felling diameter is 70 cm, and is cited by IUCN (2004) as a lower risk least concern species. The sawdust may cause dermatitis respiratory problems in humans if inhaled.

**Tree Features**

**The tree** is up to 30 m high and a maximum girth of 2.5 m with dark foliage crown. **The bole** is slightly fluted with large high buttresses and large scaly plate bark. **The slash** is red with spots of red and fine ripple marks. **The leaves** are pinnate, up to 5 leaflets, oblong, 10 cm by 4 cm, glabrous with cuneate base and recurved margin, very glossy with prominent regular reticulations with fruity acidic taste. **The flowers** are formed in September, small

greenish-brown, with black ellipsoid berry fruit up to 3 cm in diameter, glabrous and single-seeded.

**Wood Macroscopic Features**

**Pores** small, exclusively solitary, low to moderate distribution, inclusions present. **Axial parenchyma** wavy-banded, reticulate, regularly spaced, very narrow, less or equal to fibre tissue bands with narrow distance between bands. **Fibre tissue** proportion is low to medium. **Ray parenchyma** is indistinct to the naked eye, very narrow, uniform, less than ¼ of vessel diameter, very high and storied. Wood is diffuse porous.

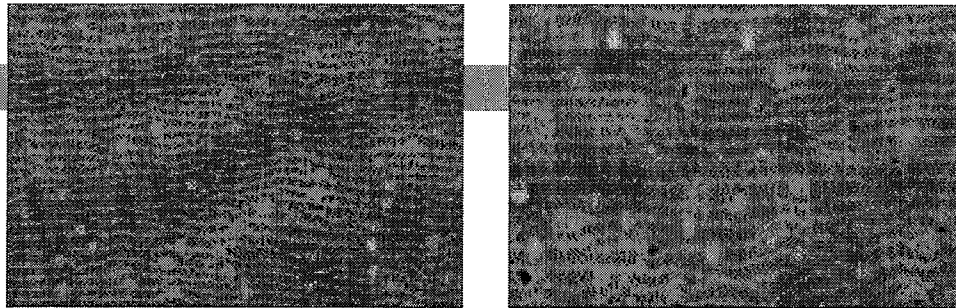
**Physical Features**

**Heartwood** pink-brown, almost black; differentiated from pale **sapwood** with fine texture. Wood is hard and of **medium to high density**.

**Splinter Burning Test**

**Splinter** burns to exude coloured liquid compounds and forms grey ash.





1 mm

### Ecology and Silviculture

*Dialium aubrevillei* is a common evergreen tree found on base-poor acid soil with high clay content. It is propagated by seed with epigeal germination, and regenerates in shade but saplings require light to grow.

### Ethnobotany

The powdered bark is drunk or used in enemas as a purgative. It is mixed into paste or with palm nuts and used for treatment of rheumatism (Irvine, 1961). The powdered leaves are used for the treatment of coughs, throat colds and pains, while the leaf-juice is used as nasal drops (Irvine, 1961). The decoction serves as a beverage for fever, jaundice, and yellow fever.

### Commercial Uses

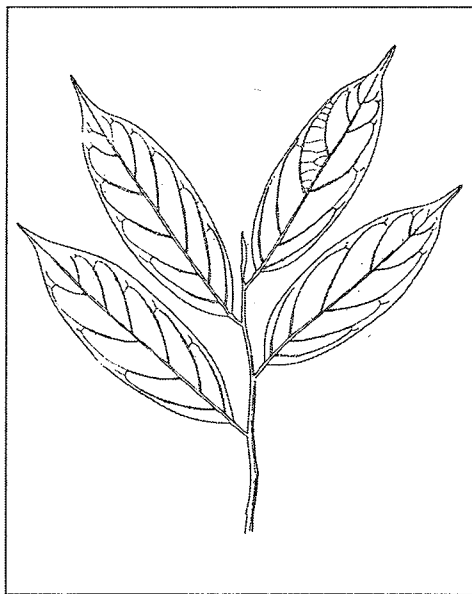
A **very durable wood** used for the following:

- Bridges, sleepers and crossties
- Poles, posts and stakes
- Floorings, steps and stairs
- Decorative veneer and plywood

Family Name: **Ebenaceae**  
 Trade Name: **African Ebony**  
 Local Names: **Omenewa (Gh); Mevini (Ca)**

#### **Distribution**

West and Central Africa, extending from Liberia to Ghana, and from Cameroon to Gabon. Sparsely found in Wet and Moist Evergreen, Moist and Dry Semi-deciduous forests of Ghana.



#### **Status**

It is a **lesser-used species** of sparse occurrence with low production for occasional export. It is sold as part of the Ebony group of timbers. The prescribed minimum felling diameter is 50 cm, and is classified by IUCN (2004) as a lower risk near threatened species. The sawdust may cause dermatitis.

#### **Tree Features**

**The tree** is up to 15 m high and about 1.6 m in girth with golden-brown crown. The branchlets are golden-tomentose with whorled branching system. **The bark** is thin but rough and bright dark-green. **The slash** is pinkish and soft. **The leaves** are simple, alternate, pale-green above and yellowish-grey below with dense yellow hairs, oblong-elliptic, and 3-6 cm by 1.5-3 cm. It has yellow hairs, especially on young leaves. The tip is cuneate with slightly cordate base.

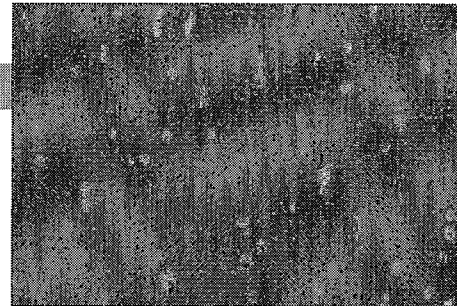
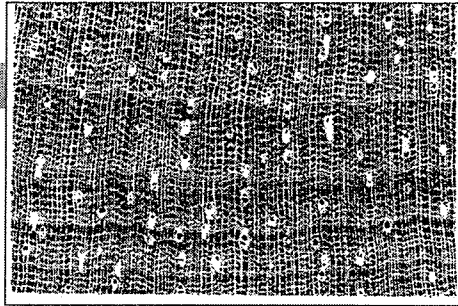
**The yellow-white flowers** appear from June to September and are dioecious. The male flowers are in axillary clusters, but the female flowers are solitary. **The oblong yellow berry fruits** mature from February to March, ellipsoid, 4 cm by 3.5 cm, each containing 6 to 8 black seeds.

#### **Wood Macroscopic Features**

**Pores** are small, indistinct to naked eye, proportion of solitary pores medium with 2 to 4 radial multiples of same size, distribution low with inclusions. **Axial parenchyma** is indistinct to naked eye, regular wavy bands, reticulate, very narrow width smaller than fibre tissue bands with narrow and regular distance between bands. Proportion of **fibre tissue** is low to medium. **Ray parenchyma** is indistinct at transverse but distinct at radial section, very narrow, uniform width, less than 1/4 to 1/2 of vessel diameter, high frequency. Wood is diffuse porous, and **growth ring** boundaries are demarcated by dark ground fibre tissue.

#### **Physical Features**

**Heartwood** is pink to dark-brown with grayish-brown bands, not demarcated from **sapwood** with fine texture. Wood is hard and of **high density**.



1 mm

### **Splinter Buening Test**

**Splinter** burns to exude coloured liquid and produces yellow-brown ash.

### **Ecology and Silviculture**

*Diospyros kamerunensis* is an evergreen tree associated with acid base-poor but well-drained soil (Hall & Swaine, 1981). It is a shade bearer and is not found in young secondary forest. Propagation is by seed and germination is epigeal (Taylor, 1960). Growth is slow but steady. The trees are more common in undisturbed forest (Hawthorne, 1994).

### **Ethnobotany**

The fruit pulp is edible (Abbiw, 1990).

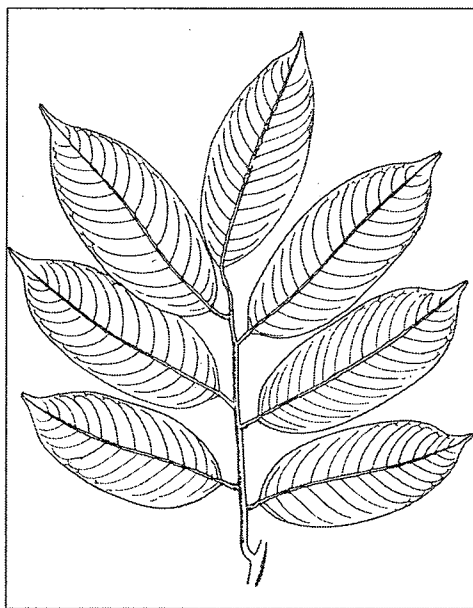
### **Commercial Uses**

A **very durable wood** used for the following:

- Artifacts, carvings and handicrafts
- Floorings, stairways and parquets
- Furniture including luxury cabinet works
- Poles and posts (small size stems)
- Turneries, handles and ornaments

***Distemonanthus benthamianus* Baill.**Family Name: **Caesalpiniaceae**Trade Names: **Ayan, Movingui**Local Names: **Ayan; Bonsamdua (Gh); Movingui (Ca)****Distribution**

West and Central Africa, extending from Sierra Leone to Gabon. Sparsely distributed in the Evergreen and Moist Semi-deciduous forests of Ghana.

**Status**

It is a **lesser-used species** of sparse forest availability, with moderate production and irregular export. The prescribed minimum felling diameter is 90 cm, and is cited by IUCN (2004) as a lower risk near threatened species. The sawdust may cause dermatitis on contrast with skin.

**Tree Features**

**The tree** is up to 35 m high and about 3.1 m in girth with small crown. **The bole** is fairly straight, with low-rounded buttresses and flaking-red bark. **The slash** is thin, orange to brown with prominent ripple marks. **The branches** are whorled with glabrous and purple branchlets. **The leaves** are pinnate with a common stalk, 7-22 cm, glabrous or slightly hairy when young. **The alternate leaflets** are 7 to 11, 3.5-10 cm by 2-3.5 cm, ovate to

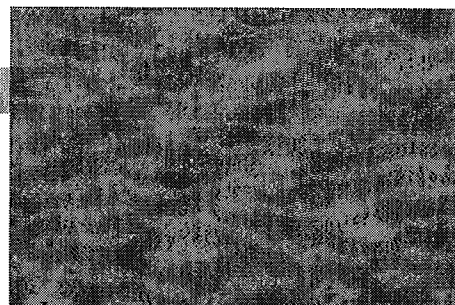
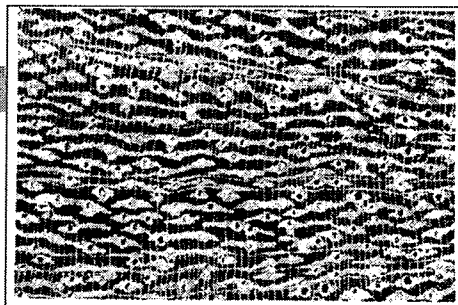
lanceolate, with acuminate tip and rounded base. **The flowers** are formed from September to November and in February. The sepals are reddish-violet, petals white, inflorescence 5 to 10 mm long. **The individual flowers** have slender hairy stalks up to 12 mm long. **The fruits** mature from November to March and from June to July. They are elliptic, 7-10 cm by 3.5 cm, hairy when young, with each fruit containing up to 5 small brown seeds.

**Wood Macroscopic Features**

**Pores** small to medium, proportion of solitary pores high with 2 to 4 radial multiples of same size, low to moderate distribution, inclusions present. **Axial parenchyma** paratracheal, aliform, confluent, marginal, narrow wavy bands smaller than fibre tissue bands, irregularly spaced with narrow distance between bands. Proportion of **fibre tissue** is low to medium. **Ray parenchyma** is indistinct, very narrow, uniform, width less than ¼ of vessel diameter, high frequency and storied. **Wood** is diffuse porous, and growth ring boundaries are demarcated by marginal parenchyma.

**Physical Features**

**Heartwood** yellow-brown, demarcated from **sapwood** which is straw-yellow, fine texture, moderately lustrous, good decorative figure. Wood is hard and of **high density**.



1 mm

### Splinter Burning Test

**Splinter** burns to form white ash.

### Ecology and Silviculture

*Distemonanthus benthamianus* is a deciduous tree most common in moist forest and more abundant in disturbed forest. It does not appear to have any soil preference and will grow in secondary forest if the soil layer is not too dense. It is propagated by seed dispersed by wind. Germination is epigeal with a germination rate of about 90 % (Taylor, 1960). The seedlings and saplings are shade tolerant and are often seen in understorey, but is reported by Hawthorne (1995) to be light demanding at later stage.

### Ethnobotany

Infusion of the powdered bark is used as a wash for skin diseases (Irvine, 1961). **The bark** is used for treating whooping cough and wounds (Mshana *et al.*, 2000).

### Commercial Uses

A **moderately durable wood** used for the following:

- Beams, joists and roof trusses
- External and interior joinery, frames and fittings
- Face veneer and plywood
- Floorings, steps and stairs
- Vehicle bodies

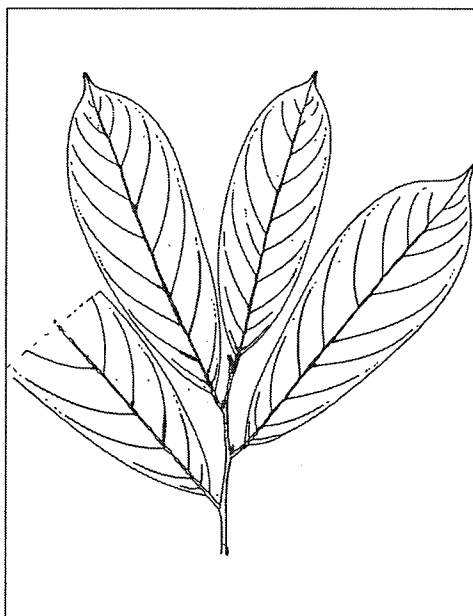
Family Name: **Annonaceae**

Recommended Trade Names: **Goldenwood; Enantia; Moambé**

Local Names: **Duasika (Gh); Mfo (Ca); Baoue (CI)**

#### **Distribution**

West Africa, extending from Sierra Leone to Cameroon. Frequently found in the Evergreen and Semi-deciduous forests of Ghana.



#### **Status**

It is a **lesser-known species** of frequent occurrence and recommended for promotion in local market. No prescribed minimum felling diameter, but 50 cm is recommended. It is classified by IUCN (2004) as a lower risk least concern species.

#### **Tree Features**

**The tree** is up to 20 m high and rarely above 1.8 m in girth, a cylindrical stem with small horizontal bough crown. **The slash** is bright golden-yellow. **The leaves** are simple and alternate, with stellate and simple hairs on the undersurface. They are oblong-oblancoate, with acuminate apex and obtuse base, 8-25 cm by 3-9 cm. **It flowers** from March to April, being greenish-yellow petals of about 25 mm and 12 mm. **The fruit** is a berry, black, elliptical, matures from May to June, and contains one ellipsoid seed.

#### **Wood Macroscopic Features**

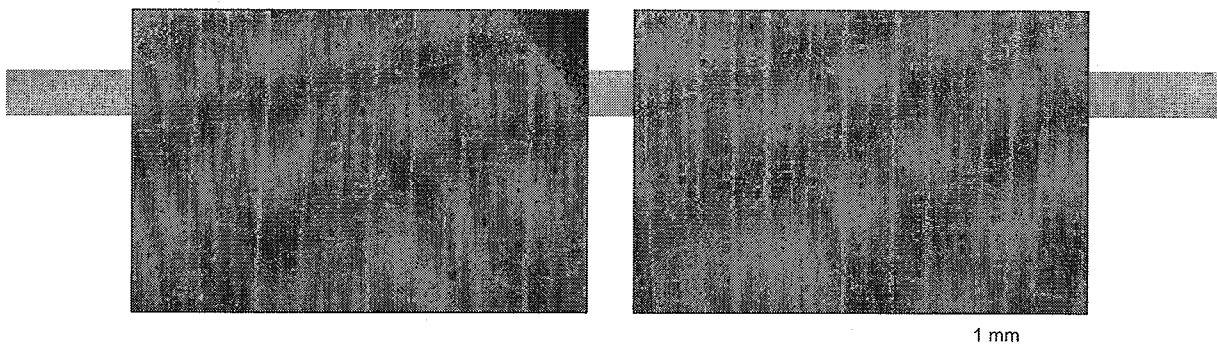
**Pores** are small, barely distinct to the naked eye, proportions of solitary pores medium with 2 to 3 radial multiples of same size, moderate distribution. **Axial parenchyma** indistinct to naked eye, scalariform with straight to wavy bands, very narrow width smaller than fibre tissue bands, regularly spaced with narrow distance between bands. Proportion of **fibre tissue** is low to medium. **Ray parenchyma** distinct, variable width, very narrow to narrow, width less than 1/2 to full size of vessel diameter, moderate frequency. Wood is diffuse porous, and fairly distinct growth ring boundaries are demarcated by dark ground **fibre tissue**.

#### **Physical Features**

**Heartwood** bright-yellow, not demarcated from yellow **sapwood**, fine texture with lustrous surface. Wood is fairly hard and of **medium density**.

#### **Splinter Burning Test**

**Splinter** burns to exude coloured liquid compounds and forms white ash.



### Ecology and Silviculture

*Enantia polycarpa* is a shade bearer, propagated by seed with epigeal germination. It is not resistant to fire and is absent in previously fire destroyed but regenerated forest (Hawthorne, 1994).

### Ethnobotany

The **bark** extract is applied to ulcers and leprous sores, and a decoction is used as antiseptic to wash wounds (Irvine, 1961; Burkill, 1985). Extract of the bark and wood is used for yellow dye leather, mats and cotton. The stem-bark is used for treating skin ulcer (Mshana *et al.*, 2000).

### Recommended Commercial Uses

A **non-durable wood** promoted for the following uses:

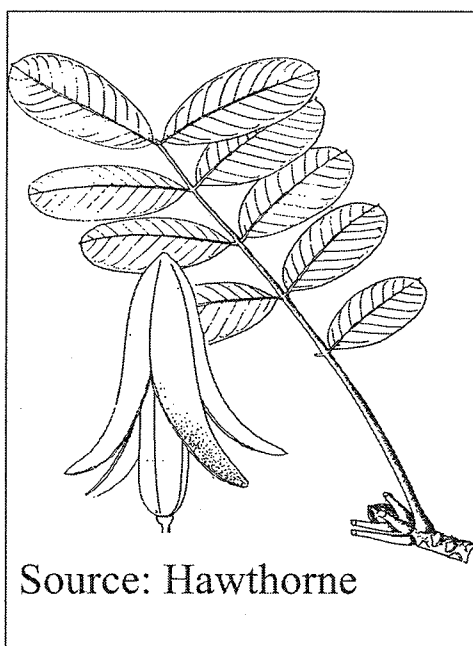
Furniture and cabinet works  
Musical instruments including xylophones

***Entandrophragma angolense* (Welw.) C. DC.**

Family Name: **Meliaceae**  
 Trade Names: **Edinam; Tiama**  
 Local Names: **Edinam (Gh); Tiama (CI)**

**Distribution**

West, Central and East Africa, extending from Guinea to Uganda and Angola. Moderately distributed in Moist Evergreen, Wet and Dry Semi-deciduous forests of Ghana.



Source: Hawthorne

**Status**

It is a **premium species** of moderate occurrence, with high production for regular export. The prescribed minimum felling diameter is 110 cm, and is cited as a vulnerable species by IUCN (2004).

**Tree Features**

**The tree** is up to 50 m high, a girth of 5 m, a long straight bole up to 25 m with broad but low buttresses and open crown. **The bark** is relatively smooth, pale grey-brown to orange-brown with flake-off scales. **The slash** is slightly scented, soft, dark-red and pink with white radial streaks. **The leaves** are pinnate, 40 cm long, with 5 to 10 pairs of opposite or sub-opposite leaflets, up to 12 cm by 5 cm. **The leaflets** are oblong elliptic, rounded and ending with a point at the apex with 9-12 lateral nerves. It flowers from November to March, white or yellowish with

short hairy panicles and long petals of 5 mm. **The fruit**, a capsule 8 to 20 cm long, matures from January to May, splits from the base but remains joined together at the apex for some time, with 5 to 6 winged seeds.

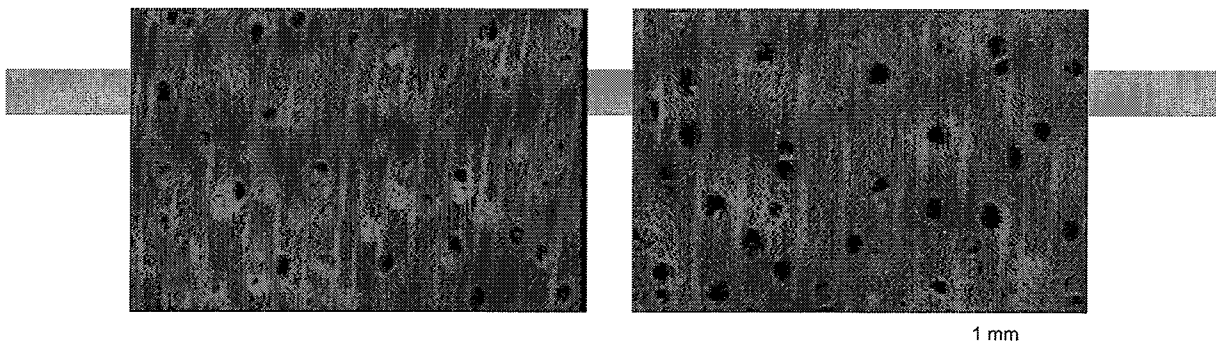
**Wood Macroscopic Features**

**Pores** medium, proportion of solitary pores high, with 2 to 4 radial multiples of same size, moderate distribution, tyloses and gum inclusions present. **Axial parenchyma** indistinct to the naked eye, paratracheal, vasicentric, aliform, straight to wavy bands and marginal, smaller than fibre tissue bands, irregularly spaced with wide distance between bands. Proportion of **fibre tissue** is low to medium. **Ray parenchyma** very narrow to narrow, uniform width, between  $\frac{1}{4}$  and  $\frac{1}{2}$  of vessel diameter, frequency is moderate. Wood is diffuse porous, and **growth ring** boundaries are demarcated by marginal parenchyma bands.

**Physical Features**

**Heartwood** dark red-brown, clearly demarcated from pinkish **sapwood**, coarse to medium texture, with low luster and aromatic odour. Wood is hard and of **medium density**.





### Splinter Burning Test

**Splinter** burns to exude coloured liquid, produces crackle or bright sparks, and forms grey ash.

### Ecology and Silviculture

*Entandrophragma angolense* is a deciduous tree common on well-drained soils. It is propagated by seed dispersed by wind. Germination is epigeal, takes 14 to 23 days with 80 to 90 % germination rate (Taylor, 1960). Stripped planting is also possible. The seeds have short viability and should be sown few days after fallen on ground. Initial stages of growth require overhead shade and later some light for development. Seedlings grow about 1 m per year and require exposure to sun thereafter. Saplings are commonly seen in gaps, and a height of 6 m in 4 years has been recorded (Taylor, 1960). Trees are more abundant in regenerated forest previously destroyed by fire . (Hawthorne, 1994). Successful plantations have been established in Côte d'Ivoire (De Clerk, 1991). Die-bark of trees in a taungya system resulting from capsid attack has been reported by Taylor (1960). The tree is prone to attack by insect defoliators, shoot borers, and other fruit and sap-feeding insects (Wagner *et al.*, 1991).

### Ethnobotany

**The bark** yields a brown dye (Abbiw, 1990). The bark, boiled with guinea grains plus salt and filtered, is drunk for treatment of fever (Irvine, 1961). The stem-bark is used to treat cough and asthma, while seeds are used for treating malaria (Mshana *et al.*, 2000).

### Commercial Uses

A **moderately durable** wood used for the following:

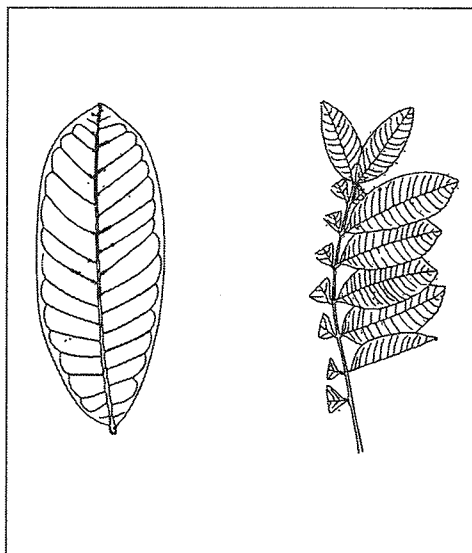
- Roof trusses, joists and beams
- Joinery, frames and trims
- Floorings, steps and stairs
- Panellings, mouldings and claddings
- Luxury cabinet and furniture works

***Entandrophragma candolei* Harms**

Family Name: **Meliaceae**  
 Trade Names: **Candolei; Kosipo**  
 Local Names: **Penkwa (Gh); Kosipo (CI)**

**Distribution**

West and Central Africa, extending from Guinea to Democratic Republic of Congo (Zaire). Sparsely found in Moist Evergreen and Moist Semi-deciduous forests of Ghana.

**Status**

It is a **commercial species** with sparse distribution, moderate production, and regular export. The prescribed minimum felling limit is 110 cm, and is cited as a vulnerable species by IUCN (2004).

**Tree Features**

**The tree** is up to 60 m high and 3.6 m in girth. It has a straight bole up to 30 m high, blunt buttresses, and a dark dense foliage crown. **The bark** is scaly and slash is white and pink, bitter, with orange granules. **The leaves** are alternate, paripinnate, about 30 cm long with 5 to 9 pairs of opposite leaflets, 3-12 cm long and 2-6 cm broad. **The leaflets** are oblong-elliptic, rounded at base, obtuse at apex with pubescence on the midrib and nerves beneath. The cream-yellow flowers

are formed from September to November. It **fruits** from February to July, has 15-cm long capsule, and up to 30 shiny grayish-brown seeds with wings pointing downwards.

**Wood Macroscopic Features**

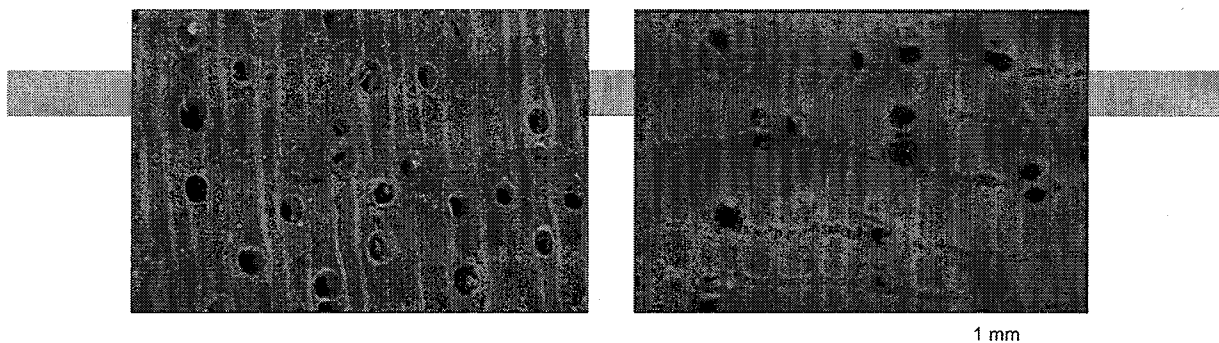
**Pores** medium to large, high proportion of solitary pores with 2 to 3 radial multiples of same size, distribution low, tyloses and other inclusions present. **Axial parenchyma** paratracheal, aliform, confluent, wavy-banded, broad, narrow, equal to fibre tissue bands, irregularly spaced with narrow distance between bands. **Fibre tissue** proportion is medium. **Ray parenchyma** is very narrow to narrow, uniform width between  $\frac{1}{4}$  and  $\frac{1}{2}$  of vessel diameter, moderate frequency. Wood is diffuse porous, **growth ring** boundaries demarcated by ground fibre tissue or marginal parenchyma.

**Physical Features**

**Heartwood** dark to reddish-brown or purple with well-defined whitish-yellow **sapwood**, coarse texture with distinct figure. Wood is fairly hard and of **medium density**.

**Splinter Burning Test**

**Splinter** burns with crackle and bright sparks, forms coloured exudates and grey ash.



### Ecology and Silviculture

*Entandrophragma candollei* is a deciduous tree with winged seeds dispersed by wind. Seeds have short viability. Germination under shade is epigeal, but saplings develop better in light with a height increment of 1 m after 2nd year (Taylor, 1960). Regeneration requirements are similar to other *Entandrophragma* species, and it does well in regenerated forest previously destroyed by fire (Hawthorne, 1994). The tree is attacked by insect defoliators, shoot borers, and other seed and fruit pests (Wagner *et al.*, 1991).

### Ethnobotany

N/A

### Commercial Uses

A **durable wood** commercially used for the following:

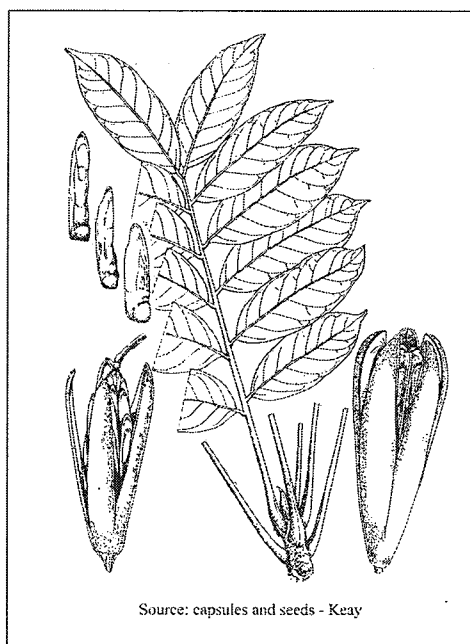
- Boats and boat components
- Claddings, panellings and mouldings
- Furniture (decorative) and cabinet works
- Joinery, frames and trims
- Floorings (light and heavy)
- Decorative veneer for plywood
- Vehicle bodies

***Entandrophragma cylindricum* (Sprague)**

Family Name: **Meliaceae**  
 Trade Names: **Sapele, Sapelli**  
 Local Names: **Penkwa (Gh); M'boyo (CAR)**

**Distribution**

West, Central and East Africa, extending from Sierra Leone to Democratic Republic of Congo (Zaire) and Uganda. Moderately found in Moist Semi-deciduous forests of Ghana.



Source: capsules and seeds - Keay

**Status**

It is a **premium species** of moderate occurrence, high production and regular export. The prescribed minimum felling diameter is 110 cm. It is cited as a vulnerable species by IUCN (2004). The sawdust may cause dermatitis and respiratory problems in humans.

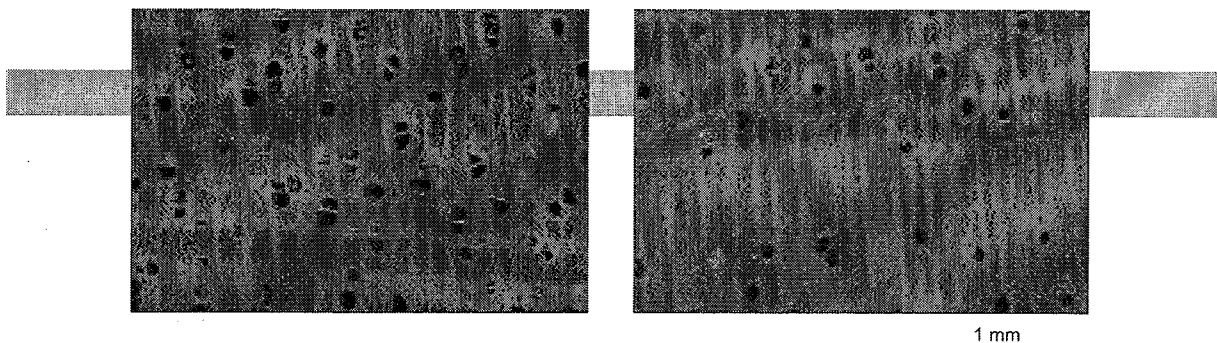
**Tree Features**

**The tree** is up to 50 m high and 5 m in girth, with a straight bole up to 30 m with broad but low buttresses. It has a rounded but compact crown with a relatively smooth bark, rough and flaky with grey-brown scales. **The slash** is fibrous, brownish-pink with cream markings, very strong and sweet scented with ripple marks. **The leaves** are pinnate up to 60 cm long with 5 to 9 pairs of opposite or sub-opposite leaflets, up to 14 cm long and 6 cm broad each. They are oblong to oblong-

lanceolate, asymmetric at base, and shortly pointed at the apex with 6 to 12 lateral nerves. **The white or cream flowers** are formed from November to April in panicles up to 30 cm long, and petals have short hairs 2 mm long. **The fruits** are capsules, mature from May to August, and are 6-10 cm long. The capsule segments split away from base and apex with 3 to 4-winged seeds in each face of the column.

**Wood Macroscopic Features**

**Pores** small to medium, proportion of solitary pores medium with 2 to 3 radial multiples of same size, low to moderate distribution, organic inclusions present. **Axial parenchyma** paratracheal, aliform, confluent, marginal, narrow wavy bands, irregularly spaced, smaller than fibre tissue bands with wide or narrow distance between bands. Proportion of **fibre tissue** is low to medium. **Ray parenchyma** is uniform, very narrow to narrow, width less than  $\frac{1}{4}$  to  $\frac{1}{2}$  of vessel diameter, medium frequency and storied. Wood is diffuse porous, and **growth ring** boundaries are demarcated by absence of pores, dark ground fibre tissue or marginal parenchyma.



### Physical Features

**Heartwood** dark red-brown, clearly demarcated from pinkish sapwood. Texture is moderately coarse, low luster with cedar-like odour.

Wood is hard and of **medium density**.

### Splinter Burning Test

**Splinter** burns to exude coloured liquid, produces crackle or bright sparks, and forms grey ash.

### Ecology and Silviculture

*Entandrophragma cylindricum* is propagated by seed dispersed by wind. Epigeal germination occurs within 14 to 26 days with a germination rate of about 90 % if seed is sown soon after collection (Taylor, 1960). Overhead light is needed for good development. Growth is slow compared with other *Entandrophragma* species, with a height growth of about 1 m after 4 years. Stripped planting using 2- to 3-year-old sapling is possible (Taylor, 1960). Regeneration is reported to be less abundant in regenerated forest previously destroyed by fire (Hawthorne, 1994). The tree is liable to attack by insect defoliators, shoot borers, fruit and seed pests (Wagner *et al.*, 1991). It is, nevertheless, the most resistant among species of the genus (Taylor, 1960).

### Ethnobotany

N/A

### Commercial Uses

A **durable wood** used for the following:

Decorative furniture and luxury cabinet works

Decorative sliced and rotary veneer for plywood

Floorings, steps and stairs

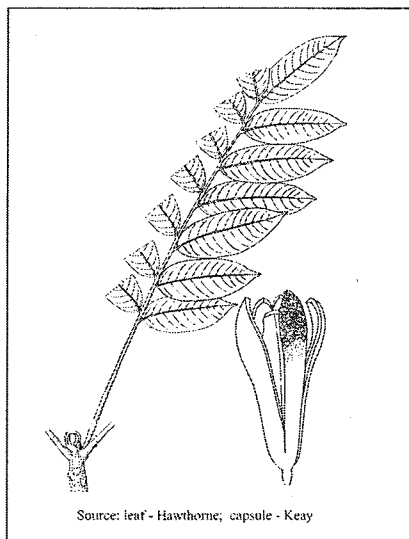
Joinery, frames and doors

Panellings, claddings and mouldings

Family Name: **Meliaceae**  
 Trade Names: **Utile; Sipo, Sapele**  
 Local Names: **Efoobrodedwo (Gh); Sipo (CI)**

#### **Distribution**

West, Central and East Africa, extending from Sierra Leone to Uganda and Angola. Sparsely found in Moist Semi-deciduous (North-West subtype) and Dry Semi-deciduous forests of Ghana.



#### **Status**

It is a **premium species** of sparse occurrence, with high production for regular export. The prescribed minimum felling diameter is 110 cm. It is classified by IUCN (2004) as a vulnerable species. The sawdust may cause dermatitis.

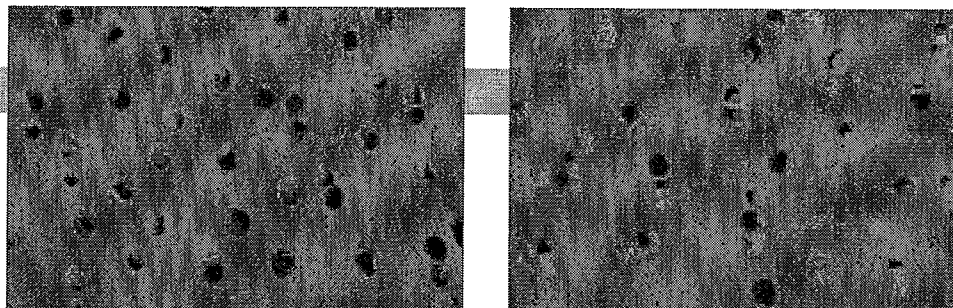
#### **Tree Features**

**The tree** is up to 50 m high and 4 m in girth, with straight cylindrical bole and low but well-developed buttresses. It has a **spreading crown** with leaves clustered at the ends of the branches. **The bark** is grey-brown with longitudinal fissures. **The slash** is almost scentless, thick, and reddish-brown with paler lines. **The leaves** are pinnate with 7 to 16 pairs of leaflets. They are sub-opposite up to 14 cm long by 5 cm broad, usually oblong-lanceolate, unequally rounded at the base, and

gradually acuminate at the apex. The 10 to 16 lateral nerves often have tufts of hair in the angles. It flowers in March, and the **white flowers** are borne in lax panicles with petals about 6 mm long. **The fruits**, which mature from December to January, are 17-28 cm long with 5 to 6-winged seeds on each face of the column.

#### **Wood Macroscopic Features**

**Pores** medium, proportion of solitary pores medium with 2 to 3 radial multiples of same size, low to moderate distribution, with gum inclusions. **Axial parenchyma** barely distinct, paratracheal, aliform, confluent and marginal, irregularly spaced narrow wavy bands, smaller than fibre tissue bands with wide distance between bands. Proportion of **fibre tissue** is medium. **Ray parenchyma** barely distinct, uniform, very narrow to narrow, width less than 1/4 to 1/2 of vessel diameter, frequency medium and storied. Wood diffuse porous, **growth ring** boundaries distinct, demarcated by marginal parenchyma.



1 mm

### Physical Features

*Heartwood* dark red-brown, clearly demarcated from pinkish *sapwood*. Texture is medium to coarse with low lustre. Wood is hard and of **medium density**.

### Splinter Burning Test

**Splinter** burns to exude coloured liquid, produces bright sparks, and forms grey ash.

### Ecology and Silviculture

*Entandrophragma utile* is a deciduous tree that prefers well-drained soil in moist and dry forests. The tree is absent from secondary forest. It is propagated by seed dispersed by wind, but stump and stripped planting are possible (Hall & Swaine, 1981). Germination is epigeal, takes about 13 to 19 days with a germination rate of 75 % (Taylor, 1960). Germination is in shade and it is strongly depressed in large gaps (Kyereh, 1994). Seedling growth is slow because root development is slow and reaches a height of 1.5 m in 4 years (Sawyer, 1960). Seedlings are usually infested with mites and other insects, unless they are shaded. Saplings require light to grow, but it is the least light demanding of the *Entandrophragma spp.* Insect damage by shoot borers and defoliators is high (Wagner *et al.*, 1991). Regeneration is highest among the group, but mortality is high due to drought and diseases (Taylor, 1960). Regeneration is more abundant in previously burnt but regenerated forest (Hawthorne, 1994).

### Ethnobotany

N/A

### Commercial Uses

A **moderately durable wood** used for the following:

- Exterior joinery frames and doors
- Luxury and decorative furniture and cabinet works
- Floorings, steps and stairs
- Sliced and rotary veneer and plywood
- Boat construction

***Erythrophleum suaveolens* (Guill. & Perr.) Brenan**

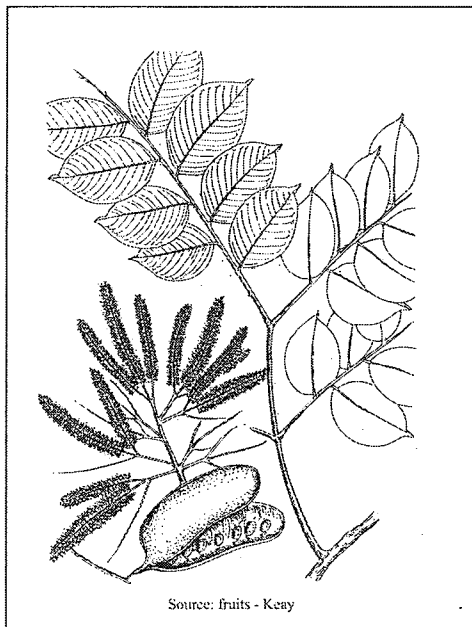
Family Name: **Caesalpiniaceae**  
 Trade Names: **Potrodom; Tali**  
 Local Names: **Potrodom (Gh); Tali (CI)**

**Synonym**

*E. guineense* G. Don

**Distribution**

West, Central and East Africa, extending from Senegal to Zambia and Tanzania. Sparsely distributed in Dry Semi-deciduous forest and Savanna woodland of Ghana.

**Status**

It is a **lesser-used** species of rare forest occurrence, low production and irregular export. No prescribed minimum felling diameter and 70 cm is recommended. It is cited as a lower risk near threatened species by IUCN (2004). The sawdust may cause dermatitis and has respiratory and poisonous effects on humans, when inhaled.

**Tree Features**

**The tree** is up to 40 m high and 2.5 m in girth with a bole of 10 to 16 m, often buttressed. It has a large dense crown with wide-spreading branches. **The poisonous bark** is grey and the slash is mottled pink and white. **The leaves** are bi-pinnate, 3 to 4 pairs of opposite pinnae, 15-30 cm long. Each pinna has 8 to 14 leaflets, 5-10 cm long by 3-4 cm broad. **It flowers** from January to February, yellowish

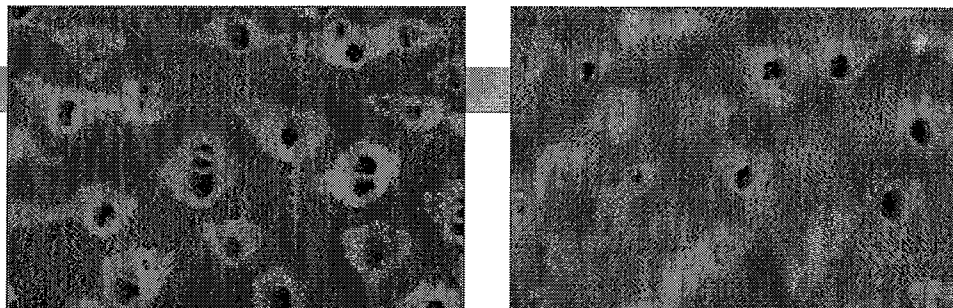
to reddish, and is densely crowded in spike-like racemes, 7.5-10 cm long and 18 mm thick. **The fruits** are woody pods, 7.5-15 cm by 3.5-5 cm, flat and rounded at both ends. They mature from February to April, and from October to November. **The seeds** are about 8 mm long and hard. The species is difficult to differentiate from *E. ivorense* found in the Moist Evergreen forest and for which the bark is less poisonous.

**Wood Macroscopic Features**

**Pores** are medium to large, proportion of solitary pores high with 2 to 3 radial multiples of different or same sizes, medium distribution with white inclusions. **Axial parenchyma** is paratracheal, vasicentric, aliform and confluent. Proportion of **fibre tissue** is medium.

**Ray parenchyma** is barely distinct, very narrow, uniform, less than ¼ of vessel diameter, high frequency. Wood is diffuse porous, **growth ring** boundaries are demarcated by absence of pores.





1 mm

### Physical Features

**Heartwood** yellow-brown to red-brown, clearly demarcated from pale sapwood. Wood is hard and of very high **density**.

### Splinter Burning Test

**Splinter** burns to form charcoal.

### Ecology and Silviculture

*Erythrophleum suaveolens* is a common deciduous tree which withstands early fires quite well. It is propagated by seed, but stump planting using 3-year-old plant is possible. Germination in darkness is irregular and takes about 7 to 21 days with 46 % germination rate (Taylor, 1960). Growth in gaps is slow and tree resists insect attack including termites and shipworms. It is fairly fire resistant and coppices well (Taylor, 1960). It is reported to have nitrogen-fixing nodules (Halliday & Nakao, 1982).

### Ethnobotany

**The bark** was formerly used for ordeal trial to punish serious offences such as witchcraft and adultery (Abbiw, 1990). The bark is used in treating wounds, headaches, and rheumatism (Mshana *et al.*, 2000).

### Commercial Uses

A **very durable wood** used for the following:

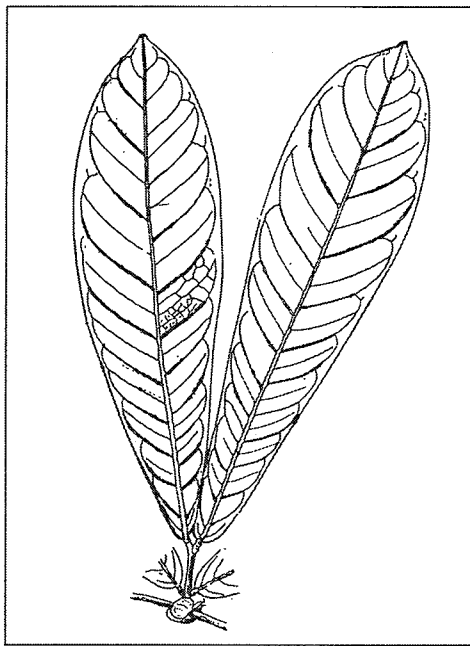
- Heavy construction
- Bridges, sleepers and crossties, piles and deckings
- Poles, post and stakes
- Floorings, steps and stairs

***Gilbertiodendron limba* J. Léonard**

Family Name: **Caesalpiniaceae**  
 Trade Names: **Limballi; Tetekon**  
 Local Names: **Tetekon (Gh); Limballi (Za); Vaa (CI)**

**Distribution**

West and Central Africa, extending from Ivory Coast to Democratic Republic of Congo (Zaire). Sparsely found in Wet and Upland Evergreen and swampy sites of Ghana.

**Status**

A **lesser-used species** of sparse forest availability, moderate production and occasional export. The prescribed minimum felling diameter is 70 cm. It is classified as a lower risk least concern species by IUCN (2004).

**Tree Features**

**The tree** is about 25 m high and up to 2.3 m in girth, with a cylindrical straight bole, spreading crown and drooping branches. **The bark** is yellowish-brown and flakes off in yellow patches with brown slash. The rachis is dense with chocolate brown hair. **The leaves** are pinnate with a common stalk up to 20 cm long, with 2 to 4 pairs of leaflets, 9-22 cm long and 3-10 cm broad. They are thick and leathery, elongated elliptic, tapering at both ends. They are glabrous on both surfaces, with 15 to 25 pairs of lateral nerves.

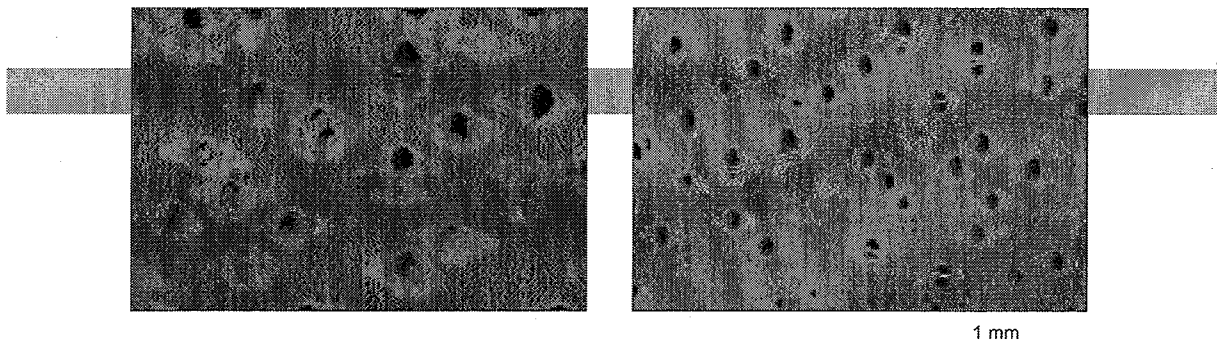
Kidney-shaped stipules are present. **The white flowers** are formed from January to April. **The fruits** are pods, formed between February and September, up to 20 cm long and 5 cm broad, curling up when dry. Each fruit contains 4 large brown, shiny, thin-coat seeds.

**Wood Macroscopic Features**

**Pores** medium to large, proportion of solitary pores high with 2 to 3 radial multiples of same size, diagonal pattern, low to moderate distribution with gum inclusions. **Axial parenchyma** paratracheal, predominantly aliform, few confluent, banded, marginal with very narrow width smaller than fibre tissue bands, irregularly spaced with wide distance between bands. **Fibre tissue** proportion is medium. **Ray parenchyma** is indistinct to the naked eye, very narrow, uniform width, less than  $\frac{1}{4}$  of vessel diameter, very high frequency. Wood diffuse porous, **growth ring** boundaries demarcated by marginal parenchyma bands.

**Physical Features**

**Heartwood** dark or copper-brown, clearly demarcated from greyish or yellowish **sapwood**, medium texture. Wood is hard and of **high density**.



### **Splinter Burning Test**

**Splinter** burns to produce crackle and bright sparks, exudes coloured liquid and forms white ash.

### **Ecology and Silviculture**

*Gilbertiodendron limba* is an evergreen tree, fairly common on sandy soils and along streams, swampy areas, slopes and uplands. It is seed propagated and epigeal germination takes about 10 days with a germination rate of about 80 % (Taylor, 1960). Saplings grow better under shade. The roots have ectomycorrhiza (Alexander, 1989).

### **Ethnobotany**

The leafy stem is used to treat pelvic congestion in female, while the leaves are used for fever (Mshana *et al.*, 2000). The leaves are also used as febrifuge and the ashes, mixed with water, are applied to ulcers (Irvine, 1961).

### **Commercial Uses**

A **moderately durable** wood used for the following:

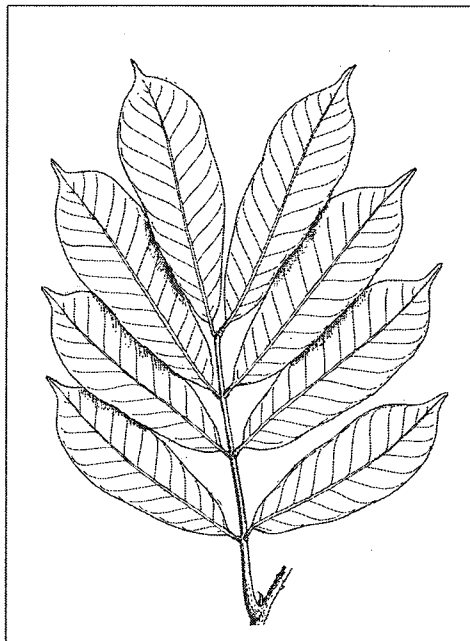
- Joinery, frames and trims
- Floorings, parquets, steps and stairs
- Deckings, wharfs, sleepers and crossties
- Vehicle and wagon bodies

***Guarea cedrata* (A. Chev.) Pellegr.**

Family Name: **Meliaceae**  
 Trade Names: **Scented Guarea; Bossé**  
 Local Names: **Kwabohoro (Gh); Bossé (CI)**

**Distribution**

West, Central and East Africa, extending from Liberia to Democratic Republic of Congo (Zaire) and Kenya. Moderately distributed in the Wet and Moist Evergreen, the Moist and Dry Semi-deciduous forests of Ghana.

**Status**

It is a **commercial species** of moderate forest occurrence, moderate production and irregular export. The prescribed minimum felling diameter is 90 cm, and is classified as a vulnerable species by IUCN (2004). It is traded as *Guarea* with *Guarea thompsonii*. The sawdust may cause dermatitis on the contact with skin and respiratory problems, if inhaled.

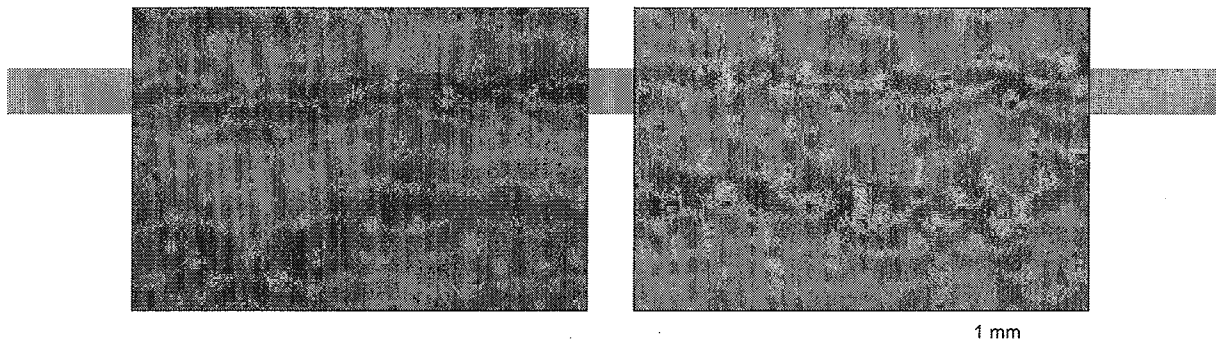
**Tree Features**

**The tree** is up to 55 m high and 2.8 m in girth with long buttresses and a dense crown. **The bark** is pale grey-brown with seashell-shaped pits where scales have fallen off. **The slash** is pale-orange, slightly reddish and fibrous with strong sweet scent, turning rusty brown. The leaves have 2 to 5 pairs of leaflets, up to 20 cm long and 5-7 cm broad, long acuminate. **The flowers**, formed from

May to August, are greenish-yellow and 5 cm long. **The yellow fig-shaped fruits** are formed from July to September, leathery, about 3.5 cm long and 3.8 cm broad with a thick stipe of 2 mm long. **The seeds** are large and oval with white streaks surrounded by an orange-coloured aril. *Guarea thompsonii*, a closely related species, has leaves which terminate in a single leaflet, dark smooth bark, pale-brown or yellow slash and not very scented.

**Wood Macroscopic Features**

**Pores** indistinct, small, proportion of solitary pores medium to high with 2 to 3 radial multiples of same size, low to moderate distribution with inclusions. **Axial parenchyma** confluent, narrow wavy bands smaller than fibre tissue bands, regular and narrow spaced. Proportion of **fibre tissue** is medium. **Ray parenchyma** is indistinct at transverse but distinct at radial surface, uniform width, very narrow, less than ¼ of vessel diameter, high frequency. Wood is diffuse porous.



### Physical Features

**Heartwood** reddish or pinkish-brown, clearly demarcated from pale **sapwood**, fine to medium texture with distinct pleasant odour. (The wood of *G. thompsonii* 'Black Guarea' is darker-brown and less scented). Wood is hard and of **medium density**.

### Splinter Burning Test

**Splinter** burns to exude coloured liquid and forms white ash.

### Ecology and Silviculture

*Guarea cedrata* is an evergreen tree widely distributed in swampy sites. It is a shade bearer propagated by seed dispersed by primates and birds (Taylor, 1960). Germination is epigeal and takes about 36 days (Taylor, 1960). It regenerates in forest shade but saplings grow better in gaps. It is the slowest growing species among most members of the Meliaceae family (Hawthorne, 1994). Seeds are prone to infestation by guarea fruit weevil (Wagner *et al.*, 1991). Regeneration is abundant in regenerated forest previously destroyed by fire. (Hawthorne, 1994).

### Ethnobotany

**The bark** extract is used in enemas for waist pains (Irvine, 1961).

### Commercial Uses

**A durable wood** used for the following:

- Decorative cabinet and furniture
- Floorings, steps and stairs
- Decorative veneer and plywood
- Panellings, mouldings and claddings
- Handicrafts, carvings and artifacts
- Cigar and match boxes
- Joinery, frames and trims
- Vehicle bodies

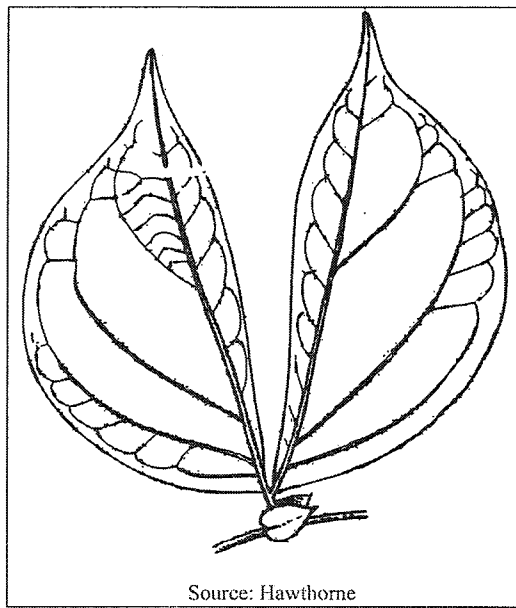
Family Name: **Caesalpiniaceae**

Trade Names: **Ovengkol; Hyedua**

Local Names: **Hyedua** (Gh); **Amazoue** (CI); **Ovengkol** (Ga)

#### **Distribution**

West and Central Africa, extending from Liberia to Gabon. It is rarely found in Moist Semi-deciduous (North-West subtype) forest of Ghana.



Source: Hawthorne

#### **Status**

It is a **commercial species** of sparse occurrence, with moderate production for occasional export. The prescribed minimum felling diameter is 90 cm. It is classified by IUCN (2004) as a vulnerable species.

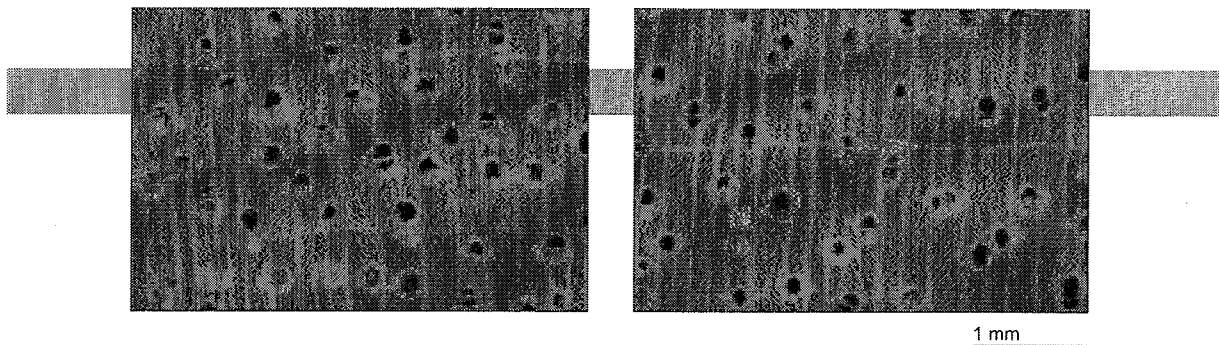
#### **Tree Features**

**The tree** is up to 45 m high and 3 m in girth with a straight bole and well-developed buttresses. **The bark** is smooth and pale-grey. **The slash** is granular, pinkish-brown or yellow-orange and exudes a clear yellow gum, slightly scented and sweet. The well-developed stipules are often persistent up to 2 cm long. **The leaves** are paired and papery, 6-14 cm long. Each pair of **leaflets** is like a half moon, 2-4.5 cm

broad with a curved long acuminate tip on a stalk about 6 mm long. **The white, scented flowers** bloom in November. They are crowded in short spikes, distantly spaced along a central stalk, forming a panicle 10 to 20 cm long. **The fruits** are pods, mature from December to February, flat, papery, broadly elliptic, measuring 3.5-6 cm long and 2.5-3.5 cm broad. They are rounded at the apex, cuneate at base, covered with a network of veins, indehiscent, each containing one flat seed.

#### **Wood Macroscopic Features**

**Pores** medium, proportion of solitary pores medium to high with 2 to 3 radial multiples of same size, occasional clusters of 2 to 3, low distribution with gum inclusions. **Axial parenchyma** paratracheal, vasicentric, aliform, confluent, and marginal narrow bands, distance between bands irregular and wide. **Fibre tissue** proportion is medium to high. **Ray parenchyma** is very narrow to narrow, uniform, width  $\frac{1}{4}$  to  $\frac{1}{2}$  of vessel diameter, medium frequency. Wood is diffuse porous, and **growth ring** boundaries are demarcated by marginal parenchyma bands and rarely by absence of pores.



### Physical Features

Striped yellow-brown to dark-brown **heartwood** clearly demarcated from pale **sapwood** with fine to medium texture, unpleasant odour when fresh. Wood is hard and of **high density**.

### Splinter Burning Test

**Splinter** burns to produce crackle and bright sparks and forms white ash.

### Ecology and Silviculture

*Guibourtia ehie* is deciduous, usually found growing gregariously in shade (Taylor, 1960). The seed is dispersed by wind, germination is epigeal with slow growth rate. Regeneration under shade is slow (Taylor, 1960), but saplings may require light to grow (Hawthorne, 1995).

### Ethnobotany

The tree yields gum copal used in cosmetic industry, and is burnt to drive away evil spirits (Abbiw, 1991).

### Commercial Uses

A **durable wood** used for the following:

- Decorative furniture and cabinet works
- Floorings steps and stairs
- Panellings, claddings and mouldings
- Boat and canoe construction
- Joinery, frames and trims
- Decorative veneer for plywood
- Vehicle frames and bodies

***Hallea stipulosa* Leroy**

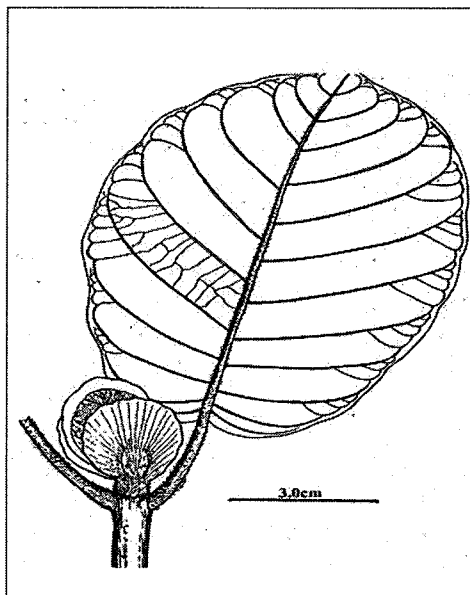
Family Name: **Rubiaceae**  
 Trade Names: **Abura; Bahia; Subaha**  
 Local Names: **Subaha (Gh); Bahia (CI)**

**Synonyms**

*Mitragyna stipulosa* (DC.) Kuntze  
*Mitragyna ciliata* Leroy (Pierre & Lepr. ex D.C.) Hiern.

**Distribution**

West, Central and East Africa, extending from Senegal to Sudan and Zambia. It is sparsely distributed in Moist and Dry Semi-deciduous forests of Ghana.

**Status**

A commercial species of sparse forest occurrence, with moderate production for irregular export. The species is used to protect river banks and is supposedly banned from exploitation. Therefore, it has no prescribed minimum felling diameter and 110 cm may be recommended when it is absolutely necessary to fell. It is classified by IUCN (2004) as a vulnerable species. The sawdust may cause dermatitis.

**Tree Features**

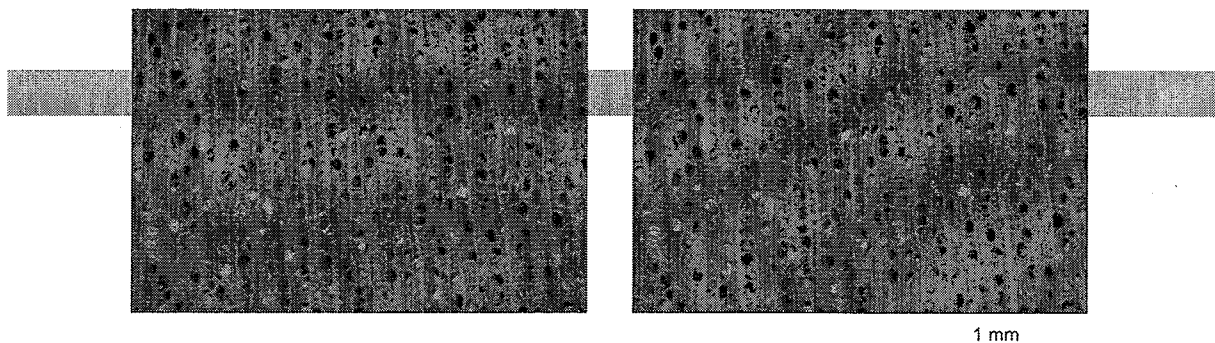
The tree is up to 30 m high and 3.5 m in girth. The bole is straight, cylindrical with short thick buttresses. The bark is pale grey-brown, slightly fissured. The slash is soft, pinkish to cream and darkens on exposure. The branchlets are quadrangular, almost glabrous with a small crown close to the stem

but conspicuous because of its large leaves. The leaves are 20-45 cm long and 12-30 cm broad, broadly elliptic, obtuse or rounded at base or apex, with red hairs on the nerves beneath when young. The stipules are foliaceous, red turning green, spatulate, about 2.5 cm long and 4 cm wide. It flowers from December to February, white and densely crowded in balls, about 18 mm in diameter. The fruits are formed from February to April in dense brown heads, up to 2.5 cm diameter, club-shaped and split open to release small winged seeds. The species is easily confused with *H. ledermanii* which occurs more in wet forests, and *H. stipulosa* more in dry forests.

**Wood Macroscopic Features**

Pores small, barely distinct to naked eye, proportion of solitary pores medium with 2 to 4 radial multiples of same size, high distribution. Axial parenchyma not distinct with naked eye, apotracheal and diffuse. Proportion of fibre tissue is very low.





**Ray parenchyma** is not distinct to naked eye, very narrow, width between  $\frac{1}{4}$  and  $\frac{1}{2}$  of vessel diameter, moderate to high frequency. Wood is diffuse porous.

### Physical Features

**Heartwood** pink-beige to pinkish-brown, not clearly demarcated from **sapwood**, texture fine, lustre low. Wood is fairly hard and of **medium density**.

### Splinter Burning Test

**Splinter** burns to exude coloured liquid and forms white ash.

### Ecology and Silviculture

*Hallea stipulosa* is an evergreen gregarious tree found in swampy areas and riverside to which it is adapted by its pneumatophores (Hall & Swaine, 1981). It is propagated by seed, dispersed by wind with epigeal germination. It requires light to grow rapidly to about 0.7 m a year (Taylor, 1960). *Declephila neril*, a polyphagous defoliator, is a common prey on the species (Wagner *et al.*, 1991).

### Ethnobotany

The large leaves are used for thatch roofing and for wrapping cola nuts to prevent them from deterioration while in storage (Abbiw, 1990). The root decoction is drunk for colic while decoction of the bark is drunk as a febrifuge (Irvine, 1961). A decoction of pulverized bark with pepper is a remedy for internal complications and pregnancy-related diseases. The leaves contain an alkaloid called mitraphylline which is applied to wounds (Irvine, 1961).

### Commercial Uses

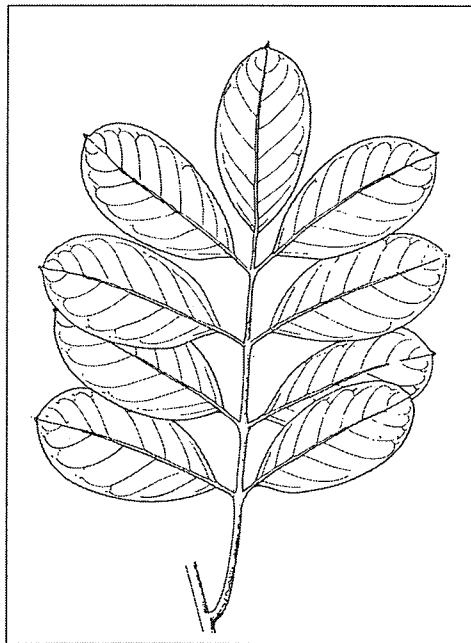
A **non-durable wood** used for the following:

- Beams, joists and roof trusses
- Panellings, claddings and mouldings
- Interior joinery, frames and trims
- Luxury furniture and cabinet works
- Decorative veneer and plywood

Family Name: **Simaroubaceae**  
 Trade Names: **Hannoa; Effeu; Fotie**  
 Local Names: **Fotie, Hotrohotro (Gh); Effeu (CI)**

#### Distribution

West and Central Africa from Guinea to Angola. Moderately found in Evergreen and Semi-deciduous forests of Ghana.



#### Status

A lesser-used species of moderate forest occurrence, low production with occasional export. The prescribed minimum felling diameter is 70 cm. It is classified as a lower risk least concern species by IUCN (2004).

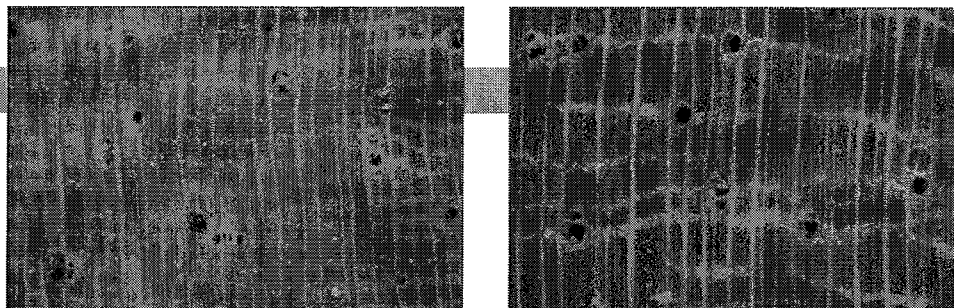
#### Tree Features

Tree is up to 36 m high and 2.5 m in girth with a straight unbuttressed bole. The bark is grey or pale brown, smooth and flaking. The slash is fibrous, whitish yellow and gritty. The crown is rounded, fairly spreading but with few branches. The pinnate leaves are in tufts at the ends of branches with a stout common stalk 20-60 cm long. The 3 to 9 pairs of opposite leaflets are 7-22 cm long and 3.5-6 cm broad, slightly obovate, rounded at the apex and cuneate at the base, glabrous, leathery, dark-green and glossy above, and terminates in a single leaf.

The tree flowers from July to September and from February to March. Flowers are polygamous, in lax panicles, as long as the leaves, yellowish-white and fragrant. The individual flowers are 6 mm long with male and bisexual flowers together. The fruits are drupes, mature from October to December, black, glossy and hanging in clusters on thick stalks, each about 2.5 cm long with one large seed per fruit. Taylor (1960) reports that species at sapling stage can easily be confused with the *Entandrophragma* spp. from which it is differentiated by its dull dark-green shoot, large white leaf scars, and flattened petioles and rachis.

#### Wood Macroscopic Features

Pores small to medium, small ones barely visible, proportions of solitary pores medium with 2 to 3 radial multiples of same size, distribution few. Axial parenchyma apotracheal, diffuse and diffuse-in-aggregate, more or less wavy to straight bands smaller than fibre tissue bands, regularly spaced with narrow distance between bands. Proportion of fibre tissue is low to medium. Ray parenchyma is narrow, uniform width, less than  $\frac{1}{4}$  to  $\frac{1}{2}$  of vessel diameter. Wood is diffuse porous.



1 mm

### Physical Features

**Heartwood** white or yellowish-white, not differentiated from **sapwood**. It has fine striations on quarter-sawn surface with coarse texture. Wood is soft and of **low density**

### Splinter Burning Test

**Splinter** burns to exude coloured liquid, forms crackle, bright sparks and white ash.

### Ecology and Silviculture

*Hannoa klaineana* is a briefly deciduous tree found on acid soil in wet and moist forests but not swampy sites, but absent in drier forests (Hall & Swaine, 1981). Mature trees are more abundant in secondary forests. Seeds are dispersed by animals, germination is epigeal and regenerates in shade. The seedlings grow quickly in light with an annual girth increment of 4 cm reported in plantations of Sierra Leone (Savill & Fox, 1967). The tree is sometimes infested with red ants.

### Ethnobotany

The bark is used for curing fever and the decoction is taken for colic (Irvine, 1961).

### Commercial Uses

A **non-durable wood** used for the following:

- General handicrafts
- Common furniture and cabinet works
- Core veneer for plywood
- Fruit containers and packing cases
- Match boxes

***Heritiera utilis* (Sprague)**

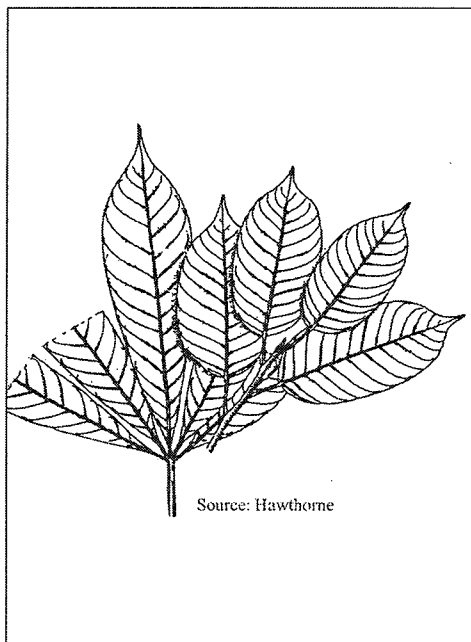
Family Name: **Sterculiaceae**  
 Trade Name: **Niangon**  
 Local Names: **Nyankon (Gh); Niangon (CI)**

**Synonym**

*Tarrietia utilis* Sprague

**Distribution**

West Africa, extending from Sierra Leone to Ghana. Moderately distributed in Ghana, but confined to Wet and Moist Evergreen forests.

**Status**

A **premium species** of moderate forest occurrence, very high production for regular export. The prescribed minimum felling diameter is 70 cm. It is classified as a vulnerable species by IUCN (2004). The sawdust may cause dermatitis.

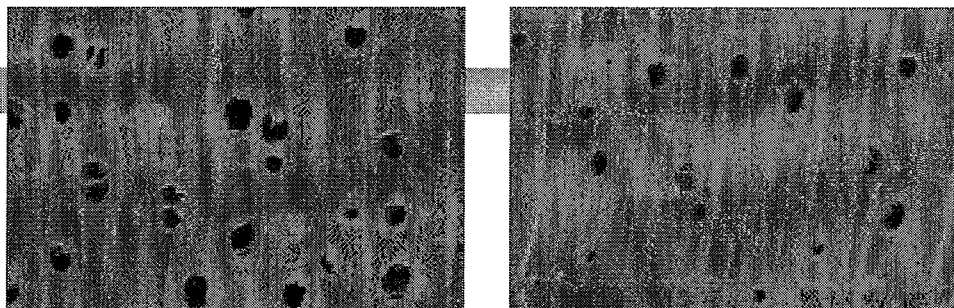
**Tree Features**

The tree is up to 30 m high and 3 m in girth. The **cylindrical bole** is up to 20 m with flying buttresses and stilt roots. The **slash** is fibrous, stringy-yellow to pink. The **crown** appears golden-brown due to scales and stellate hairs on the leaves. The **leaves** are brown and densely scaly below, very variable, simple, elliptic and entire with an acuminate tip and cuneate base, otherwise digitate with 5-7 long oblanceolate leaflets about 30 cm by 10 cm. The **monoecious flowers** are formed from September to

January. They are small, white and in clusters on racemose axillary panicles, scaly and pubescent. The **samara fruit** contains one large seed, matures from December to February, red and scaly winged, 6 to 10 cm long.

**Wood Macroscopic Features**

**Pores** are large, proportion of solitary pores is high with 2 to 4 radial multiples of same size, low in distribution with gum inclusions. **Axial parenchyma** is paratracheal, vasicentric, aliform and confluent. Proportion of **fibre tissue** is medium. **Ray parenchyma** of variable width, very narrow and wide, less than ¼ to full size of vessel diameter, few to moderate frequency. Wood is diffuse porous, and **growth ring** boundaries are demarcated by dark ground fibre tissue.



1 mm

### Physical Features

**Heartwood** is pink-brown, **sapwood** pale, texture fairly coarse, quarter-sawn surface with conspicuous rays as dark flecks. Wood is hard and of medium density.

### Splinter Burning Test

**Splinter** burns to produce crackle, bright sparks and forms white ash.

### Ecology and Silviculture

*Heritiera utilis* is an evergreen tree found in the lowlands, very drought-sensitive and shows no strong preference for base-poor or rich soils (Swaine & Veenendaal, 1994). It is propagated by seed which is dispersed by wind. Germination is epigeal, takes about 11 days with a germination rate of about 85 % if fresh seeds are used. Early growth is very erratic but rapid under light conditions. Seedlings thrive better under high shade (Savill & Fox, 1967), but saplings and young trees are strongly favoured by gaps (de Klerk, 1991). Savill & Fox (1967) report of annual girth increments of 5 cm over 15 years and a height of 20 m.

### Ethnobotany

The bark contains oleo-resin used as tannin (Abbiw, 1990). A bark decoction or seed oil is taken as an aphrodisiac (Taylor, 1960).

### Commercial Uses

A **moderately durable wood** used for the following:

- Exterior joinery, frames and doors
- Common and decorative furniture
- Decorative veneer and plywood
- Boat and vehicle bodies

***Hexalobus crispiflorus* A. Rich.**

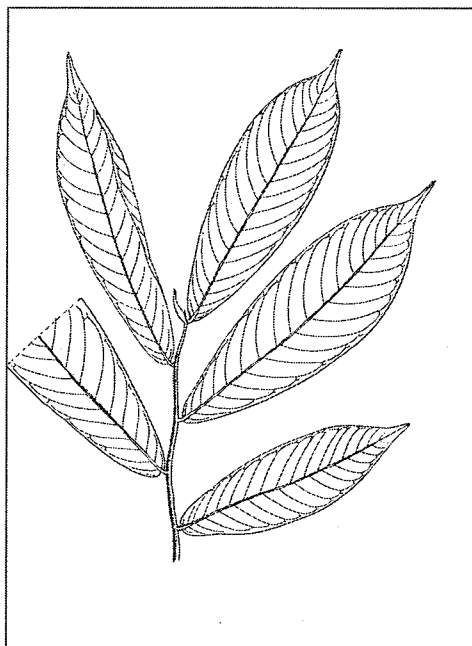
Family Name: **Annonaceae**

Recommended Trade Names: **Hexalobus; Duabaha**

Local Names: **Duabaha** (Gh); **Owui** (Ca); **Siélélé** (CI)

**Distribution**

West and Central Africa, extending from Senegal to Democratic Republic of Congo (Zaire) and Angola. Moderately distributed in Moist Evergreen and Moist Semi-deciduous forests of Ghana.

**Status**

A lesser-known species of moderate forest occurrence. No prescribed minimum felling diameter and 70 cm is recommended. It is classified as a lower risk least concern species by IUCN (2004).

**Tree Features**

**The tree** is up to 25 m high and girth is seldom above 2.2 m with high fluted bole.

**The bark** is smoky-grey, fissured and rough.

**The slash** is thin and brittle, yellow-brown turning orange-brown.

**The branches** are slender and at first horizontal, but the branching system is irregular in older, and larger trees.

**The leaves** are simple, alternate, 12-20 cm long and 3.5-7.5 cm broad. They are elongated elliptic, acutely acuminate at the tip, rounded or broadly cuneate at base, glabrous and glossy above with prominent up-curving nerves.

**The flowers** are formed from October to March, pale-yellow, fragrant,

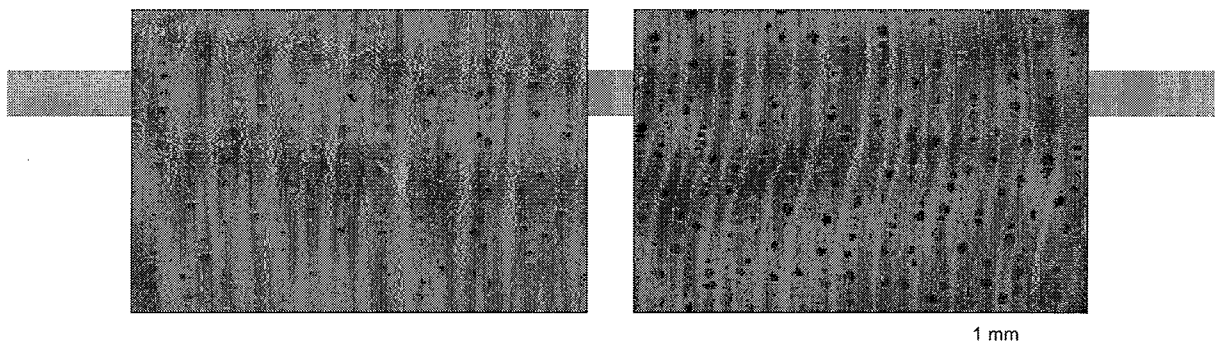
and usually solitary among the leaves. **The berry fruits** mature from April to August. They are red to dark-brown, each consists of 1-4 hard very dark-brown ellipsoid carpels, about 7.5 cm long and 5 cm diameter, hanging from a stout common stalk 5.0-7.5 cm long.

**Wood Macroscopic Features**

**Pores** small, proportion of solitary pores medium with 2 to 4 radial multiples of same and different sizes, occasionally clusters of 2 to 4, moderate distribution. **Axial parenchyma** indistinct to the naked eye, scalariform, very narrow straight bands smaller than fibre tissue bands, regularly spaced with narrow distance between bands. Proportion of **fibre tissue** is low to medium. **Ray parenchyma** variable, wide and narrow width, equal to or larger than vessel diameter, low to moderate frequency. Wood is diffuse porous.

**Physical Features**

**Heartwood** brown, pink or pale-yellow not differentiated from **sapwood**. It has striped figure on quarter-sawn surface with fine texture and high lustre.



Wood is hard and of **medium density**.

#### **Splinter Burning Test**

**Splinter** burns to exude coloured liquid and forms grey ash.

#### **Ecology and Silviculture**

*Hexalobus crispiflorus* is a deciduous tree and a shade bearer. It is abundant in undisturbed forests (Hawthorne, 1994).

#### **Ethnobotany**

The young bark is stripped for fibre (Abbiw, 1990). The leaf, bark and root are used in treating diarrhoea and dysentery (Burkill, 1985).

#### **Recommended Commercial Uses**

A **moderately durable wood** promoted for following uses:

- Handicrafts and carvings
- Floorings, parquets, steps and stairs
- Furniture and cabinet works
- Joinery frames and trims
- Pulp, paper and particleboard
- Vehicle and truck bodies
- Tools, turneries and ornaments

## ***Holarrhena floribunda* (G.Don) Durand & Schinz**

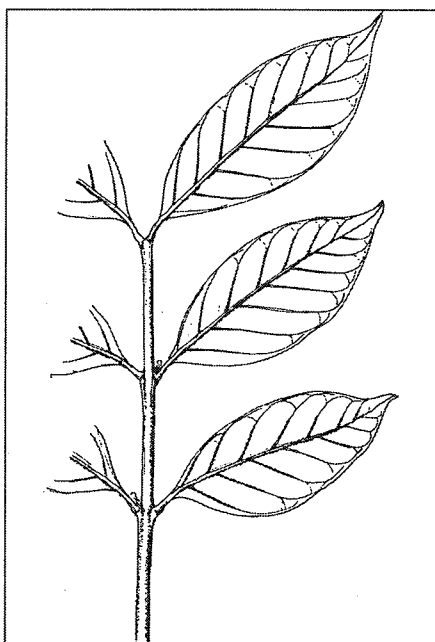
Family Name: **Apocynaceae**

Recommended Trade Names: **Holarrhena; Sese**

Local Name: **Sese (Gh)**

### **Distribution**

West and Central Africa, extending from Senegal to Central African Republic and Democratic Republic of Congo (Zaire). Sparsely distributed in Dry Semi-deciduous and Southern Marginal forests and Savanna woodland of Ghana.



### **Status**

A **lesser-known species** of sparse forest availability recommended for promotion in local market. No prescribed minimum felling diameter and 50 cm is recommended. It is yet to be exploited as a timber species.

### **Tree Features**

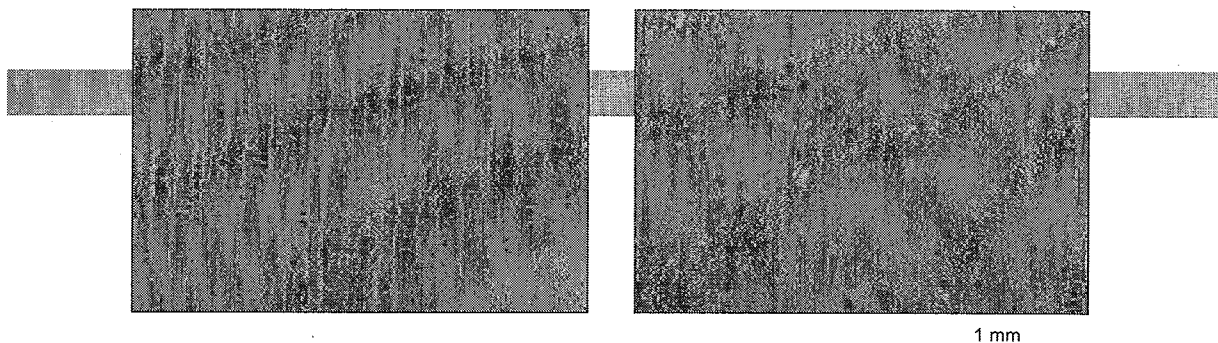
**The tree** is up to 25 m high and 1.5 m in girth with fairly straight bole. **The bark** is grey and smooth with many lenticels. **The slash** is pale-brown and yields abundant white latex. **The branches** are slender, tend to droop and bear many lenticels. **The crown** is quite close to the tree but tends to spread a little in isolated specimens. **The leaves** are simple, opposite, 7-13 cm long and 3.5-6 cm broad, ovate to elliptic-lanceolate, taper to the apex, slightly acuminate at the tip, broadly cuneate and rounded at the base. The small, gregarious, densely **clustered flowers** are formed from February to July after

the new leaves. **The fruits**, up to 60 cm long and about 6 mm thick with slender follicles hanging in pairs, persist throughout the wet season. It contains many flattened seeds, about 6 mm long, with numerous brownish silky tuft hairs, about 5 cm long. Taylor (1960) distinguishes the species from *Funtumia* by its rough bark, much longer and thinner follicles, with more open crown.

### **Wood Macroscopic Features**

**Pores** small, barely distinct to naked eye, proportion of solitary pores low with 2 to 4 radial multiples of same size, moderate distribution. **Axial parenchyma** indistinct to naked eye, apotracheal, diffuse-in-aggregates. Proportion of **fibre tissue** is low to medium. **Ray parenchyma** is indistinct at transverse but distinct at radial surface, very narrow, uniform width,  $\frac{1}{4}$  to  $\frac{1}{2}$  to full size of vessel diameter, high frequency. Wood is diffuse porous.





### Physical Features

**Heartwood** pale yellow-white, not differentiated from **sapwood** with fine texture. Wood is fairly hard and of **medium density**.

### Splinter Burning Test

**Splinter** burns to exude coloured liquid and forms grey ash.

### Ecology and Silviculture

*Holarrhena floribunda* is a deciduous tree found on old farm lands in secondary forests. It is dispersed by wind, propagated by seed with good viability, and epigeal germination takes about 18 days (Taylor, 1960). It is a pioneer species and saplings grow quickly in fairly open conditions or gaps (Hawthorne, 1995). It thrives more in regenerated forest previously destroyed by fire (Hawthorne, 1994). The tree is susceptible to *Imbrasia nictitans*, a defoliating insect (Wagner *et al.*, 1991).

### Ethnobotany

It is used for carving traditional stool (Abbiw, 1990). The tree contains many alkaloids which are used as an antidote for dysentery and fever, and for bathing skin diseases (Irvine, 1961). The leaf-juice is used as a haemostatic for bad cuts. The leaves are used for treating jaundice (Mshana *et al.*, 2000). The bark is used for treatment of skin diseases, the root for stomach disorders, and a mixture of leaf, bark and root as a febrifuge (Burkill, 1985).

### Recommended Commercial Uses

A **non-durable wood** recommended for the following uses:

Artifacts, carvings and handicrafts  
Food containers and packing cases

***Holoptelea grandis* (Hutch.) Mildbr.**

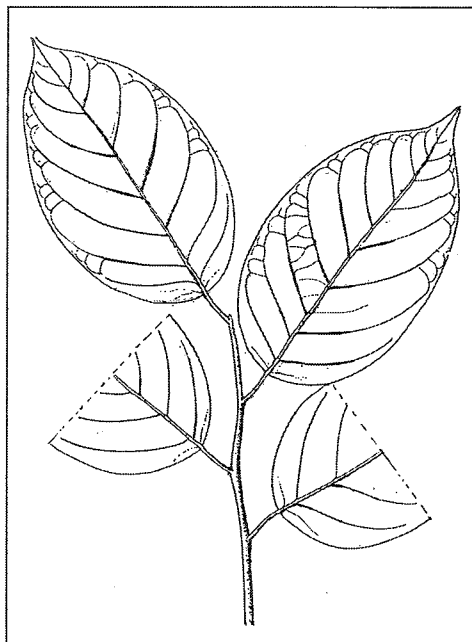
Family Name: **Ulmaceae**

Recommended Trade Name: **Holoptelea, Kékélé**

Local Names: **Nakwa (Gh); Mbosso (Co); Kékélé (CI)**

**Distribution**

West, Central and East Africa, extending from Ivory Coast to Uganda and Sudan, and south to Democratic Republic of Congo (Zaire). Sparsely distributed in Dry Semi-deciduous and Southern Marginal forests and Savanna woodland of Ghana.

**Status**

A **lesser-used species** of sparse forest availability recommended for local use. No prescribed minimum felling diameter and 70 cm is recommended. It is cited by IUCN (2004) as a lower risk least concern species.

**Tree Features**

The tree is up to 45 m high and 3 m in girth with a crooked bole 20 m high and a rounded crown. It has narrow buttresses that may run high up the trunk. **The bark** is rough and orange with lenticels. **The slash** is very hard, dry and light-brown with iodine smell. **The leaves** are simple, alternate, 7-15 cm by 5-7.5 cm, ovate, acuminate at the tip and rounded to slightly cordate at base, with basal nerves arising just above the base. **The leaf** is entire, glabrous and glossy above, and appears quite dark with white spots on the surface. **The flowers** are polygamous, formed from

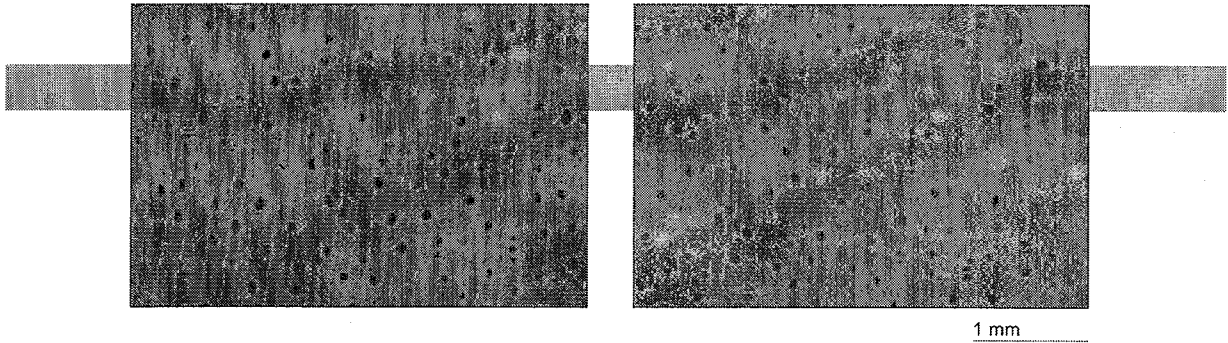
January to February, inconspicuous and green. They appear in clusters on the branchlets shortly before the new leaves. **The winged samara fruits** mature from February to May. They are flat, papery, obovate, up to 3.5 cm long by 2.5 cm broad, each with a single seed.

**Wood Macroscopic Features**

**Pores** are small, proportion of solitary pores high with 2 to 3 radial multiples of same size, distribution is moderate. **Axial parenchyma** is fairly distinct to the naked eye, paratracheal, aliform and confluent. Proportion of **fibre tissue** is medium. **Ray parenchyma** distinct at transverse and indistinct at radial section, very narrow, uniform, less than 1/4 of vessel diameter, moderate to high frequency storied. Wood is diffuse porous.

**Physical Features**

The yellow-white **heartwood** is not discernible from **sapwood** with moderately coarse texture. Wood is moderately hard and of **medium density**.



### **Splinter Burning Test**

**Splinter** burns to exude coloured liquid and forms white ash.

### **Ecology and Silviculture**

*Holoptelea grandis* is a deciduous tree occurring in drier forests. The seed is dispersed by wind and germination is epigeal. It regenerates in moderate shade but being a pioneer species, the seedlings and saplings are strongly associated with canopy gaps and exposure to sunlight (Hall & Swaine, 1981). It is more common in regenerated forest previously destroyed by fire (Hawthorne, 1994).

### **Ethnobotany**

The roots and bark are beaten and applied as a poultice for rheumatism, while the bark infusion is given as an anthelmintic (Irvine, 1961). The seeds are reported to have laxative properties.

### **Recommended Commercial Uses**

A **non-durable wood** promoted for the following uses:

- Handicrafts and carvings
- Panellings, mouldings and claddings
- Floorings, steps and stairs
- Joinery, interior trims and frames
- Decorative furniture and luxury cabinet works
- Decorative veneer and plywood
- Food containers and packing cases

***Homalium longistylum* Mast.**Family Name: **Flacourtiaceae**Recommended Trade Name: **Homalium**Local Names: **Owebiribi (Gh); Melefoufou (CI)****Synonym***H. aylmeri* Hutch**Distribution**

West, Central and East Africa, extending from Guinea to Kenya, Mozambique and Angola. Rare in Ghana, from Evergreen and Dry Semi-deciduous (Inner Zone subtype) forests.

**Status**

A **lesser-known** species of rare occurrence currently unexploited. No inventory data and no prescribed minimum felling diameter, but 50 cm is recommended. The genus is, however, one of the most important commercial species of Papua New Guinea. It is classified by IUCN (2004) as a lower risk least concern species.

**Tree Features**

**The tree** is up to 27 m high and 1.2 m in girth. **The bole** is straight and sometimes slightly buttressed. **The bark** is greyish-brown with many small lenticels, often rough with corky scales. **The slash** is thick, hard, yellowish and granular. **The branches** are more or less horizontal and whorled. **The**

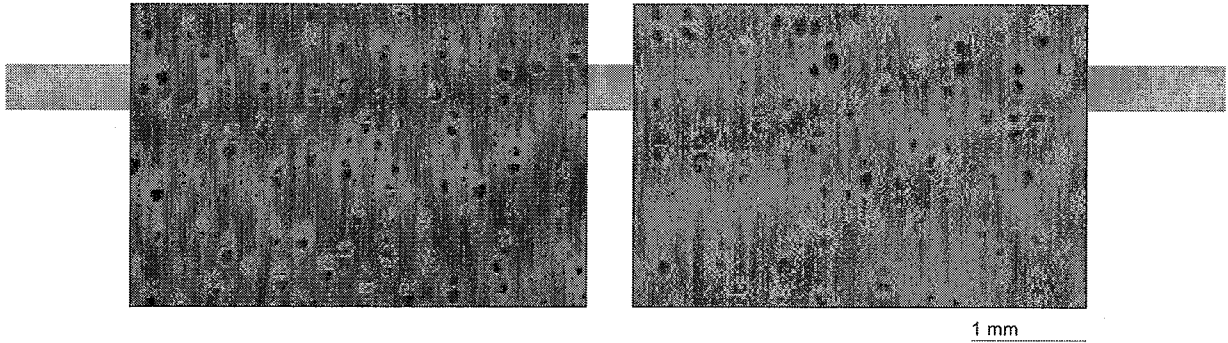
**leaves** are 7-20 cm long by 5-10 cm broad, elliptic, cuneate, with a pair of basal nerves. The margin is wavy or toothed. **The greenish, white flowers** are formed from August to April, shortly stalked, in clusters along narrow racemes up to 30 cm long. **The winged fruits** appear from August to April, about 12 mm across and 6 mm long.

**Wood Macroscopic Features**

**Pores** medium to large, proportion of solitary pores low, with 2 to 3 radial multiples of same size, occasionally clusters of 2 to 3, moderate distribution with inclusions. **Axial parenchyma** is indistinct to the naked eye and with hand lens. Proportion of **fibre tissue** is low to medium. **Ray parenchyma** is very narrow to narrow, uniform, less than ¼ to ½ vessel diameter, high frequency. Wood is diffuse porous.

**Physical Features**

**Heartwood** and **sapwood** are yellow, not demarcated with fine texture. Wood is hard and of high density.



### **Splinter Burning Test**

**Splinter** burns to exude coloured liquid and forms white ash.

### **Ecology and Silviculture**

*Homalium longistylum* is an evergreen tree found in swamps, creeks, streams and other wet places. The fruit is dispersed by wind and germination is epigeal (Taylor, 1960). It is a light demander and does well in disturbed forest.

### **Ethnobotany**

It is used as ornamental plant because of its flowers and fruits (Abbiw, 1990). The bark is used in local religious practices in Liberia (Irvine, 1961).

### **Recommended Commercial Uses**

A **moderately durable wood** promoted for the following uses:

- Poles and posts
- Sleepers and crossties
- Floorings and parquets

## ***Hymenostegia afzelii* (Oliv.) Harms**

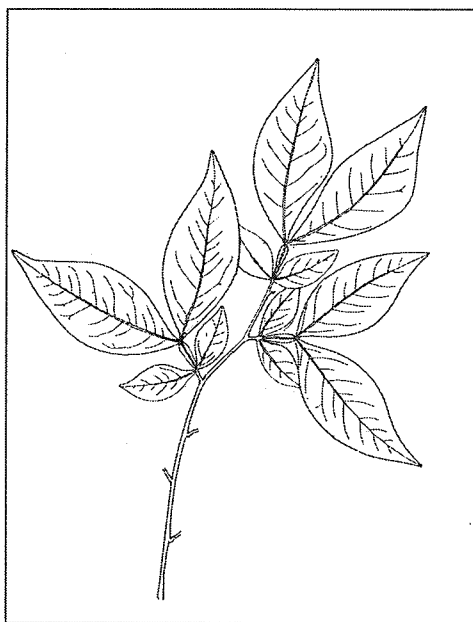
Family Name: **Caesalpiniaceae**

Recommended Trade Name: **Hymenostegia**

Local Names: **Takrowa** (Gh); **Kouekoue** (CI)

### **Distribution**

West and Central Africa, extending from Guinea to Cameroon. Frequently found in all forest types of Ghana including Southern Marginal, except in Wet Evergreen.



### **Status**

A **lesser-known species** of frequent forest occurrence for promotion in local market. There is no prescribed minimum felling diameter and 50 cm is recommended. It is categorised as a lower risk least concern species by IUCN (2004).

### **Tree Features**

**The tree** is slender, up to 15 m high and barely 1.5 m in girth, with slightly fluted bole. **The bark** is smooth and the slash is reddish-brown, gritty with sweet taste. **The leaves** are pinnate with a common stalk, 1-3 cm long, winged between the upper and lower pair of leaflets. The upper pair is 5-13 cm long and 2-5 cm broad, elliptic and unsymmetrical; the lower pair is much smaller. **The white or pinkish flowers** appear from November to May and in

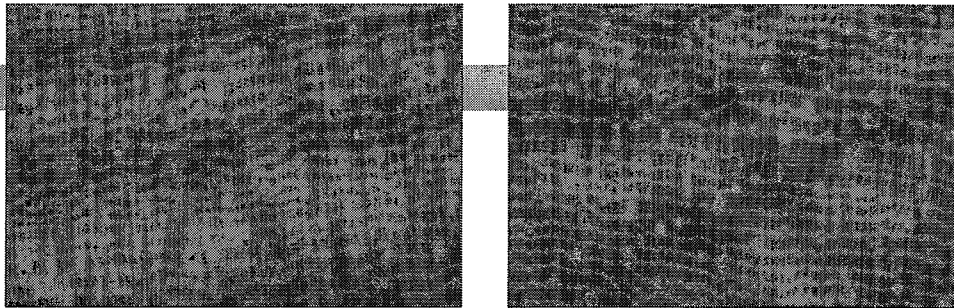
August, in slender terminal or axillary racemes as long as the leaves. **The flat fruits** are explosive pods which mature in May. They are 5-8 cm long and 2.5-3.5 cm broad, widening toward the apex, and dehiscing to release 1 to 3 flattened seeds in a fruit.

### **Wood Macroscopic Features**

**Pores** small, indistinct to the naked eye, proportion of solitary pores high with 2 to 3 radial multiples of same size, distribution moderate to numerous. **Axial parenchyma** is apotracheal, very narrow wavy bands smaller than fibre tissue bands, regularly spaced with narrow distance between bands. **Fibre tissue** proportion is low to medium. **Ray parenchyma** is indistinct to the naked eye and barely distinct with hand lens, uniform, very narrow, less than  $\frac{1}{4}$  of vessel diameter, high frequency. Wood is diffuse porous, **growth ring** boundaries demarcated by dark ground fibre tissue and absence of pores.

### **Physical Features**

**Heartwood** yellow, demarcated from white **sapwood** with fine texture. Wood is hard and of **high density**.



1 mm

### **Splinter Burning Test**

**Splinter** burns to exude coloured liquid and forms white ash.

### **Ecology and Silviculture**

*Hymenostegia afzelii* is an understorey forest tree common in a wide range of forests, though less common in lowland wet evergreen forest. It is sometimes gregarious in wet and dry forests, but sensitive to fire damage. It is propagated by seed released when the fruit pod dehisces. Sometimes it grows in pure stands in very dry forest (Hall & Swaine, 1981). It is a shade bearer with regeneration being more abundant in undisturbed forest (Hawthorne, 1994).

### **Ethnobotany**

The twigs are used as chewing sticks (Abbiw, 1990). A root decoction is used as a cough remedy or is chewed as a remedy for piles (Irvine, 1961). The roots are used for treating haemorrhoids (Mshana *et al.*, 2000).

### **Recommended Commercial Uses**

A **moderately durable wood** promoted for the following uses:

- Tool handles and agricultural implements
- Sporting goods
- Poles, posts and stakes
- Crossties, sleepers, piles and deckings
- Veneer for plywood
- Boat and vehicle bodies

***Irvingia gabonensis* (O'Rorke) Baill.**

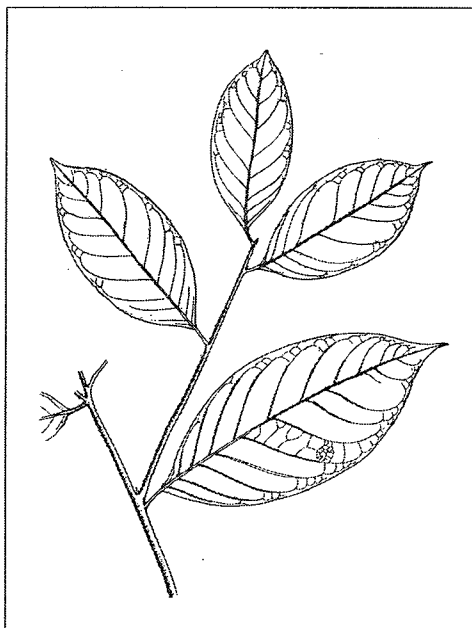
Family Name: **Irvingiaceae**

Recommended Trade Names: **Irvingia; Andok**

Local Names: **Abesebuo** (Gh); **Andok** (Ga, Ca)

**Distribution**

West, Central and East Africa, extending from Senegal to Sudan and south to Angola. Sparse occurrence in Ghana, sporadically distributed in all forest types except Dry Semi-deciduous.

**Status**

A **lesser-known species** of sparse forest availability, insignificant production for use in local market. It has no prescribed minimum felling diameter and 70 cm is recommended. It is a lower risk least concern species according to IUCN (2004) categorisation.

**Tree Features**

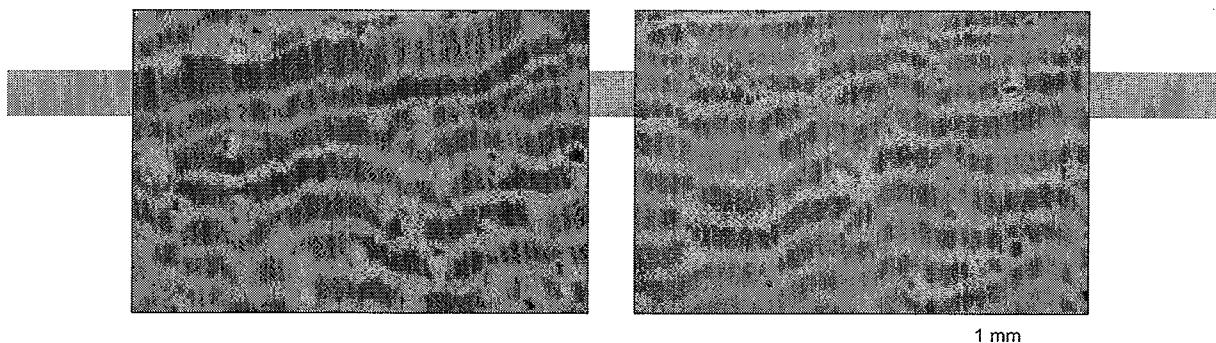
**The tree** is up to 35 m high and about 2.3 m in girth, with a cylindrical bole and narrow buttresses, up to 6 m high. **The bark** is grey and smooth or very slightly scaly. **The slash** is brittle and yellowish-brown to light-yellow, with sweet watery exudate and dark vertical streak. **The crown** is small, compact and rounded and stipules are large and curved. **The leaves** are simple, 15 cm long and 2.5-6 cm broad, dark-green with an elliptic acute tip and a cuneate or slightly

rounded base, with 5 to 10 pairs of lateral nerves. **The small fragrant flowers** open from November to March and in June, yellowish to greenish-white, in slender clustered racemes among the leaves. **The fruit** is a drupe and aromatic, matures from April to July and in September. It is yellow, 5-7.5 cm long with a yellowish fibrous pulp surrounding a large single-seeded nut. Two forms may exist: the tall tree form as var. *excelsa* and the smaller form as var. *gabonensis* (Hall & Swaine, 1981).

**Wood Macroscopic Features**

**Pores** medium to large, proportion of solitary pores low to medium with 2 to 3 radial multiples of same size, low in distribution, tyloses present. **Axial parenchyma** narrow to wide wavy bands, equal to or smaller than fibre tissue bands, regularly spaced with narrow distance between bands. Proportion of **fibre tissue** is low to medium. **Ray parenchyma** is indistinct, very narrow, uniform, less than 1/4 of vessel diameter, high frequency. Wood is diffuse porous, **growth ring** boundaries demarcated by absence of pores and dark ground fibre tissue.





### Physical Features

**Heartwood** pale-brown to grey-brown, **sapwood** with red stripes not clearly differentiated, fine to medium texture. Wood is hard and of **high density**.

### Splinter Burning Test

**Splinter** burns to form grey ash.

### Ecology and Silviculture

*Irvingia gabonensis* is an evergreen tree scattered throughout the forest zones. Mature trees are common in low-lying areas and small trees can be found on higher land in dry forests (Lawson *et al.*, 1970). It is propagated by seed, dispersed by rodents and elephants, and germinates in shade. All sizes of the tree are more abundant in undisturbed forests (Hawthorne, 1994).

### Ethnobotany

**The fruits** of the cultivated type are good to eat, but those of the wild trees are bitter and acrid (Irvine, 1961). The kernels of wild and cultivated plants are important source of human food in various parts of Africa. The seed oil is a cocoa-butter substitute (Abbiw, 1990). The powder from the kernels is applied to burns and used for astringent remedies (Irvine, 1961).

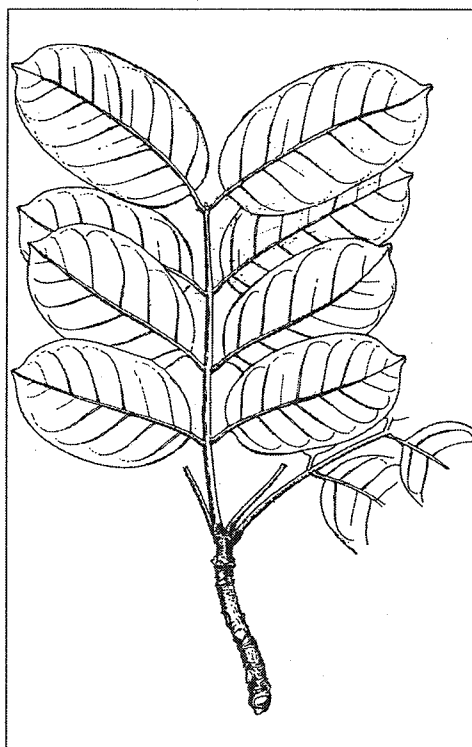
### Recommended Commercial Uses

A **moderately durable wood** promoted for the following uses:

- Handicrafts and carvings
- Poles, posts and stakes
- Floorings, steps and stairs
- Sporting goods and tool handles
- Vehicle and truck bodies

***Khaya anthotheca* (Welw.) C. DC.**Family Name: **Meliaceae**Trade Names: **African Mahogany; Acajou blanc**Local Names: **Krumben (Gh); Acajou (CI)****Distribution**

West, Central and East Africa, extending from Sierra Leone to Congo, Angola and Uganda. Occurs sparsely in Ghana, largely confined to Moist Semi-deciduous (North -West subtype) forest.

**Status**

A **premium species** of sparse forest occurrence, high to moderate production and very regular export. It is one of the three most important African Mahogany group of timbers with a prescribed minimum felling diameter of 110 cm. It is a vulnerable species according to IUCN (2004) categorisation. A special permit for felling was introduced in 1998. The sawdust may cause dermatitis.

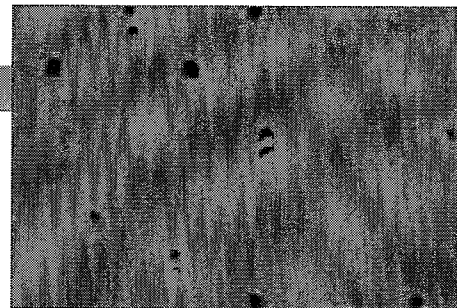
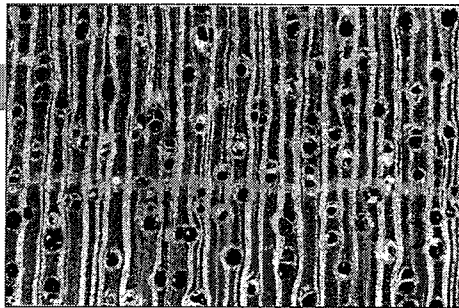
**Tree Features**

The tree is up to 60 m high and 3 m in girth with straight clear bole and buttress. The bark is smooth, pale with green patches. The slash is thick, bitter and scented, creamy yellow with red inner margin. The crown is rounded and the branches are stout. The leaves are pinnate and in tufts at the ends of branches. The leaflets are 2 to 4, 15 cm by 8 cm, thin and papery with rounded apex, shortly cuneate at base with 6 to 9 pairs of lateral nerves. The small white flowers are monoecious, formed in March, generally in

fours (occasionally in fives). The fruits are woody capsules, 4-valved (occasionally 5) and woody, 8 cm in diameter, flat and golden-brown with tiny seeds, surrounded by a narrow irregular thin wing. *Khaya anthotheca* from moist forest may be confused with *K. grandifoliola* which is more confined to dry forest with dark rough bark (Hawthorne, 1995).

**Wood Macroscopic Features**

Pores are medium to large, proportion of solitary pores medium with same size of radial multiples of 2, distribution low, gum inclusions present. Axial parenchyma is barely distinct to naked eye, paratracheal, vasicentric and marginal. Ray parenchyma is variable, very narrow and wide, less than  $\frac{1}{4}$  to  $\frac{1}{2}$  of vessel diameter, moderate frequency. Ground tissue fibre proportion medium to high. Wood is diffuse porous, growth ring boundaries demarcated by marginal parenchyma.



1 mm

### Physical Features

**Heartwood** red-brown, clearly demarcated from creamy-white to yellow-white **sapwood**, texture is fine to medium, low lustre and light pleasant odour.

Wood is hard and of **medium density**.

### Splinter Burning Test

**Splinter** burns to form black ash.

### Ecology and Silviculture

*Khaya anthotheca* is an evergreen tree but briefly deciduous (Hall & Swaine, 1981). The tree grows on deep fertile soils and river banks and has similar distribution with *Entandrophragma utile*. The winged seeds are wind dispersed. Propagation is by seed and growth is more rapid at the beginning. It is a non-pioneer light demander that requires more light to grow than *K. ivorensis* (Hawthorne, 1995). Saplings are susceptible to shoot borer attack in open conditions (Wagner *et al.*, 1991). Sap-feeding insects, gall-producing pests, mahogany shoot borers (*Hypsipyla robusta*), and several pests have been recorded on growing trees of the species (Wagner *et al.*, 1991).

### Ethnobotany

The bitter bark decoction is taken as febrifuge for cough and fever, while the bark alone is used as condiment and for strengthening fermented drinks (Irvine, 1961). The stem-bark is used for treating cough (Mshana *et al.*, 2000).

### Commercial Uses

A **moderately durable wood** used for the following:

- Claddings, panellings and mouldings
- Luxury furniture and cabinet works
- Floorings, steps and stairs
- Joinery, doors, frames and trims
- Decorative veneer for plywood
- Boat construction

***Khaya ivorensis* A. Chev.**

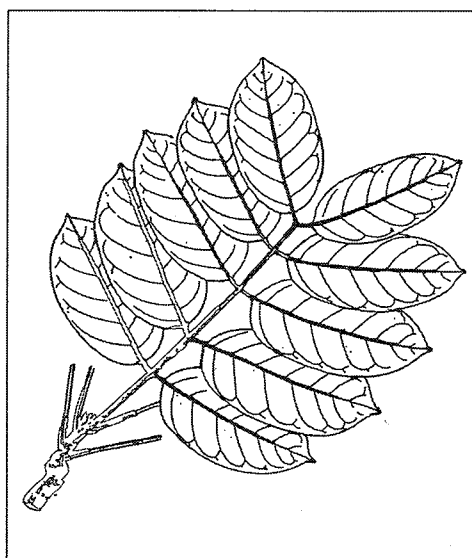
Family Name: **Meliaceae**  
 Trade Names: **African Mahogany; Acajou**  
 Local Names: **Dubini (Gh); Acajou (CI).**

**Synonym**

*K. klainei* Pierre ex Pellegr.

**Distribution**

West and Central Africa, extending from Ivory Coast to Gabon. Frequently found in Ghana in Wet and Moist Evergreen and Moist Semi-deciduous (South-East subtype) forests.

**Status**

A **premium species** traded with other *Khaya* species as African Mahogany. Forest availability is frequent with very high production for very regular export. The prescribed minimum felling diameter is 110 cm and is cited as a vulnerable species by IUCN (2004). A special permit for felling has been in place since 1998. The sawdust may cause dermatitis.

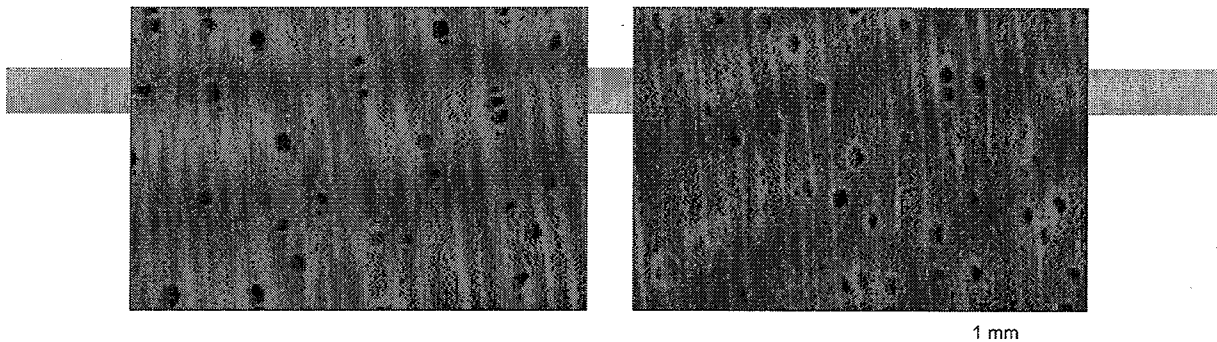
**Tree Features**

The tree is up to 50 m high and 6 m in girth with long clear bole of 30 m, buttresses being absent from trees of drier forest. The bark is scaly and grey or reddish-brown with deep pits where scales have fallen off. The slash is pinkish-red, fibrous, bitter and scented. The crown is open and the leaves, inclined

upwards, are crowded at the ends of the branches. The leaves are pinnate with 4-7 pairs of leaflets, 7.5-14 cm long and 2.5-4.5 cm broad, oblong with acuminate apex. The flowers are white, formed from September to December, and from February to May, in panicles with individual flowers about 4 mm long. The fruits, 8 cm by 3 cm, mature from February to June, being globose woody capsules usually with 5 valves. The seed, about 2.5 cm in diameter, is narrowly winged all round.

**Wood Macroscopic Features**

Pores medium, proportion of solitary pores high with low radial multiples of 2, with same size, moderate distribution, inclusions present. Axial parenchyma is indistinct, scanty paratracheal, vasicentric, occasionally aliform and confluent. Proportion of fibre tissue is medium to high. Ray parenchyma is variable, narrow and very narrow, between  $\frac{1}{4}$  and  $\frac{1}{2}$  of vessel diameter, moderate to high frequency. Wood is diffuse porous, growth ring boundaries demarcated by dark ground fibre tissue, absence of pores and sometimes marginal parenchyma.



### Physical Features

**Heartwood** red-brown, clearly demarcated from creamy-white to yellow-white **sapwood**. Texture is fine to medium with low lustre and light pleasant odour. Wood is hard and of **medium density**.

### Splinter Burning Test

**Splinter** burns to form black ash.

### Ecology and Silviculture

*Khaya ivorensis* is an evergreen tree that prefers heavy or rich alluvial soils near watercourses and damp areas with good drainage (Taylor, 1960). Seeds are produced throughout the year (Gyimah, 1986) and are dispersed by wind, but are heavily attacked by predators (Gyimah, 1986). Germination is hypogeal, takes 8 to 21 days with a germination rate of about 60 % (Taylor, 1960). Seedlings require some shade during first 2 years. It is very susceptible to shoot borer (*Hypsipyla*) attack if it is subjected to open conditions, resulting in high mortality of young plants (Taylor, 1960). Regeneration is more abundant in unburnt forest (Hawthorne, 1994). A sap-feeding insect that produces numerous galls and mahogany shoot borer, *Hypsipyla robusta*, that preys on shoot, have been recorded on the tree species (Wagner *et al.*, 1991). The larvae of a weevil, *Cledus obesus*, are reported to tunnel into the branch axis of the stem (Wagner *et al.*, 1991).

### Ethnobotany

The bark decoction is drunk and used in bath treatment of lumbago, rheumatic pains and enemas, while the pounded leaves with guinea grains are used as liniment (Irvine, 1961). The bark is used for treating enemas (Mshana *et al.*, 2000).

### Commercial Uses

A **moderately durable wood** used for the following:

- Claddings, panellings and mouldings
- High quality furniture and luxury cabinet works
- Floorings, steps and stairs
- Joinery, doors, frames and trims
- Decorative veneer for plywood
- Boat and canoe construction

***Khaya senegalensis* (Desr.) A. Juss.**

Family Name: **Meliaceae**

Trade Names: **"Dry zone" African Mahogany; Acajou**

Local Names: **Kuntunkuri (Gh); Acajou (CI)**

**Distribution**

West, Central and East Africa, extending from Senegal to Sudan and Uganda. Moderately found in Ghana's Dry Semi-deciduous (Inner Zone type) forest and Savanna woodland.

**Status**

A **lesser-used species** of rare forest availability, low production for occasional export. It is the least popular of the African Mahogany group of species. The prescribed minimum felling limit is 110 cm and is cited by IUCN (2004) as a vulnerable species. It may cause dermatitis.

**Tree Features**

**The tree** is up to 35 m high and 3 m in girth. It has a **dense crown** and a short bole, covered with a dark-grey scaly bark. **The slash** is dark-pink and yields gum. **The leaves** are pinnate with 3 to 4 pairs of leaflets, 5-10 cm long and 2.5-5 cm broad, more or less elliptic and obtuse or very shortly acuminate at apex. **The flowers** appear from January to April, have pale-green sepals and cream petals with a staminal tube. **Each fruit** is about 6 cm long and 2.5 mm thick, matures from December to April and dehisces

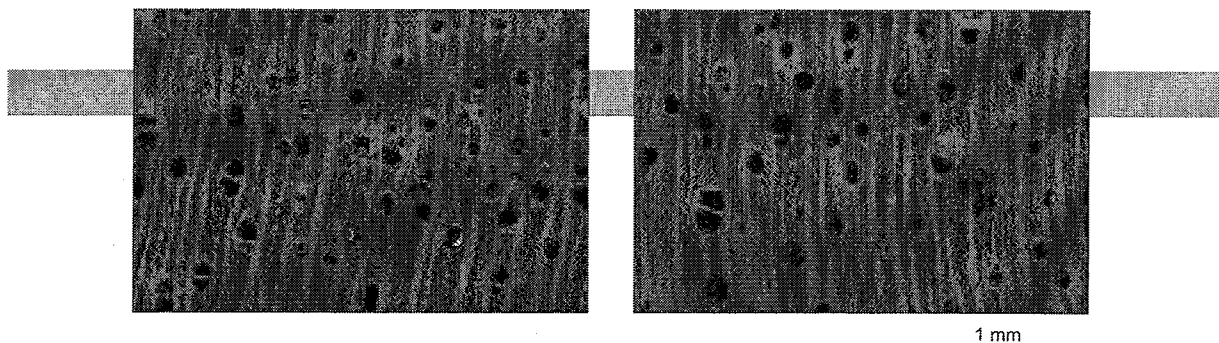
through 4 valves. **Seeds** are oblong-elliptic, winged and about 6 cm broad.

**Wood Macroscopic Features**

**Pores** medium to large, proportion of solitary pores medium with same size of radial multiples of 2, occasionally clusters, distribution low, tyloses and other inclusions present. **Axial parenchyma** scanty paratracheal, vasicentric and occasionally marginal. Proportion of **fibre tissue** is medium to high. **Ray parenchyma** variable, narrow to broad,  $\frac{1}{4}$  to  $\frac{1}{2}$  of vessel diameter, moderate frequency. Wood is diffuse porous, **growth ring** boundaries demarcated by marginal parenchyma bands when present.

**Physical Features**

**Heartwood** is red-brown, clearly demarcated from creamy to yellowish-white **sapwood**, texture is fine to medium with low lustre and pleasant odour. Wood is hard and of **medium density**.



### Splinter Burning Test

**Splinter** burns to form black ash.

### Ecology and Silviculture

*Khaya senegalensis* is deciduous and gregariously found in low-lying areas besides streams. It is commonly planted as an avenue tree. Seeds germinate in the open and can be transplanted, although natural regeneration is reported by Irvine (1961) to be poor. It has been tested and planted in mixed plantation with species like Niangon, Okoumé, and Bilinga with a rotation period of 40 years. It can also be propagated through suckers (Irvine, 1961). The tree is attacked by sap-feeding gall-producing insects and mahogany shoot borer, *Hypsipyla robusta* (Wagner *et al.*, 1991).

### Ethnobotany

The bark yields a brown dye for dyeing clothes, treatment of fever and as a blood tonic (Abbiw, 1990). The bark powder from the stem-base is used for treating convulsion, arthritis, haemorrhoids, malaria, boils, and heat rash (Irvine, 1961). The leaves are for treating headache and loss of appetite (Mshana *et al.*, 2000). It is often planted and used as avenue tree in Savanna regions, but is often disfigured by persistent debarking for medicine (Abbiw, 1990).

### Commercial Uses

A **moderately durable wood** used for the following:

- Artifacts and handicrafts
- Floorings, parquets, steps and stairs
- Panellings, claddings and mouldings
- Decorative furniture and cabinet works
- Decorative veneer and plywood

***Klainedoxa gabonensis* Pierre ex Engl.**

Family Name: **Irvingiaceae**

Recommended Trade Names: **Klainedoxa; Eveuss; Kroma**

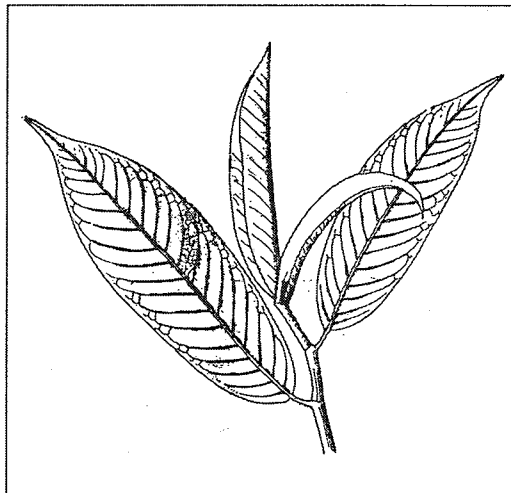
Local Names: **Kroma** (Gh, CI); **Eveuss** (Ga, EG, Za)

**Synonym**

*K. oblongifolia* (Engl.) Stapf.

**Distribution**

West, Central and East Africa, extending from Guinea-Bissau to Democratic Republic of Congo (Zaire) and Sudan. Moderately distributed in Wet and Moist Evergreen and Moist Semi-deciduous forests of Ghana.

**Status**

It is a **lesser-known species** of sparse forest availability, very low production for local use only. The minimum felling limit is 90 cm, and is recommended by IUCN (2004) as a lower risk least concern species.

**Tree Features**

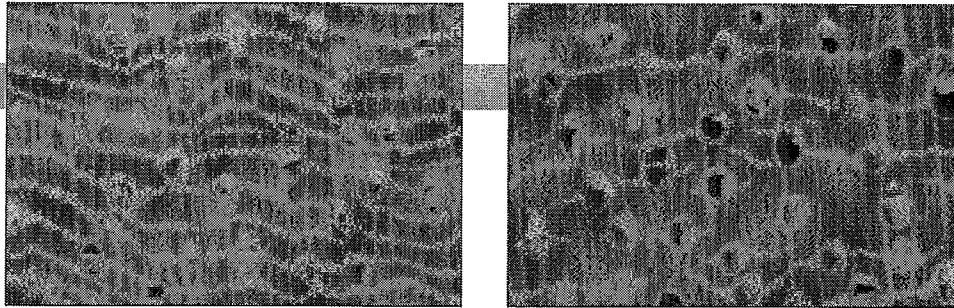
**The tree** is evergreen, up to 50 m high and 5 m in girth with a dense rounded crown. **The slender bole** is 30 m with thin widely spreading buttresses up to 5 m high, very extensive and planked in large trees. **The bark** is grey, sometimes slightly fissured. **The slash** is granular

and orange-brown, stipules up to 7 cm long. **The leaves** are simple, 5-15 cm long and 2.5-6 cm broad. They are leathery, ovate to elliptic or sometimes slightly obovate, acuminate at the tip and rounded or cuneate and slightly unequal at the base. **The red or pinkish flowers** are formed from January to April and in November. They are numerous up to 15 cm long, arranged in panicles at the ends of the shoots. **The black fruits** mature in June and July. They are flattened-globose, slightly 5-lobed up to 7.5 cm across with 4 to 6 hard-shelled stones in a fruit with tough fibrous covering.

**Wood Macroscopic Features**

**Pores** large, proportion of solitary pores medium with uniform radial multiples of 2 to 3, distribution low. tyloses present. **Axial parenchyma** paratracheal, vasicentric, aliform, confluent and in wavy narrow bands, smaller than fibre tissue bands, regularly spaced with narrow distance between bands. Proportion of **fibre tissue** is medium. **Ray parenchyma** very narrow to narrow, uniform width less than ¼ of vessel diameter, moderate to high frequency. Wood is diffuse porous.





1 mm

### Physical Features

**Heartwood** is orange-yellow or golden-brown, darkens to dark-brown, not clearly differentiated from **sapwood**. The texture is medium with low lustre. Wood is hard and of very **high density**.

### Splinter Burning Test

**Splinter** burns to produce crackles or bright sparks and forms white ash.

### Ecology and Silviculture

*Klainedoxa gabonensis* is an evergreen tree found on sandy soils associated with damp situations. All sizes of trees are more abundant in undisturbed forest than in forest previously destroyed by fire (Hawthorne, 1994). It is propagated by seeds that remain viable on forest floor after felling before dispersal by elephants (Alexandre, 1978). Germination under shade is epigeal. Saplings do not require full overhead light for its development (Savill & Fox, 1967).

### Ethnobotany

The seeds are oily and edible (Abbiw, 1990). The young leaves and roots have aphrodisiac properties (Irvine, 1961). Burkill (1985) lists the following medicinal uses for the species: the bark for dropsy, oedemas, haemorrhoids and menstrual complications; and the root for emetic, naso-pharyngeal and pulmonary diseases.

### Recommended Commercial Uses

A **very durable wood** promoted for the following uses:

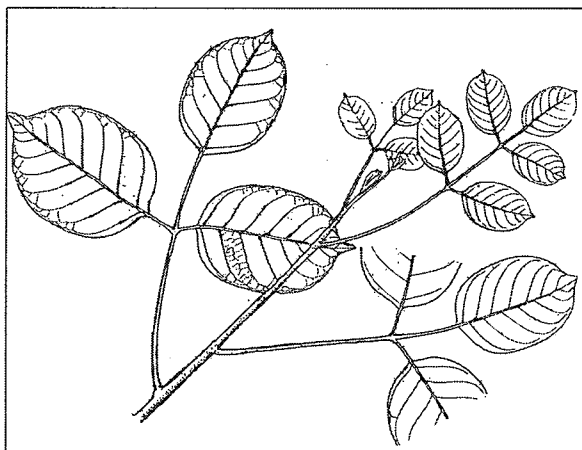
Bridges, sleepers, crossties, piles and piers  
 Floorings and parquets  
 Poles, posts and stakes  
 Vehicle and truck bodies

***Lannea welwitschii* (Hiern.) Engl.**

Family Name: **Anacardiaceae**  
 Trade Names: **Lannea, Kumanini; Kumbi**  
 Local Names: **Kumanini (Gh); Kumbi (Za); Loloti (CI)**

**Distribution**

West, Central and East Africa, extending from Ivory Coast to Democratic Republic of Congo (Zaire), South-east Kenya, and South-west Tanzania. Sparsely found in Ghana in Moist and Dry Semi-deciduous forests.

**Status**

A lesser-used species with sparse distribution, very low production and occasional export. The prescribed minimum felling diameter is 70 cm. It is classified by IUCN (2004) as a lower risk least concern species.

**Tree Features**

The tree is up to 30 m high, 3 m in girth with straight cylindrical bole and light rounded crown.

The bark is grey with characteristic pitted bark like gunshot wounds.

The slash is thick, reddish with white streaks producing sticky exudate. The leaves are pinnate with a glabrous common stalk 7-23 cm long with 1-4 pairs of leaflets, 7-15 cm long by 5-7.5 cm broad with terminal leaflet. They are thin and glabrous, elliptic, with a long acuminate tip, rounded to cuneate at the base. The numerous, very small, yellowish-green flowers are formed from January to April among the leaves in panicles 5-20 cm long. The fruits are drupes, mature from March to April and in July. They are black, flattened and broadly elliptic, about 6 mm long, hanging in conspicuous clusters beneath the leaves.

**Wood Macroscopic Features**

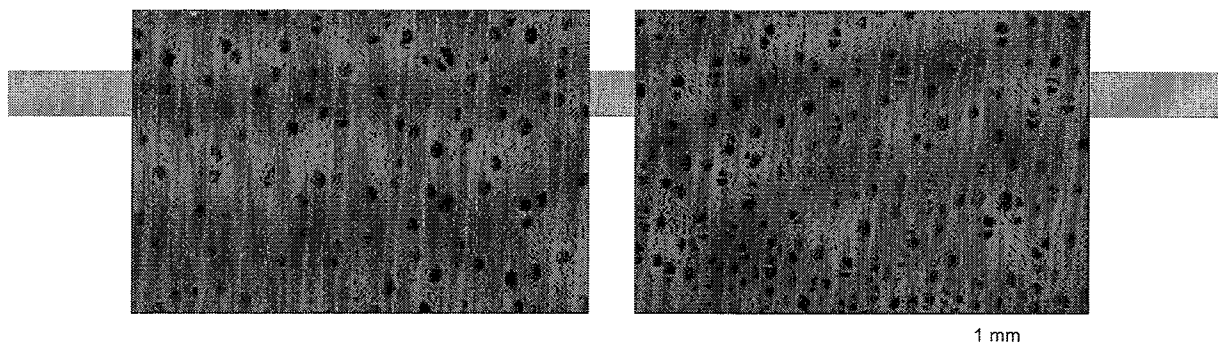
Pores are medium, low proportion of solitary pores with same size of 2 to 4 radial multiples, moderate distribution, tyloses present. Axial parenchyma is indistinct with hand lens. Fibre tissue proportion is medium to high. Ray parenchyma very narrow to narrow,  $\frac{1}{4}$  to  $\frac{1}{2}$  vessel diameter, high frequency. Wood is diffuse porous.

**Physical Features**

Heartwood is pink-grey to pale-brown, occasionally light brown, not demarcated from sapwood, texture medium with low lustre. Wood is soft with low density.

**Splinter Burning Test**

Splinter burns to exude coloured liquid and forms grey ash.



### Ecology and Silviculture

*Lannea welwitschii* is a light-demanding deciduous tree common in wet and swampy places. Ripe fruits are dispersed by birds and seed germinates in shade with high mortality (Hall & Swaine, 1981). Saplings grow in gaps and regeneration is more abundant in undisturbed forest (Hawthorne, 1994).

### Ethnobotany

The fruits are acidic and edible (Abbiw, 1990). The tree is commonly debarked and is used for concoction which is drunk for cough treatment. The seeds serve as a purgative. Traditionally, the characteristic gunshot wounds on the bark of the tree are believed to offer spiritual protection to anyone taking the bark decoction for medicinal purpose after performing the necessary rituals (Abbiw, 1990). The roots are used for the treatment of venereal diseases (Irvine, 1961). A bark infusion is used for stomach troubles while decoction of root-bark is used as bath or lotion for skin diseases (Irvine, 1961). The bark is used in treating skin ulcer and lower abdominal pain (Mshana *et al.*, 2000). The bark and root are used for general medicine (Burkill, 1985).

### Commercial Uses

A **non-durable wood** used for the following:

- Joinery, frames and trims
- Common furniture and cabinet works
- Rotary and core veneer for plywood
- Match boxes, match splints and pencils
- Claddings, mouldings and panellings
- Boxes, crates, pallets and packing cases
- Veneer for plywood

***Lophira alata* Banks ex Gaertn.**

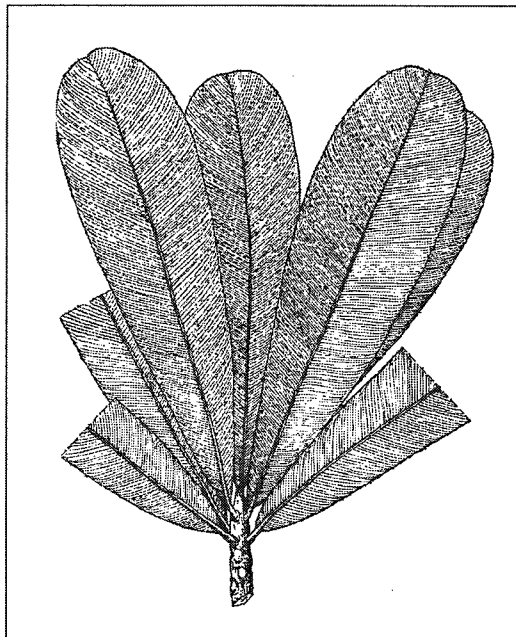
Family Name: **Ochnaceae**  
 Trade Names: **Azobe; Ekki**  
 Local Names: **Kaku (Gh); Azobe (CI)**

**Synonym**

*L. procera* A. Chev.

**Distribution**

West, Central and East Africa, extending from Sierra Leone to Democratic Republic of Congo (Zaire), Sudan and Uganda. Sparsely distributed in Ghana, predominantly in Wet Evergreen and scattered in Moist Evergreen forests.

**Status**

It is a **commercial species** of sparse forest availability, moderate production and regular export. The prescribed minimum felling limit is 110 cm. It is recommended as a vulnerable species by IUCN (2004). Sawdust may cause dermatitis.

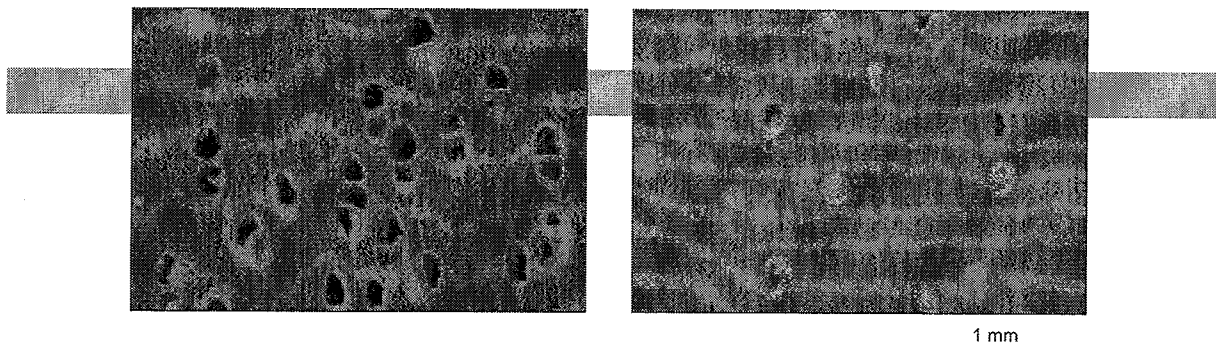
**Tree Features**

**The tree** is usually 50 m high, occasionally 60 m and 5 m in girth. It has a straight, occasionally fluted bole. **The bark** is red and flakes off in small patches with bright-yellow slash. **The branching** system is heavy but the foliage is open. The leaves are simple, alternate, 12-38 cm long by 3.5-10 cm broad, in tufts at the ends of the branches, bright-red during expansion. They are oblanceolate or obovate, rounded at the apex or markedly

notched, cuneate at the base with leaf stalk up to 2.5 cm long. **It flowers** from November to January, centred panicle, 3.75 cm in diameter. **The fruit** matures from January to March, an elongated nut, 2.5 cm long.

**Wood Macroscopic Features**

**Pores** are large to very large, proportion of solitary pores medium with uniform multiples of 2 to 4, distribution low, white inclusions present. **Axial parenchyma** is straight to wavy wide bands, smaller than fibre tissue bands and regularly spaced. Proportion of **fibre tissue** is low to medium. **Ray parenchyma** is indistinct to the naked eye, uniform, very narrow width less than 1/4 of vessel diameter, high to very high frequency and storied. Wood is diffuse porous.



### Physical Features

**Heartwood** dark-red to purple-brown, clearly demarcated from **sapwood** which is pale-pink; coarse textured. Wood is very hard and of **very high density**.

### Splinter Burning Test

**Splinter** burns to produce crackle or bright sparks and forms white ash.

### Ecology and Silviculture

*Lophira alata* is an evergreen tree found on poor acid and sandy soils, principally in evergreen forests but also near rivers in drier forest, being sensitive and notably absent from rocky soils. It is a pioneer species that requires full light at seedling and sapling stage. Fruits produced at end of dry season are dispersed by wind. It is propagated by seed and germination takes 9 to 16 days, being hypogeal with about 90 % germination rate (Taylor, 1960). Seedlings are reported to attain a height of 15 cm in 2 years and almost 20 cm in 4 years (Taylor, 1960). Mean annual girth increment of 2 cm has been recorded (Savill & Fox, 1967). Young plants are more susceptible to insect borer attack.

### Ethnobotany

Fruits are used to produce edible oil (Abbiw, 1990). The bark decoction is used for treating backache, fevers and gastro-intestinal ailments, and the root bark for yellow fever (Irvine, 1961). The roots are also reportedly used to treat ulcer and wound (Mshana *et al.*, 2000).

### Commercial Uses

A **durable wood** used for the following:

- Bridges, sleepers, crossties and pilings
- Poles, posts and stakes
- Industrial floorings and parquets
- Heavy construction works and beams
- Vehicle and truck bodies

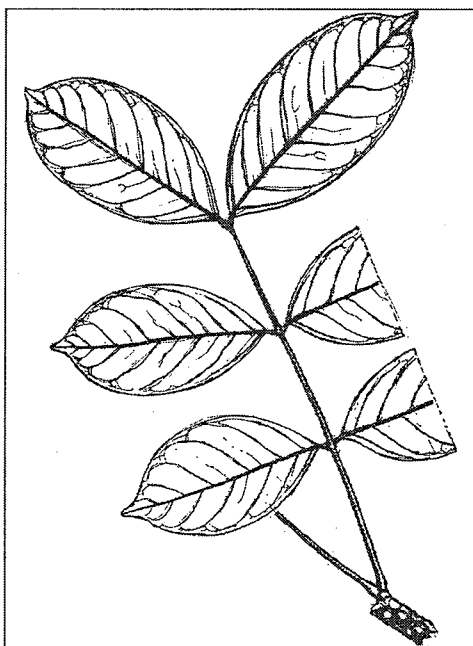
Family Name: **Meliaceae**  
 Trade Names: **African Walnut; Dibétou**  
 Local Names: **Dubinibiri (Gh); Dibétou (CI)**

#### **Synonym**

*L. klaineana* Pierre ex Sprague

#### **Distribution**

West and Central Africa, extending from Sierra Leone to Congo and Angola. Rarely found in Wet and Moist Evergreen and Moist Semi-deciduous (South-East subtype) forests of Ghana.



#### **Status**

It is a **premium species** of moderate forest availability, moderate production and regular export. The prescribed minimum felling limit is 90 cm, and is classified by IUCN (2004) as a vulnerable species. The sawdust may cause dermatitis and respiratory problems.

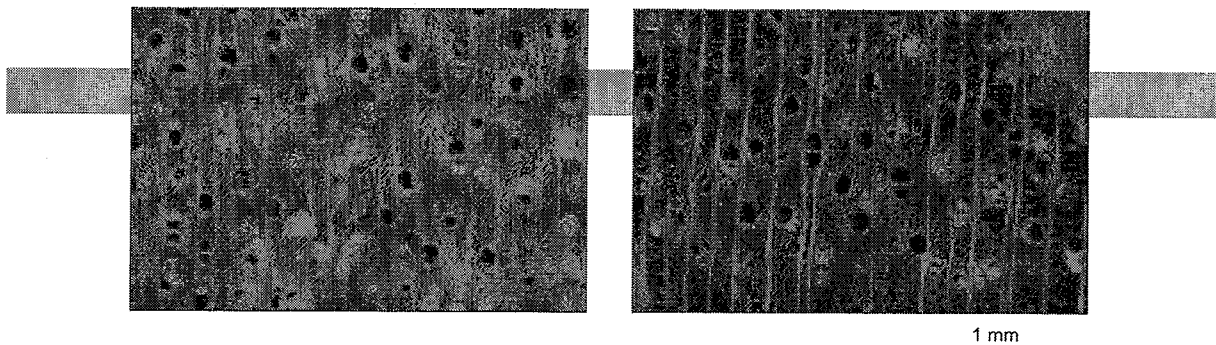
#### **Tree Features**

**The tree** is up to 50 m high and about 4 m in girth with a clear cylindrical bole 20 to 30 m with a dark heavy crown. **The buttresses** are occasionally present, being rather thick, short and blunt. **The bark** is relatively smooth, pale-brown, with many lenticels becoming rough with age. **The slash** is sweetly scented, dull-red or pink with faint-white streaks. **The leaves** are pinnate, about 50 cm long with flattened stalk, 5 opposite or almost opposite pairs of leaflets, 18 cm long by 7.5 cm broad, elliptic and sub-acuminate at the apex. **The**

**flowers** are borne on wide axillary and terminal panicles about 30 cm long and are formed from October to December. They are white, scented, small and numerous. **The fruit** is a woody capsule 2.5-5 cm, matures in March. It is black or purplish-black, opens from the base by 4 recurving segments, releasing up to 8 seeds.

#### **Wood Macroscopic Features**

**Pores** medium size, proportion of solitary pores medium with 2 to 3 radial multiples of same size, distribution moderate with gum inclusions. **Axial parenchyma** is paratracheal, scanty vasicentric and marginal. Proportion of **fibre tissue** is low to medium. **Ray parenchyma** is uniform, narrow, width less than  $\frac{1}{4}$  to  $\frac{1}{2}$  of vessel diameter, moderate frequency. Wood diffuse porous. **growth ring** boundaries demarcated by dark ground fibre tissue and marginal parenchyma.



### Physical Features

**Heartwood** grey-brown to yellow-brown with darker streaks, clearly demarcated from **sapwood**, which is light-grey to light-yellow. Texture is fine to medium with low lustre. Wood is fairly hard and of **medium density**.

### Splinter Burning Test

**Splinter** burns to produce crackle or bright sparks and forms charcoal.

### Ecology and Silviculture

The tree is evergreen and is associated with acid base-poor soils (Hall & Swaine, 1981) but well-drained sites (Taylor, 1960). Seeds are dispersed by wind and are viable for a short period only. The mode of propagation is by seed, and Kyereh *et al.* (1993) have reported no difference in either germination in light or darkness. Germination is epigeal, takes about 16 days with a germination rate of about 80 % (Taylor, 1960). Seedlings attain 1-m height after 2 years and 9 m after 7 years (Sanders, 1953). Saplings grow better in light (Hawthorne, 1995). The tree is resistant to fungal and shoot borer attack (Irving, 1961), but is susceptible to attack by boring insects with larvae feeding on fruits and seeds (Wagner *et al.*, 1991).

### Ethnobotany

N/A

### Commercial Uses

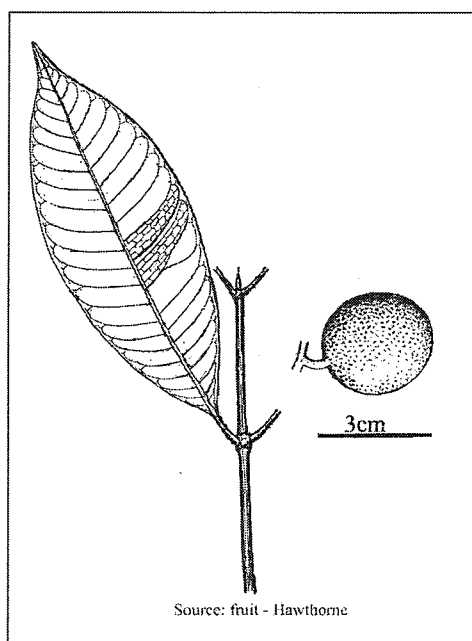
A **moderately durable wood** used for the following:

- Decorative furniture and cabinet works
- Floorings, steps and stairs
- Panellings, claddings and mouldings
- Joinery, frames and trims
- Decorative, sliced and rotary veneer for plywood

Family Name: **Guttiferae**  
 Trade Names: **African Apple; Bompagya; Oboto**  
 Local Names: **Bompagya (Gh); Oboto (Ga); Djimbo (Cl)**

#### Distribution

West and Central Africa, extending from Sierra Leone to Uganda and Angola. Sparsely found in Wet and Moist Evergreen, and Moist Semi-deciduous (South-East subtype) forests of Ghana.



#### Status

A **lesser-used species** of sparse forest availability, very low production with occasional export. The prescribed minimum felling limit is 70 cm, and is recommended by IUCN (2004) as a lower risk near threatened species. It may cause dermatitis.

#### Tree Features

The tree is up to 40 m high and 4 m in girth with a cylindrical bole of 15 m. The bark is dark-orange and flakes off in scales. The slash exudes sticky yellow latex, fibrous and gritty. The crown is dense, with short regular horizontal branches. The leaves are simple, opposite, 15-25 cm long by 5-8 cm broad. They are elongated elliptic, with acute or abruptly acuminate tip and cuneate or rounded base, conspicuously dotted with translucent points. The flowers with white petals and yellow stamens are formed in the

axils of the leaves from August to December and are either solitary or few, about 3.5 cm across. The fruit matures from March to April; solitary and on thick stalks 5-7.5 cm long. It is orange when ripe, more or less spherical, 10 cm in diameter, each containing 3 very hard seeds, 5 cm long embedded in an edible acid-yellow pulp.

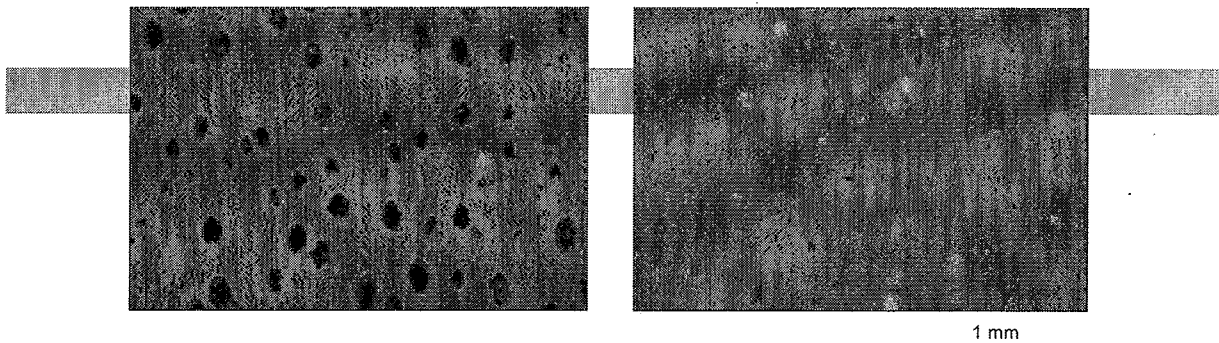
#### Wood Macroscopic Features

Pores medium and large, exclusively solitary, diagonal pattern, low to medium distribution, tyloses present. Axial parenchyma indistinct with the naked eye, barely distinct with hand lens, apotracheal, diffuse and diffuse-in-aggregate. Proportion of fibre tissue is medium to high. Ray parenchyma is indistinct to the naked eye, barely distinct with hand lens, uniform, very narrow width less than 1/4 of vessel diameter, high frequency. Wood diffuse porous, growth ring boundaries demarcated by absence of pores and dark ground fibre tissue.

#### Physical Features

Heartwood dark-red or red-brown, clearly demarcated from light-brown or pink-brown





sapwood. Texture is medium to coarse with low lustre. Wood is hard and of **high density**.

#### **Splinter Burning Test**

**Splinter** burns to exude coloured liquid and forms white ash.

#### **Ecology and Silviculture**

*Mammea africana* is an evergreen tree strongly associated with base-poor soils (Hall & Swaine, 1981). The fruits are produced in dry season, dispersed by elephants and rodents. Seed germination is hypogeal, irregular and slow, lasting up to 8 months with about 80 % germination rate (Taylor, 1960). Saplings are shade tolerant with an average growth rate of 30 cm per year. Seedlings are more abundant in undisturbed forest (Hawthorne, 1994).

#### **Ethnobotany**

The fruits are edible and the seed oil is used as cooking fat and in cosmetics (Abbiw, 1990). A lotion made from the root is used for skin diseases and the yellow bark for treating syphilis (Irvine, 1961). The bark is used for treating dermatitis, rheumatism and skin ulcers, the roots for pruritis, and the resin for scabies (Mshana *et al.*, 2000).

#### **Commercial Uses**

A **durable wood** used for the following:

- Exterior joinery, frames and trims
- Industrial floorings, steps and stairs
- Common furniture and cabinet works
- Wagon and vehicle bodies

## ***Manilkara obovata* (Sabine & G. Don) J.H. Hemsley**

Family Name: **Sapotaceae**

Recommended Trade Names: **Manilkara; Monghinza**

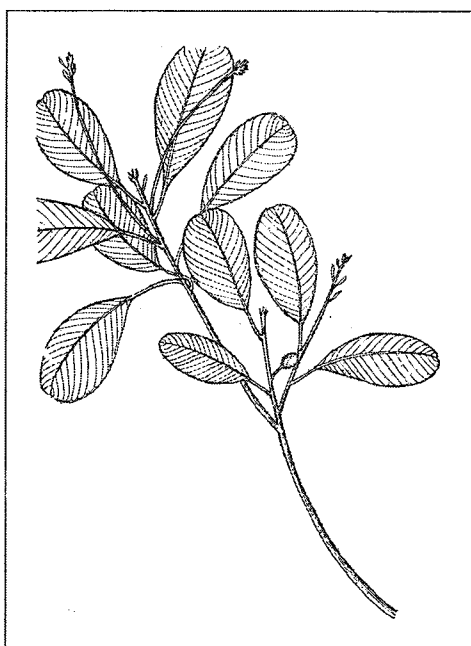
Local Names: **Berekankum** (Gh); **Sisina** (CI); **Monghinza** (CAR)

### **Synonym**

*M. multinervis* (Baker) Dubard (sometimes considered as a different species)

### **Distribution**

West and Central Africa, extending from Côte d'Ivoire to Gabon. Scarcely found in Wet Evergreen and Dry Semi-deciduous (Inner Zone and Southern Marginal subtypes) forests of Ghana.



### **Status**

It is a **lesser-known** species of rare forest availability, insignificant production for local use only. No prescribed minimum felling diameter and 70 cm is recommended. It is classified by IUCN (2004) as a lower risk near threatened species. The sawdust can cause dermatitis.

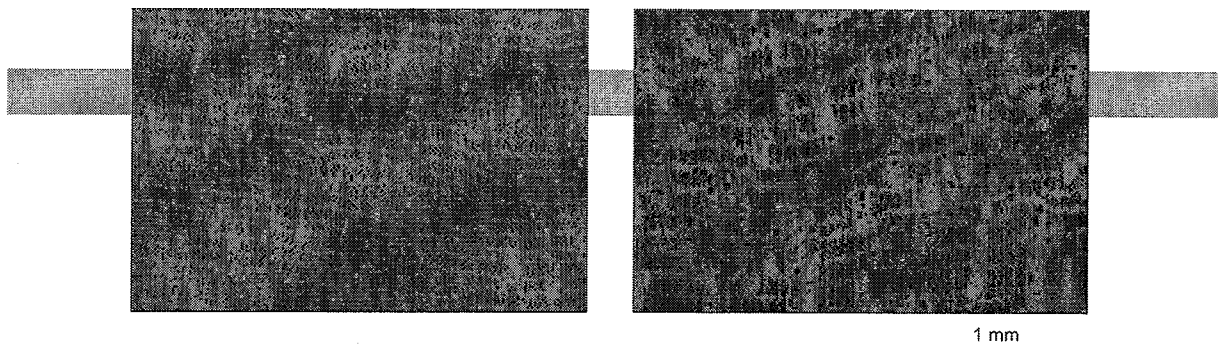
### **Tree Features**

**The tree** is 30 m high, with a long straight cylindrical bole about 3.2 m in girth, often fluted at the base, but scarcely buttressed. **The bark** is pale-brown with narrow fissures. **The slash** is red to pink, fibrous-stringy, and exudes sticky white latex. **The leaves** are simple, up to 16 cm long by 9 cm broad, obovate to oblanceolate, rounded or sub-acute at apex, wedge-shaped at the base and silvery-white below with more than 30 pairs of lateral nerves. **The flowers** are

centred formed from December to February, in clusters in the leaf-axil, borne on minutely hairy stalks about 1 cm long. **The fruits** mature from January to April and in June, pale-yellow, more or less globose or fig-shaped, each about 25 mm long by 20 mm broad with a **single seed** measuring 3 to 4 mm long. Several forms of this species, are found in different ecological zones, and are difficult to differentiate, especially as saplings.

### **Wood Macroscopic Features**

**Pores** indistinct to naked eye, small, predominantly 3 to 4 radial multiples of same size, some more than 4, low to moderate distribution, tyloses present. **Axial parenchyma** barely distinct to the naked eye, more or less straight to wavy bands, very narrow width, smaller than fibre tissue bands, regularly spaced with narrow distance between bands. Proportion of **fibre tissue** is low to medium. **Ray parenchyma** barely distinct with hand lens, narrow, uniform width,



less than  $\frac{1}{4}$  of vessel very diameter, high frequency. Wood diffuse porous, **growth ring** boundaries demarcated by absence of pores.

### Physical Features

**Heartwood** is red-brown, clearly demarcated from the yellowish to pale **sapwood**, fine texture with low lustre. Wood is very hard and of **very high density**.

### Splinter Burning Test

**Splinter** burns to produce crackle or bright sparks and forms white ash.

### Ecology and Silviculture

Several tree forms of *Manilkara obovata* are found in different vegetation zones of Ghana, including coastal dry forests and hilly sites extending into fringing forests in Savanna zones (Taylor, 1960; Hall & Swaine, 1981). Only those found in wetter forests which are shade bearers grow to timber size (Hawthorne, 1993). It regenerates in shade (Hall & Swaine, 1981).

### Ethnobotany

The flexible young branches are used for making bows while the wood is carved and used as mortar (Abbiw, 1990). The tree yields gutta-percha and the bark decoction is drunk to cure dysentery (Irvine, 1961; Burkill, 1985). The food is edible (Irvine, 1961). The bitter bark dried and pulverised is used the treatment of leg ulcers (Dalziel, 1937).

### Recommended Commercial Uses

A **very durable wood** promoted for the following uses:

Bridges, sleepers, crossties and deckings

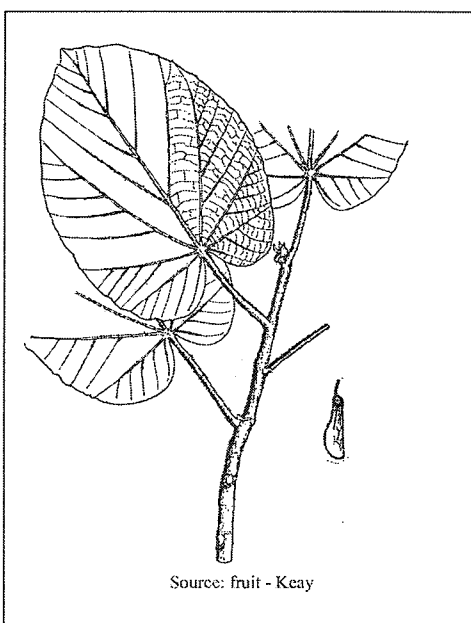
Heavy industrial construction

Industrial floorings, steps and stairs

Industrial structures, beams and joists

***Mansonia altissima* A. Chev.**Family Name: **Sterculiaceae**Trade Names: **Mansonia; Bété**Local Names: **Opronon (Gh); Bété (CI); Koul (Ca)****Distribution**

West and Central Africa, extending from Côte d'Ivoire through Ghana to Cameroon. Moderately found in Ghana in Moist Semi-deciduous (North-East subtype), Dry Semi-deciduous, and Southern Marginal forests.

**Status**

It is a **commercial species** of moderate forest availability, moderate production and irregular export. The prescribed minimum felling diameter is 90 cm. It is cited as a lower risk near threatened species by IUCN (2004). Sawdust may cause acute respiratory problems and dermatitis.

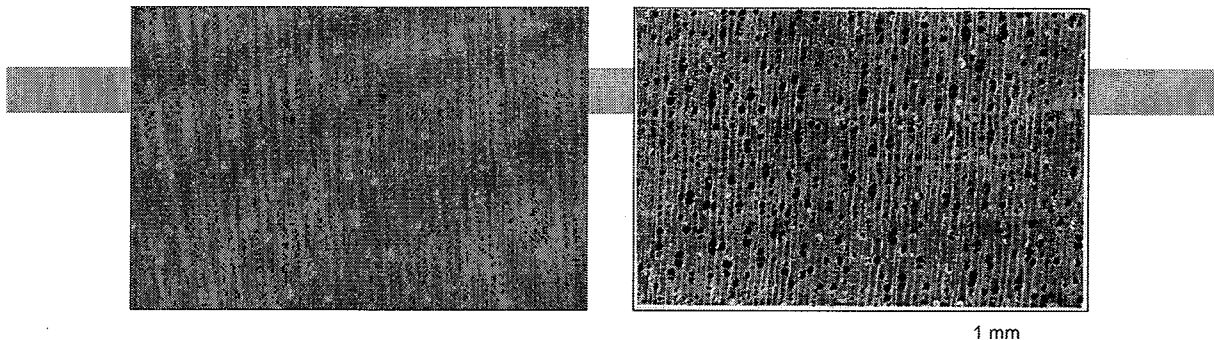
**Tree Features**

**The Tree** is deciduous, up to 40 m high and about 2.5 m in girth with clear 20-metre cylindrical bole with blunt buttresses. **The crown** is narrow with branches more or less whorled and almost horizontal boughs. **The bark** is pale brownish-grey with longitudinal fissures. **The slash** is soft, yellowish and fibrous with brown streaks which change to dark-brown with ripple marks. **The leaves** are simple, 15 – 30 cm long by 7 – 23 cm

broad, obovate, cordate at the base and slightly pointed at the apex. The margin is toothed and wavy and the surface is densely covered with soft stellate hairs. **The flowers** are in panicles, formed from June to August, white, borne at the ends of the shoots on inflorescence 7.5-12.5 cm long and fragrant. **The fruit**, a winged samara, matures from October to January, and hangs in small clusters at the ends of the branchlets, 3-6 cm long and 18 mm across.

**Wood Macroscopic Features**

**Pores** indistinct with the naked eye, barely distinct with hand lens, small, proportion of solitary pores is medium with 2 to 3 radial multiples of same size, moderate distribution, tyloses present. **Axial parenchyma** is barely distinct with hand lens, apotracheal, diffuse and diffuse-in aggregate. Proportion of **fibre tissue** is very low to low. **Ray parenchyma** very narrow to narrow, uniform width between  $\frac{1}{4}$  and  $\frac{1}{2}$  of vessel size, high frequency and storied. Wood is diffuse porous.



### Physical Features

**Heartwood** is yellowish-brown to dark grey-brown with purple tinge fading on exposure. It is clearly demarcated from the white to pinkish-white **sapwood**. Texture is fine, silver figure, low lustre with slight odour. Wood is hard and of **medium density**.

### Splinter Burning Test

**Splinter** burns to exude coloured liquid and forms white ash.

### Ecology and Silviculture

*Mansonia altissima* is a deciduous tree found on fertile soils in dry forest and less swampy ground (Hall & Swaine, 1981). It is tolerant of drought and regenerates well in disturbed forest. Seedlings grow better on fertile soil. Propagation is by seed but can be planted using strips or stumps from young plants. Seed is dispersed by wind and epigeal germination takes about 16 days with a germination rate of 75 % (Taylor, 1960). Growth is not uniform but young trees in logged forest can attain 6 m height in 4 years (Hawthorne, 1993). Regeneration is more abundant in regenerated forest previously destroyed by fire (Hawthorne, 1994). It has great potential as a plantation timber, but it is attacked by pests including leaf skeletonizer and polyphagous larvae defoliators (Foaham, 1990; Wagner *et al.*, 1990).

### Ethnobotany

The bark produces bitter exudate, mansonin, used on arrows as a cardiac poison. The bark decoction is used in enemas for leprosy. The steeped roots in enemas are aphrodisiac (Irvine, 1961). The leaves are used for treating of leprosy (Mshana *et al.*, 2000). Twigs are used as chew sticks (Irvine, 1961).

### Commercial Uses

A **durable wood** used for the following:  
 Panellings, mouldings and claddings  
 Decorative and high quality furniture and cabinet works  
 Floorings, parquets, steps and stairs  
 Sliced and rotary veneer for plywood  
 Tools, turneries and ornaments

***Milicia excelsa* (Welw.) C. C. Berg (including *M. regia* (A. Chev.) C. C. Berg)**

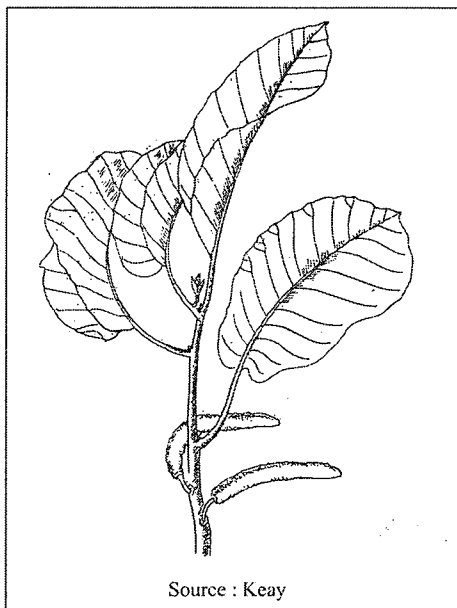
Family Name: **Moraceae**  
 Trade Names: **Iroko; Odum**  
 Local Names: **Odum (Gh); Abang (Ca, Ga); Iroko (CI)**

**Synonyms**

*Chlorophora excelsa* Benth & Hook. f.; *Chlorophora regia* A. Chev. for *M. regia*

**Distribution**

West, Central and East Africa, extending from Guinea Bissau to Mozambique, but *M. regia* appears to be restricted only to West Africa. Moderately found in all the major forest types except the Wet Evergreen forest of Ghana.



Source : Keay

**Status**

A **premium species** of moderate forest availability, very high production with very regular export. The prescribed minimum felling diameter for any of the two species is 110 cm. The two species are not differentiated in timber trade, and are classified as a vulnerable species by IUCN (2004). A special permit for felling in Ghana was instituted in 1998, but not with much success. The sawdust may cause dermatitis and respiratory problems. It is sometimes referred to as African teak.

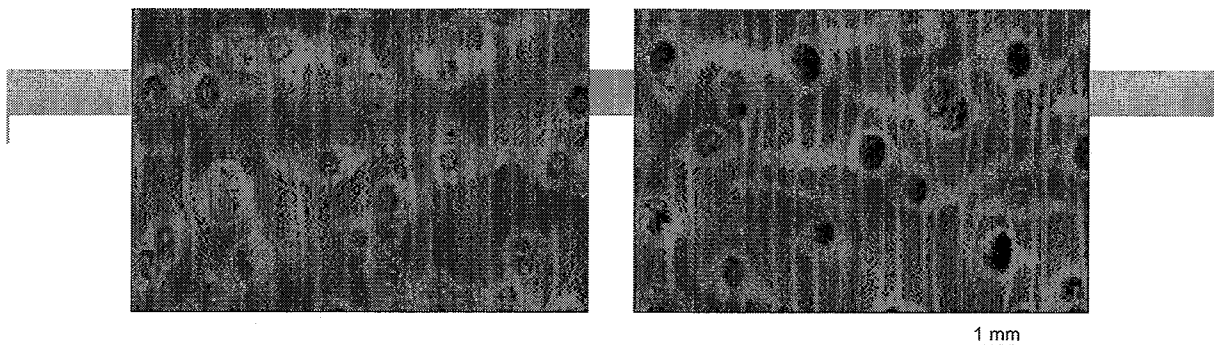
**Tree Features**

**The tree** is up to 50 m high and 5 m in girth with straight cylindrical bole up to 20 m and short blunt buttresses. **The bark** is rough, grey to dark-brown with conspicuous lenticels. **The slash** is thick, gritty and exudes watery latex. **The tree** is dioecious and the male and female flowers are borne on separate trees. The male tree has smaller crown with a flatter top and

nearly vertical boughs; the female tree has a larger rounded crown with a wider branching angle. **The leaves** are simple, 10 – 20 cm long by 5 – 10 cm broad. They are elliptic, shortly acuminate at the tip, unequally cordate or rounded at base and glabrous above. **The flowers** bloom from December to March in single spikes in the axils of young leaves, with white male flowers measuring 20 cm long and the green female flowers 5 cm by 1.5 cm. **The fruits** mature from February to April, green, wrinkled, fleshy, 5 – 7.5 cm long by about 2.5 cm broads, sausage-shaped and resemble fat green caterpillars. The brown **seeds** are very small nuts, 2.5 mm and numerous. The leaves of *M. excelsa* are densely covered with hairs and have more than 10 pairs of lateral nerves, but those of *M. regia* have few hairs and up to 10 pairs of lateral nerves.

**Wood Macroscopic Features**

**Pores** are large to very large, proportion of solitary pores is medium with 2 to 3 radial multiples of same size, distribution low, tyloses present. **Axial parenchyma** is paratracheal,



vasicentric, aliform and confluent with short broad wavy bands. **Fibre tissue** proportion is low to medium. **Ray parenchyma** is narrow, uniform, width  $\frac{1}{4}$  to  $\frac{1}{2}$  vessel diameter, moderate frequency. Wood is diffuse porous.

#### Physical Features

**Heartwood** yellow-brown to dark brown, clearly demarcated from the yellowish white **sapwood**; texture medium to coarse, lustre low. Wood is hard and of **medium density**.

#### Splinter Burning Test

**Splinter** burns to exude coloured liquid and forms white ash.

#### Ecology and Silviculture

*Milicia excelsa* and *M. regia* are deciduous trees, the former noted for its abundance in the forest fire zone whilst the latter is more associated with moist deciduous forests. *Milicia excelsa* does not show any preference for wet or dry forest soils (Swaine & Veenendaal, 1994), and both are fairly common in secondary forests where they show a strong preference for flat but well-drained soil (Taylor, 1960). Propagation is by seed, dispersed by birds and bats (Osmaston, 1965), but stumped and stripped planting are possible (Hawthorne, 1995). Germination is epigeal, light-dependent, and takes 2 to 3 weeks, with a germination rate of about 90 % when seeds are fresh (Taylor, 1960). Seedlings thrive best under light shade, where they are almost free from *Phytolyma lata* gall attack. Seedling development is rapid and young stem coppices readily. Defoliating insects prey on tree shoots and they can strip the bark from the stem (Roberts, 1969; Gardner, 1957). Trees are easily attacked by borers and sap feeders (Wagner *et al.*, 1991; Cobbinah & Wagner, 2000). Saplings have large taproots and a 3-year-old plant attains a height of less than a 1m when it is attacked by gall. Ongoing research at Forestry Research Institute of Ghana shows promise of producing seedlings resistant to *P. lata* (Cobbinah & Wagner, 2000).

#### Ethnobotany

Irving (1961) reports that a bark decoction is used as a drink for treatment of elephantiasis of the scrotum, and infusion of the bark is used as a purgative. The latex is used to induce lactation in nursing mothers and as an antiseptic, and a leaf decoction is taken for treatment of fever. The stem-bark is used to treat cough (Mshana *et al.*, 2000).

#### Commercial Uses

A **durable wood** used for the following:

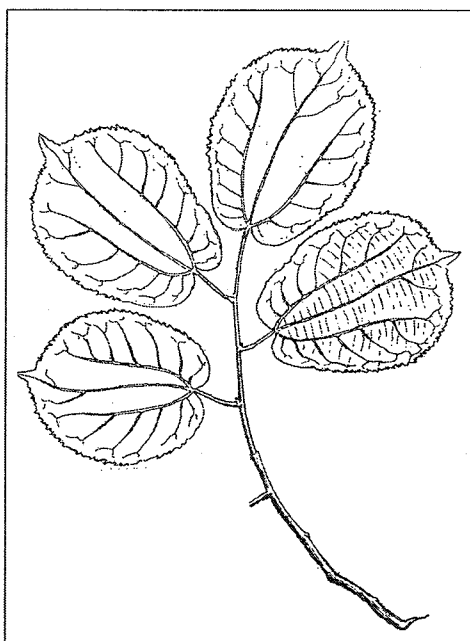
Exterior and interior joinery, frames and doors. Luxury cabinet works and garden furniture. Roof trusses, beams and joists. Floorings, parquets, steps and stairs. Claddings, panellings and mouldings. Decorative veneer and plywood. Vehicle and truck bodies.

***Morus mesozygia* Stapf.**

Family Name: **Moraceae**  
 Trade Names: **Difou; Morus; Wonton**  
 Local Names: **Wonton (Gh); Difou (CI)**

**Distribution**

West and Central Africa, extending from Senegal to Democratic Republic of Congo (Zaire). Rarely found in Ghana in Moist Semi-deciduous (North-West subtype) and Dry Semi-deciduous (Fire zone) forests, and the Savanna woodland.

**Status**

A lesser-used species of rare forest availability, very low production for local use only. The prescribed minimum felling diameter is 90 cm. It is cited by IUCN (2004) as a lower risk near threatened species. The sawdust may cause dermatitis on contact with skin and acute respiratory problems, if inhaled.

**Tree Features**

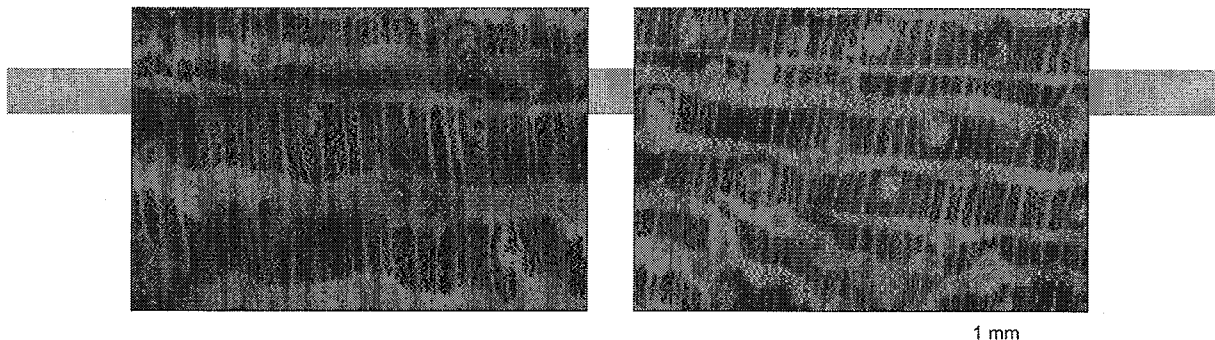
The tree is up to 27 m high and 2.2 m in girth, with a dense rounded crown, deciduous but renewing its leaves very quickly. The **bole** is short, straight and cylindrical without buttresses. The **bark** is slightly fissured, grey with large lenticels in conspicuous corky lines. The **slash** exudes cream latex liquid. The **leaves** are 7–13 cm long by 5–10 cm broad, elliptic, shortly acuminate and cordate. It has small regular forward-pointing

teeth with the midrib and the two side nerves more or less parallel. It **flowers** in January, the male flowers in catkins about 2.5 cm long in leaf-axil; but female flowers form a head about 6 mm across composed of 6 to 8 green flowers. The **green fruits** mature in March, with each enveloped in persistent sepals forming a head about 12 mm across on a stalk about 2.5 cm long.

**Wood Macroscopic Features**

**Pores** medium to large, proportion of solitary pores medium with 2 to 3 short radial multiples of same size, distribution low, tyloses present. **Axial parenchyma** marginal, wide wavy bands, equal to or less than fibre tissue bands, regularly spaced with narrow distance between bands. Proportion of **fibre tissue** is medium. **Ray parenchyma** uniform, narrow, width less than ¼ of vessel diameter, moderate to high frequency, storied. Wood diffuse porous, **growth ring** boundaries demarcated by marginal parenchyma.





### Physical Features

**Heartwood** yellow, mellowing to yellow-brown, clearly demarcated from the pale-grey **sapwood**, texture fine with low lustre. Wood is hard and of **high density**.

### Splinter Burning Test

**Splinter** burns to form white ash.

### Ecology and Silviculture

*Morus mesozygia* is a deciduous tree found in drier forests and commonly planted as a shade and farm boundary tree. The species does not regenerate in secondary forest where competition from shrubs and climbers is too great. It is propagated by seed dispersed by birds. Germination is epigeal and takes about 18 days (Taylor, 1960). Young trees coppice very well (Taylor, 1960). It is a pioneer and strong light demander (Hawthorne, 1993), with saplings in forest gaps attaining a height growth of 2 m in the first year (Taylor, 1969). Regeneration is more common in regenerated forest previously destroyed by fire (Hawthorne, 1994). A brown longhorn beetle breeds on dead and attacks healthy trees (Wagner *et al.*, 1990).

### Ethnobotany

The latex was formerly used as an adulterant for industrial rubber production. The fruits are edible (Abbiw, 1990). The bark extract is used for curing lumbago, asthenia and rheumatic pains (Burkill, 1985), while the juice from young shoots is used as a nasal drug and for treating syphilis (Irvine, 1961).

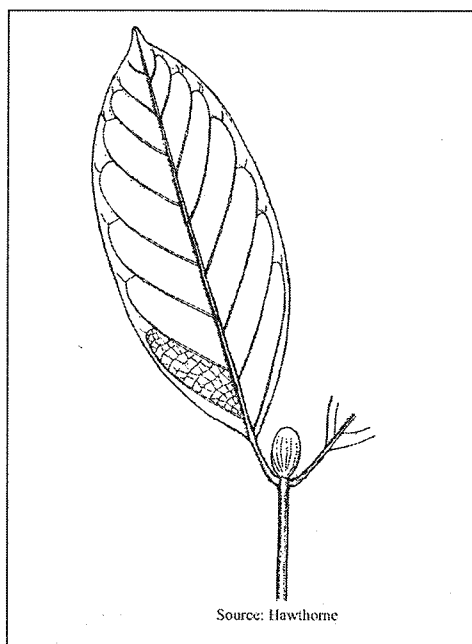
### Commercial Uses

A **moderately durable wood** promoted for the following uses.

- Heavy general construction
- Exterior joinery, frames and trims
- Domestic and industrial floorings, parquets and stairs
- Roof trusses, beams and joists
- Vehicle and truck bodies

***Nauclea diderrichii* (De Wild. & Th. Durand) Merr.**Family Name: **Rubiaceae**Trade Names: **Bilinga; Kusia; Opepe**Local Names: **Kusia (Gh); Bilinga (Ga); Badi (CI)****Synonym***Sarcocephalus trillesii* Pierre**Distribution**

West, Central and East Africa, extending from Sierra Leone to Uganda and south to Mozambique. Sparsely found in Ghana, in Wet Evergreen and Moist Semi-deciduous forests.

**Status**

It is a **commercial species** with sparse forest availability, with high production for regular export. The prescribed minimum felling limit is 110 cm, and is classified by IUCN (2004) as a vulnerable species. A special felling permit has been in place since 1998. The sawdust may cause dermatitis.

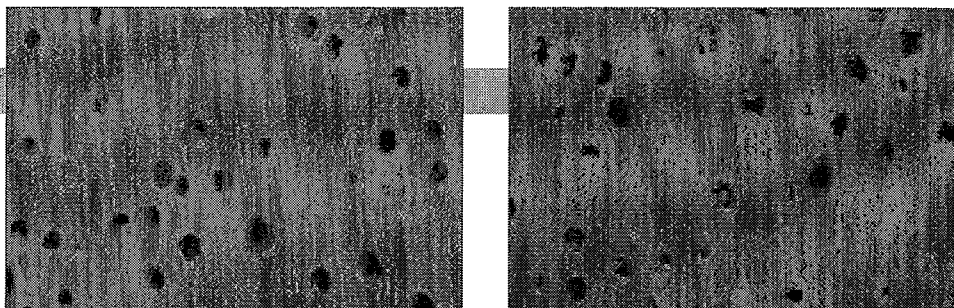
**Tree Features**

**The tree** is up to 40 m high and about 5 m in girth with a rounded crown. **The bole** is cylindrical up to 27 m with low buttresses if present. The bark is brownish-orange and slightly fissured. **The slash** is fibrous and yellowish-brown. **The leaves** are simple, 8 to 15 cm long by 4 – 10 cm broad, elliptic, blunt at the apex, cuneate at the base and with stout stalk measuring up to 2.5 cm long. They are glabrous, with 5 to 8 pairs of prominent upcurving lateral nerves. The stipules are

broadest in the middle. **The flowers** open from May to July and in November. They are yellowish-white, in small globose terminal heads, 1–3 cm with a small corolla. **The berry fruits** mature from May to June, and from November to January. They are orange, each 18–35 mm in diameter; the surface covered with circular pits about 2.5 – 5 mm across with numerous small and light-brown seeds.

**Wood Macroscopic Features**

**Pores** medium and large, exclusively solitary, distribution low with inclusions. **Axial parenchyma** indistinct to naked eye, apotracheal, diffuse. Proportion of **fibre tissue** is medium. **Ray parenchyma** narrow, uniform width, between  $\frac{1}{4}$  and  $\frac{1}{2}$  of vessel diameter, high to very high frequency. Wood diffuse porous, **growth ring** boundaries demarcated by dark ground fibre tissue and absence of pores.



1 mm

### Physical Features

**Heartwood** is yellow to orange-yellow, clearly demarcated from white to pale-yellow **sapwood**. Texture is moderately coarse, lustrous, sometimes with ribbon figure.

Wood is hard and of **medium density**.

### Splinter Burning Test

**Splinter** burns to produce crackle or bright sparks, exudes coloured liquid compounds and forms charcoal.

### Ecology and Silviculture

*Nauclea diderrichii* is an evergreen tree that occurs in low density with slight preference for well- drained light soils and disturbed areas. The species, a pioneer and a strong light demander, grows vigorously where sufficient overhead light is available. Propagation is by seed, dispersed by animals especially elephants (Taylor, 1960; Gyimah 1986), but stumped planting is equally possible. Seed is usually dormant (Keay, 1960; Hall & Swaine, 1980), but viable seeds germinate in light within 14 days, being epigeal with high seed mortality (Taylor, 1960). A height growth of 12 m and a dbh of 10 cm in 4 years have been recorded (Hawthorne, 1993). It is widely use in taungya plantation with a rotation period of 30 to 40 years (Neil, 1983). Seedlings are susceptible to attack by shoot borer (Taylor, 1960) that establishes permanently on living trees (Wagner *et al.*, 1980).

### Ethnobotany

The fruits are edible and are eaten in times of food scarcity (Abbiw, 1990). The bark decoction serves as a remedy for gonorrhoea and is drunk for stomach pains (Irvine, 1961). The leaf decoction is used to treat diarrhoea and fever (Irvie, 1961). The alkaloid in the wood is poisonous (Burkill, 1985). The leaves and bark are used for treating jaundice (Burkill, 1985); the bark for treatment of pains, and the root for anaemia (Mshana *et al.*, 2000).

### Commercial Uses

A **very durable wood** used for the following:

- Bridges, sleepers, piles, sea defence and pilings
- Boat construction
- Floorings, steps and stairs
- Panellings, claddings and mouldings
- Exterior structures, beams and joists
- Furniture and luxury cabinet works
- Vehicle and truck bodies

## ***Nesogordonia papaverifera* (A. Chev.) R. Capuron**

Family Name: **Sterculiaceae**

Trade Names: **Danta; Kotibé**

Local Names: **Danta (Gh); Kotibé (CI); Owoe (Ca)**

### **Distribution**

West and Central Africa, extending from Sierra Leone to Gabon and Central African Republic. It is frequently found in Ghana in all forest types except the Wet Evergreen.



### **Status**

It is a **commercial species** of frequent forest availability, moderate production for regular export. The prescribed minimum felling diameter is 70 cm. It is cited by IUCN (2004) as a vulnerable species.

### **Tree Features**

**The tree** is up to 30 m high and 3 m in girth, a straight bole up to 20 m long with narrow sharp buttresses. **The bark** is grey, flaking off to expose dark-brown patches. **The slash** is soft-fibrous, pink or brown, becoming darker with ripple marks. **The crown** is small, rounded and dense. **The leaves** are simple, 4-12 cm long and 3-7 cm broad, elliptic and rounded, obtuse or cuneate at base and acuminate at the tip. The leaf in mature foliage has entire margin, but in the seedling stage it is toothed. The flowers bloom from November to December, yellowish-white, fragrant, few

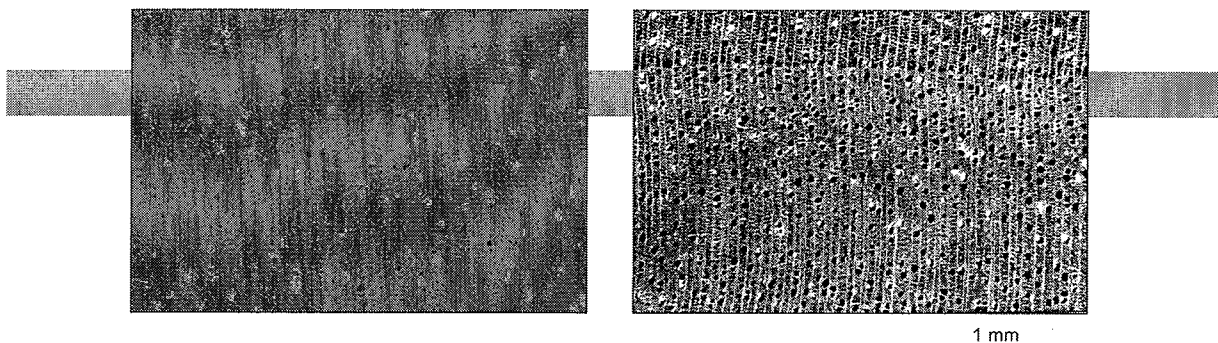
and in slender axillary cymes. The woody **capsular fruits** mature either in February or July, or from October to December. Each fruit is shaped like a small 5-angled bell, 2.5 cm long, splits open to release 2-winged seeds about 1.5 cm long from each of the 5 cells.

### **Wood Macroscopic Features**

**Pores** indistinct to the naked eye, small, proportion of solitary pores high, with 2 to 3 radial multiples of same size, moderate to high distribution. **Axial parenchyma** is indistinct to the naked eye, apotracheal, diffuse and diffuse-in-aggregate. Proportion of **fibre tissue** is medium. **Ray parenchyma** indistinct to the naked eye, very narrow, uniform width between  $\frac{1}{4}$  and  $\frac{1}{2}$  of vessel diameter, high frequency and storied. Wood diffuse porous, **growth rings** demarcated by dark ground fibre tissue.

### **Physical Features**

**Heartwood** red-brown, clearly demarcated from the pale **sapwood**. Texture is fine with low lustre. Wood is hard and of **medium density**.



### Splinter Burning Test

**Splinter** burns to produce crackle or bright sparks and forms white ash.

### Ecology and Silviculture

*Nesogordonia papaverifera* is an evergreen tree common on base-rich soils (Hall & Swaine, 1981). It is propagated by seed dispersed by wind. Germination is epigeal and takes 11 to 26 days with a germination rate of about 75 % (Taylor, 1960). Stripped and stumped plants can also be used for propagation (Taylor, 1960). It tolerates dense shade in the seedling and sapling stage. Saplings can reach 1 to 1.5 m height in 4 years in tropical shelterwood plots. Saplings are less common in regenerated forest previously destroyed by fire (Hawthorne, 1994). The larvae of *Anomis leona*, a polyphagous defoliator, attack tree foliage (Wagner *et al.*, 1991).

### Ethnobotany

The twig is used as a chewing stick (Abbiw, 1990) while the root is used for general medicine (Irvine, 1961; Burkill, 1985).

### Commercial Uses

A **moderately durable wood** used for the following:

- Decorative furniture and luxury cabinet works and bench tops
- Floorings, parquets, steps and stairs
- Panellings, claddings and mouldings
- Quality joinery, frames and trims
- Tools, turneries and ornaments
- Decorative veneer and plywood
- Vehicle and truck bodies

Family Name: **Olivaceae**

Recommended Trade Name: **Octoknema, Wisuboni**

Local Name: **Wisuboni (Gh)**

#### **Distribution**

West Africa, restricted from Guinea to Ghana only. Moderately found in Ghana in Wet and Moist Evergreen and Moist Semi-deciduous (South-East subtype) forests.



#### **Status**

It is a **lesser-known** species of moderate forest availability yet to be exploited. It has no prescribed minimum felling diameter and 50 cm is recommended. It is cited by IUCN (2004) as a lower risk least concern species.

#### **Tree Features**

**The tree** is up to 30 m high and 2 m in girth with straight long bole and low buttresses. **The bark** is pale, flaky and pitted with ridges. **The slash** has a sweet fruity taste. **The crown** is dense and has a subdued metallic reddish hue. The leaves are simple, 20 cm long and 6-8 cm broad with 6 to 9 pairs of lateral nerves. The small **yellowish-green flowers** with stellate hairs formed in February are dioecious. They are in crowded axillary racemes over 6 cm long. The fruits, each less than 2 cm long, are sub-globose with broad persistent calyx-lobes containing small seeds.

#### **Wood Macroscopic Features**

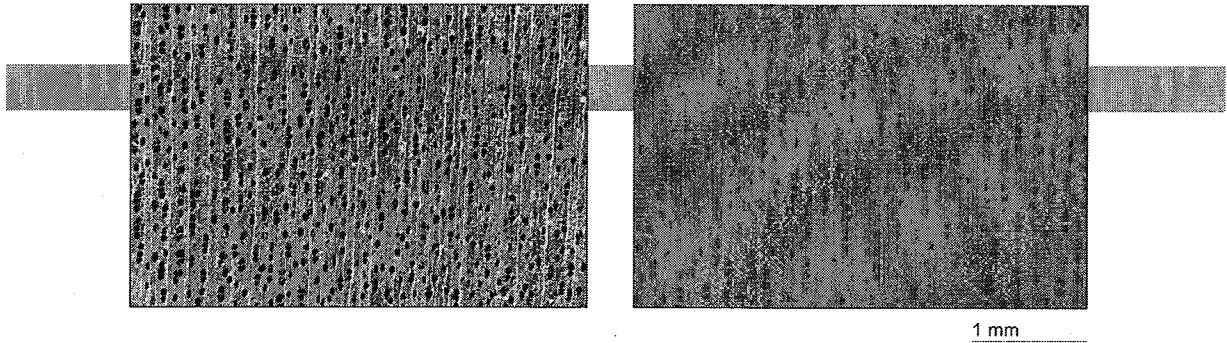
**Pores** indistinct to the naked eye, small, proportion of solitary pores low with 2 to 4 radial multiples of same size, high to very high distribution. **Axial parenchyma** is not distinct even with hand lens. Proportion of **fibre tissue** is medium. **Ray parenchyma** is indistinct to naked eye, very narrow, uniform width,  $\frac{1}{4}$  to  $\frac{1}{2}$  of vessel diameter, high frequency. Wood is diffuse porous.

#### **Physical Features**

**Heartwood** yellow to pale-brown, not differentiated from **sapwood** with fine texture and unpleasant smell. Wood is fairly hard and of **medium density**.

#### **Splinter Burning Test**

**Splinter** burns to exude coloured liquid and forms grey ash.



### **Ecology and Silviculture**

*Octoknema borealis* is most common in moist forest slopes and regenerates in shade (Hall & Swaine, 1981; Hawthorne, 1995).

### **Ethnobotany**

The ground bark is rubbed on the skin as a remedy for fever (Abbiw, 1990; Burkill, 1985).

### **Recommended Commercial Uses**

A **durable wood** promoted for the following uses:

Poles, posts and stakes

Frames, claddings and panellings

## Ongokea gore (Hua) Pierre

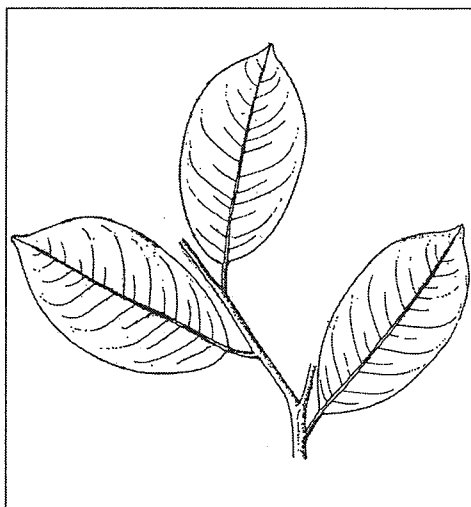
Family Name: **Olacaceae**  
 Trade Names: **Ongokea; Angeuk**  
 Local Names: **Bodwe (Gh); Angeuk (Ga); Kouero (CI)**

### Distribution

West and Central Africa, extending from Sierra Leone to Angola. Sparsely found in Ghana scattered in Semi-deciduous forest.

### Status

A **lesser-used species** with sparse forest availability, insignificant production with occasional export. It has no prescribed minimum felling diameter and 50 cm is recommended. It is classified by IUCN (2004) as a lower risk least concern species.



### Tree Features

The tree is up to 40 m high and 2.0 m in girth with straight cylindrical bole and no buttresses. The **dark-green bark** is about 2 cm thick. The **slash** is yellow-brown, soft and granular. The **crown** is medium, rounded and fairly dense with pale-green foliage. The **leaves** are simple, green and shiny, about 6 cm long and 3 cm broad. They are elliptic, alternately arranged, and acuminate at the tip with slightly cuneate base. The **flowers** are small, almost inconspicuous, dumb-bell shaped, white and in profuse panicles, opening from May to June. The fruits are depressed, globose yellow drupes with persistent and enlarged calyx, 5 cm in diameter with an offensive odour, splitting into 3 to 4 lobes. The **seeds** are very small nuts, spherical with bitter taste and are edible.

### Wood Macroscopic Features

**Pores** large, exclusively solitary, low to moderate distribution, diagonally arranged with tyloses. **Axial parenchyma** apotracheal, diffuse and in diagonal or tangential bands. **Fibre tissue** proportion is low. **Ray parenchyma** is indistinct to the naked eye, very narrow, width less than  $\frac{1}{4}$  of vessel diameter, high frequency. Wood is diffuse porous, and **growth ring** boundaries are demarcated by dark ground fibre tissue and absence of pores.

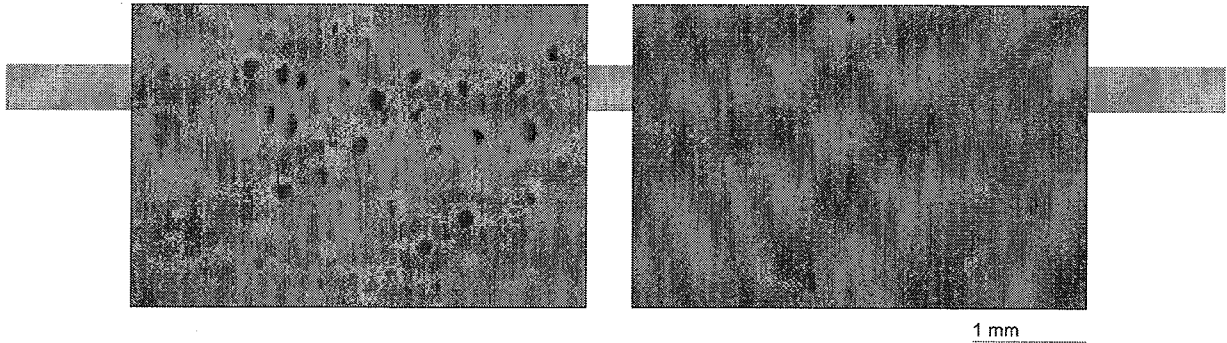
### Physical Features

**Heartwood** is pale-yellow, not clearly demarcated from **sapwood**; texture is moderately coarse with low lustre. Wood is hard and of **high density**.

### Splinter Burning Test

**Splinter** burns to exude coloured liquid and forms grey ash.





### Ecology and Silviculture

*Ongokea gore* is an evergreen tree propagated by seed dispersed by larger mammals (Taylor, 1960). Germination in shade starts after 6 weeks and may last up to 1 year. Seedlings and saplings require light to grow.

### Ethnobotany

The fruits are edible (Abbiw, 1990). The seed oil is used in soap manufacture (Burkill, 1985). The oil is also used as a lubricant for anointing the body; the bark infusion is a remedy for constipation in young infants, either in enemas or as a drink (Irvine, 1961). The styptic sap is used to stop bleeding (Mshana *et al.*, 2000; Burkill, 1985).

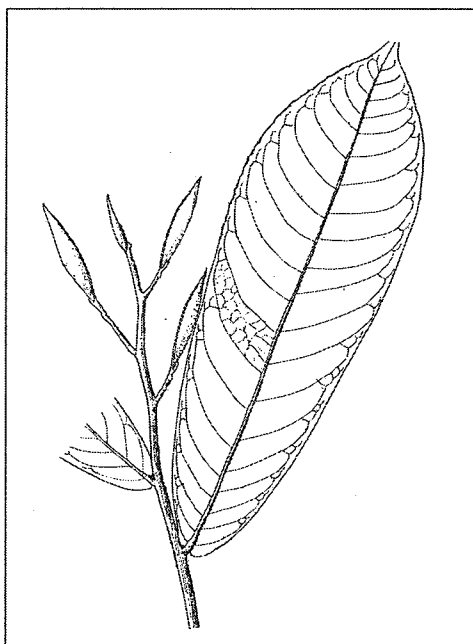
### Commercial Uses

A **durable wood** used for the following:

- Exterior joinery, frames and trims
- Industrial beams, joists and roof trusses
- Industrial floorings, steps and stairs
- Bridges, sleepers and pilings
- Vehicle and truck bodies

***Pachypodanthium staudtii* (Engl. & Diels) Engl.**Family Name: **Annonaceae**Recommended Trade Names: **Pachypo; Kumdwie**Local Names: **Kumdwie (Gh); Ntom (Ca)****Synonym***Uvaria staudtii* Engl. & Diels**Distribution**

West and Central Africa, extending from Sierra Leone to Cameroon and Democratic Republic of Congo (Zaire). Frequently found in Ghana in Moist Evergreen and Moist Semi-deciduous forests.

**Status**

It is a **lesser-known** species of moderate forest availability recommended for promotion in local market. It has no prescribed minimum felling diameter and 50 cm is recommended. It is classified by IUCN (2004) as a lower risk least concern species.

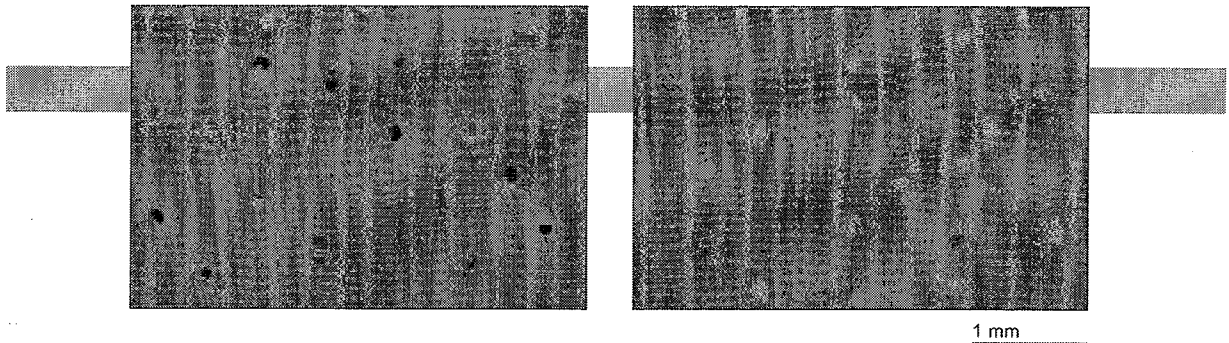
**Tree Features**

**The tree** is medium, up to 30 m high and about 2 m in girth, with a clear large cylindrical bole and no buttresses. **The bark** is thick and smooth with a pungent smell. **The slash** is yellowish-white turning brown. **The crown** is narrow with horizontal branches. **The leaves** are simple, oblong-lanceolate, shortly tapered at each end, up to 24 cm long and 6 cm broad. **The margin** is entire and wavy with 10 to 15 lateral nerves, lower surface slightly glaucous. The flowers are formed from February to May, pale-

yellow and borne on very short stalks. **Each fruit** is about 5 cm in diameter, consists of numerous carpels and matures in July. They are loosely united at the base, red and fleshy when ripe, with one red pubescent seed.

**Wood Macroscopic Features**

**Pores** small, predominantly solitary, distribution low with inclusions. **Axial parenchyma** scalariform, very narrow straight bands, equal to or smaller than fibre tissue bands, regularly spaced with narrow distance between bands. Proportion of **fibre tissue** is low. **Ray parenchyma** of variable size, very narrow and wide,  $\frac{1}{2}$  size of vessel diameter or equal to vessel diameter, moderate frequency. Wood diffuse porous, **growth ring** boundaries demarcated by dark ground fibre tissue and absence of pores.



### Physical Features

**Heartwood** red-brown or yellow-brown with occasional olive tinge and stripes, not clearly demarcated from **sapwood**; texture is fine.

Wood is hard and of **medium density**.

### Splinter Burning Test

**Splinter** burns to form grey ash and exudes coloured liquid.

### Ecology and Silviculture

*Pachypodanthium staudtii* is an evergreen tree, prefers well-drained moist and swampy soil and is absent from dry forest. It is a non-pioneer light demander that tolerates medium shade in early growth. Mode of propagation is by seed and germination in shade is epigeal (Taylor, 1960). It regenerates in shade and tolerates medium shade in early growth (Hall & Swaine, 1981). It is more common in regenerated forest previously destroyed by fire (Hawthorne, 1994).

### Ethnobotany

The bark is chewed with cola nuts for gastro-intestinal pains. The bark decoction is used as an insecticide for killing headlice and as a vermifuge (Irvine, 1961).

### Recommended Commercial Uses

A **moderately durable wood** promoted for the following uses:

Handicrafts, artifacts and carvings

Poles, stakes and posts

Domestic floorings, steps and stairs

Common furniture and cabinet works

***Parinari excelsa* Sabine**

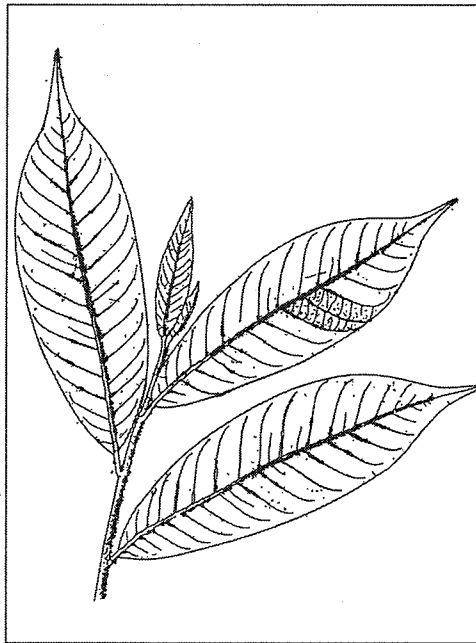
Family Name: **Chrysobalanaceae**

Recommended Trade Names: **African Greenheart; Sougué, Afam**

Local Names: **Afam (Gh); Sougué (CI); Mubura (Ug)**

**Distribution**

West, Central and East Africa, extending from Senegal and Guinea to Tanzania and Uganda. Sparsely found in Ghana scattered in Wet and Moist Evergreen and Moist Semi-deciduous forests.

**Status**

A lesser-known species of sparse forest availability, very low production for local use only. The prescribed minimum felling diameter is 90 cm. It is cited by IUCN (2004) as a lower risk least concern species.

**Tree Features**

The tree is up to 50 m high and 4 m in girth, with widely spreading branches and big rounded crown. The bole is cylindrical, slightly buttressed with a tendency to fluting with a rough bark. The slash is thick, dark-red and smells like rotten sugar. The branchlets are purplish with numerous white lenticels. The leaves are simple, 5 – 13 cm long by 2.5 – 5 cm broad. They are glabrous, elliptic, acuminate at the apex and cuneate at the base. They are dark-green above with conspicuous golden-brown felt beneath. The dirty-white flowers are formed from January to May and from

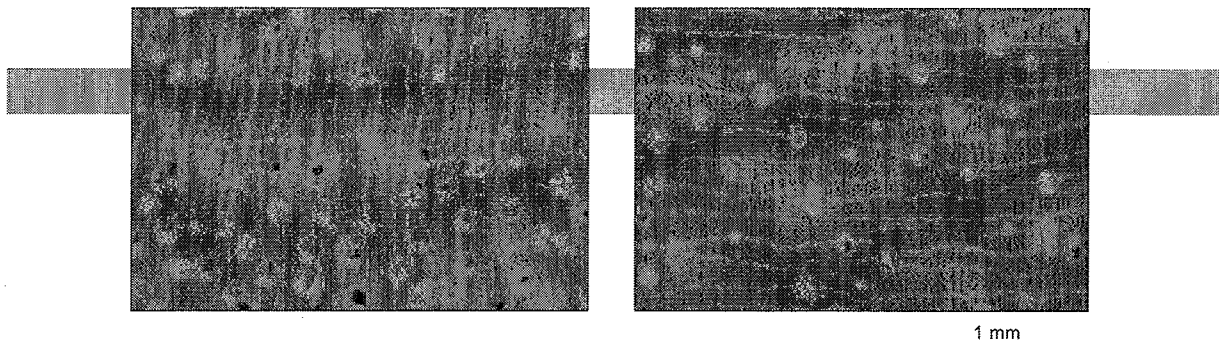
October to November. They are mostly in panicles and the inflorescence is densely hairy. The brown fruits, each 5 cm by 3 cm, mature from November to December and in March. They are ellipsoid, with a yellowish edible pulp containing one large seed per fruit.

**Wood Macroscopic Features**

Pores large to very large, exclusively solitary, distribution low. Axial parenchyma is straight to wavy narrow bands, smaller than fibre tissue bands, regularly spaced with narrow distance between bands. Fibre tissue proportion is medium. Ray parenchyma is indistinct to the naked eye, very narrow, uniform width less than ¼ of vessel diameter, very high frequency. Wood is diffuse porous.

**Physical Features**

Heartwood pale-red, chocolate-brown or greenish-grey, not clearly demarcated from yellow-white sapwood, moderately coarse with low lustre, pleasant smell when fresh. Wood is hard and of high density.



### **Splinter Burning Test**

**Splinter** burns to form grey ash.

### **Ecology and Silviculture**

*Parinari excelsa* prefers moist alluvial soil of evergreen forest near river banks. It also occurs gregariously at high elevations between 1000 and 2000 m, and does not occur in secondary forest. It is propagated by seed dispersed by elephants (Lieberman *et al.*, 1987). Germination in shade is hypogeal with a germination rate of about 70 % (Taylor, 1960). All sizes of the tree are less common in forests previously destroyed by fire (Hawthorne, 1994).

### **Ethnobotany**

The fruits and seed oil are edible (Abbiw, 1990). The ashes of the bark and wood are used for tanning, the fruits used in dyeing industry, and the macerated bark is applied on circumcision wounds (Irvine, 1961) and for blood disorders (Burkill, 1985). The fruit is drunk to treat diarrhoea and dysentery (Mshana *et al.*, 2000).

### **Recommended Commercial Uses**

A **moderately durable wood** promoted for the following uses:

- Bridges, sleepers, piers and piles
- Industrial floorings and parquets
- Steps and stairs
- Boat construction
- Vehicle and wagon bodies

***Parkia bicolor* A. Chev.**

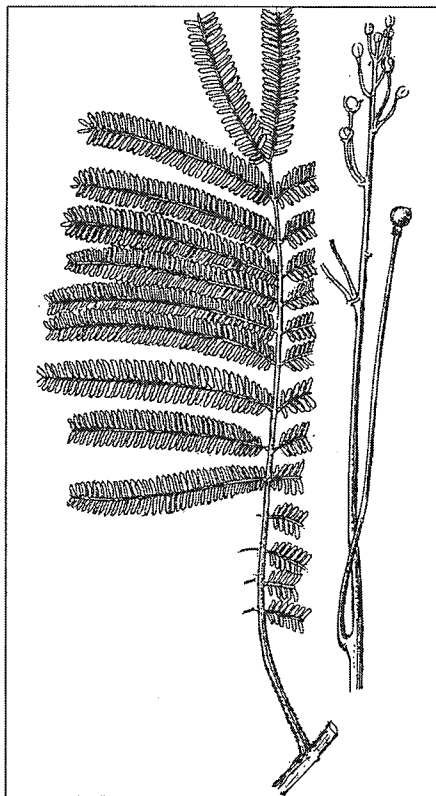
Family Name: **Mimosaceae**

Recommended Trade Names: **Parkia, Essang**

Local Names: **Asoma** (Gh); **Essang** (Ca); **Lo** (Cl)

**Distribution**

West and Central Africa, extending from Guinea to Democratic Republic of Congo (Zaire). Moderately found in Ghana in Wet and Moist Evergreen and Moist Semi-deciduous forests.

**Status**

A **lesser-known species** of moderate forest availability, very low production for local use only. The minimum felling diameter is 70 cm. It is classified by IUCN (2004) as a lower risk least concern species.

**Tree Features**

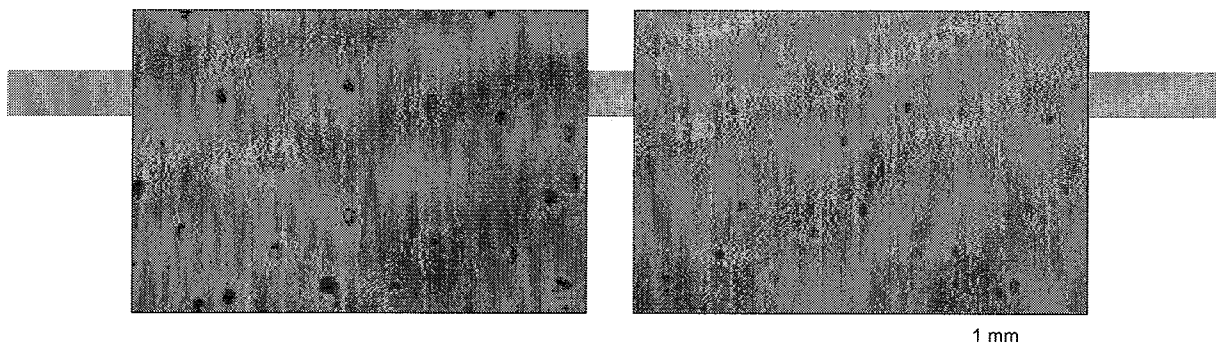
**The tree** is up to 32 m high and 3.7 m in girth with a wide rather flat crown. **The bole** is usually crooked with widely spreading branches and well-developed thin buttresses. **The bark** is light-brown to dark reddish-brown, smooth and flaking off in thin patches. **The slash** is dirty-yellow with dark-red streaks with sticky orange exudate. **The leaves** are bi-pinnate with a minutely hairy common stalk 30 – 45 cm long. The 10 to 26 pairs of slender pinnae are 7.5 – 15 cm long. The pinnae are mostly opposite or sub-opposite with 20 to 50 pairs of leaflets. **The flowers** are formed with new leaves from November to February. They are pink, bluish-red or reddish-yellow and in heads measuring about 4 cm across. **The fruits** mature from March to April, each 25-40 cm long by 18-32 mm broad with up to 20 seeds in a pod.

**Wood Macroscopic Features**

**Pores** medium, exclusively solitary, distribution low, inclusions present. **Axial parenchyma** is paratracheal, aliform and confluent, narrow straight regular bands, smaller than fibre tissue bands. Proportion of **fibre tissue** is low. **Ray parenchyma** is indistinct to the naked eye, very narrow, uniform, less than ¼ of vessel diameter, high frequency. Wood diffuse porous, **growth ring** boundaries demarcated by dark ground fibre tissue and absence of pores.

**Physical Features**

**Heartwood** is brown or pale-brown, not clearly demarcated from yellow **sapwood**. Texture is coarse, lustrous with foetic odour. Wood is fairly hard and of **medium density**.



### **Splinter Burning Test**

**Splinter** burns to form black ash.

### **Ecology and Silviculture**

Mature trees of *Parkia bicolor* are found in a wide variety of forest sites but prefer wet areas like river banks and swamps. The species is only briefly deciduous, and the crown is never completely bare. Propagation is by seed dispersed by mammals, and epigeal germination in shade takes about 18 days with about 40 % germination rate (Taylor, 1960). It tolerates moderate shade in early growth, but it is essentially a light demander (Hawthorne, 1995). Seedling growth is very rapid, about 1 m in the 1st year (Taylor, 1960). All sizes of trees are less common in forests previously destroyed by fire (Hawthorne, 1995). The dry fruit and the bark of felled trees are easily attacked by insects (Wagner *et al.*, 1991).

### **Ethnobotany**

The pulp is edible and is also relished by monkeys (Abbiw, 1990). The edible seeds are used for thickening soup and are usually sold in the market in northern Ghana (Abbiw, 1990). The macerated bark and leaves are used as eye lotion, and the dried pulverised bark applied to wounds (Irvine, 1961; Mshana *et al.*, 2000).

### **Recommended Commercial Uses**

A **non-durable wood** promoted for the following uses:

- Interior joinery, frames and trims
- Common furniture and cabinet works
- Boxes, crates, fruits and packing cases
- Rotary veneer and plywood
- Boats and canoe building
- Light construction

***Pentaclethra macrophylla* Benth.**

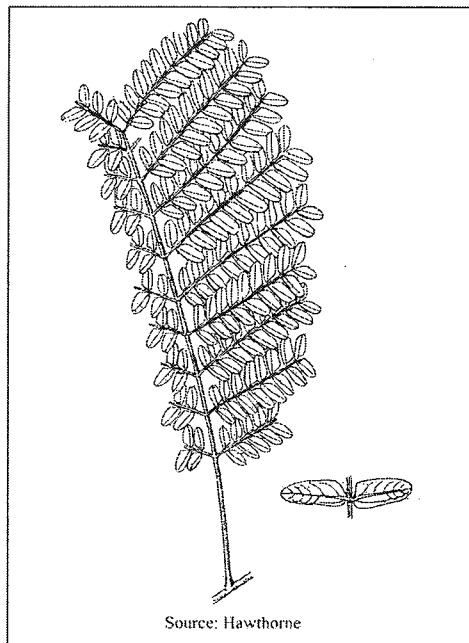
Family Name: **Mimosaceae**

Recommended Trade Names: **Pentaclethra, Ataa**

Local Names: **Ataa** (Gh); **Mubala** (Ca); **Ovala** (CI)

#### Distribution

West and Central Africa, extending from Senegal to Angola. Moderately found in Ghana in Wet and Moist Evergreen, and Moist Semi-deciduous forests.



#### Status

A **lesser-known species** of moderate forest occurrence yet to be exploited. No prescribed minimum felling limit and 110 cm is recommended. It is cited by IUCN (2004) as a lower risk least concern species.

#### Tree Features

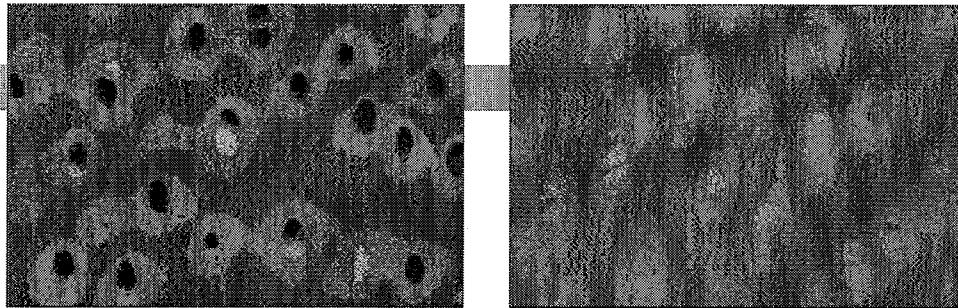
**The tree** is up to 20 m high and 5 m in girth with low branching to form spreading crown. **The bole**, 6 m in length, is crooked, fluted or with low-wide buttresses. **The bark** is thin, scaly greyish flakes with yellow pits and vertical lines of lenticels. **The slash** is thick, fibrous and reddish-orange. **The leaves** are bipinnate with a common stalk 20 – 45 cm long. There are 10 to 12 pairs of stout opposite pinnae, 12 to 15 pairs of opposite stalkless leaflets, 12 – 25 mm long by 5 – 10 mm broad. **The flowers** are creamy-yellow or pinkish-white and sweet-smelling, blooming from

March to April, and June and November. They are crowded in narrow spikes, 7 – 20 cm long and arranged in panicles on the older tree. **The large fruits** mature in most seasons of the year and are very persistent, each measuring 35 – 45 cm long by 5 – 10 cm broad. They are black, very hard and woody, each containing about 8 to 12 flat glossy brown **edible seeds** measuring up to 7 cm long.

#### Wood Macroscopic Features

**Pores** large to very large, proportion of solitary pores medium to high with 2 to 3 radial multiples of same size, few clusters, low to moderate distribution, inclusions present. **Axial parenchyma** is paratracheal, aliform, confluent, marginal, occasionally wavy-banded, equal to fibre tissue bands with uniform distance between bands. **Ray parenchyma** is indistinct, very narrow, less than  $\frac{1}{4}$  of vessel diameter, distribution high, frequently storied. Proportion of **fibre tissue** is medium. Wood is diffuse porous, **growth rings** demarcated by marginal parenchyma and absence of pores.





1 mm

### Physical Features

**Heartwood** is red-brown to brown, demarcated from white-yellow **sapwood**; texture moderately coarse and lustrous. Wood is hard and of **high density**.

### Splinter Burning Test

**Splinter** burns to exude coloured liquid and forms charcoal.

### Ecology and Silviculture

*Pentaclethra macrophylla* has widespread distribution but it is absent from dry forest and shows preference for wetter sites, near streams and river banks. The tree is evergreen and is frequently seen on roadsides and in farms. It is propagated by seed, dispersed by wind after the fruit has exploded to release the seeds. Germination is hypogeal, takes 14 to 16 days with about 90 % germination rate (Taylor, 1960). Seedlings grow better in partial shade and not in full gaps (Hawthorne, 1995). Regeneration is more abundant in forest previously destroyed by fire (Hawthorne, 1994).

### Ethnobotany

The seeds are eaten after roasting and the seed oil is suitable for making soap, candle and lubricant, but not for cooking (Abbiw, 1990; Burkill, 1985). It is a good fuel wood for charcoal (Abbiw, 1990). The ashes from burned pods are used as cooking salt and in the dye industry. The bark and seeds serve as fish poison and as ingredients in preparing arrow poison (Irvine, 1961).

### Recommended Commercial Uses

A **moderately durable wood** promoted for the following uses:

- Poles, posts and stakes
- Industrial structures, trusses, beams and joists
- Exterior joinery frames and trims
- Sporting goods, tools and handles
- Vehicle and truck bodies
- Sleepers and crossties

***Pericopsis elata* (Harms) van Meeuwen**

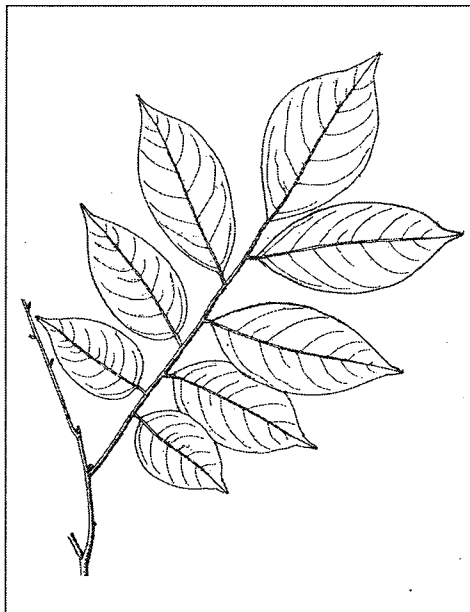
Family Name: **Papilionaceae**  
 Trade Names: **Afrormosia, Kokrodua**  
 Local Names: **Kokrodua; Asamela (CI)**

**Synonym**

*Afrormosia elata* Harms.

**Distribution**

West and Central Africa, extending from Côte d'Ivoire to Democratic Republic of Congo (Zaire). Rarely available in Ghana, restricted to Moist Semi-deciduous (North-West subtype) and Dry Semi-deciduous forests.

**Status**

A **premium species** of rare forest availability, very low production and irregular export. The prescribed minimum felling diameter is 110 cm. It is one of two species classified by IUCN (2004) as an endangered species. A special permit for felling was instituted in 1998 with limited success. The sawdust may cause respiratory problems in humans if inhaled and can cause dermatitis on contact with skin. First shipped to U.K. in 1948 and used as a substitute for teak (Irvine, 1961).

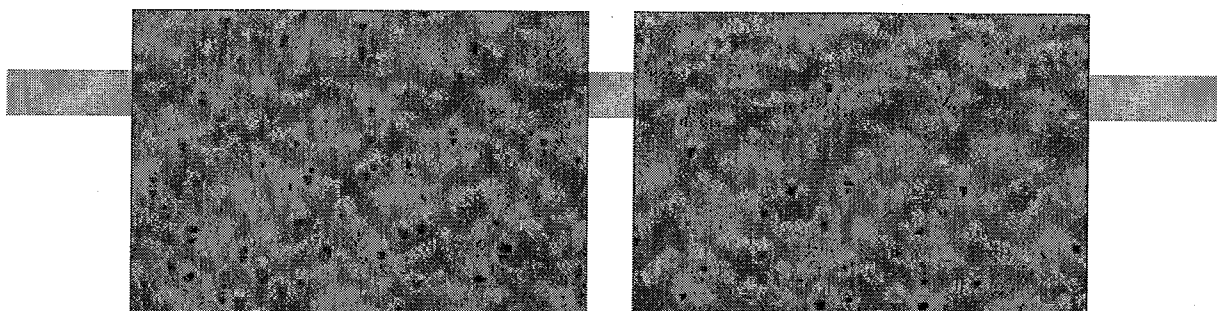
**Tree Features**

**The tree** is up to 45 m high and 2 m in girth. It has massive spreading branches and a flat-topped triangular crown. **The bole** is straight up to 30 m with low blunt buttresses up to 2.5 m high. **The bark** is smooth, greyish and

flakes off to show the reddish-brown inner bark. **The slash** is bright-green, turning reddish-brown. **The leaves** are pinnate with a common stalk grooved along the upper surface, 7-15 cm long with about 9 alternate leaflets, 6-9 cm long by 2.5-3.5 cm broad. They are glabrous, elliptic to ovate-elliptic, thin with 5 to 10 pairs of lateral nerves. The white to cream-greenish flowers are about 2 cm broad and are formed in April, appearing with the new leaves at the ends of the shoots. **The fruits** mature in December; they are elongated, flat, with brown pods pointed at each end, 7-15 cm long by 2.5-3 cm broad. **Each fruit** contains 1 to 3 flat reddish-brown seeds, 1 cm in diameter.

**Wood Macroscopic Features**

**Pores** small, proportion of solitary pores medium, with 2 to 3 radial multiples of same size, diagonal pattern, moderate to very high distribution, inclusions present. **Axial parenchyma** paratracheal, vasicentric, aliform, confluent, regularly spaced narrow wavy bands, less or equal to **fibre tissue** bands, narrow distance between bands, occasionally marginal. Proportion



1 mm

**Ray parenchyma** is indistinct at transverse, distinct at radial, very narrow width less than  $\frac{1}{4}$  of vessel diameter, high frequency and storied. Wood diffuse porous, **growth ring** boundaries demarcated by dark ground fibre tissue and absence of pores (and occasionally by marginal parenchyma).

### Physical Features

**Heartwood** is yellow-brown, darkens on exposure with dark veins, clearly demarcated from the pale-brown **sapwood**. Quarter-sawn surface is streaked dark and mottled. Texture is fine with low lustre and light aromatic odour.

Wood is hard and of **medium density**.

### Splinter Burning Test

**Splinter** burns to exude coloured liquid and forms white ash.

### Ecology and Silviculture

**Pericopsis elata** is tolerant of drought, but is common in swampy and flat areas where it tends to be gregarious. It is propagated by seed dispersed by wind. Germination is epigeal, takes about 8 days with a rate of about 80 % when planted in shade but 5 % when in full sunlight (Taylor, 1960). It tolerates overhead shade in the seedling stage and in early growth (Hawthorne, 1995). Seedlings are also drought-resistant with no preference for fertile or infertile soils (Swaine & Veenendal, 1994). Growth is slow in the early stages and can attain 26 m in 16 years (Howland, 1979). Regeneration is low but more abundant in forest previously damaged by fire (Hawthorne, 1994). *Lamprosema lateritialis* is a serious insect defoliator that builds its nests on the leaves and feeds on the seeds (Wagner *et al.*, 1991).

### Ethnobotany

N/A

### Commercial Uses

A **durable wood** used for the following:

Decorative furniture and luxury cabinet works

Exterior quality joinery, frames and trims

Panellings, claddings and mouldings

Decorative veneer and plywood

It is used as substitute for teak

## **Petersianthus macrocarpus (P. Beauv.) Liben**

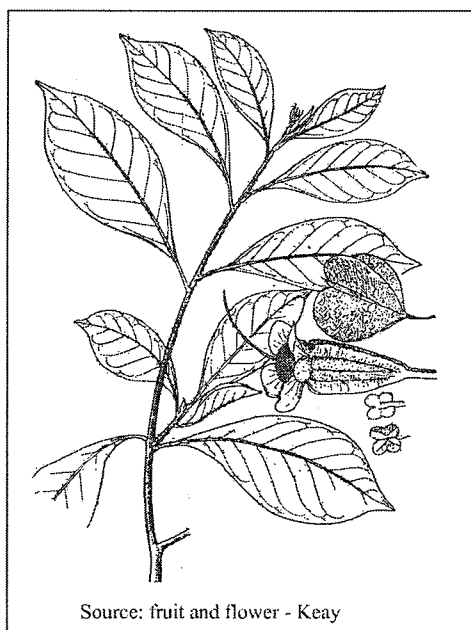
Family Name: **Lecythidaceae**  
 Trade Names: **Petersianthus; Esia**  
 Local Names: **Esia** (Gh); **Abing** (Ca, Ga); **Abale** (CI)

### **Synonyms**

*Combretodendron macrocarpum* (P. Beauv.) Keay  
*Combretodendron africanum* Exell

### **Distribution**

West and Central Africa, extending from Guinea to Democratic Republic of Congo (Zaire) and Angola. Abundantly available in Ghana in Moist Evergreen and Moist Semi-deciduous forests.



Source: fruit and flower - Keay

### **Status**

A **lesser-used species** with abundant forest availability, moderate production with irregular export. The prescribed minimum felling diameter is 70 cm. It is cited by IUCN (2004) as a lower risk least concern species.

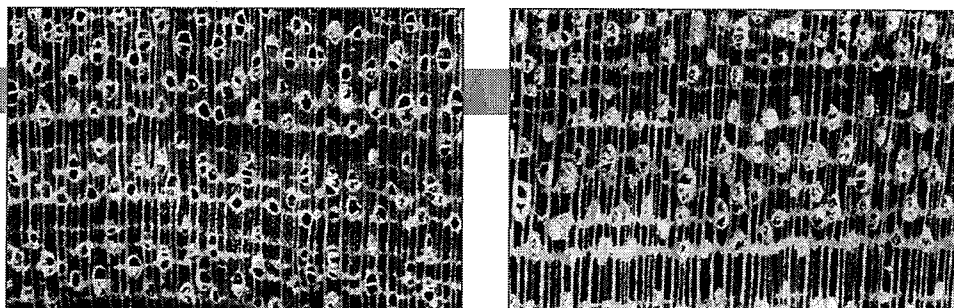
### **Tree Features**

The tree is up to 40 m high and 2.5 m in girth. The **bole** is straight and cylindrical with no buttresses. The **bark** is brownish with regular longitudinal fissures. The **slash** is tough and fibrous, pink-brown, thick, bitter with foetid smell. The **leaves** are simple, 5 – 17 cm long and 4 – 7.5 cm broad, obovate, abruptly acuminate at the tip, tapering to cuneate base. The margin is entire or slightly toothed with 8 to 12 pairs of lateral nerves. The **white flowers** are formed from November to January, and from April to June. They are about 6 mm across on jointed

stalks, 12 mm long in small racemes at the ends of the shoots. The **4-winged fruits** are samara, mounted on slender jointed stalks about 4 cm long and up to 6.5 cm across.

### **Wood Macroscopic Features**

**Pores** small to medium, proportion of solitary pores low, with 2 to 3 radial multiples, few clusters of 2 to 3, tangential pattern, moderate distribution, tyloses and other inclusions present. **Axial parenchyma** is paratracheal, vasicentric, aliform, confluent and marginal, very narrow, irregularly spaced bands, smaller than fibre tissue bands. Proportion of **fibre tissue** is medium. **Ray parenchyma** is indistinct at transverse, distinct at radial, very narrow and uniform, width less than ¼ to ½ of vessel diameter, moderate to high frequency. Wood diffuse porous, **growth ring** boundaries distinct, demarcated by dark ground fibre tissue, marginal parenchyma and absence of pores..



1 mm

### Physical Features

**Heartwood** is pinkish-brown, clearly demarcated from the yellow-white **sapwood**, unpleasant odour. Texture is fine to moderately coarse with low lustre. Wood is hard and of **high density**.

### Splinter Burning Test

**Splinter** burns to produce crackle or bright sparks and forms white ash.

### Ecology and Silviculture

*Petersianthus macrocarpus* is an evergreen tree which is occasionally deciduous, common in moist forest but avoids swampy areas. It is propagated by seed and dispersed by wind, with epigeal germination that takes about 25 days (Taylor, 1960). Although a pioneer species (Hawthorne, 1995), seedlings occur in shade (Hall & Swaine, 1981) and saplings are moderate light demanders. All sizes of tree are more abundant in undisturbed forest (Hawthorne, 1994). The branches of the tree are usually girdled by adult stage wood borer, resulting in death of tissues above the girdle (Wagner *et al.*, 1991).

### Ethnobotany

A bark decoction is drunk as an expectorant to loosen bronchial secretions (Irvine, 1961). The bark is used for treating gonorrhoea and syphilis (Burkill, 1985), and a hot decoction of the bark is applied to treat lumbago (Irvine, 1961). The leaves are used for backache, threatened abortion, headache, and fracture. The stem-bark is used for treatment of fibroid, rheumatism, cough, and lumbago (Mshana *et al.*, 2000; Burkill, 1985).

### Commercial Uses

A **moderately durable wood** used for the following:

- Sleepers, crossties, deckings and piles
- Heavy construction
- Industrial floorings
- Exterior joinery frames and trims
- Vehicle and truck bodies

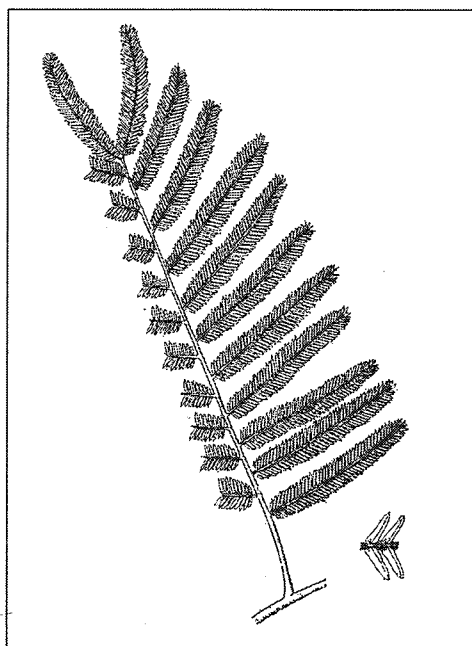
Family Name: **Mimosaceae**  
 Trade names: **Dahoma, Dabéma**  
 Local Names: **Dahoma (Gh); Dabema (CI)**

#### Synonym

*Piptadenia africana* Hook. F.

#### Distribution

West, Central and East Africa, extending from Senegal to Angola and Uganda. Abundantly found in Ghana in all major forest types except the dry forest.



#### Status

A **commercial species** with abundant forest availability, very high production for regular export. The prescribed minimum felling diameter is 70 cm. It is sold in the local market as a substitute for Odum. It is cited by IUCN (2004) as a lower risk near threatened species. The sawdust may cause acute respiratory problems if inhaled and dermatitis on contact with skin.

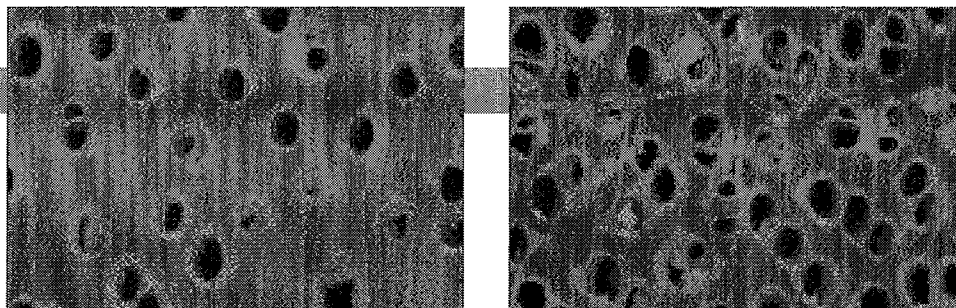
#### Tree Features

**The tree** is up to 40 m high and 3.5 m in girth with a wide spreading crown. **The bole** is straight and clear of branches to a considerable height, with broadly triangular buttresses 3 m high or more. **The bark** is smooth and brown. **The slash** is pale-yellow and red beneath with musty smell. **The leaves** are bipinnate, with 10 – 16 pairs of pinnae, younger ones with tufts of ginger hair

at base of leaflets. **The leaflets** are small and numerous, about 2 cm long, narrow, touching each other and closing at night. The yellowish-white flowers are formed from June to September, in narrow spikes, 5 – 13 cm long. **The fruits** mature from October to March, 15 – 35 cm long by 18 – 32 mm broad. They split open along one margin to expose 6 to 8 **flat seeds**, each about 7 cm by 2.5 cm attached by a thread to the pod.

#### Wood Macroscopic Features

**Pores** large to very large, proportion of solitary pores medium with 2 to 3 radial multiples of same size, in diagonal arrangement, distribution few, brown inclusions present. **Axial parenchyma** is paratracheal, vasicentric, aliform and confluent. Proportion of **fibre tissue** is medium. **Ray parenchyma** indistinct to the naked eye, narrow to very narrow, uniform, less than ¼ of vessel diameter, moderate frequency. Wood is diffuse porous.



1 mm

### Physical Features

**Heartwood** is light-brown to yellow-brown, clearly demarcated from **sapwood**; coarse texture with low lustre. It has an ammoniac unpleasant odour. Wood is hard and of high to **medium density**.

### Splinter Burning Test

**Splinter** burns to produce crackle or bright sparks and forms white ash.

### Ecology and Silviculture

*Piptadeniastrum africanum* is a deciduous tree common in most forest types, except dry forests. Propagation is by seed, dispersed by wind with epigeal germination taking 15 to 20 days at 60 % germination rate with very slow growth (Taylor, 1960). It tolerates shade as seedling and sapling (Hawthorne, 1995). Mean annual increment of 3.75 cm over the first 20 years has been recorded in Sierra Leone (Savil & Fox, 1967). All sizes of tree are less abundant in forest previously destroyed by fire (Hawthorne, 1994).

### Ethnobotany

The bark has abortive properties and is used as a gargle for toothache (Abbiw, 1980). The root and bark are used in enemas while the bark infusion is for headache (Irvine, 1961).

### Commercial Uses

A **moderately durable wood** used for the following:  
 Exterior construction for beams, joists and other structures  
 Exterior joinery, frames and trims  
 Sleepers, crossties, piles and deckings  
 Industrial and domestic floorings, steps and stairs  
 Common and outdoor furniture  
 Vehicle and truck bodies

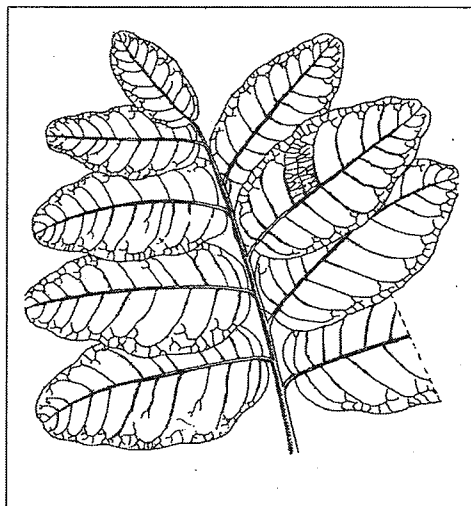
Family Name: **Meliaceae**

Recommended Trade Names: **Pseudocedrela, Krubeta**

Local Names: **Krubeta** (Gh); **Segodere** (BF)

#### **Distribution**

West and East Africa, extending from Senegal to Uganda. Sparsely found in southern Savanna woodland of Ghana.



#### **Status**

A **lesser-known species** of sparse forest availability, currently unexploited. No prescribed minimum felling limit and 50 cm is recommended. It is cited by IUCN (2004) as a lower risk least concern species.

#### **Tree Features**

**The tree** reaches 12 to 20 m height with a girth of 2, m if it is protected from fire. It has a **rounded crown** and an ascending branching system. **The bark** is thick, silvery grey and fissured. **The slash** is bright crimson with a gum exudate. **The leaves** are pinnate with 4 to 6 opposite or alternate leaflets on each side, with or without a terminal one, up to 11 cm long and 5 cm broad. They are ovate-oblong,

obtuse at apex, and rounded at base with wavy margin. **The fragrant white flowers** are flowered from February to March, in panicles 30 cm long in the axils of the leaves. **The fruits** are erect, woody capsules, each 10-12.5 cm long, mature in February and open from apex by 5 recurving segments. **The seeds** are brown with terminal oblong wings over 5 cm long.

#### **Wood Macroscopic Features**

**Pores** are indistinct to the naked eye, small, proportion of solitary pores low with same size of 2 to 4 radial multiples, diagonal arrangement, medium distribution with white inclusions.

**Axial parenchyma** very narrow bands, smaller than fibre tissue bands, reticulate, regularly spaced with narrow distance between bands. **Ray parenchyma** indistinct to the naked eye, uniform width, ¼ to full size of vessel diameter, moderate to high frequency. **Fibre tissue** proportion is medium. Wood is diffuse porous, **growth ring** boundaries distinct, demarcated by marginal parenchyma bands.

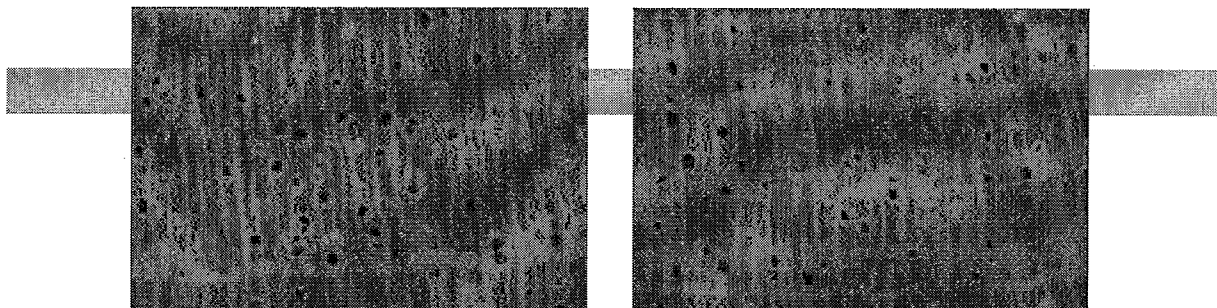
#### **Physical Features**

**Heartwood** is red-brown, clearly demarcated from pale-brown **sapwood**. Texture is medium with low lustre and slightly scented. Wood is hard and of **high density**.

#### **Splinter Burning Test**

**Splinter** burns to from grey ash.





1 mm

### Ecology and Silviculture

*Pseudocedrela kotschy* is widespread in savanna where it grows gregariously around rivers. It is propagated by seeds most of which are scorched by bushfires, but it can also be propagated using root suckers (Irvine, 1961). Seedlings do not transplant well and stump planting is recommended (Irvine, 1961).

### Ethnobotany

The trunk is used for dugout canoes (Abbiw, 1990). A decoction of the root-bark and leaves is used for piles, rheumatism, dysentery, febrifuge and aphrodisiac (Irvine, 1961; Burkill, 1985). The pulped leafy twigs are used for stomach pains and for headache. A bark preparation is used as poison for fishing. The bitter bark is used in infusion for gastro-intestinal problems, febrile and rheumatic conditions. The root-bark is used for treating numbness, dental cares, and for asthma (Mshana *et al.*, 2000). The bark is used as a brown cloth-dye (Irving, 1961)

### Recommended Commercial Uses

A **durable wood** promoted for the following uses:

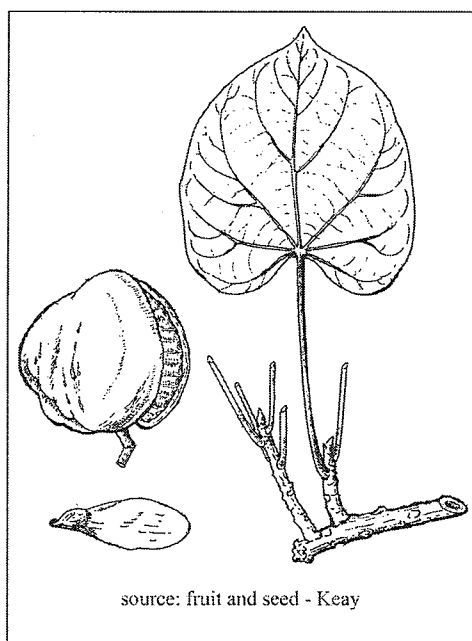
- Roof trusses, beams and joists
- Floorings, parquets, steps and stairs
- Mouldings, panellings and claddings
- Common furniture and cabinet works
- Face veneer, plywood and cigar boxes
- Musical instruments, carvings and artifacts
- Vehicle and truck bodies

***Pterygota macrocarpa* K. Schum.**

Family Name: **Sterculiaceae**  
 Trade Names: **Koto; Pterygota**  
 Local Names: **Kyere (Gh); Koto (CI); Ake (Ga)**

**Distribution**

West and Central Africa, extending from Sierra Leone to Democratic Republic of Congo (Zaire). Frequently occurs in Ghana in Moist and Dry Semi-deciduous forests, but absent from Evergreen forests.

**Status**

A **commercial species** of frequent forest availability, with very high production for very regular export. The prescribed minimum felling diameter is 70 cm. It is cited by IUCN (2004) as a vulnerable species.

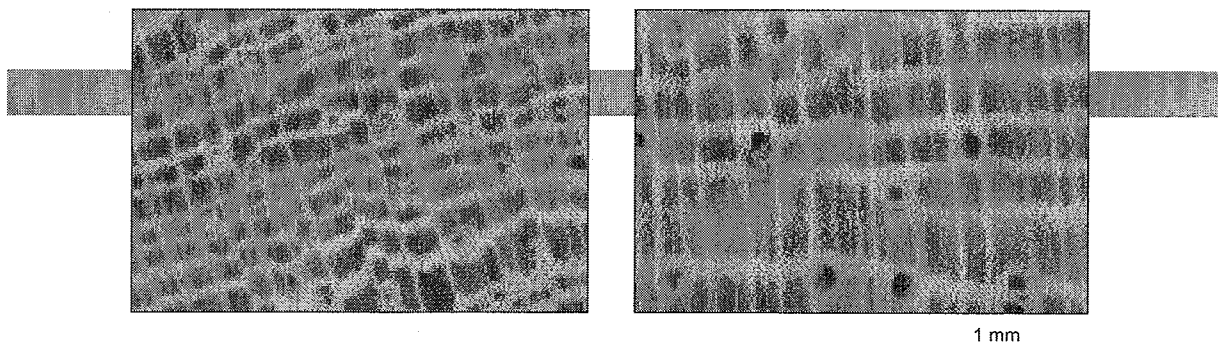
**Tree Features**

The tree is up to 40 m high and 3 m in girth with a compact rounded crown. It has a clean straight bole about 25 m high with buttresses reaching 4 m. The bark is smooth and greenish-grey. The slash is white with yellow markings and thin green edge. The branchlets are covered with short stellate hairs, conical and close to the stem in young trees. The leaves are simple, 10-37 cm long and 8-25 cm broad, pentagonal-ovate, deeply cordate at base, acuminate at the apex, usually 7-nerved with petiole longer than 5

cm. The flowers are formed from November to January and are borne in axillary panicles with 5 sepals about 2 cm long. The fruits, 12-20 cm long and 10-13 cm broad, mature from October to March and in June, ellipsoid or sub-globose, with a stout stalk 15-20 mm in diameter. Each seed, 8-13 cm long and 3.5-5 cm broad, is flattened and dull-brown. The species is similar to *P. bequaerti* which has smaller leaves and is rare in Ghana.

**Wood Macroscopic Features**

Pores large, proportion of solitary pores medium with 2 to 3 radial multiples of same and different sizes, distribution low, inclusions present. Axial parenchyma is paratracheal, vasicentric, aliform with wavy narrow bands, width less than fibre tissue bands, regularly spaced with narrow distance between bands, storied. Ray parenchyma is variable, very narrow to narrow, width less than ¼ to ½ of vessel diameter, moderate frequency. Fibre tissue proportion is medium. Wood is diffuse porous, growth ring boundaries demarcated by dark ground fibre tissues.



### Physical Features

**Heartwood** creamy-white, not demarcated from **sapwood**. Texture is medium to coarse with high lustre and freshly aromatic. Wood is fairly hard and of **medium density**.

### Splinter Splinter Burning Test

**Splinter** burns to exude coloured liquid and forms grey ash.

### Ecology and Silviculture

*Pterygota macrocarpa* is a deciduous tree with preference for base-rich soils (Hall & Swaine, 1981). It is tolerant of drought and prefers light well-drained soil. It is propagated by seed dispersed by wind. Germination in shade is epigeal and takes about 18 days (Taylor, 1960), but saplings are light demanders. Propagation by stripped planting is possible, with annual height growth of 6 m, reaching a girth of 16 cm in 10 years (Taylor, 1960).

### Ethnobotany

The large leaves are used as food wrappers and as thatch for roofing huts (Abbiw, 1990). A leaf decoction is drunk for stomach, bladder and urinary complaints, and as a carminative for flatulence (Irvine, 1961).

### Commercial Uses

A **non-durable wood** used for the following:

- Panellings, joinery and claddings
- Interior joinery, frames and trims
- Decorative furniture and cabinet works
- Boxes and coffins
- Sliced and rotary veneer for plywood

## *Pycnanthus angolensis* (Welw.) Warb.

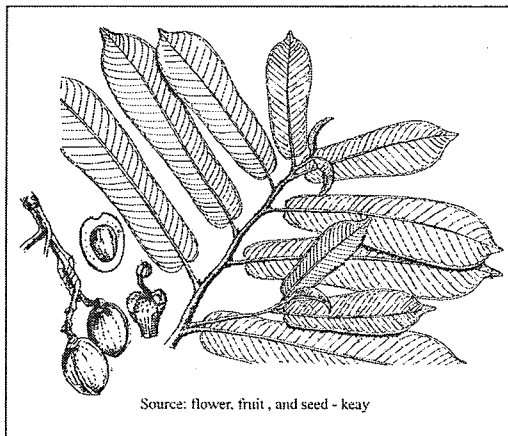
Family Name: **Myristicaceae**  
 Trade Names: **Illomba; Otie**  
 Local Names: **Otie (Gh); Eteng (Ca, Ga)**

### Synonym

*Pycnanthus kombo* (Baill.) Warb.

### Distribution

West and Central Africa, extending from Guinea to Uganda and Angola. Frequently occurs in Ghana, abundant in Wet and Moist Evergreen, and common in Moist and Dry Semi-deciduous forests.



Source: flower, fruit, and seed - keay

### Status

A **lesser-used species** of frequent forest availability, very high production and regular export. The prescribed minimum felling limit is 70 cm, and is cited by IUCN (2004) as a lower risk near threatened species. The sawdust may cause dermatitis.

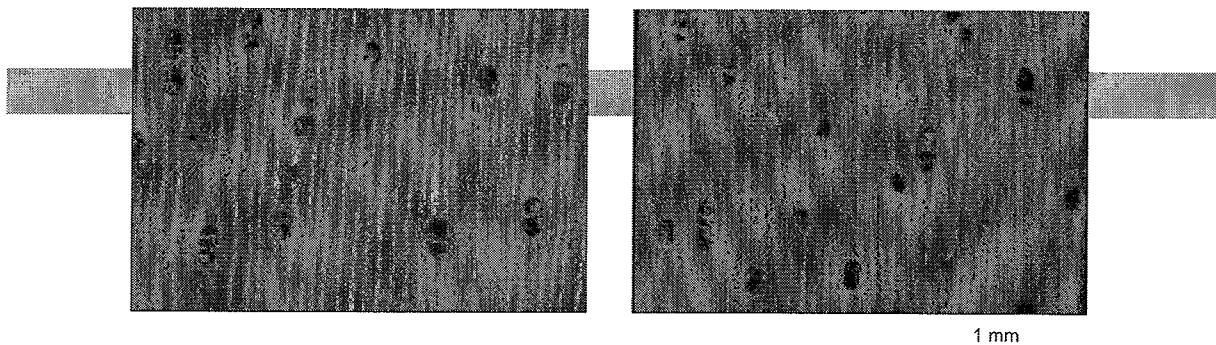
### Tree Features

The tree is up to about 35 m high and 2.5 m in girth, with fairly large **flattened crown** composed of slender, sometimes drooping branches. The **bole** is straight and cylindrical, often with a marked taper

and no buttresses. The **bark** is grey to brown and longitudinally fissured. The **slash** is reddish and exudes a watery honey-coloured exudate which turns red. The **branching system** is in whorls and at right angles to the stem. The **leaves** are simple, 18-30 cm long and 5-9 cm broad. They are acuminate at the apex, cordate at the base and usually characterised with insect holes and rusty stellate hair underside. The **flowers** open from December to March and in June. They are densely clustered at the ends of panicles 7.5-15 cm long. The **oblong fruits** mature from September to April, and are up to 3.5 cm long with rather thick shell which split longitudinally to release **single brown seed** from a fruit.

### Wood Macroscopic Features

**Pores** medium, proportion of solitary pores high with same or different sizes of 2 to 4 radial multiples, few clusters of 2-4, distribution low. **Axial parenchyma** is indistinct to the naked eye, scanty paratracheal. Proportion of **fibre tissue** is medium. **Ray parenchyma** is barely visible at radial and tangential sections, very narrow, uniform, width  $\frac{1}{4}$  to  $\frac{1}{2}$  vessel diameter, moderate to high frequency. Wood diffuse porous, **growth ring** boundaries demarcated by dark ground fibre tissue and differences in pore diameter.



1 mm

### Physical Features

**Heartwood** light-brown to yellow-brown, demarcated from the light-coloured **sapwood**; texture medium to coarse, moderate lustre with slight smell when freshly cut. Wood is fairly soft and of **low density**.

### Splinter Test

**Splinter** burns to exude coloured liquid and forms white ash.

### Ecology and Silviculture

*Pycnanthus angolensis* is an evergreen tree highly sensitive to drought and common in disturbed forest, gaps and farm fallow. Mature fruits split open and seeds are dispersed by birds. Seeds are propagated by wind, with hypogeal germination which takes about 16-36 days (Taylor, 1960). A mean annual girth increment of 2 to 7.5 cm has been recorded in Sierra Leone (Savill & Fox, 1967). Regeneration is more abundant in undisturbed forest (Hawthorne, 1994). The leaves of mature trees are heavily attacked by insects, giving them a characteristic perforation (Wagner *et al.*, 1991).

### Ethnobotany

The seed oil, commercially known as kombo oil, is used for soap and candle making (Abbiw, 1990). The pounded bark is used for loss of appetite and as a cure for toothache. A bark infusion is used as a mouthwash and for treating crawcraw-skin infection leading to ulceration (Irvine, 1961). A bark decoction is used as an emetic or in enemas by nursing mothers for purifying breast milk (Irvine, 1961). Mshana *et al.* (2000) report that the leaves are used for treatment of rashes; the stem-bark for threatened abortion, anaemia, chest pain, headache and scabies; and the roots for helminthiasis.

### Commercial Uses

A **non-durable wood** used for the following:

- Boat and canoe construction
- Interior joinery, frames and trims
- Boxes, crates and packing cases
- Panellings, claddings and mouldings
- Shingles, shakes and weatherboards
- Rotary core veneer and plywood

***Ricinodendron heudelotii* (Baill.) Pierre ex Heckel**

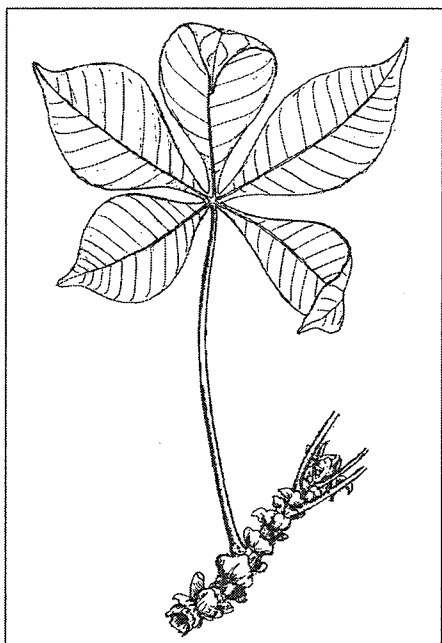
Family Name: **Euphorbiaceae**

Trade Names: **Ricinodendron; Erimado**

Local Names: **Wama (Gh); Eho (CI); Erimado (Ni)**

**Distribution**

West, Central and East Africa, extending from Guinea to Sudan, Uganda, Tanzania, Angola and Mozambique. Abundantly available in Ghana, mostly in Moist and Dry Semi-deciduous forests and occasionally in Moist Evergreen forest.

**Status**

It is a **lesser-known species** of abundant forest availability, but insignificant production for local use only. It has no prescribed minimum felling diameter, and 70 cm is recommended. It is cited by IUCN (2004) as a lower risk least concern species.

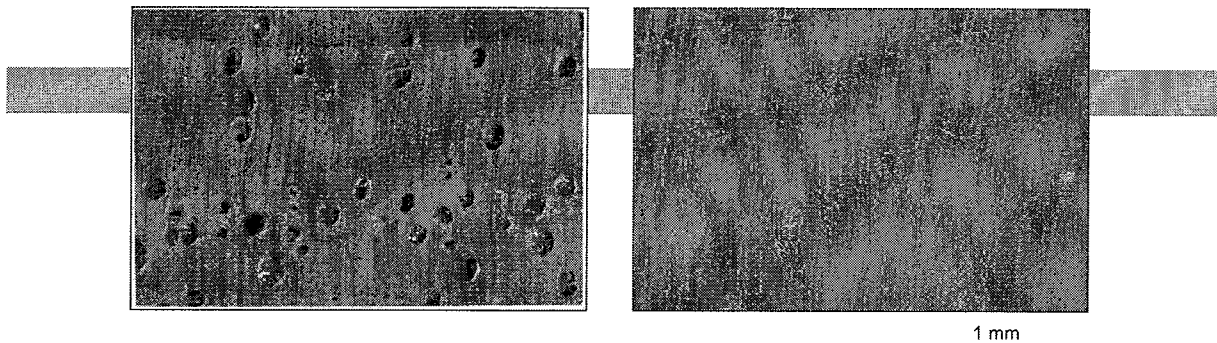
**Tree Features**

**The tree** is deciduous up to 50 m high and about 2.5 m in girth. **The bole** is straight, sometimes with short buttresses. **The bark** is brown, smooth, becoming rough and scaly. **The slash** is orange to pink, soft and granular with red exudates and savoury smell. **The branches** are stout and whorled, widely spreading and crooked when old. **The crown** is low and spreading. **The leaves** are compound digitate with 3-5 leaflets on a stalk, up to 25 by 15 cm. The almost 4-sided leaflets are 6-24 cm long by 2.5-11 cm broad. **The yellow-white tomentose**

**flowers** are formed from March to May, monoecious and usually in terminal panicles. The male panicles are up to 30 cm long with shorter female panicles. **The yellow fruit**, a 3-lobed drupe, matures from May to October, 2.5 cm or more across, contains 2 or 3 black seeds, each 2 cm by 1.5 cm.

**Wood Macroscopic Features**

**Pores** are large, proportion of solitary pores medium with 2 to 4 radial multiples of same and different sizes, few clusters, distribution low, tyloses present. **Axial parenchyma** is indistinct to the naked eye, apotracheal, diffuse-in-aggregate. **Fibre tissue** proportion is medium to high. **Ray parenchyma** is indistinct at transverse, distinct at radial section, very narrow, uniform width less than  $\frac{1}{4}$  of vessel diameter, high frequency. Wood diffuse to semi-ring porous, **growth ring** boundaries demarcated by dark ground fibre tissue and absence of pores.



### Physical Features

**Heartwood** dull white or pale-yellow, not differentiated from **sapwood**; texture is coarse. Wood is very soft and of **low density**.

### Splinter Burning Test

**Splinter** burns to form white ash.

### Ecology and Silviculture

*Ricinodendron heudelotii* has a widespread distribution, common in secondary forest and absent from the driest forest types. The large seeds are dispersed by birds (hornbills) and mammals, for example, bats (Taylor, 1960). Seeds have also been found in piles of elephant dung (Hawthorne, 1993). It is propagated by seed and epigeal germination takes about 12 days (Taylor, 1960). Kyereh *et al.* (1999) found that germination occurred in two stages extending over 110 days. The rate of germination is about 80 %; and it is one of the fastest-growing pioneer species, attaining 10-m height in 4 years but has a short life span (Taylor, 1960). Regeneration is more abundant in forest previously destroyed by fire (Hawthorne, 1994). The seedlings are susceptible to aphid attack in the first year and causes the leaves to curl and eventually kills the tree (Wagner *et al.*, 1991).

### Ethnobotany

The seeds are eaten either boiled or roasted, while the wood ashes from freshly felled trees are used as cooking salt, for soap making, and in the indigo dye industry (Abbiw, 1990). The root-bark together with pepper and salt, is used as a cure for constipation, the pounded bark is warmed and applied locally to treat elephantiasis, and a bark infusion is used to relieve labour pains and prevent miscarriage (Irvine, 1961). The stem-bark is for treating female infertility (Mshana *et al.*, 2000).

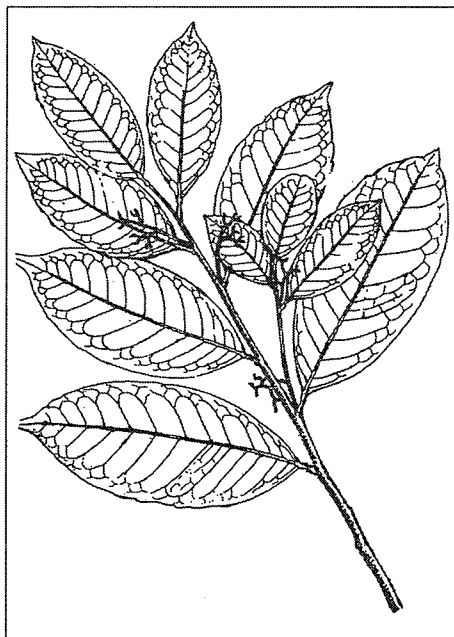
### Recommended Commercial Uses

A **non-durable wood** promoted for the following uses:

Artifacts, carvings and handicrafts  
Boxes, food containers and packing cases

***Sacoglottis gabonensis* (Baill.) Urb.**Family Name: **Humiriaceae**Trade Names: **Sacoglottis; Ozouga; Fawere**Local Names: **Fawere (Gh); Ozouga (Ga); Akouapo (CI)****Distribution**

West and Central Africa, extending from Sierra Leone to Gabon, Democratic Republic of Congo (Zaire) and Angola. Rarely found in Wet and Moist Evergreen forests of Ghana.

**Status**

It is a **lesser-known species** of sparse availability, yet to be exploited. No prescribed minimum felling diameter, and 90 cm is recommended. It is cited by IUCN (2004) as a lower risk near threatened species.

**Tree Features**

**The tree** is up to 30 m high and 3 m in girth with a dense bushy crown and dark-green foliage with heavy branching system. **The bole** is deeply and irregularly fluted and twisted with ingrown bark. **The reddish-brown bark** is rough and easily peels off. **The slash** is red, fibrous with yellowish exudates. **The leaves** are simple, 7.5-15 cm long and 3-6 cm broad on a base-swollen petiole, elliptic, acuminate at the tip and cuneate at the base. The margin is slightly notched with shallow forward-pointing teeth. **The flowers** are formed in November to January and from July to August, have yellow

petals and are crowded in branched axillary inflorescences. **The fruits** mature from November to January. They are ellipsoid or spherical, 2.5-4.5 cm long with a hard-stony seed in a fruit.

**Wood Macroscopic Features**

**Pores** are small, exclusively solitary, moderate distribution with brown inclusions. **Axial parenchyma** is indistinct to the naked eye, apotracheal, diffuse and diffuse-in-aggregate. **Fibre tissue** proportion is medium. **Ray parenchyma** is indistinct to the naked eye, very narrow, uniform width less than  $\frac{1}{4}$  of vessel diameter, high frequency. Wood is diffuse porous.

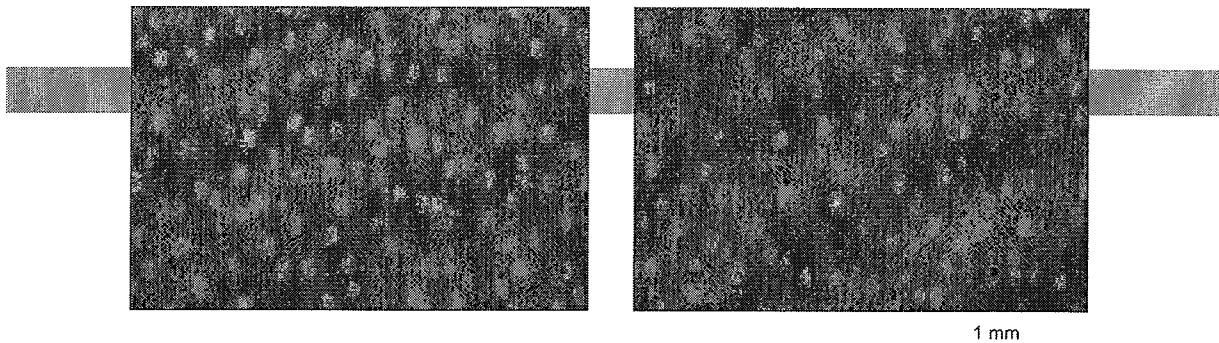
**Physical Features**

**Heartwood** purple-red or brown, not clearly demarcated from sapwood, texture is fine to medium with low lustre and distinct odour. Wood is hard and of **high density**.

**Splinter Burning Test**

**Splinter** burns to exude coloured liquid and forms white ash.





#### **Ecology and Silviculture**

*Sacoglottis gabonensis* is an evergreen tree confined to sandy soils of riverine and swampy areas. The hard and stony seed is dispersed by mammals including hornbills, elephants and monkeys after the fruit has been eaten. It is propagated by seed with epigeal germination that takes about 125 days (Taylor, 1961).

#### **Ethnobotany**

The fruit is edible and is also eaten by monkeys and other animals (Abbiw, 1990). The dried bark is usually sold in the market, and is added to palm-wine to render it more intoxicating. It is emetic and is used as a febrifuge for preventing fever (Irvine, 1961).

#### **Recommended Commercial Uses**

A **very durable wood** recommended for the following uses:

Bridges, sleepers and crossties  
 Poles, posts and stakes  
 Industrial floorings, parquets, steps and stairs  
 Industrial roof trusses, joists and beams  
 Vehicle and truck bodies

***Samanea dinklagei* (Jacq.) Merr.**

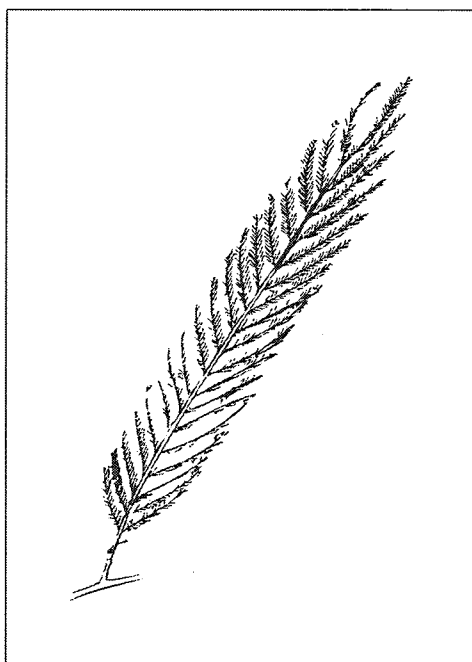
Family Name: **Leguminosae**  
 Trade Name: **Samanea**  
 Local Name: **Abobonkahyire** (Gh.)

**Synonym**

*Albizia dinklagei*

**Distribution**

West Africa, extending from Guinea-Bissau to Ghana. Occurs sparsely in Evergreen and Semi-deciduous forests of Ghana and in riverine forest of Savanna woodland.

**Status**

A **lesser-known** species of rare occurrence with insignificant production for local use only. No prescribed minimum felling diameter and 50 cm is recommended. It is cited by IUCN (2004) as a lower risk near threatened species. The sawdust may cause irritation in the nose and throat.

**Tree Features**

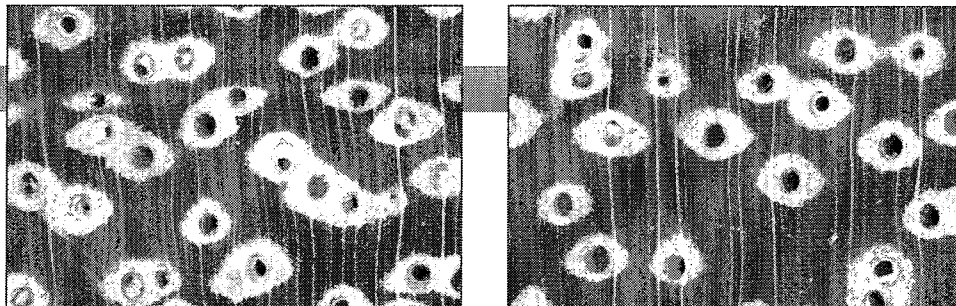
**The tree** is up to 25 m high and 2 m in girth with short buttresses if present. **The crown** is low, heavily branched and drooping. **The bark** is rough, brown and scaly. **The leaves** are bipinnate, up to 30 pairs of pinnae with narrow linear leaflets up to 40 pairs. **The creamy-white flowers** bloom from February to April. The reddish-brown fruits are pods which mature from November to February, about 18 cm by 3 cm, with up to 25, **small grayish-green seeds** embedded in a solid pulp.

**Macroscopic Features**

**Pores** are of medium size, very high proportion of solitary pores with 2 to 3 radial multiples of same size, distribution low, white inclusions present. **Axial parenchyma** is paratracheal, vasicentric, aliform and confluent. **Fibre tissue** proportion is medium. **Ray parenchyma** is indistinct, very narrow, uniform, width less than 1/4 of vessel diameter, high frequency. Wood is diffuse porous.

**Physical Features**

**Heartwood** pale to dark-brown, demarcated from white or yellow **sapwood**; texture moderately coarse and lustrous. Wood is hard and of **medium density**.



1 mm

### Splinter Burning Test

**Splinter** burns to form yellow-brown ash.

### Ecology and Silviculture

*Samanea dinklagei* is a deciduous tree that occurs on riverbanks in secondary forests. It is propagated by seeds that are dispersed when ripe fruits fall to the ground and are eaten by elephants (Hawthorne, 1995). Germination is epigeal, takes about 70 to 90 days (Taylor, 1960). Trees in secondary forest grow to about 45 cm dbh in 40 years (Kahn, 1982).

### Ethnobotany

The peeled pounded bark, together with ashes of the pod, is used as soap substitute (Abbiw, 1990). The pod ashes are used to treat special skin infection called crawcraw. The bark decoction is used as an emetic or in enemas by nursing mothers to purify breast milk, the inner bark as purgative and the juice from fresh leaves is used for eye treatment (Irvine, 1961).

### Recommended Commercial Uses

A **very durable wood** promoted for the following uses:

- Bridges, sleepers, crossties, deckings and piles
- Cabinet works and furniture
- Claddings, panellings and mouldings
- External and internal joinery
- Decorative veneer for plywood
- Tools, turneries and ornaments

**Scottellia klaineana Pierre**

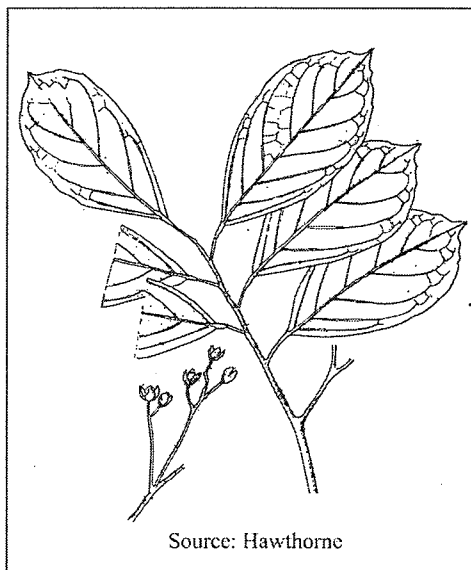
Family Name: **Flacourtiaceae**  
 Trade Name: **Akossika**  
 Local Names: **Tiabutuo (Gh); Akossika (CI)**

**Synonym**

*S. coriacea* A. Chev. ex Hutch & Dalz.

**Distribution**

West and Central Africa, extending from Sierra Leone to Gabon, Democratic Republic of Congo (Zaire) and Angola. Frequently available in Ghana in Wet and Moist Evergreen, and Moist and Dry Semi-deciduous forests.



Source: Hawthorne

**Status**

A lesser-known species of frequent forest availability, insignificant production for local use only. No prescribed minimum felling diameter, and 70 cm is recommended. It is cited by IUCN (2004) as a lower risk least concern species.

**Tree Features**

The tree is up to 35 m high with a girth usually not exceeding 2.5 m with small dense crown. The bole is slightly fluted or with low buttresses at the base. The bark is thin and smooth. The slash is granular, yellowish-orange, turns brown with sweet amber-coloured gum. The leaves are simple, 5 – 15 cm long by 2.5 – 7.5 cm broad. They are obovate, shortly and broadly acuminate at the tip, cuneate at the base, with 4 to 6

upcurving lateral nerves with slightly wavy or serrated margin. The yellow-white fragrant flowers are about 7 cm long and are formed from April to June. The small capsular fruits mature from August to September, dehiscing from apex to release 2 to 3 angular orange-red seeds per fruit.

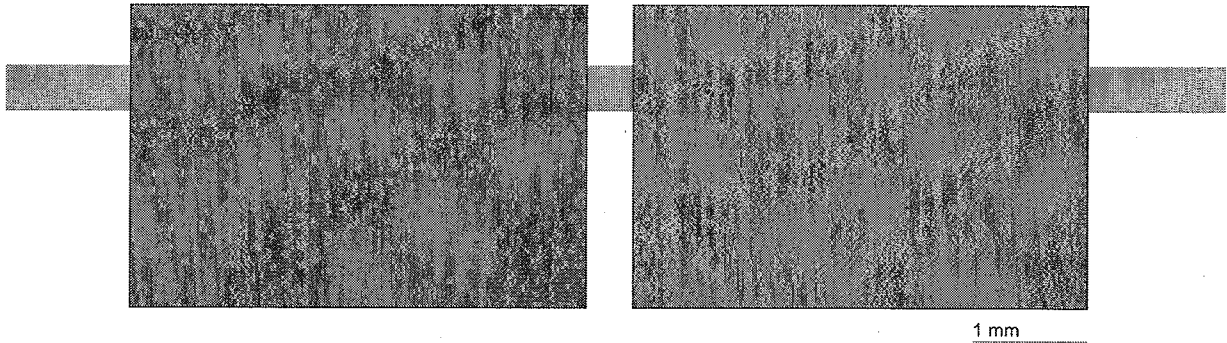
**Wood Macroscopic Features**

Pores are not distinct to the naked eye, small, proportion of solitary pores medium with same size of 2 to 4 radial multiples, moderate distribution, tyloses and other inclusions present.

Axial parenchyma indistinct to the naked eye, apotracheal and diffuse. Fibre tissue proportion is low to medium. Ray parenchyma very narrow to narrow, variable width, less than ½ to full size of vessel diameter, high frequency. Wood is diffuse porous.

**Physical Features**

Heartwood and sapwood are pale-yellow to brownish-yellow, not demarcated. Texture is fine with moderate lustre. Wood is hard and of medium density.



### **Splinter Burning Test**

**Splinter** burns to exude coloured liquid and forms white ash.

### **Ecology and Silviculture**

*Scottellia klaineana* is an evergreen tree which is widespread and common along banks of streams except in the drier forest. It is propagated by seeds that are dispersed by birds (Taylor, 1960). Germination is epigeal and seedlings and saplings are shade-tolerant, but older trees are light demanding. Regeneration is more common in undisturbed forest (Hawthorne, 1994).

### **Ethnobotany**

The wood ashes are used in soap making (Abbiw, 1990). The bark and leaves are believed to have superstitious uses in Liberia (Irvine, 1961).

### **Recommended Commercial Uses**

A **non-durable wood** promoted for the following uses:

- Internal panellings, claddings and mouldings
- Interior joinery, frames and trims
- Furniture and cabinet works
- Domestic floorings, steps and stairs
- Decorative or face veneer and plywood

***Sterculia oblonga* Mast.**

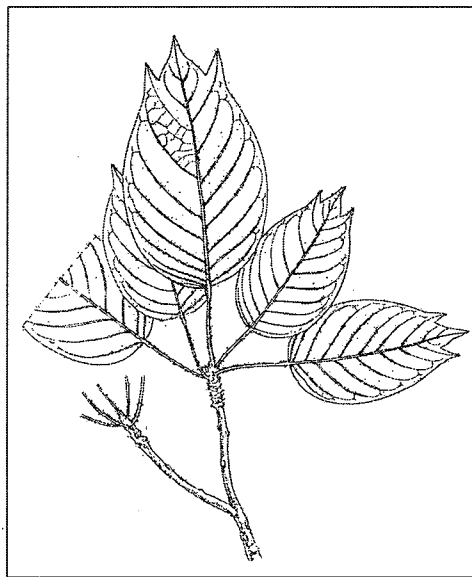
Family Name: **Sterculiaceae**  
 Trade Names: **Sterculia; Eyong; Ohaa**  
 Local Names: **Ohaa (Gh); Eyong (Ca)**

**Synonym**

*Eribroma oblonga* Bodard

**Distribution**

West and Central Africa, extending from Côte d'Ivoire to Cameroon. Moderately found in Ghana in Moist Evergreen and Moist and Dry Semi-deciduous forests, but absent from Wet Evergreen forest.

**Status**

A lesser-used species of moderate forest occurrence, low production and irregular export. The prescribed minimum felling diameter is 70 cm, and is sold as part of the *Sterculia* group of species. It is cited by IUCN (2004) as a lower risk least concern species.

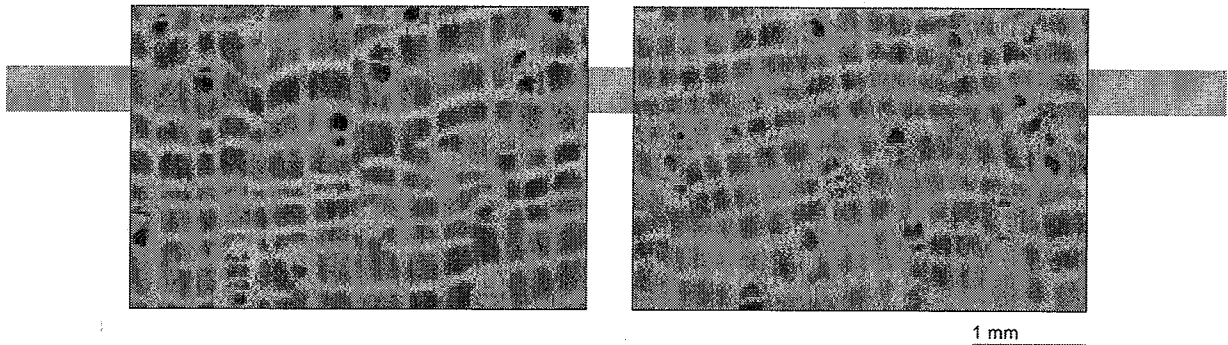
**Tree Features**

The tree is up to 35 m high and 2.5 m in girth with light compact crown. The bole is clean and fairly straight up to 15 m, often with narrow buttresses. The bark is grey, rather smooth and not fissured but with small scales. The slash is white to yellow, fibrous with orange streaks and distinctive musty smell. The leaves are simple, over 12 cm long and 7 cm broad, oblong-elliptic, with an

entire margin, an acuminate tip and cuneate to rounded at the base showing about 12 prominent lateral nerves. It flowers from September to October and in January, producing greenish-yellow to yellow-brown and hairy flowers. The fruits mature from October to January, and are greenish-yellow or greyish-brown. The hairy follicles are elliptical, up to 15 cm long and 7-10 cm broad. Fruit splits to expose numerous seeds, each covered by a thin yellow aril.

**Wood Macroscopic Features**

Pores are medium to large, proportion of solitary pores medium with same size of 2 to 3 radial multiples, low in distribution with occasional tyloses. Axial parenchyma is broad, straight and wavy bands, smaller or equal to fibre tissue bands, regularly spaced, narrow distance between bands. Fibre tissue proportion is medium. Ray parenchyma variable, very narrow and wide, less than  $\frac{1}{4}$  or  $\frac{1}{2}$  of equal to vessel diameter, moderate frequency, storied. Wood is diffuse porous.



### Physical Features

**Heartwood** and **sapwood** are not clearly demarcated, creamy-white to pale-yellowish brown. Texture moderately coarse, silver figure and high lustre. Wood is fairly hard and of **medium density**.

### Splinter Burning Test

**Splinter** burns to exude coloured liquid and forms grey ash.

### Ecology and Silviculture

*Sterculia oblonga* is deciduous and is propagated by seeds dispersed by birds. Germination under shade is epigeal, takes about 12 days with germination rate of 95 % (Taylor, 1960). Saplings are light demanders with an annual height increment of about 30 cm, a height from 3 to 15 m, and a girth of 9 to 35 cm for a 9-year-old tree (Taylor, 1960). Regeneration is in shade and is more common in undisturbed forest (Hawthorne, 1994).

### Ethnobotany

The pole-size stems are sometimes used for pestles while the seeds are eaten in Cameroon (Irvine, 1961).

### Commercial Uses

A **moderately durable wood** used for the following:

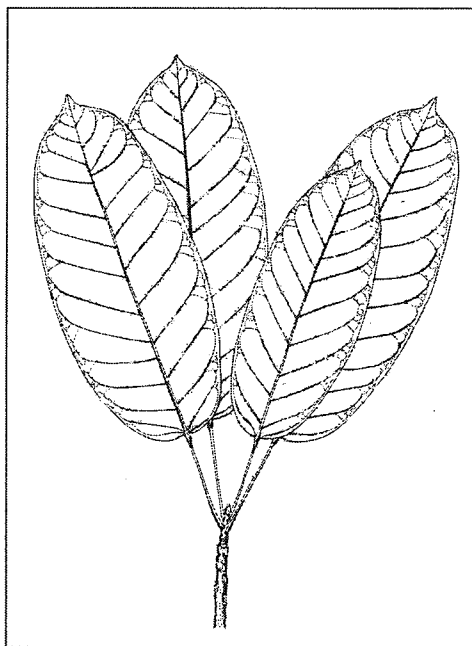
- Panellings, claddings and mouldings
- Domestic floorings, steps and stairs
- Interior joinery, frames and trims
- Rotary and sliced veneer for plywood

***Sterculia rhinopetala* K. Schum.**

Family Name: **Sterculiaceae**  
 Trade Names: **Sterculia; Nawabima**  
 Local Names: **Wawabima (Gh); Lotofa (CI)**

**Distribution**

West Africa, extending from Cote d'Ivoire to Cameroon. Frequently found in Ghana in Moist and Dry Semi-deciduous forests with a distribution very similar to *S. oblonga*.

**Status**

A **lesser-used species** of frequent forest availability, high production and irregular export. It is traded as part of the Sterculia group of species, and is the most desirable of the group. The prescribed minimum felling diameter is 70 cm. It is cited by IUCN (2004) as a lower risk least concern species.

**Tree Features**

**The tree** is up to 40 m high, 4 m in girth with small open crown and short branches. **The bole** is cylindrical with buttresses up to 3 m high. **The bark** is greyish-brown and flakes off in small square pieces. **The slash** is pink or red, bitter with thin white or cream streaks, which turn bluish later. **The leaves** are simple, 10-30 cm long, 3-16 cm broad, oblong, rounded at base, shortly acuminate at apex and densely stellate. **The flowers** bloom from September to November, and

fruits mature from February to April. They are follicles with 4 to 5 brown boat-shaped carpels, each 5-7 cm long and closely covered with stellate hairs outside but glabrous inside. **The fruit** is a brown follicle, 6 cm by 3 cm, splits to expose 8-10 kernels. **Each seed** is red-brown and oblong, 1.5 cm by 0.6 cm, covered by a red aril and attached by a thread-like funicle.

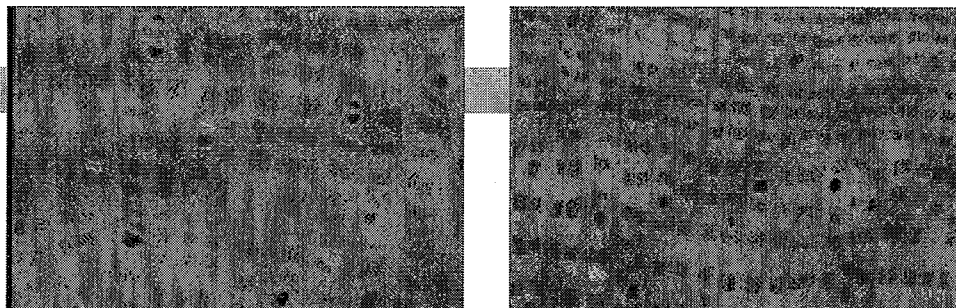
**Wood Macroscopic Features**

**Pores** small to medium size, proportion of solitary pores medium with same size of 2 to 4 radial multiples, distribution low with inclusions. **Axial parenchyma** broad, straight to wavy bands, equal to or larger than fibre tissue bands, regularly and narrowly spaced. Proportion of **fibre tissue** is low. **Ray parenchyma** is variable, wide and narrow, width  $\frac{1}{4}$  to full size of vessel diameter, moderate frequency. Wood is diffuse porous, **growth rings** demarcated by marginal parenchyma and absence of pores.

**Physical Features**

**Heartwood** dark red-brown, differentiated from pale **sapwood**, coarse texture. Wood is hard and of high density.





1 mm

### **Splinter Burning Test**

**Splinter** burns to form black ash.

### **Ecology and Silviculture**

*Sterculia rhinopetala* is a deciduous tree less common in evergreen forests and in old secondary forests. It is propagated by seed, dispersed by birds (Hawthorne, 1995). Germination is epigeal, takes about 10 days with a germination rate of about 95 % (Taylor, 1960). It regenerates in shade but requires light after sapling stage. Mean annual girth increment is 0.6 – 0.8 cm, and a height increment of 0.5 m has been recorded by Taylor (1960). Regeneration is less abundant in regenerated forest previously destroyed by (Hawthorne, 1994). The tree is liable to infestation by polyphagous defoliator and tree borer (Wagner *et al.*, 1991).

### **Ethnobotany**

The wood ashes are used as salt substitute and in soap making, while the powdered bark with oil is applied externally to swellings and taken internally as a carminative for flatulence (Irvine, 1961). The stem-bark is used for treating skin disease (Burkill, 1985).

### **Commercial Uses**

A **moderately durable wood** used for the following:

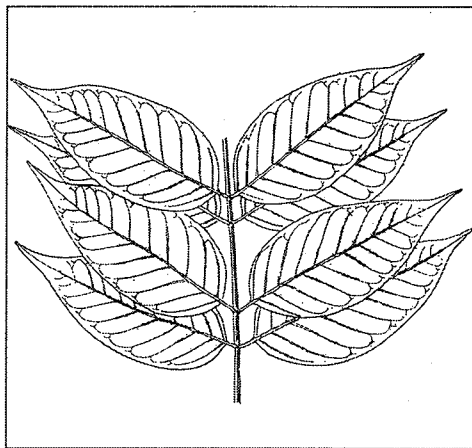
- Floorings, steps and stairs
- Exterior joinery, frames and doors
- Rotary veneer and plywood
- Industrial structures, joists and beams

***Stereospermum acuminatissimum* K. Schum.**

Family Name: **Bignoniaceae**  
 Trade Name: **Stereospermum**  
 Local Name: **Esonotokwakofuo** (Gh)

**Distribution**

West and Central Africa, extending from Guinea to Gabon. Sparsely found in Dry Semi-deciduous forest and scattered in Savanna woodland of Ghana.

**Status**

A **lesser-known species** of sparse forest availability, with no reported production. No prescribed minimum felling diameter and 50 cm is recommended. It is cited by IUCN (2004) as a lower risk least concern species.

**Tree Features**

**The tree** is up to 40 m high and rarely above 1.8 m in girth with a slender stem. **The slash** is pale pin with brown gritty streak and have **the bark** is soft-fibrous, chunky and crumbly. **The leaves** are pinnate with 5 to 6 pairs of leaflets, each measuring up to 15 cm long. They are glabrous, oblong, with a long

acuminate tip. The rachis and leaves are completely hairless with lax-reticulate venation. **The flowers** are formed from March to July; they are whitish to pale pink-purple, showy, with a tubular corolla 3 cm long. **The fruits** mature in September; they are slender, cylindrical, over 1 m long, with winged seeds surrounded by pulp.

**Wood Macroscopic Features**

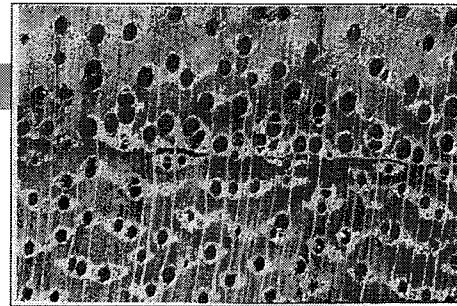
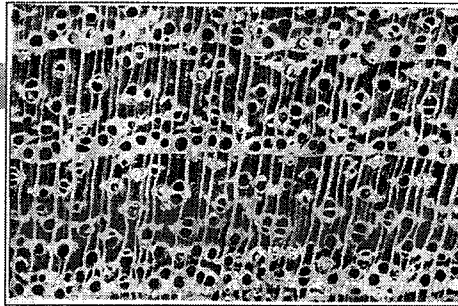
**Pores** medium to large size, proportion of solitary pores medium with same size of 2 to 4 radial multiples, tangentially and diagonally arranged, moderate distribution, inclusions present. **Axial parenchyma** paratracheal, aliform, confluent, short bands with occasional presence of marginal parenchyma. **Fibre tissue** proportion is medium. **Ray parenchyma** is distinct at transverse but indistinct at radial section, very narrow, uniform width less than  $\frac{1}{4}$  to  $\frac{1}{2}$  of vessel diameter, high frequency. Wood is diffuse porous, **growth ring** boundaries present, demarcated by marginal parenchyma and absence of pores.

**Physical Features**

**Heartwood** is yellowish-white to yellow-brown, not demarcated from **sapwood**. Texture is moderately coarse. Wood is hard and of **medium to high density**.

**Splinter Burning Test**

**Splinter** burns to produce crackle or bright sparks, to exude coloured liquid and forms grey ash.



1 mm

### Ecology and Silviculture

*Stereospermum acuminatissimum* is a deciduous tree found on shallow soils and at the edge of rock outcrops (Hall & Swaine, 1981). It is a pioneer species that is difficult to grow from seed, but wild seedlings or suckers can be transplanted. Sapling is more common in regenerated forest previously destroyed by fire (Hawthorne, 1994).

### Ethnobotany

**The bark** is haemostatic and the fresh leaf-juice is used for healing sores and wounds (Burkill, 1985; Irvine, 1961). **The bark** is also used for treating skin ulcers (Mshana *et al.*, 2000). The tree has beautiful red flowers and is used as ornamental plant (Abbiw, 1990).

### Recommended Commercial Uses

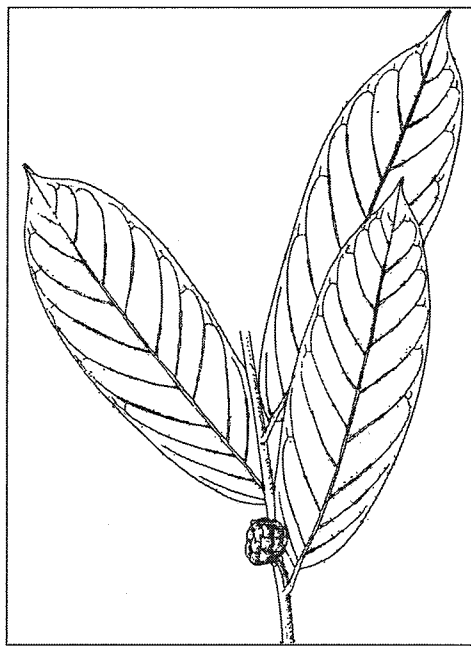
A **moderately durable wood** promoted for the following uses:

Furniture and cabinet works  
Tool handles and sporting goods  
Joinery, frames and trims

Family Name: **Combretaceae**  
 Trade Names: **Strephonema; Awuruku**  
 Local Names: **Awuruku (Gh); Potopoto (CI)**

#### **Distribution**

In West Africa, extending from Sierra Leone to Cameroon. Moderately occurs in Wet and Moist Evergreen forests of Ghana.



#### **Status**

A lesser-known species of moderate forest availability yet to be exploited. No prescribed minimum felling limit and 90 cm is recommended. It is cited by IUCN (2004) as a lower risk least concern species.

#### **Tree Features**

**The tree** is large and unbuttressed up to 35 m high and 3 m in girth, with narrow crown and a cylindrical bole. **The slash** is pinkish-brown, soft, brittle and gritty with a gummy exudate. **The leaves** are simple, up to 2-4 cm long and 8 cm broad with basal gland. They are oblong-elliptic with acuminate tip, a rounded base, and an entire margin with 9 to 12 pairs of lateral nerves. **The flowers** open from August to September; they are brown-tomentose with yellowish-white corolla, borne on racemose-like inflorescence over 6 cm long. **The drupe fruits** are formed from

December to February. They are red-brown, tomentose and verrucose, nearly 6 cm by 8 cm with solitary dicotyledonous seed resembling true cola nuts.

#### **Wood Macroscopic Features**

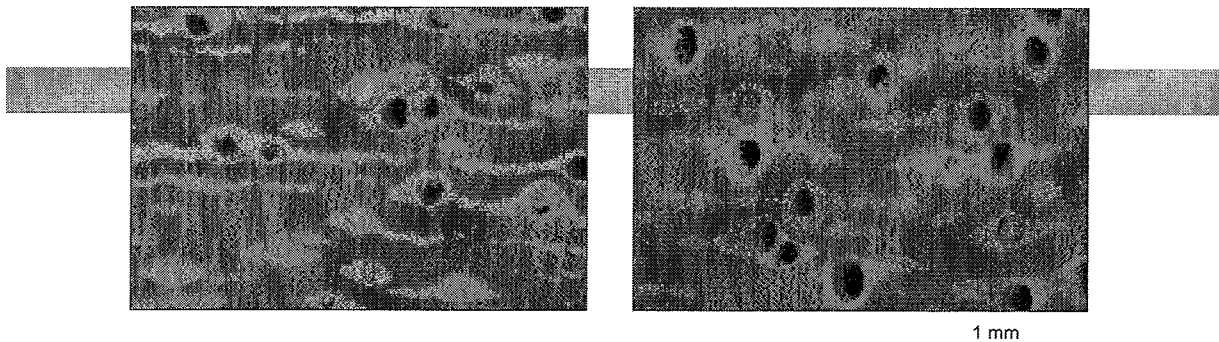
**Pores** medium to very large size, exclusively solitary, distribution low, tyloses present. **Axial parenchyma** is paratracheal, vasicentric, aliform and confluent. **Ray parenchyma** is very narrow to narrow, width less than ¼ of vessel diameter, very high frequency. **Fibre tissue** proportion is medium. Wood is diffuse porous.

#### **Physical Features**

**Heartwood** is yellow-brown or pale-olive, not clearly demarcated from paler **sapwood**, moderately coarse texture. Wood is hard and of **medium to high density**.

#### **Splinter Burning Test**

**Splinter** burns to produce crackle, bright sparks and coloured liquid and forms grey ash.



### Ecology and Silviculture

*Strephonema pseudocola* is an evergreen tree found on river sides and other wet places (Hawthorne, 1995). It regenerates best in shade (Hall & Swaine, 1981).

### Ethnobotany

The bitter seeds are edible and sometimes used to adulterate cola nuts (Abbiw, 1990). **The bark** extract is a remedy for treating diarrhoea. The decoction of the bark, after prolonged boiling with that of *Syzygium*, *Fagara*, *Diospyros* and *Ceiba*, is used for relieve of difficult confinements (Irvine, 1961). A leaf decoction is drunk as a beverage or used as a bath to treat dropsy and inflammation, while the bark is used to treat dystocia (Mshana *et al.*, 2000).

### Recommended Commercial Uses

A **moderately durable wood** promoted for the following uses:

- Handicrafts, carvings and artifacts
- Floorings, steps and stairs
- Boat and canoe construction
- Handles and sporting goods
- Common furniture and cabinet works

***Strombosia glaucescens* Engl.**

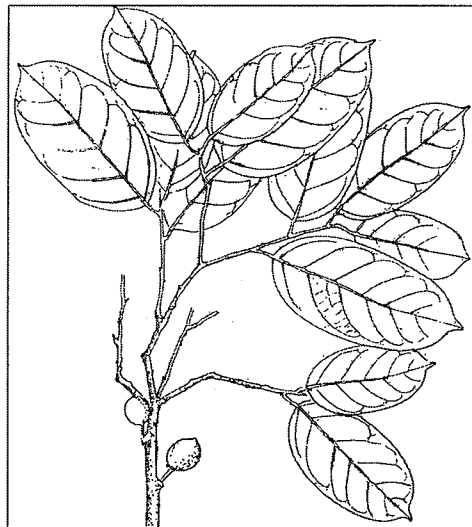
Family Name: **Olacaceae**  
 Trade Names: **Afena; Strombosia**  
 Local Names: **Afena (Gh.); Mukundu (Co, Ga)**

**Synonym**

*S. pustulata* Oliv.

**Distribution**

In West and Central Africa, extending from Sierra Leone to Nigeria and Democratic Republic of Congo (Zaire). Frequently found in Wet and Moist Evergreen, and Moist Semi-deciduous forests of Ghana, but absent from drier forests.

**Status**

A **lesser-used species** of frequent occurrence, insignificant production and occasional export. The prescribed minimum felling diameter is 70 cm. It is cited by IUCN (2004) as a lower risk least concern species.

**Tree Features**

The tree is up to 30 m high and rarely above 2.2 m in girth with a straight bole and a compact crown. The bark is smooth and peels off in flakes. The slash is hard, orange with fine white lines. The leaves are simple, 14-18 cm long and 6-10 cm broad. They are dark-green, shiny, oblong-lanceolate to oblong-elliptic, acuminate at the tip with cuneate base and serrate margins. The flowers are formed in August; they are small,

white with pinkish tinge, and in compact axillary fascicles. The drupe fruits mature in March, each nearly 2 cm in diameter, globose or ellipsoid, purple-black when ripe with a single elliptical vertically wrinkled seed. The species is very similar to *S. pustulata*.

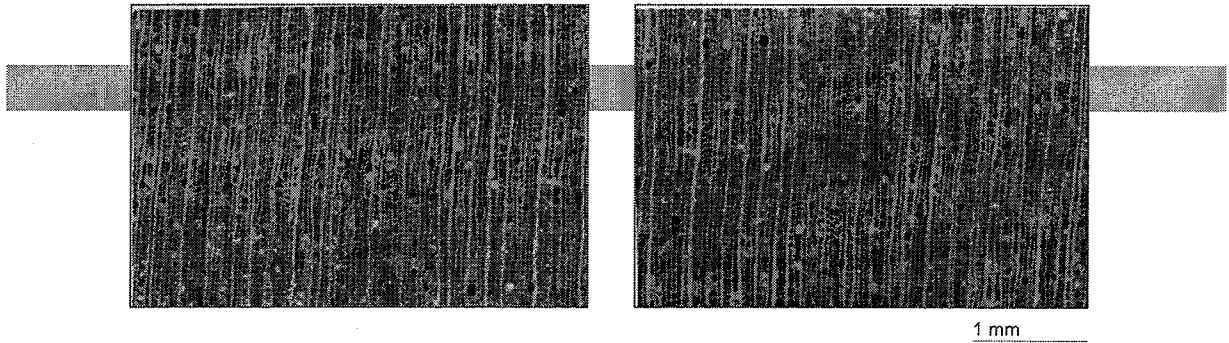
**Wood Macroscopic Features**

Pores are small, proportion of solitary pores medium with same size of 2 to 4 radial multiples, moderate distribution. Axial parenchyma indistinct to the naked eye, apotracheal, diffuse-in-aggregate. Proportion of fibre tissue is low to medium. Ray parenchyma very narrow to narrow, variable, width less than ¼ to full size of vessel diameter, high frequency. Wood is diffuse porous, growth ring boundaries distinct, demarcated by dark ground fibre tissue.

**Physical Features**

Heartwood is brown or pale-brown with purple streaks, clearly demarcated from the paler sapwood, texture fine and moderate lustre.

Wood is hard and of high density.



### **Splinter Burning Test**

**Splinter** burns to produce crackle or bright sparks, exuding coloured liquid and forms grey ash.

### **Ecology and Silviculture**

*Strombosia glaucescens* is an evergreen tree which shows no preference for fertile or infertile soil (Swaine & Veenendal, 1994). Mode of propagation is by seed, dispersed by birds (Taylor, 1960). Germination is epigeal and irregular from 16 to 30 days, with seedlings attaining an average height of 15 cm in a year and about 1 m in 4 years (Taylor, 1960). *Strombosia glaucescens* is a shade bearer, but flourishes in small gaps after sapling stage (Hawthorne, 1995).

### **Ethnobotany**

The leaf-juice is drunk for hiccough. The oil from the seed is used as a laxative and a lubricant for massage (Irvine, 1961).

### **Commercial Uses**

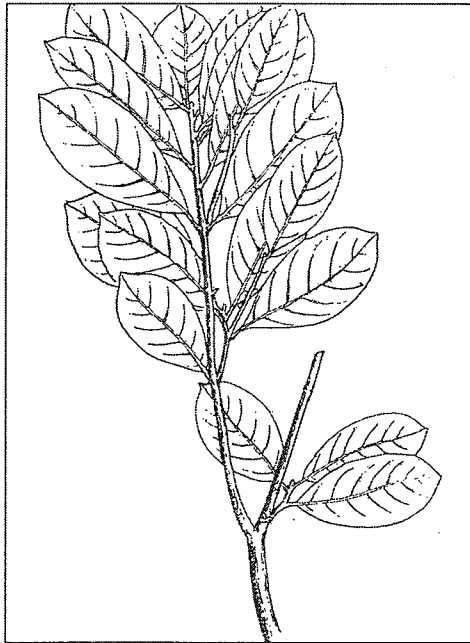
A **durable wood** used for the following:

- Poles, posts and stakes (a major use for high transmission pole in Ghana)
- Heavy industrial structural work, beams, joists and trusses
- Sleepers, crossties, deckings and piles
- Industrial floorings, steps and stairs
- Tool handles
- Vehicle and truck bodies

Family Name: **Combretaceae**  
 Trade Names: **Emeri; Framiré; Emire**  
 Local Names: **Emeri (Gh); Framiré (CI)**

#### **Distribution**

In West Africa, extending from Guinea to Cameroon. Sparsely found in Ghana predominantly in Moist and Dry Semi-deciduous forests.



#### **Status**

A **premium species** of sparse forest availability, high production and regular export. The prescribed minimum felling diameter is 90 cm. It is cited as a vulnerable species by IUCN (2004). The sawdust may have unspecified toxic effects on humans.

#### **Tree Features**

**The tree** is tall and straight up to 50 m and 5 m in girth. **The buttresses** are blunt, extending up the scaly bole which is black, fluted and unbranched up to 25 m with slight taper. **The bark** is dark and has longitudinal fissures with vivid yellow slash. **The leaves** are simple, up to 12 cm long and 7 cm broad, obovate, acuminate at the tip, rough on the under surface, with up to 8 to 9 pairs of prominent lateral nerves. **The white fragrant flowers**, which bloom from February to August, are borne on slender racemes, 10 to 14

cm long, and grouped near the ends of the twigs. **The samara fruits** mature from January to February, and from September to November. Each fruit is up to 9 cm long and 3 cm broad, winged and finely puberulous, containing a **single seed** about 1 cm long and 0.5 cm broad.

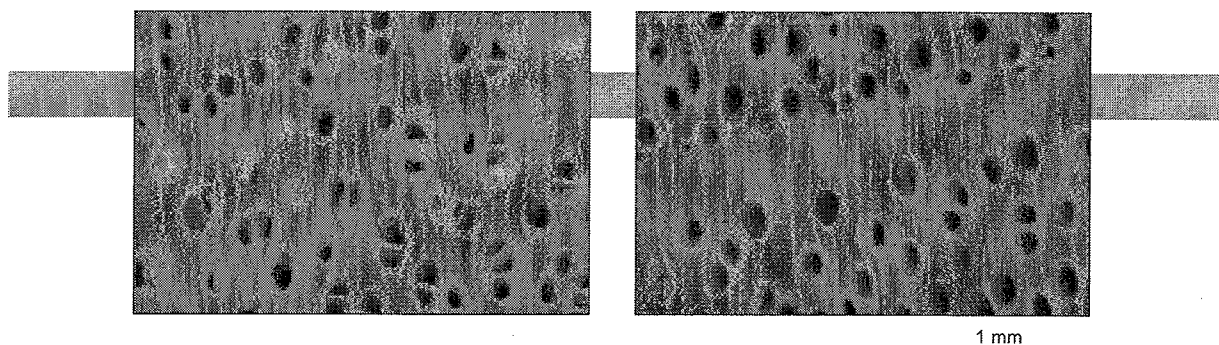
#### **Wood Macroscopic Features**

**Pores** medium to large, proportion of solitary pores medium with 2 to 4 radial multiples of same size, distribution low, tyloses present. **Axial parenchyma** is paratracheal, vasicentric, rarely confluent. **Fibre tissue** proportion is low to medium. **Ray parenchyma** very narrow to narrow, uniform, width  $\frac{1}{4}$  of vessel diameter, distribution moderate. Wood is diffuse porous, **growth ring** boundaries distinct, demarcated by absence of pores and dark ground fibre tissue. Resin canals are present.

#### **Physical Features**

**Heartwood** yellowish-white to pale yellowish-brown, often greenish, not clearly demarcated from **sapwood**, texture medium to fairly coarse with low lustre. Wood is fairly hard and of **medium density**.





### Splinter Burning Test

**Splinter** burns to exude coloured liquid and forms white ash.

### Ecology and Silviculture

*Terminalia ivorensis* is a drought-tolerant deciduous tree common in secondary forests. Larger trees are found in low-lying parts of the Semi-deciduous forest and along roadsides. It is a pioneer species that regenerates only in gaps. Fruits are dispersed by wind and seed germination is epigeal, very irregular, takes about 32 days with 40 % germination rate even if seeds are pre-treated by alternate soaking and drying for a week (Taylor, 1960). Natural abscission accounted for half of fruit abortion, with fungal and insect attack accounting for other half in a plantation in Nigeria (Oni, 1990). Stumped and stripped planting may be used for propagation, but frequent dieback in mono-specific stands has been reported. Natural regeneration is less common and occurs in regenerated forest previously destroyed by fire (Hawthorne, 1994). The branches are self-pruning and growth in gaps is rapid, reaching 80-cm diameter at breast height and 17-m height in 8 years (Taylor, 1960). Widespread dieback in a 30-year-old plantations has been reported in Ghana (Anin Bonsu, 1968; Ofosu-Asiedu & Canon, 1976). The trees are susceptible to attack by all major types of forest tree pests, including insect defoliators, sap feeders and tree borers (Wagner *et al.*, 1991).

### Ethnobotany

The bark yields a yellow dye for dyeing cloth (Abbiw, 1990; Burkill, 1985). A bark decoction is used as a lotion for sores, the pounded bark is sprinkled on ulcerated wounds, and the bark extract is applied as a remedy for rheumatism (Irvine, 1961). The bark is used to treat skin ulcers and wound (Mshana *et al.*, 2000) and venereal diseases (Burkill, 1985).

### Commercial Uses

A **moderately durable wood** used for the following:

- Panellings, claddings and mouldings
- Domestic floorings, stairs and steps
- Joinery, frames, doors and trims
- Doors, furniture and cabinet works
- Domestic roof trusses, joists, beams and domestic structures
- Shakes, shingles and weather boards
- Decorative veneer and plywood

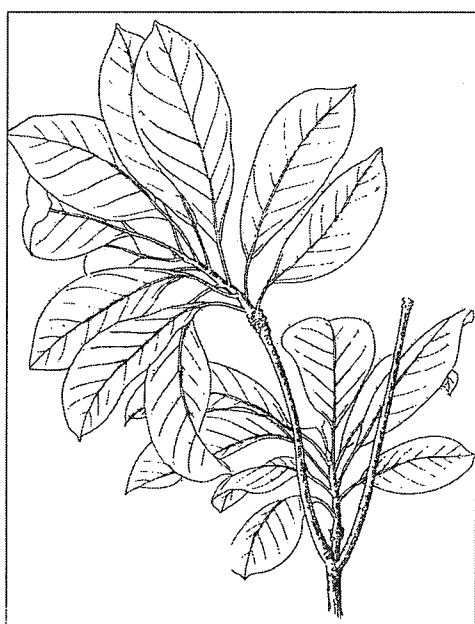
Family Name: **Combretaceae**

Trade Names: **Limba; Fraké; Ofram**

Local Names: **Ofram (Gh); Fraké (CI); Afara (Ni)**

#### **Distribution**

West and Central Africa, extending from Guinea to Angola. Abundant in Ghana predominantly in Moist Evergreen, Moist and Dry Semi-deciduous forests.



#### **Status**

A **commercial species** of abundant occurrence, very high production and very regular export. The prescribed minimum felling limit is 90 cm. It is cited as a lower risk near threatened species by IUCN (2004). The sawdust may cause respiratory problems and dermatitis.

#### **Tree Features**

**The tree** is large up to 50 m high, a girth of 3 m, with a straight bole and a spreading crown. **The buttresses** are up to 2.5 m high. **The bark** is silvery-grey, loose and scaly with yellow slash. **The branching** system is horizontal and almost in regular whorls. **The leaves** are simple, up to 18 cm long and 10 cm broad, obovate, glabrous, acuminate at the tip, and have long petioles. **The yellowish-white flowers** bloom from

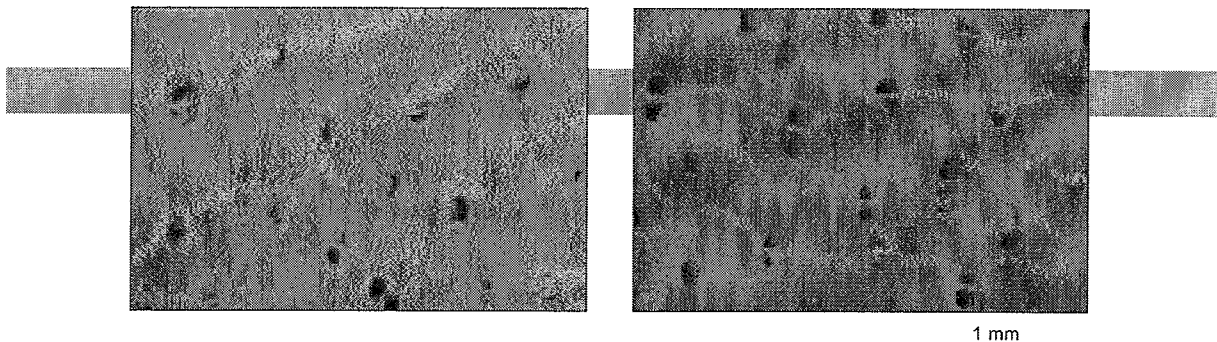
January to June, in loose pendulous axillary spikes 10 cm long. **The samara fruits**, about 3 cm by 6 cm each, mature in November, each being **1-seeded** with two lateral wings.

#### **Wood Macroscopic Features**

**Pores** are large, proportion of solitary pores medium with 2 to 4 radial multiples of same size, occasional clusters of 2 to 4, distribution low with inclusions present. **Axial parenchyma** paratracheal, vasicentric, aliform and confluent, marginal and wavy narrow bands, smaller than fibre tissue bands, irregularly spaced with wide distance between bands. Proportion of **fibre tissue** is medium. **Ray parenchyma** is indistinct to naked eye at transverse but distinct at radial section, very narrow to narrow, uniform width  $\frac{1}{4}$  of vessel diameter, frequency very high. Wood is diffuse porous, **growth ring** boundaries demarcated by dark ground fibre tissue and marginal parenchyma bands.

#### **Physical Features**

**Heartwood** is yellowish-white or blackish-brown stripes or greyish-brown heart. It is not clearly demarcated from **sapwood** except when heartwood has black stripes. Texture is fine to moderately coarse with low lustre. Wood is fairly hard and of **medium density**.



### Splinter Burning Test

**Splinter** burns to exude coloured liquid and forms white ash.

### Ecology and Silviculture

*Terminalia superba* is briefly deciduous and may be almost evergreen in drier forests. It has no preference for wet or dry forests, and is a pioneer and a strong light demander (Hawthorne, 1995). The young plant tolerates slight shade at first, but requires full overhead light for good development. It is propagated by seed dispersed by wind. Germination is epigeal, with an uneven germination period of up to 32 days with a germination rate of about 65 % (Taylor, 1960). Growth is fast after the 1st year. It can also be grown from stumps. It is widely used as a plantation species in Ghana and West Africa where height increment of 1.5 to 3 m has been recorded after 4 years and a girth of 100 cm at breast height after 13 years (Taylor, 1960). Larvae of a common moth feed on seed and fruit while cocoon breeds on the fruit (Wagner *et al.*, 1991).

### Ethnobotany

**The bark** yields a yellow dye (Abbiw, 1990) that is used to treat burns (Mshana *et al.*, 2000). **The bark** is also used for treating pulmonary disorders, and the root as a laxative (Burkill, 1985).

### Commercial Uses

A **non-durable wood** used for the following:

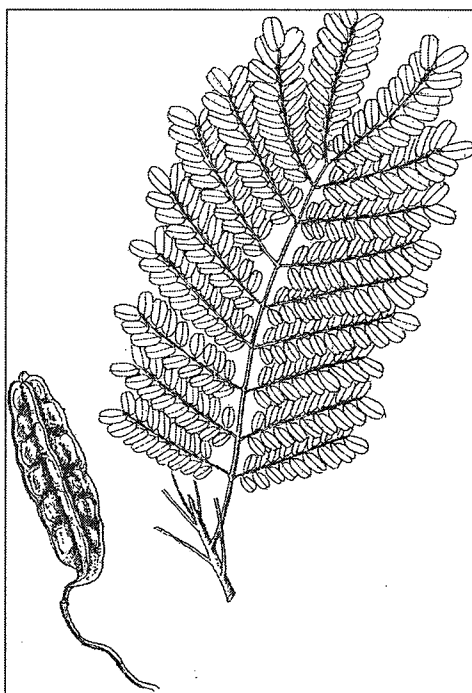
- Furniture and cabinet works
- Interior joinery, frames and trims
- Panellings, claddings and mouldings
- Rotary and decorative veneer and plywood

***Tetrapleura tetraptera* (Schum. & Thonn.) Taub.**

Family Name: **Mimosaceae**  
 Trade Names: **Tetrapleura; Prekese**  
 Local Names: **Prekese (Gh); Akpa (Ca); Esehese (CI)**

**Distribution**

In West and Central Africa, extending from Senegal to Democratic Republic of Congo (Zaire) and Uganda. Sparsely occurs in Moist Evergreen, and Moist and Dry Semi-deciduous forests of Ghana.

**Status**

A **lesser-known species** of rare forest availability with no production. No prescribed minimum felling diameter and 50 cm is recommended. It is cited by IUCN (2004) as a lower risk near threatened species.

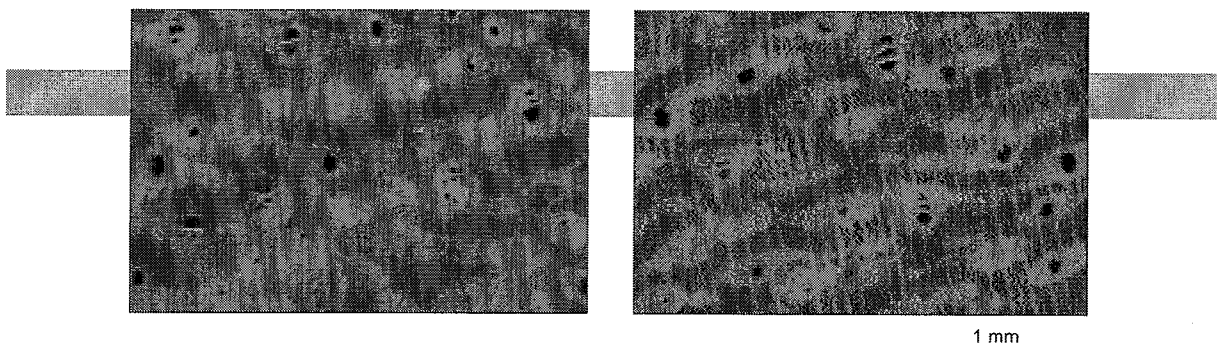
**Tree Features**

The species occur in two forms. A short type, up to 20 m high and 1 m in girth with low branches and flat crown commonly called "female" by local people, is well known for fruit production. The tall "male" type, up to 35 m high and 2.0 m in girth with limited upper branches, is more suitable for production of timber. **The buttresses** of male trees are sharp with dark foliage. **The bark** is thin, smooth and silvery-grey to reddish. **The slash** is pink or orange with white streaks, caramel smell, and a bitter taste. The leaves are bipinnate, very sensitive with 6 to 8 pairs of opposite pinnae. **The leaflets** are 8 to 12

pairs, alternate, each up to 2.5 by 1.5 cm. They are oblong-elliptic with rounded ends. **The flowers** are formed open from March to June, pinkish-cream turning orange. They are either solitary or in paired axillary or terminal racemes up to 8 cm long. **The shiny brown black fruits** are pods, mature in August, up to 22 cm long, oily and aromatic. They are characterized by 4 longitudinal wing-like ridges at right angles to each other. The numerous small **black hard seeds** rattle in the fruit pods which contain oil.

**Wood Macroscopic Features**

**Pores** medium, proportion of solitary pores medium with 2 to 4 radial multiples of same size, distribution low, inclusions present. **Axial parenchyma** is paratracheal, aliform and confluent, forming broad wavy bands. **Fibre tissue** proportion is medium. **Ray parenchyma** is indistinct to the naked eye, very narrow, less than ¼ of vessel diameter, high frequency. Wood is diffuse porous, **growth rings** demarcated by dark ground fibre tissue and absence of pores.



### Physical Features

**Heartwood** is pale-red darkening to yellow-red or brown. It is clearly demarcated from the white or grey **sapwood** with fine texture.

Wood is hard and of **medium density**.

### Splinter Burning Test

**Splinter** burns to produce crackle or bright sparks and forms white ash.

### Ecology and Silviculture

*Tetrapleura tetraptera* is a deciduous tree with widespread distribution except in drier forest types. It is common in secondary and fringing forests. It is a pioneer species with a regeneration that is strongly light demanding. The fruits are indehiscent and their smell attracts small animals. It is propagated by seed, dispersed by rodents and elephants (Lieberman *et al.*, 1987). Seeds germinate in shade and is epigeal. Germination takes up to 56 days, but it is enhanced to 10 days with 90 % germination rate when seeds are treated with concentrated sulphuric acid (Hawthorne, 1995). Most sizes of the tree more abundant in fire-disturbed regenerated forests (Hawthorne, 1994).

### Ethnobotany

The fruits are commonly used in flavouring soup, while the pod ashes are used as salt substitute and in soap making (Abbiw, 1990). The bark extract is used in enemas for constipation and in treating gonorrhoea, and a decoction as an emetic (Irvine, 1961). The fruit pods are used as bait for catching fish. The bark is used for treating gastric ulcer and dysentery, while the fruit is used for malaria (Mshana *et al.*, 2000).

### Recommended Commercial Uses

The wood of the "tall" type is **moderately durable**, and is promoted for the following uses:

- General handicrafts
- Domestic floorings, steps and stairs
- Common furniture and cabinet works
- Core veneer and plywood
- Poles, posts and stakes
- Boat construction

## ***Tieghemella heckelii* Pierre ex A. Chev.**

Family Name: **Sapotaceae**  
Trade Names: **Makore; Baku**  
Local Names: **Baku (Gh); Makore (CI)**

### **Synonym**

*Dumoria heckelii* A. Chev.

### **Distribution**

West and Central Africa, extending from Sierra Leone to Nigeria. Sparsely distributed in Evergreen and Moist Semi-deciduous forests of Ghana.



### **Status**

A **premium species** of sparse forest availability, with high production for regular export. The prescribed minimum felling diameter is 110 cm. It is one of two species cited by IUCN (2004) as an endangered species. A special felling permit was instituted in 1998 with limited success. The sawdust may have acute respiratory problems and can cause dermatitis.

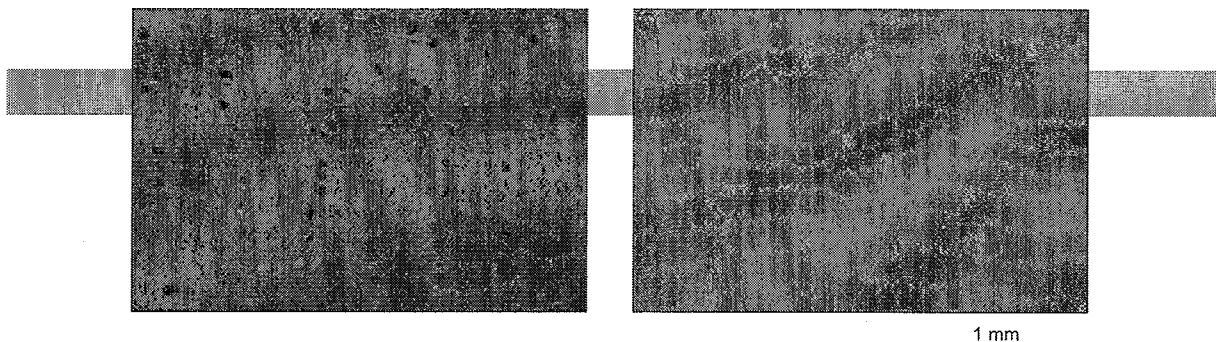
### **Tree Features**

The tree is up to 60 m high, 10 m in girth with unbuttresses a cylindrical bole up to 30 m. The species has the biggest growing timber in Ghana with a girth of 10.1 m at DBH and a height of 64 m growing in the moist semi-deciduous forest near Oda. The bark is thick, grey and fissured with longitudinal ridges exuding white latex. The slash is bright-pink and fibrous. The leaves are simple, about 15 cm long and 7.5 cm broad, obovate, dark-green and shiny with

numerous faint lateral nerves. The small and **scented flowers**, formed from January to April, are white and glabrous outside, being crowded at the tips of the branchlets. The **yellow berry fruits** mature from August to September, greenish-yellow, 10-13 cm long and 8-10 cm broad. The pulp is yellow with unpleasant smell and contains a single boat-shaped seed 6 cm long. One half of the seed is shiny while the other half is rough and dull.

### **Wood Macroscopic Features**

**Pores** are small to medium size, proportion of solitary pores medium with same size of 2 to 4 radial multiples, few clusters, diagonally arranged, distribution low, tyloses present. **Axial parenchyma** indistinct to the naked eye, reticulate wavy bands, very narrow, smaller than fibre tissue bands, irregularly to regularly spaced with narrow distance between bands.



**Fibre** tissue proportion is low. **Ray parenchyma** is indistinct at transverse section, distinct at radial, very narrow, uniform width between  $\frac{1}{4}$  and  $\frac{1}{2}$  of vessel diameter, moderate frequency. Wood is diffuse porous.

#### Physical Features

**Heartwood** is pinkish-brown to dark red-brown, clearly demarcated from the white to pale-pink **sapwood**, fine to moderately coarse texture with low lustre.

Wood is hard and of **medium density**.

#### Splinter Burning Test

**Splinter** burns to produce crackle, bright sparks and forms grey ash.

#### Ecology and Silviculture

*Tieghemella heckelii* is an evergreen tree which prefers fairly heavy but well-drained soil and is uncommon in drier forest. It is easily propagated by seed dispersed by rodents (Taylor, 1960) and elephants (Alexandre, 1978). Germination in shade is epigeal but saplings have rapid growth when exposed to light (Hawthorne, 1995). Mackay (1953) in Nigeria, recorded a height growth of 30 m with a girth of 1 m in a 22-year-old plantation. Poor regeneration of the species is attributed to possible decline in elephant population (Hall & Swaine, 1981; Voorhoeve, 1965).

#### Ethnobotany

The seed oil is used for making local soap, pomade and for cooking (Abbiw, 1990). The bark decoction is used as a mouthwash for treating toothache and the seeds as fish poison (Irvine, 1961).

#### Commercial Uses

A **very durable wood** used for the following:

- Carvings, artifacts and handicrafts
- Panellings, claddings and mouldings
- Floorings, steps and chairs
- Decorative furniture and cabinet works
- Interior and exterior joinery, frames and trims
- Decorative veneer and plywood
- Sporting goods and handles
- Vehicle and truck bodies

Family Name: **Meliaceae**  
 Trade Names: **Trichilia; Tandro**  
 Local Name: **Tandro** (Gh)

#### **Synonym**

*T. heudelotii* Planch. ex Oliv.

#### **Distribution**

In West and Central Africa, extending from Guinea to Democratic Republic of Congo (Zaire). Moderately found in Ghana in Wet and Moist Evergreen, Moist and Dry Semi-deciduous forests and southern part of Savanna woodland.



#### **Status**

A **lesser-known species** of moderate forest availability with no reported production. No prescribed minimum felling diameter and 50 cm is recommended. It is cited by IUCN (2004) as a lower risk least concern species.

#### **Tree Features**

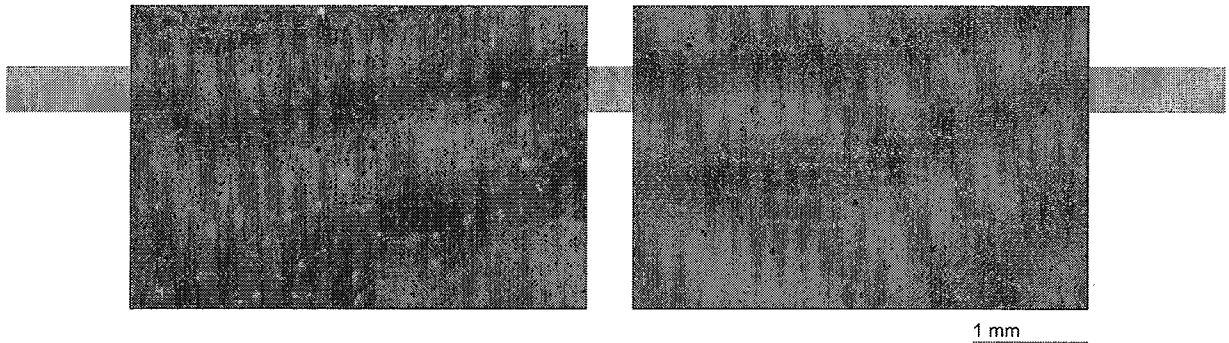
A medium size evergreen tree up to 20 m high and 2 m in girth with a straight bole and spreading brown-tomentose crown. **The bark** is brown and **the slash** is dark with white latex. **The leaves** are pinnate, up to 38 cm long with 4 to 7 pairs of leaflets 15 cm by 5 cm, ending in a single terminal leaf. They are oblong or oblanceolate to obovate, acuminate tip with rounded base and numerous lateral nerves with short pubescent below. **It flowers** from February to May and in August, producing whitish or greenish-yellow flowers, scented, funnel-shaped, and in axillary

panicles. **The capsular fruits** are in clusters, obovoid-globose, up to 2.5 cm in diameter with fine hairs, pale-green, tinged with pink when ripe with about 7 seeds in a fruit. The **seeds** are large, black and shiny with red aril.

#### **Wood Macroscopic Features**

**Pores** small, proportion of solitary pores high, with 2 to 4 radial multiples of same size, distribution moderate. **Axial parenchyma** indistinct to the naked eye, paratracheal, vasicentric, aliform, wavy or narrow straight bands smaller than fibre tissue bands, irregularly spaced with narrow distance between bands. **Fibre tissue** proportion is high. **Ray parenchyma** is very narrow, uniform width, between ¼ and full size of vessel diameter, frequency high. Wood is diffuse porous.





### Physical Features

**Heartwood** whitish-cream to golden-yellow, not demarcated from the **sapwood**; texture is moderately coarse. Wood is fairly hard and of **medium density**.

### SplinterSplinter Burning Test

**Splinter** burns to exude coloured liquid and forms white ash.

### Ecology and Silviculture

*Trichilia monadelpha* is an evergreen lower-storey tree common at the forest edge. It is propagated by seed and germinates under shade, but saplings require light to grow (Hall & Swaine, 1981). Regeneration is more abundant in undisturbed forest (Hawthorne, 1994).

### Ethnobotany

The reddish-brown dye is used for dyeing cloth and hides (Abbiw, 1990). A decoction of the bark is used as aphrodisiac and for treating sores, stomach pains and gonorrhoea while leaf decoction is used to treat heart ailments (Irving, 1961).

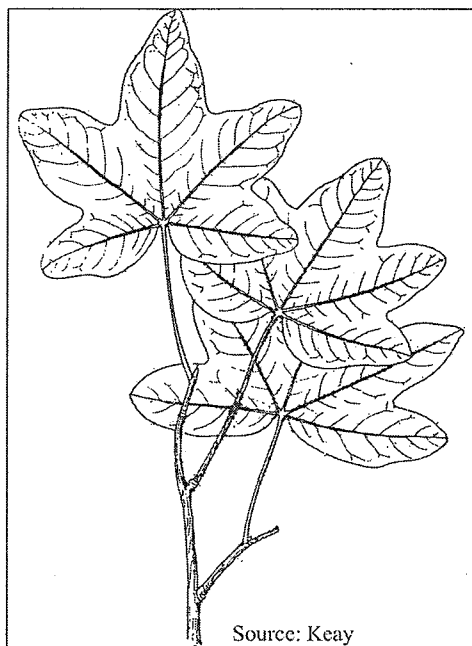
### Recommended Commercial Uses

A **fairly durable wood** promoted for the following uses:

- Packing cases
- Furniture and cabinet works
- Exterior structures, beams and joists
- Internal joinery, frames and doors
- Claddings, panellings and mouldings
- Floorings, parquets, steps and chairs
- Piles, posts and poles

***Triplochiton scleroxylon* K. Schum.**Family Name: **Sterculiaceae**Trade Names: **Obeche; Wawa; Ayous; Samba**Local Names: **Wawa (Gh.); Samba (CI); Ayous (Ca); Obeche (N)****Distribution**

In West and Central Africa, extending from Guinea to Democratic Republic of Congo (Zaire). Abundant in Ghana in all major forest types, except Wet and Upland Evergreen forests.

**Status**

A **premium species** of abundant forest availability, extremely high production with frequent export. The prescribed minimum felling diameter is 90 cm. The species has, for many years, been the leading export timber from Ghana (and Côte d'Ivoire). It is cited by IUCN (2004) as a lower risk near threatened species. The sawdust may cause respiratory problems and dermatitis.

**Tree Features**

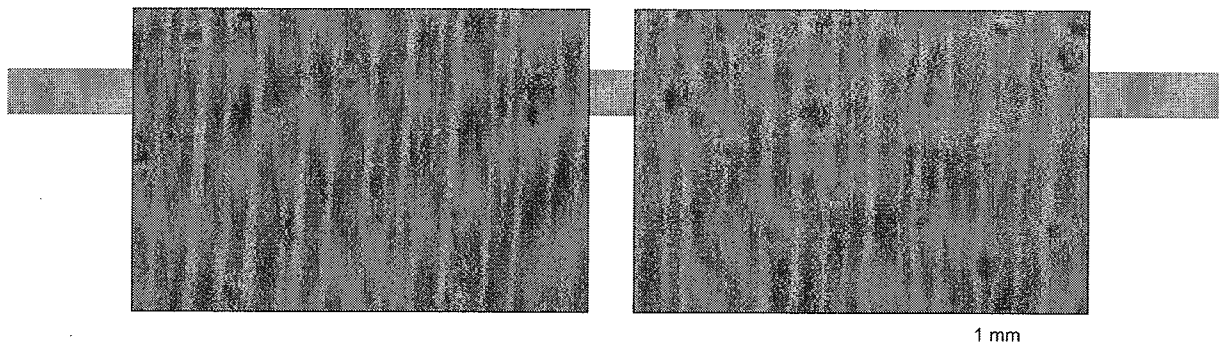
The tree is up to 50 m high and 3.5 m in girth. The **bole** is straight and unbranched up to 25 m. It has extensive sharp buttresses extending about 8 m up the trunk. The **bark** is grey to orange, smooth at first but becoming scaly later. The slash is fibrous. The **leaves** are simple palmate, usually 5-7 lobed, about 8 cm long and 10 cm broad. The margin is entire, cordate and glabrous.

with a petiole about 4 cm long. The **flowers** are hermaphrodite, formed from November to March when the tree is leafless. They are scented, each measuring about 3 cm in diameter, with few flowers on each inflorescence. The calyx is brown-velvety and the petals are white. The **fruit**, a samara, matures in March with unilateral brown wing measuring about 6 cm by 2 cm.

**Wood Macroscopic Features**

**Pores** medium to large, proportion of solitary pores high, with 2 to 4 radial multiples of same size, diagonal pattern, distribution low, tyloses and inclusions present. **Axial parenchyma** indistinct to the naked eye, apotracheal diffuse-in-aggregate, marginal and straight narrow bands smaller than fibre tissue bands, irregularly spaced with wide distance between bands.

**Fibre tissue** proportion is very low. **Ray parenchyma** is very narrow to broad, variable, width less than  $\frac{1}{4}$  to  $\frac{1}{2}$  of vessel diameter, moderate frequency. Wood is diffuse porous, **growth ring** boundaries demarcated by dark ground fibre tissue and marginal parenchyma.



### Physical Features

**Heartwood** is white to pale-straw, not clearly demarcated between **sapwood** and heartwood. Texture is moderately coarse with silver figure, low lustre, and distinct smell when fresh. Wood is fairly soft and of **low density**.

### Splinter Burning Test

**Splinter** burns to produce crackle, bright sparks and forms grey ash.

### Ecology and Silviculture

*Triplochiton scleroxylon* is a deciduous tree found on base-rich soils of high pH (Hall & Swaine, 1981). It prefers moist and dry infertile forests (Swaine, 1996), and grows poorly in soil from Wet Evergreen forest (Veenendaal *et al.*, 1996). It is propagated using stump and seed (Taylor, 1960), but seed production is sporadic and unpredictable with short viability. Germination of seed is epigeal and takes about 6 to 15 days with a germination rate of about 55 % (Taylor, 1960). It is a pioneer species and requires light to grow at sapling stage. Seedling growth is rapid, 3 m in a year and 8 m with 40 cm dbh in 3 years (Taylor, 1960). Regeneration is better in logged forest, and height growth of 15 m with a girth of 15 cm at breast height within 4 years have been recorded (Hawthorne, 1993). Seedling infestation by *Diclidophlebia* insect is greatest in slightly shaded plants but less severe in fully exposed or fully shaded plants (Osisanya, 1970). Seedlings are defoliated by the caterpillar of *Anaphe venata* while stumps are liable to attack by termites (Taylor, 1960). Various types of insect defoliators, sap feeders, tree borers and other pest on flower, fruit and seed pests have been reported by Wagner *et al.* (1991).

### Ethnobotany

The bark is used for roofing huts (Abbiw, 1990). A decoction of the root-bark is given to pregnant women for oedemas (Irvine, 1961; Mshana *et al.*, 2000).

### Commercial Uses

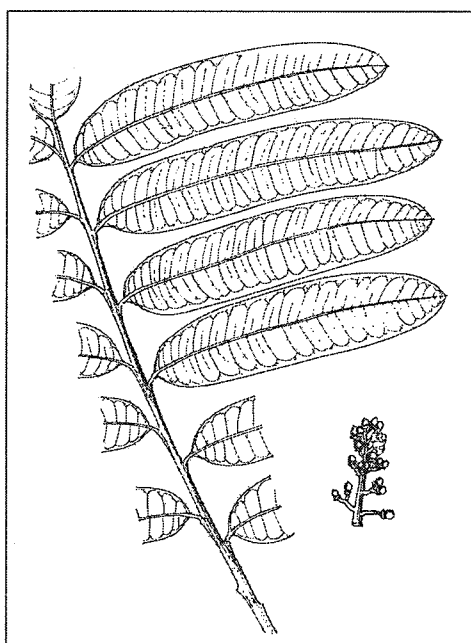
A **non-durable wood** used for the following:  
 Internal panellings, mouldings and claddings  
 Common utility furniture and cabinet works  
 Particle, chip and flake boards  
 Core veneer and plywood  
 Toys

***Turraeanthus africanus* (Welw. ex C. DC.) Pellegr.**

Family Name: **Meliaceae**  
 Trade Name: **Avodiré**  
 Local Names: **Apapaye (Gh); Avodiré (Cl); Lusamba (Za)**

**Distribution**

West, Central and East Africa, extending from Sierra Leone to Angola, Democratic Republic of Congo (Zaire) and Uganda. Frequently distributed in Ghana in Moist Evergreen and Moist Semi-deciduous (South-East subtype) forests.

**Status**

A **commercial species** of frequent forest availability, moderate production for irregular export. The prescribed minimum felling diameter is 70 cm, and is cited by IUCN (2004) as a vulnerable species. The sawdust may cause dermatitis.

**Tree Features**

**The tree** is evergreen up to 40 m high, and a girth of 3 m with heavy dark foliage and large buttresses. **The bark** is grey with papery skin, stripped off in thin pieces. **The slash** is pale-yellow, with orange speckles and distinctive characteristic cedar-like odour. **The branchlets** are covered with rusty scales. **The leaves** are pinnate, with shiny leaflets, oblong with a curious twist at the end of each leaflet. There are about 7 to 11 pairs of leaflets, 20 cm long and 5 cm broad. **The flowers** are yellow formed in

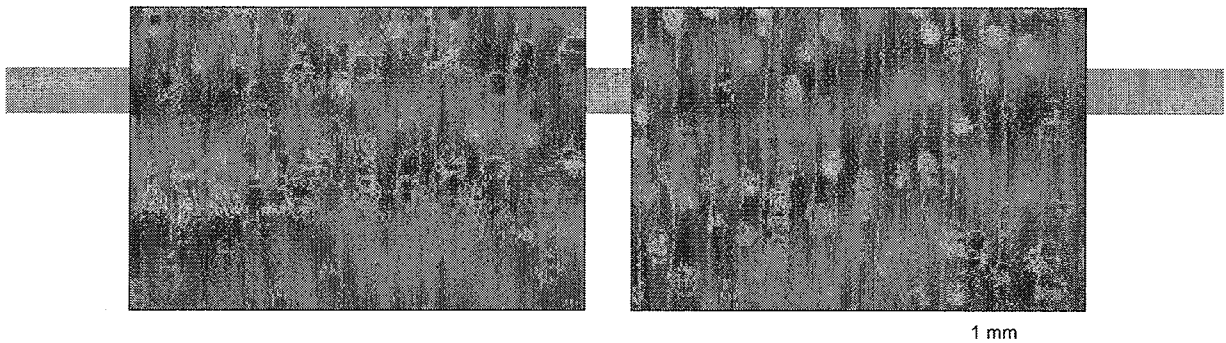
June in axillary panicles about 10 cm long. **The fruits** are almost spherical capsules, mature from March to September, 3-celled each containing 4 to 5 oblong seeds surrounded by a sweet-tasting pulp.

**Wood Macroscopic Features**

**Pores** are small, proportion of solitary pores medium, with 2 to 4 radial multiples of same sizes, some clusters of 2 to 4, moderate distribution with inclusions. **Axial parenchyma** is not distinct to naked eye and with hand lens. **Fibre tissue** proportion is medium to high. **Ray parenchyma** is uniform, very narrow,  $\frac{1}{4}$  to  $\frac{1}{2}$  of vessel diameter, moderate frequency. Wood diffuse porous, **growth rings** demarcated by dark ground fibre tissue and absence of pores.

**Physical Features**

**Heartwood** creamy-white to pale-yellow, darkening to golden-yellow, not clearly demarcated from **sapwood**. It has fine texture with high lustre. Wood is moderately hard and of **medium density**.



### **Splinter Burning Test**

**Splinter** produces crackle or bright sparks and forms grey ash.

### **Ecology and Silviculture**

*Turraeanthus africanus* is evergreen and gregarious, avoiding very wet and dry sites. It is propagated by seed, dispersed by animals and germinates under shade (Alexandre, 1977). Germination is hypogeal, up to 36 days although 15 to 18 days have been recorded at a rate of 85 % after 6 weeks (Taylor, 1960). It is a shade bearer (Hawthorne, 1995) and young seedlings are abundant in forest shade, but growth is best under small gaps (Alexandre, 1977). Height growth is rapid, 40-50 cm in 18 months and 1-1.75 m in 3 years (Taylor, 1960). Regeneration is more abundant in forest not disturbed by fire (Hawthorne, 1984).

### **Ethnobotany**

The bark, leaves and seed oil are used for poisoning fish; the seed oil alone is used for poisoning grasscutters, a favourite bush meat in West Africa (Irvine, 1961).

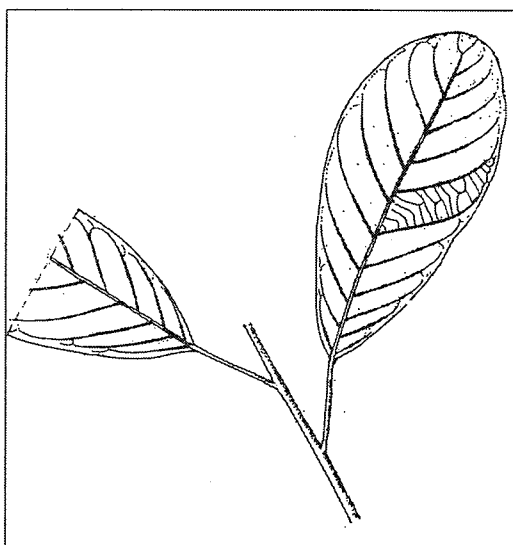
### **Commercial Uses**

**A non-durable wood** used for the following:

- Interior panellings, mouldings and claddings
- Decorative furniture and cabinet works
- Decorative veneer and plywood

***Uapaca guineensis* (Don.) Müll. Arg.**Family Name: **Euphorbiaceae**Trade Names: **Uapaca; Kontan**Local Names: **Kontan (Gh); Rikio (CI); Assam (Ca, Ga)****Distribution**

Evergreen and Semi-deciduous forests of West and Central Africa, extending from Sierra Leone to Gabon and Democratic Republic of Congo (Zaire). Sparsely found in Wet and Moist Evergreen and Moist Semi-deciduous forests of Ghana.

**Status**

A lesser-known species of sparse forest availability, not yet exploited. No prescribed minimum felling diameter and 50 cm is recommended. It is cited by IUCN (2004) as a lower risk least concern species.

**Tree Features**

The tree is 30 m high and rarely above 2 m in girth, with a bole up to 13 m with stilt roots system. The bark is reddish-grey and warty with longitudinal cracks. The slash is red and exudes a red sticky sap that dries to form gum. The leaves are simple, over 30 cm long and 15 cm broad, thin and papery. They are borne on long petioles near the ends of the

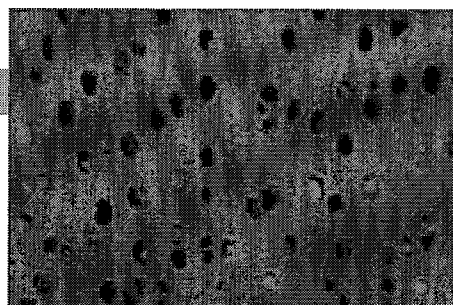
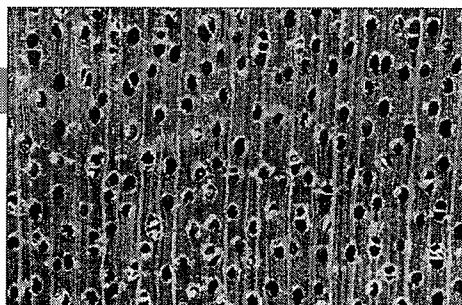
twigs. They are ovate or oblanceolate and either rounded at the tip or obtusely pointed. The leaves are cuneate at base with 6 to 11 pairs of lateral nerves. The greenish-yellow flowers are formed in May and from November to December. The berry fruits are globose and mature in February. They are on short stalks about 2.5 cm in diameter, and are yellowish-red when ripe with 3 to 4 seeds embedded in sweet pulp in the fruit.

**Wood Macroscopic Features**

Pores medium, proportion of solitary pores high with 2 to 4 radial multiples of same size, few clusters of 2-4, moderate distribution with tylosis. Axial parenchyma is indistinct to the naked eye and not visible with hand lens. Fibre tissue proportion is high. Ray parenchyma is barely visible, very narrow, uniform width between  $\frac{1}{4}$  and  $\frac{1}{2}$  size of vessel diameter, moderate frequency. Wood is diffuse porous.

**Physical Features**

Heartwood is pale-red to red-brown, not clearly demarcated from paler sapwood, texture coarse with moderate lustre. Wood is hard and of high density.



1 mm

### Splinter Burning Test

**Splinter** burns to exude coloured liquid and forms grey ash.

### Ecology and Silviculture

*Uapaca guineensis* is an evergreen tree found in well-drained moist soil and along river banks, but not on permanently swampy sites. Development of stilt roots is hastened by wet soil conditions (Taylor, 1960). Seedlings are shade-tolerant but saplings may require some light to grow (Hawthorne, 1995). Fruit is dispersed by elephants (Martin, 1991). It forms ectotrophic mycorrhizae with nine fungal species in Guinea (Ba, 1987; Theon & Ducousso, 1989). Kahn (1982) records a 30-cm breast height diameter in a 40-year-old tree from secondary forest.

### Ethnobotany

The fruits are edible and are also relished by snails. The roots are used as an aphrodisiac. The unripe fruits are taken for cough remedy, while the bark and flowers are ingredients for preparing arrow poison (Irvine, 1961). The bark alone is used for enemas, as an emetic, or in lotions for skin troubles.

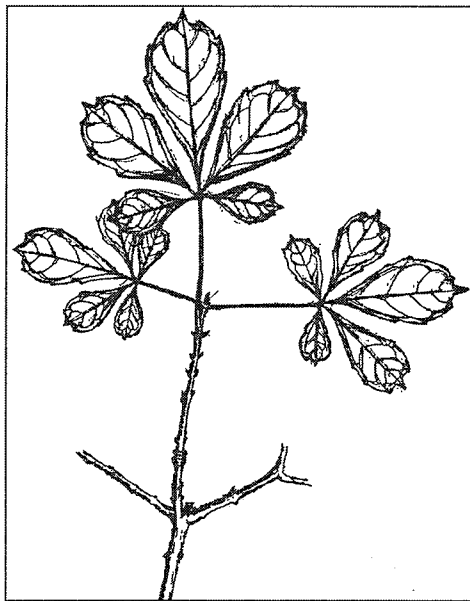
### Recommended Commercial Uses

A **very durable wood** promoted for the following uses:

- Roof trusses, joists and beams
- Floorings, parquets, steps and stairs
- Vehicle and truck bodies

***Xylopia quintasii* Engl. & Diels**Family Name: **Annonaceae**Trade Names: **Xylopia; Obaa**Local Names: **Obaa (Gh); Elo (CI); Mvomba (Ca)****Synonyms***Polyalthia mayubensis* Exell*Xylopia striata* Eng.**Distribution**

West and Central Africa, extending from Sierra Leone to Democratic Republic of Congo (Zaire). Sparsely found in Evergreen and Moist Semi-deciduous forests of Ghana.

**Status**

A lesser-known species of sparse forest availability, yet to be exploited. It has no prescribed minimum felling diameter and 50 cm is recommended. It is cited by IUCN (2004) as a lower risk least concern species.

**Tree Features**

The tree is evergreen, 30 m high with a girth of about 1.8 m. It has a clean straight bole up to 18 m, fluted at the base with short buttresses. The crown is slender with a horizontal branching system. The bark is dark-grey to brown and fairly smooth but peels off in scales. The slash is olive-brown and slightly fragrant. The leaves are simple, reddish when young, up to 12 cm long and 6 cm broad, obovate, acuminate at the tip with entire margin, brown underside, showing 6 to 8 pairs of lateral nerves. The small creamy-

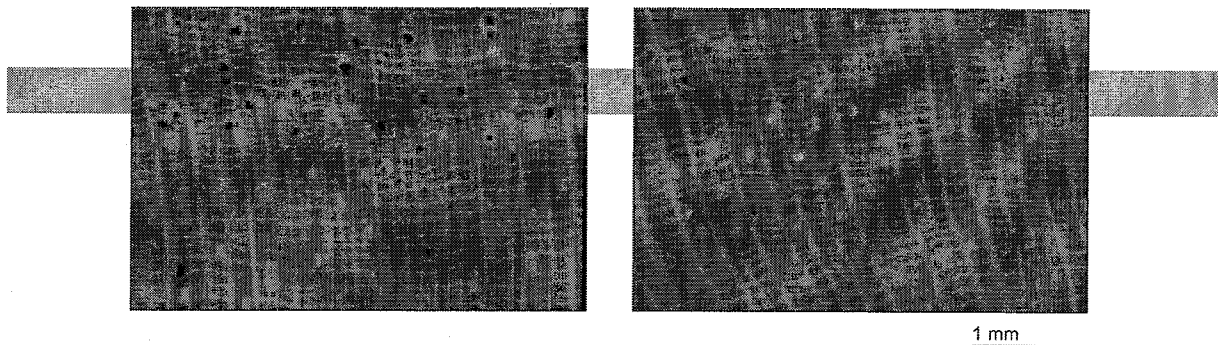
white flowers are formed in December and from January to May, in clusters in the axils of the leaves. Mature fruits are red, 3-5 finger-like carpels about 5 cm long and 1.5 cm broad, maturing from June to September. Each fruit contains 2 to 4 brown smooth seeds, each measuring about 1.5 cm long and 0.8 cm broad covered by red-brown aril.

**Wood Macroscopic Features**

Pores are small, exclusively solitary with low distribution. Axial parenchyma apotracheal, reticulate or scalariform, marginal and banded, regularly spaced, very narrow bands smaller than fibre tissue bands, narrow distance between bands, marginal parenchyma present.

Proportion of fibre tissue is low to medium. Ray parenchyma is variable, very narrow to narrow, between ¼ to full size of vessel diameter, moderate to high frequency. Wood diffuse porous, growth ring boundaries demarcated by differences in pore diameter and dark ground fibre tissue.





### Physical Features

**Heartwood** yellow to brown, clearly demarcated from paler **sapwood**. Wood is hard and of high density.

### Splinter Burning Text

**Splinter** burns to exude coloured liquid and forms yellow-brown ash.

### Ecology and Silviculture

*Xylopia quintasii* is evergreen tree not found in drier forest. It is a shade bearer (Hawthorne, 1995) growing near moist sites but does not inhabit swamps (Taylor, 1960). It regenerates in shade and trees are more abundant in forest not damaged by fire (Hawthorne, 1994).

### Ethnobotany

The roots are used as aphrodisiac in Equatorial Guinea. The inner bark, when beaten, is used as a mouthwash in Liberia, while the smoke-dried fruits are used as medicine for common ailment (Irvine, 1961). The roots are used for treating anaemia (Mshana *et al.*, 2000). The bark and flowers are used as ingredients for arrow poison in Nigeria. The unripe fruit is used as medicine for treating cough. The root is used to treat skin diseases and pulmonary complications (Burkill, 1985).

### Recommended Commercial Uses

A **moderately durable wood** promoted for the following uses:

- General handicrafts and carvings
- Poles, posts and stakes
- Floorings, parquets, steps and stairs
- Sporting goods and handles
- Vehicle and truck bodies

Family Name: **Rutaceae**

Recommended Trade Names: **Zanthoxylum, Okuo**

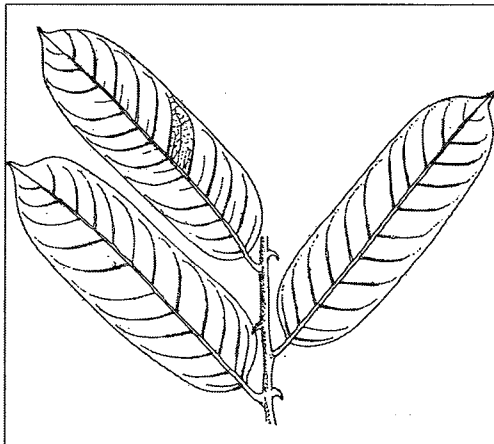
Local Name: **Okuo (Gh)**

#### **Synonym**

*Fagara macrophylla* Engl

#### **Distribution**

West, Central and East Africa, extending from Sierra Leone to Angola, Democratic Republic of Congo (Zaire) and Uganda. Sparsely found in Ghana scattered in Dry Semi-deciduous forest and Savanna woodland.



#### **Status**

A **lesser-known species** of sparse forest availability with insignificant production for local use only. The prescribed minimum felling diameter is 70 cm. It is cited by IUCN (2004) as a lower risk least concern species.

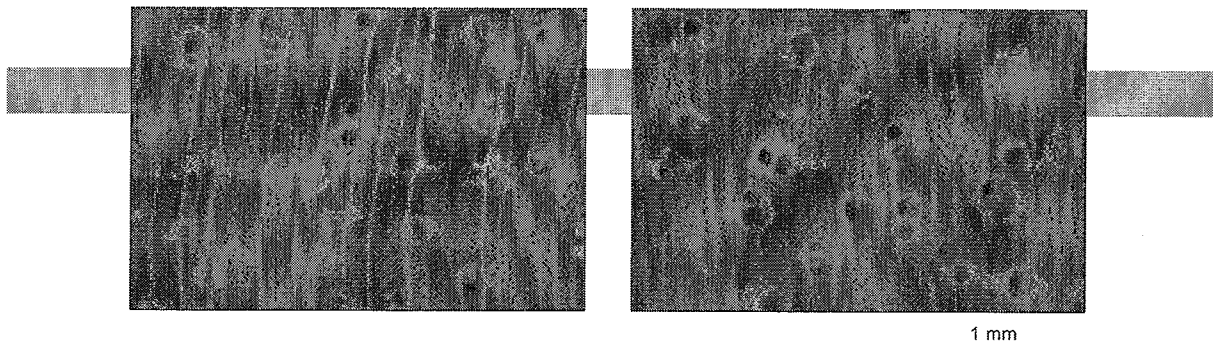
#### **Tree Features**

**The bole** is evergreen up to 30 m high and 2 m in girth. **The bark** is straight, characterized by large corky thorns on the trunk and on the branches. **The leaves** yields gum. **The leaves** are pinnate, large, 20 cm to 1 m long with 15 to 50 leaflets,

elongated-oblong, 10-25 cm long and 3-8 cm broad with spines on the leaf stalk. They are unequal-sided with a cordate base with numerous lateral nerves and spines below rachis and midrib. The leaf and flower stalks are also armed with straight spines about 5 mm long. **The flowers** are formed in June in large lax panicles. They are sessile, reddish-brown, and colonized with ants. **The red fruits** are capsules and suborbicular, about 1 cm in diameter with a peppermint scent and taste. **The seeds** are small, round and black with one seed in a fruit.

#### **Wood Macroscopic Features**

**Pores** are medium to large, proportion of solitary pores medium with 2 to 4 radial multiples of same size, distribution low, inclusions and resin canals present. **Axial parenchyma** is paratracheal, vasicentric, rarely aliform, marginal and narrow bands, irregularly spaced with wide distance between bands. Proportion of **fibre tissue** is medium to high. **Ray parenchyma** is variable, width very narrow to narrow,  $\frac{1}{4}$  to  $\frac{1}{2}$  full vessel diameter, moderate frequency. Wood is diffuse porous, **growth rings** demarcated by dark ground fibre tissue and marginal parenchyma.



### Physical Features

**Heartwood** pale-yellow or greenish-yellow, not demarcated from **sapwood**, texture fine with pleasant odour. Wood is hard and of medium to **high density**.

### Splinter Burning Test

**Splinter** burns to produce crackle or bright sparks and forms yellow-brown ash.

### Ecology and Silviculture

*Zanthoxylum gillettii* is an evergreen tree with short viable seeds dispersed by birds (Hall & Swaine, 1981; Savill & Fox, 1967). Germination is epigeal and growth is fast (Taylor, 1960). Seedlings are more common in gaps (Hawthorne, 1995) and sapling is unbranched, with a small crown and numerous spines on the stem, being more abundant in regenerated forest previously destroyed by fire (Hawthorne, 1994). Kahn (1982) recorded 50 – cm diameter at breast height in a 40-year-old tree from secondary forest, but a diameter of 105 cm for a 29-year-old plantation tree.

### Ethnobotany

Bark extracts have anti-leukaemia properties (Abbiw, 1990). Root bark tastes like peppermint and is rubbed on gums to ease toothache while the young shoot, crushed and steeped in lemon-juice, is used for heart palpitation (Irvine, 1961). The bark is used for treating backache, genito-urinary pains, rheumatism, and lumbago (Irvine, 1961).

### Recommended Commercial Uses

A **moderately durable wood** used for the following:

- Furniture and cabinet works
- Decorative veneer for plywood
- Floorings, parquets and steps
- Joinery, frames and trims
- Panellings, claddings and mouldings
- Vehicle bodies



## **CHAPTER 5: DICHOTOMOUS AND COMPUTER-AIDED WOOD IDENTIFICATION**

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### **5.1 METHODS OF WOOD IDENTIFICATION**

The four most frequently used wood identification methods are identification by comparison, dichotomous keys, multiple entry keys and more recently computer-aided identification. These four methods have been extensively reviewed by Wheeler & Baas (1998) and only short summaries are provided in this book.

#### **5.1.1 Identification by Comparison**

In identification by comparison, macroscopic, microscopic and physical features of the unknown wood species are compared with the same features of authentically identified wood species from a xylarium. The species that closely matches the unknown species is chosen as the name for the unknown. This method has been used for about 100 years by many authors including Pashin & de Zeeuw (1980), Schweingruber (1978), Wagenfuhr (1966) and Oteng-Amoako (1998) for timbers of Papua New Guinea.

#### **5.1.2 Dichotomous Identification**

The dichotomous identification method involves a series of paired contrasting diagnostic features for each dichotomy, out of which one of the choices applies to the unknown wood species. The key then directs the user to the next dichotomy of two diagnostic choices with one of them applying, again to the unknown timber. The process is continued until finally a name of the unknown species, species group, genera or family is reached (Wheeler & Baas, 1998). The starting point and sequence of the dichotomous key is predetermined by the author who uses diagnostic features he considers to be useful for the purpose. It is therefore useful for unknown species for which there is limited number of possible matches.

#### **5.1.3 Multiple Entry or Synoptic Key**

The multiple entry keys or synoptic key for wood identification, lists and numbers all possible wood diagnostic features on a special card that has perforations on the edges. One diagnostic feature corresponds to one perforation on the card which has inscriptions of all macroscopic, microscopic, physical and other features. One card is used for one species and all predetermined diagnostic features of a named species, usually not more than 100, which are noted on the card by notching out the perforation corresponding to the feature of a species present on the card. Thus, a completed card for a species shows notched perforations for all diagnostic features of the species named on the card. On the other hand, intact perforation symbolizes diagnostic features which are not present for the named species. The numbers corresponding to features present in the species are also listed on the card.

To identify an unknown wood species, most, if not all, the diagnostic features of the unknown wood species should be examined with hand lens microscope and other physical means. One diagnostic feature, preferably a feature not common in many species, is chosen. A needle is then

passed through the stack of card keys, compiled for all wood species in the xylarium, at a perforation that corresponds to the chosen feature of the unknown species.

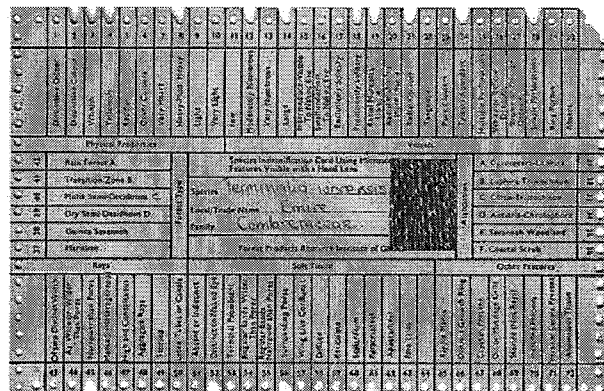


Fig. 5.1 A card sorting key with perforated edges used for wood identification  
The notched perforated edges denote identification features of the species.

Card keys of species without the chosen feature stay on the needle while cards with the chosen feature fall out from the needle. The card keys that fall out are assembled again and the process is repeated using another unique feature already identified from the unknown wood species. The sorting out process is repeated until a single card (or few cards) falls out as the identified name of the unknown wood species or group of species. Although the advent of computer-aided identification has rendered this method almost redundant, it is still used in some laboratories in developing countries including the Wood Anatomy Laboratories of the Forestry Research Institute of Ghana and Papua New Guinea Forestry Research Institute.

#### 5.1.4 Computer-assisted Wood Identification

Computer-assisted or computer-aided wood identification is relatively new and was first discussed by Miller in 1980. The programme is based on comprehensive databases collected for all wood species which are included in the computer programme. The more extensive the database, the more species the programme can identify. There are many databases including the GUESS programme using Oxford Keys data and CSIROID programme based on CSIRO Keys. A comprehensive review of different computer-aided wood identification programmes has been made by Wheeler and Baas (1998). Though computer-aided wood identification programme is now used in many labs in industrialized world, it is still a novelty in labs of many developing countries.

#### 5.2 Dichotomous Identification of the 100 Species

This macroscopic key applies to the 100 species described in chapter 4 of the book. In many cases, two or more possibilities are matching for one species, which makes the species name appear a number of times (which gives a total of 155 mentions for 100 species). After ending in a species group, the final determination of a species is made with the help of main differentiating features, comparing with illustrations in the descriptive part and with distinctive specific macroscopic, physical wood descriptions and splinter test. In several of the

species groups, an undergroup is constituted by the woods with more or less clearly storied rays, and additionally by species with clearly high wood density or low wood density (indicated as Hwd / Lwd), but without grouping.

The following dichotomous identification key for 100 species is based on wood macroscopic features compiled each of the species in Chapter 4.

1. Pores or vessels absent → Gymnosperms (not represented here)  
Pores or vessels present → 2
2. More than 90% solitary vessels → A1 - A4  
Less than 90% solitary vessels → 3
3. Parenchyma absent / not visible by lens → B1 - B3  
Parenchyma visible → 4
4. Radial multiples with often more than 4 vessels → C  
Shorter radial vessel multiples → 5
5. Vessel density (frequency) moderate with a tendency to low ((1-5)+(6-20/mm<sup>2</sup>)) → D1-D3  
Vessel density (frequency) higher or exclusively low → 6
6. Vessel density (frequency) moderate or high / very high (always more than 6/mm<sup>2</sup>) → E1-E4  
Vessel density (frequency) exclusively low (1-5/mm<sup>2</sup>) → 7
7. Axial parenchyma scalariform or reticulate → F1 - F3  
Axial parenchyma of another type → 8
8. Vessels or pores large to very large (> 0.2 mm) → G1 - G3  
Vessels smaller → 9
9. Rays indistinct to naked eye at cross section → H1 - H3  
Rays distinct → 10
10. Axial parenchyma conspicuous, paratracheal vasicentric, aliform or confluent → I  
Axial parenchyma mainly of other types → 11
11. Axial parenchyma mainly apotracheal diffuse or in aggregates → J  
Other type of axial parenchyma → 12
12. Features not as above → K

**A1. Axial parenchyma absent, not visible by lens. If visible → A2**

*Anthrocaryon micraster* (12)

Hwd *Dacryodes klaineana* (33)

**A2. Vessel density (frequency) > 6/mm<sup>2</sup>. If less → A3**

*Allanblackia floribunda* (5)

*Antiaris toxicaria* (11)

Hwd *Ongokea gore* (71)

*Pseudocedrela kotschy* (79)

Hwd *Sacoglottis gabonensis* (83)

*Terminalia ivorensis* (91)

Hwd *Trichilia monadelpha* (95)

Rays clearly storied

Hwd *Dialium aubrevillei* (35)

*Distemonanthus benthamianus* (37)

**A3. Axial parenchyma paratracheal conspicuous, vasicentric, aliform or confluent. If not —> A4**

- Albizia adianthifolia* (2)
- Hwd *Anopyxis klaineana* (10)
- Antiaris toxicaria* (11)
- Berlinia grandiflora* (13)
- Cordia millenii* (29)
- Hwd *Cylicodiscus gabunensis* (31)
- Distemonanthus benthamianus* (37)
- Hwd *Erythrophleum suaveolens* (43)
- Parkia bicolor* (74)
- Samanea dinklagei* (84)
- Hwd *Strephonema pseudocola* (89)
- Terminalia ivorensis* (91)

**A4. Not as above**

- Corynanthe pachyceras* (30)
- Hwd *Mammea africana* (63)
- Nauclea diderrichii* (68)
- Hwd *Parinari excelsa* (73)
- Sterculia rhinopetala* (87)
- Terminalia ivorensis* (91)

**B1. Vessel density (frequency) low (<5/mm<sup>2</sup>), or at the limit of moderate. If higher -->B2**

- Antrocaryon micraster* (12)
- Blighia sapida* (14)
- Khaya ivorensis* (57)
- Pycnanthus angolensis* (81)
- Lwd *Ricinodendron heudelotii* (82)
- Turraeanthus africanus* (97)
- Canarium schweinfurthii* (18)

Rays clearly storied

**B2. Vessel density (frequency) clearly moderate (6-20/mm<sup>2</sup>). If higher —> B3**

- Hwd *Anogeissus leiocarpus* (9)
- Hallea stipulosa* (47)
- Holarrhena floribunda* (51)
- Hwd *Homalium longistylum* (53)
- Lannea welwitschii* (60)
- Lovoa trichilioides* (62)
- Octoknema borealis* (70)
- Hwd *Strombosia glaucescens* (90)
- Hwd *Uapaca guineensis* (98)
- Mansonia altissima* (65)
- Nesogordonia papavifera* (69)

Rays +/- clearly storied

**B3. Vessel density (frequency) high to very high (>21/mm<sup>2</sup>).**

- Hallea stipulosa* (47)
- Octoknema borealis* (70)
- Scottellia klaineana* (85)



**C. Radial multiples often >4 vessels**

*Holarrhena floribunda* (51)

Hwd *Manilkara obovata* (64)

*Tieghemella heckelii* (94)

**D1. Axial parenchyma scalariform or reticulate. If (only) other types —> D2**

*Aningeria altissima* (8)

*Chrysophyllum perpulchrum* (25)

Hwd *Xylopia quintasii* (99)

**D2. Axial parenchyma paratracheal vasicentric, aliform or confluent. If other types —> D3**

*Antiaris toxicaria* (11)

*Calpocalyx brevibracteatus* (17)

*Stereospermum acuminatissimum* (88)

*Terminalia ivorensis* (91)

*Terminalia superba* (92)

Rays clearly storied

*Distemonanthus benthamianus* (37)

*Entandrophragma angolense* (39)

*Entandrophragma cylindricum* (41)

Hwd *Guibourtia ehie* (46)

**D3. Axial parenchyma banded**

*Celtis mildbraedii* (22)

*Guarea cedrata* (45)

*Pseudocedrela kotschyi* (79)

*Terminalia superba* (92)

**E1. Axial parenchyma scalariform or reticulate. If other types —> E2**

*Celtis mildbraedii* (22)

*Chrysophyllum albidum* (24)

*Chrysophyllum subnudum* (26)

*Enantia polycarpa* (38)

*Hexalobus crispiflorus* (50)

**E2. Axial parenchyma paratracheal vasicentric, aliform or confluent. If other types —> E3**

*Carapa procera* (19)

*Celtis adolphi-friderici* (21)

*Celtis zenkeri* (23)

*Lovoa trichilioides* (62)

Rays clearly storied

*Holoptelea grandis* (52)

*Pericopsis elata* (76)

**E3. Axial parenchyma apotracheal diffuse / in aggregates. If other type —> E4**

*Hallea stipulosa* (47)

*Hexalobus crispiflorus* (50)

Hwd *Strombosia glaucescens* (90)

*Mansonia altissima* (65)

Rays +/- clearly storied

*Nesogordonia papavifera* (69)

**E4. Axial parenchyma normally banded**

*Celtis mildbraedii* (22)

*Celtis zenkeri* (23)

*Hymenostegia afzelii* (54)

**F1. Vessels small (<0.1mm). If larger —> F2**

Hwd *Diospyros kamerunensis* (36)

**F2. Rays very narrow (<0.05mm). If wider —> F3**

Lwd *Alstonia boonei* (6)

**F3. Rays narrow to wide (>0.05mm)**

*Cola gigantea* (27)

*Pachypodanthium staudtii* (72)

*Pterygota macrocarpa* (80)

*Sterculia oblonga* (86)

**G1. Rays wide (>0.1mm) or distinct to naked eye at cross section. If indistinct —> G2**

Lwd *Bombax buonopozense* (15)

Lwd *Ceiba pentandra* (20)

*Copaifera salikounda* (28)

*Pterygota macrocarpa* (80)

*Sterculia oblonga* (86)

*Triplochiton scleroxylon* (96)

*Zanthoxylum gillettii* (100)

*Heritiera utilis* (49)

Rays clearly storied

Hwd *Morus mesozygia* (67)

**G2. Axial parenchyma predominantly paratracheal vasicentric, aliform or confluent. If other type —> G3**

*Afzelia africana* (1)

*Copaifera salikounda* (28)

Hwd *Klainedoxa gabonensis* (59)

*Milicia excelsa* (66)

*Tetrapleura tetraptera* (93)

*Zanthoxylum gillettii* (100)

Rays clearly storied

*Albizia ferruginea* (3)

*Heritiera utilis* (49)

*Piptadeniastrum africanum* (78)

**G3. Axial parenchyma clearly banded or broadly marginal**

*Khaya ivorensis* (57)

Hwd *Klainedoxa gabonensis* (59)

Hwd *Lophira alata* (61)

Rays clearly storied

Hwd *Amphinas pterocarpoides* (7)

*Daniellia ogea* (34)

Hwd *Morus mesozygia* (67)

**H1. Axial parenchyma conspicuous, predominantly paratracheal vasicentric, aliform or confluent. If other types —> H2**

*Afzelia africana* (1)

*Albizia zygia* (4)

Hwd *Bussea occidentalis* (16)

*Copaifera salikounda* (28)

*Gilbertiodendron dewevrei* (44)

Hwd *Klainedoxa gabonensis* (59)

Hwd *Petersianthus macrocarpus* (77)



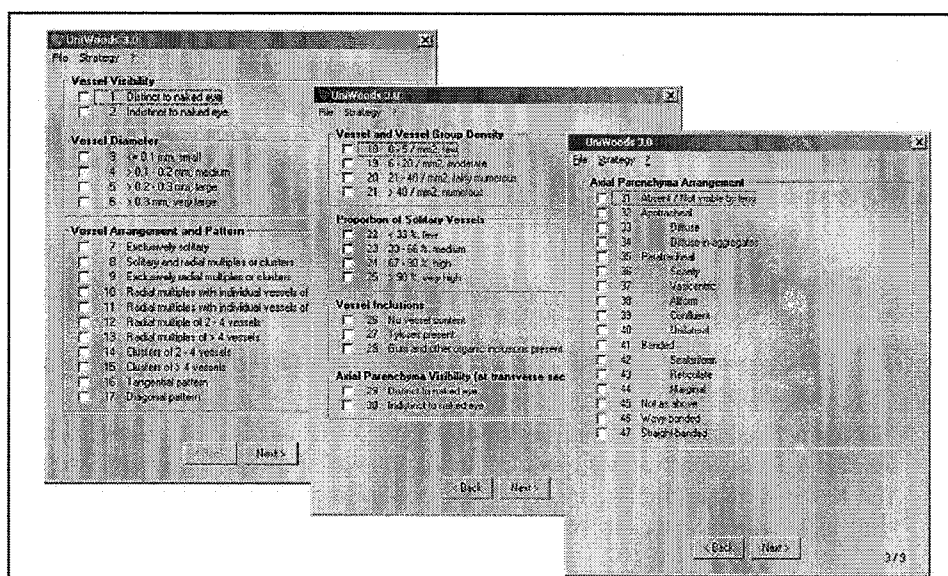
This is done by building a reference data bank, entering a new species with its specific features and by consulting the list respectively for the features of the already registered species. The third part of this chapter describes the operations linked to the identification of an unknown wood species. Finally, some additional recommendations or suggestions are made for achieving ultimate identification and for obtaining the maximum possible guarantee of correctness.

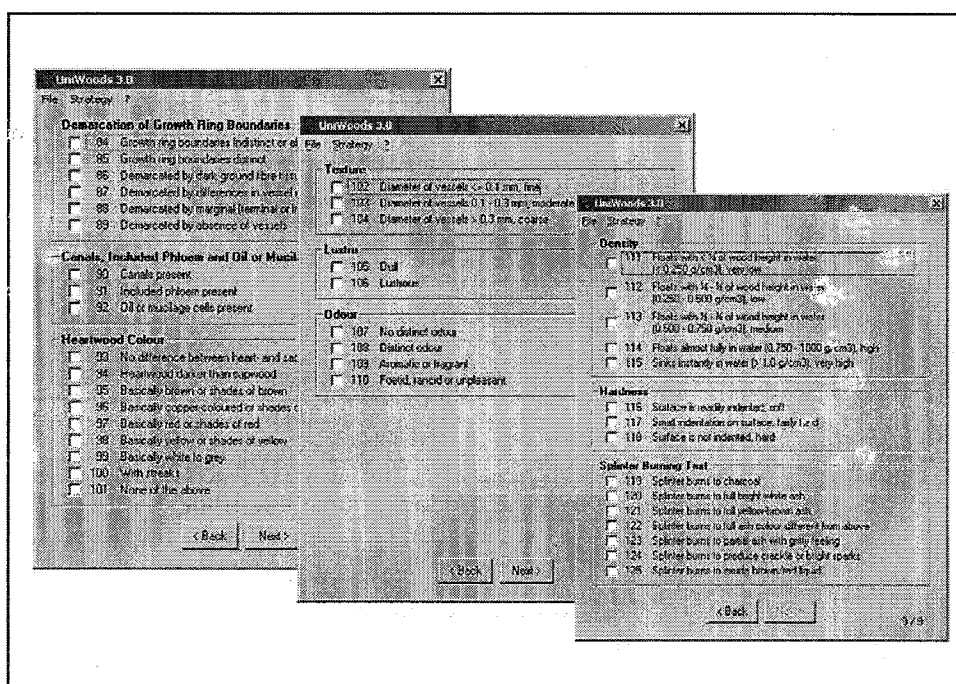
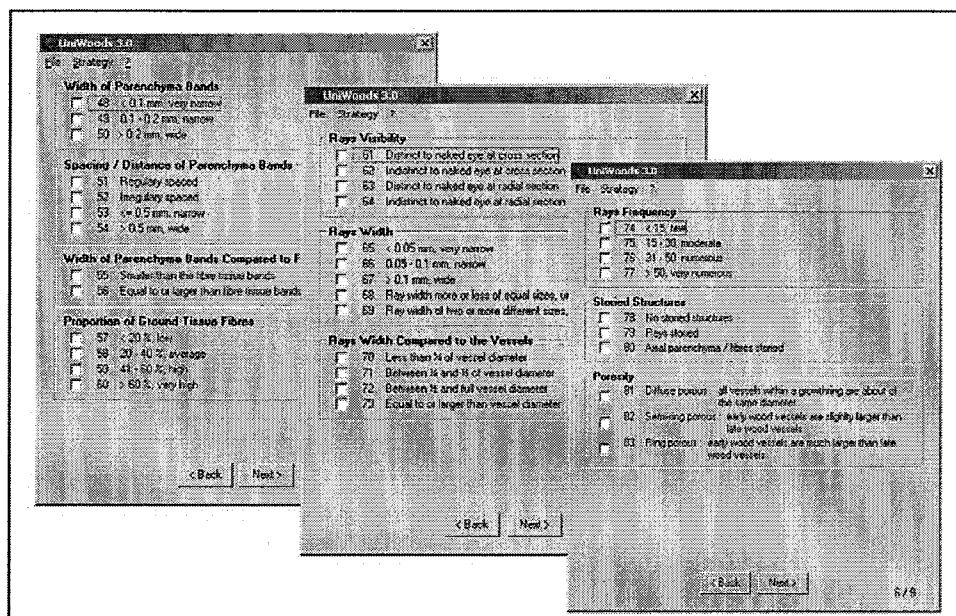
### 5.3.1 Information on the software “UniWoods 2.0 / UniWoods 3.0”

The basic software was programmed with the help of MODULA 2 with special emphasis placed on a user-friendly end-product. It runs on every computer desktop station or lap-top which meets the minimum requirements of 640 kB RAM and MS DOS 3.0.

The installation and use of this specially developed tropical wood identification software is under a licenced contract (Lizenzvertrag) signed between the Swiss Federal Institute of Technology, Zürich, represented by Prof. O.Holdenrieder (licence-giver), and SWOOD (Swiss School of Engineering for the Wood Industry, now called HSB, University of Applied Science, Berne, as the licenced recipient. Adaptation of “UniWoods 2.0” and subsequent improvement made at it at HSB led to the version “UniWoods 3.0”. The flow-diagram of the software is structured such that the term “tree” is henceforth used for the name of the species.

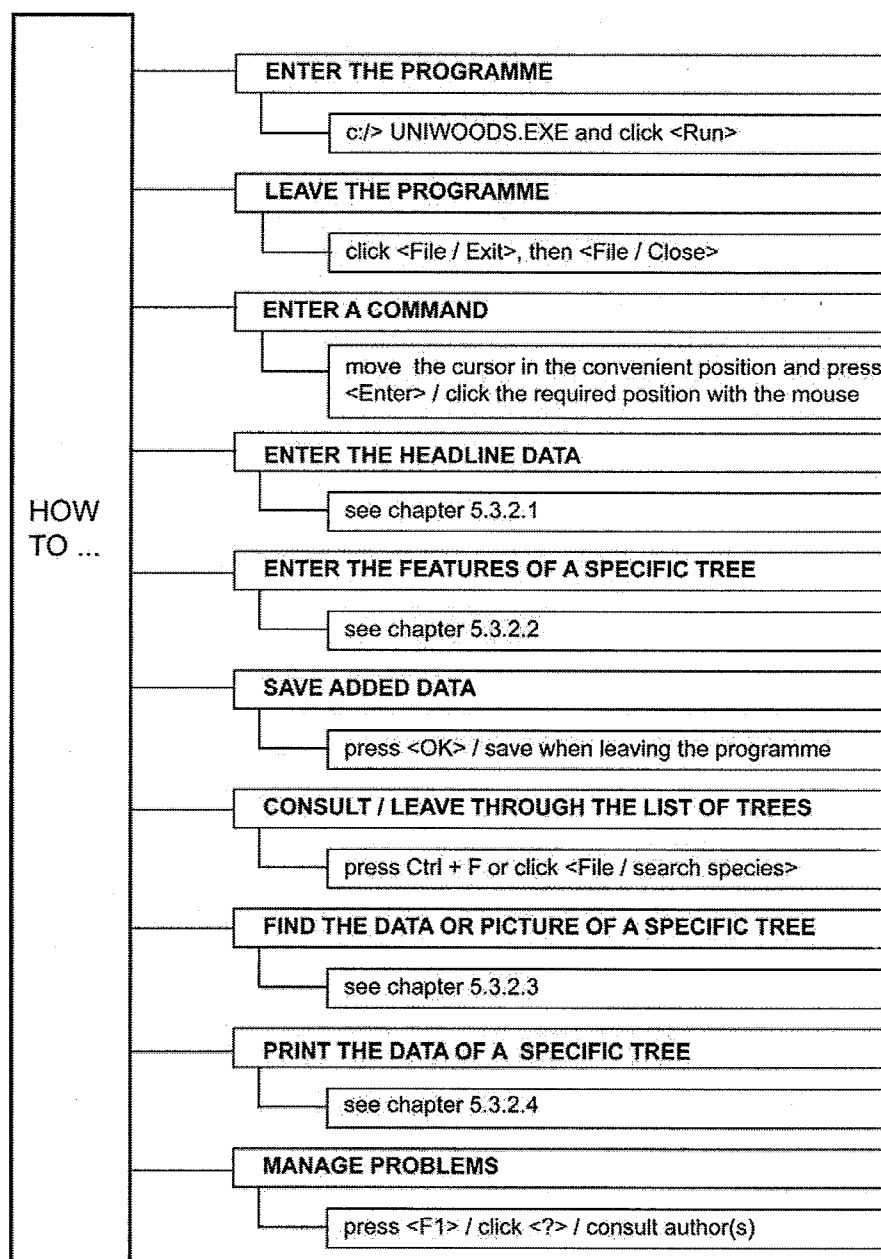
The series of 125 defined descriptive identification features listed at the end of chapter 2 are grouped in 9 successive sequences in the next page.





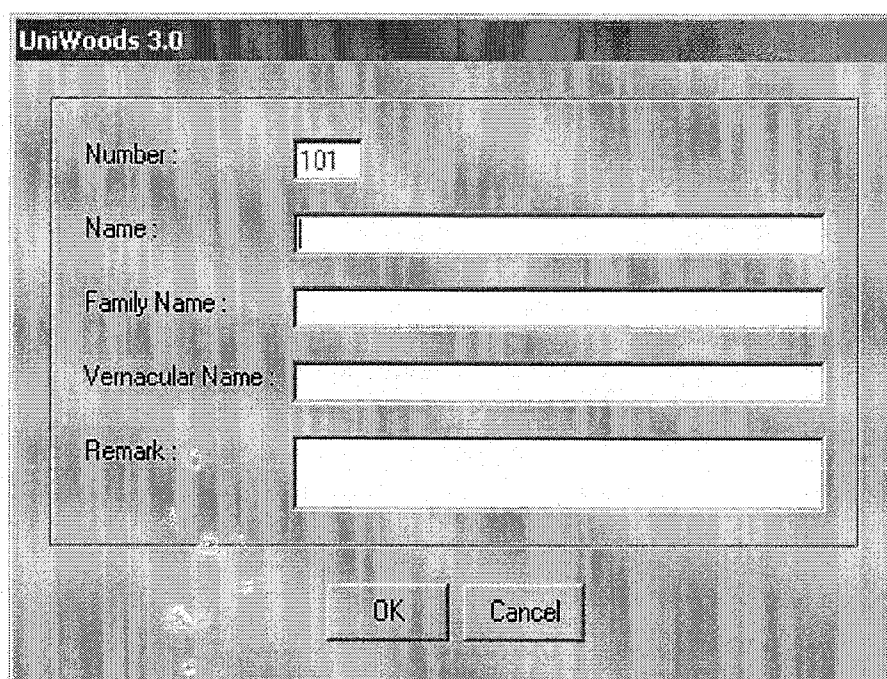
### 5.3.2. Data input for a known sample

The following overview with 10 options, indicates the operations linked with the entering of the features of a new known species into the reference database.



#### 5.3.2.1 How to enter the headline data

Click the top of the frame of the first page (the page number is indicated at the bottom on the left) with the mouse, on <File /Modifications / Add / Yes ("Do you want to add a new species?")>. A new window appears in the upper part of the screen. Under the next open Tree number (appearing automatically), there are four categories at your disposal: "(Tree species) Name", "(Tree) Family Name", "(Tree) Vernacular (and/or commercial) Name" and "Remark". The scientific name (generic and species) is given with the name of the scientist or authority.. The family name is also cited. The vernacular name(s) corresponding to local dialects is completed with established trade name for the commercial or traded species. Under the field for remarks, complementary specific identification elements can be formulated, or precision to some occurring features of the list. After entering all the above names of the species, click "OK".

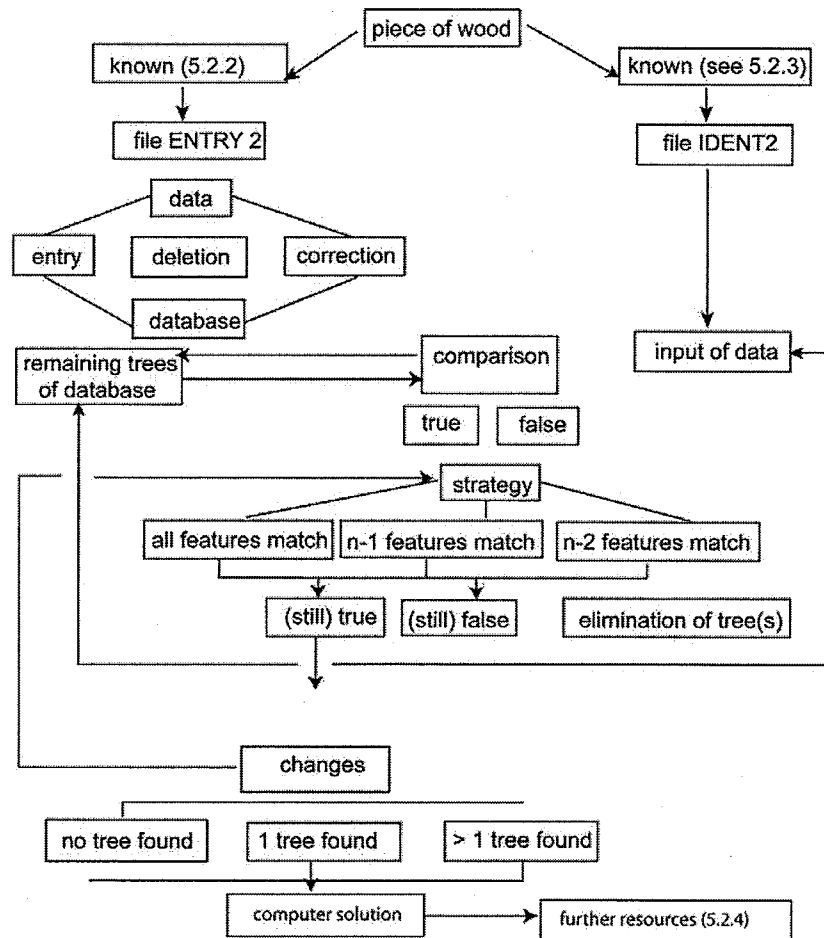


The image shows a screenshot of a software window titled "UniWoods 3.0". Inside the window, there is a form with five labeled input fields: "Number:", "Name:", "Family Name:", "Vernacular Name:", and "Remark:". The "Number:" field contains the value "101". The other four fields are empty. At the bottom of the window, there are two buttons: "OK" and "Cancel".

#### 5.3.2.2 How to enter the features of a specific tree

Nine screen pages with a total of 125 optional features for each species stand at the user's disposal after having entered the headline data. The occurring features are indicated, after a switch to the corresponding line of the features list <- /> (valid inside a features' group). A simple click is made on the open field on the left of the feature number. To move to the previous / next page of the screen, press <Back/Next>. The last feature of a chosen tree in the mask is found with the cursor, or pressing <Back>. To delete a feature: click again on the mark. To switch to the headline, click on <File>. To avoid wrong identification, only those features clearly visible from the wood sample should be selected. In case of uncertainty, do not enter a specific feature.

flow-diagram of the computer-aided wood identification system  
UniWoods 2.0 / UniWoods 3.0 SOFTWARE



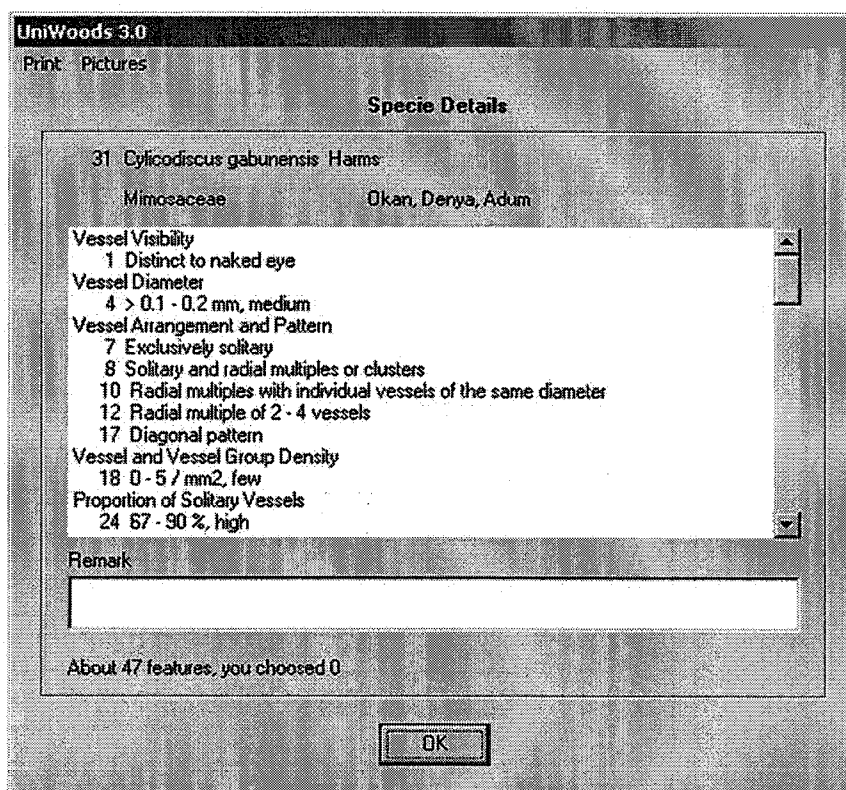


### 5.3.2.3 How to find quickly the data or pictures of a specific tree

The function <File / Search species> opens the total list of the described species (initially 100, grouped in 10 sequences) that can be consulted with the function <Next / Back>. Click on a specific species name for obtaining the corresponding list of features. The corresponding macrograph (picture) can be seen with the function <Picture> figuring at the top right-hand side of the monitor.

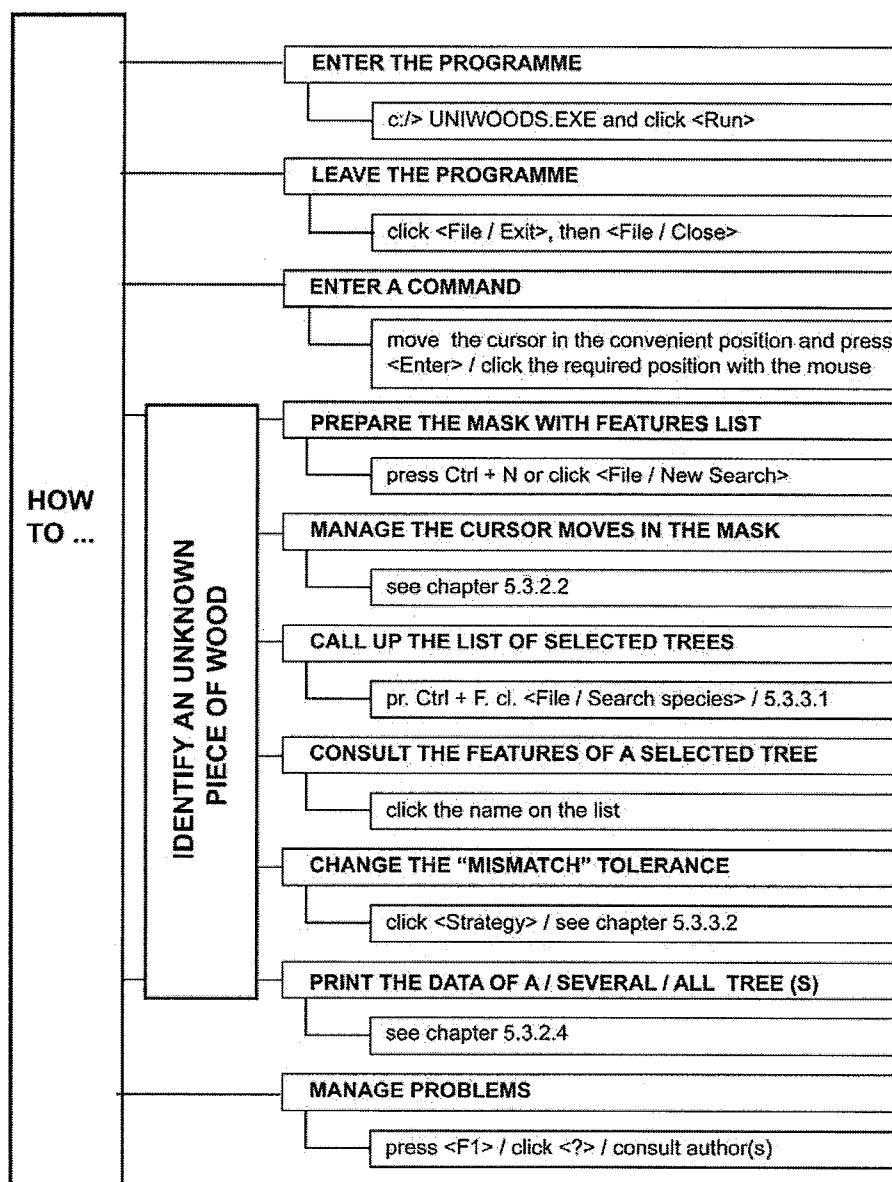
### 5.3.2.4 How to print the data of a specific tree

The new window corresponding to a specific species shows the totality of descriptive features that can be consulted by scrolling up or down. The total list is automatically printed with the function <Print> that appears on the top left-hand side of the monitor. The appropriate printer must first be selected before printing.



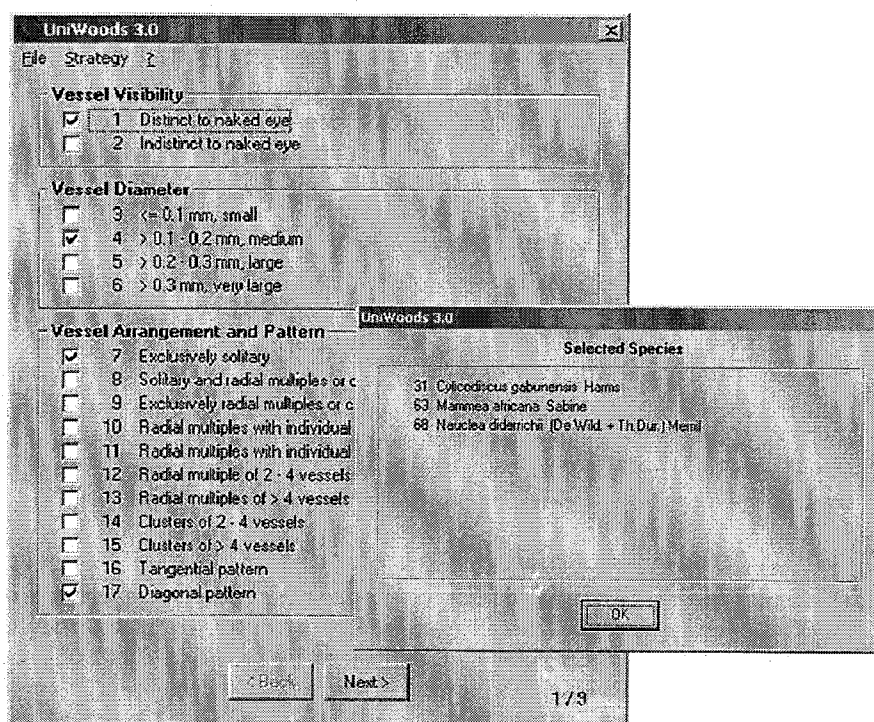
### 5.3.3 Data input for an unknown sample and comparative identification

The following overview with 10 options indicates the operations linked with the entering of the features of an unknown species for comparison with the reference database and resulting identification.



### 5.3.3.1 Stepwise identification

Corresponding to the progressive entry of observed features from an unknown wood sample, the function <Search Species> gives a list of the trees having these features in common. The more features are entered, the shorter the list of candidates will be. If a wood sample is analyzed without being represented in the data bank, the list will either remain empty, or a species with identical features will appear. This makes clear why a subsequent control of the proposed identification result is necessary, according to the further resources (see last chapter 5.3.4).



### 5.3.3.2 How to change the “mismatch” tolerance

The concept of the identification programme implies that a certain flexibility can be introduced into the identification process. As a perfect solution between the observed features of a species sample and the species reference list of the data bank is biologically not always given, it is possible to tolerate a certain unprecision (“mismatch tolerance”), which will have to be compensated by a larger number of entered features before reaching the definitive identification. In the same sense, if for a given features-series the mismatch tolerance is enhanced, the list of candidates will be longer. Three levels can be chosen under <Strategy>:

- “All features match”: no mismatch tolerance
- “N-1 features match”: one mismatch is tolerated
- “N-2 features match”: up to two mismatches are tolerated.

### **5.3.4 Further resources**

As a result of the search cycle, the computer proposes one or more species as a solution. In any case, the computer-solution is the basis of the end-solution. Depending on the selected strategy, the proposed solution will have either exactly the same features as the wood sample, or it will be a solution within the given mismatch tolerance. Neither the qualitative nor the quantitative range of the solution is definitive, they must be determined or precised. Therefore the user needs further resources.

#### **5.3.4.1 Printout(s) of features of selected tree(s)**

The corresponding printouts are obtained for the species figuring on the list of selected species. The unknown wood sample is then compared to the complete listed proposals (control). The same can be done by reading the information from the screen, but it is less easy to survey.

#### **5.3.4.2 Additional features**

Special features - if occurring - appear at the end of each list of features (under "Remark"). They are a convenient resource for more precise identification.

#### **5.3.4.3 Macrophotographs**

The tree species identified using the computer can also be visually compared with the unknown wood sample with the aid of the pairs of macrographs in the handbook which are a very informative element of the wood descriptions. The same macrographs are also available via the computer-aided identification program, with the function <Pictures>.

#### **5.3.4.4 Wood sample collection**

The same procedure of comparison can be applied with a collection of wood samples which have been reliably identified, labelled and stored in a dust-free environment. If not yet available, the progressive constitution of a reliable reference collection of wood samples from the correctly identified tree species growing in the concerned region is highly recommended.

#### **5.3.4.5 Literature**

As only a limited selection of features is stored in the computer, additional specialized literature can be of help. It can also be useful to consult the electronically available wood descriptions elaborated by recognized specialists as reviewed at the beginning of the chapter. For example, reliable and very detailed descriptions have been made for the main commercial timbers (hardwoods) at the University of Hamburg by H.G.Richter and M.J.Dallwitz. Plant Resources of Tropical Africa (PROTA) Volume 7, which deals with description of timber resources of Africa, is expected to compile very comprehensive macroscopic, microscopic, and physical identification features of over 400 timber species when completed in 2008.

An adequate combination of computer-solution and further resources deliver a satisfactory identification for all practical purposes. Where this is unsuccessful, a microscopic examination of the wood becomes necessary, ideally with the help of an expert with solid knowledge in wood anatomy.

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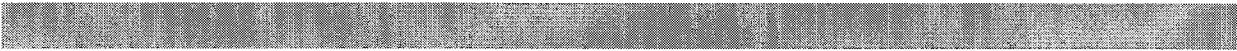
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## GLOSSARY

<b>acid</b>	a sharp sour or bitter taste like unripe fruit
<b>acrid</b>	a sharp, hot, unpleasant taste or a smell like acid
<b>acuminate</b>	(leaf) having a sharp-pointed or tapering end
<b>acute</b>	(leaf) sharp at the base or apex with abrupt end at angle less than 90°
<b>adulterant</b>	an exudate from some trees, added to rubber to increase the quantity
<b>adventitious</b>	(shoot, root) arising on bole or boughs, and so bursting through bark
<b>alternate</b>	(branches or leaves) inserted at different levels along the stem, one per node, and not opposite
<b>analgesic</b>	a drug or substance that relieves or lessens pain
<b>anastomosing</b>	splitting and rejoining like strings in a net, interconnections between vessels or veins in a leaf
<b>annual ring</b>	annual increment of wood as it appears on a transverse surface or in a transverse section, same as annual growth ring
<b>antemetic</b>	a remedy to check or stop vomiting
<b>anthelmintic</b>	a drug that expels or eliminates worms
<b>apex</b>	the tip or end part of a leaf
<b>aphrodisiac</b>	a substance or drug that increases sexual desire
<b>apiculate</b>	ending abruptly in a small point (a leaf or fruit)
<b>appressed</b>	(leaf hairs) lying flat against surface
<b>appetiser</b>	improving the desire to eat
<b>aril</b>	a thin usually fleshy layer which partially surrounds a seed
<b>aromatic</b>	a pleasant scent like incense or spices
<b>asthenia</b>	general weakness or loss of strength
<b>asthma</b>	a chest illness causing difficulty in breathing
<b>astringent</b>	an agent or drug that lessens or stops bleeding
<b>asymmetric</b>	not symmetrical, cannot be divided into halves
<b>auriculate</b>	with ear-like lobe, usually at base of leaf
<b>axillary</b>	growing in an axil of a branch, leaf, or vein
<b>axis</b>	main stem from which branches or other parts arise
<b>bark</b>	the phloem tissue formed on the outside of a tree by the cambium
<b>berry</b>	a fruit with seeds immersed in pulp
<b>bipinnate</b>	leaves with two orders of branching, usually with small leaflets (e.g. Dahoma, Acacia)
<b>bird-lime</b>	a sticky latex used to catch birds
<b>bisexual</b>	a flower containing both stamens and ovaries
<b>bitter</b>	a taste like quinine
<b>blade</b>	limb of a leaf

<b>blennorrhoea</b>	an excessive mucous discharge from eye as a result of gonorrhoea
<b>bough</b>	main massive branches of crown
<b>bract</b>	a small leaf subtending the flower stalk
<b>buttress</b>	a flattened outgrowth of the trunk, connecting its entire length, usually triangular in side view
<b>caducous</b>	falling off early
<b>calyx</b>	an outer whorl of perianth leaves (sepals), often green
<b>cambium</b>	the thin growing cell layer between wood (xylem) and bark (phloem) which divides to form these two tissues
<b>carminative</b>	a substance that promotes the discharge of flatus
<b>capsule</b>	a dry fruit which splits open (dehiscence) to release the seeds
<b>cell wall</b>	the rigid outermost layer of cells found in plants consisting of several layers
<b>chancre</b>	the hard and soft forms of sores caused by syphilis
<b>chologogue</b>	a drug which stimulates the flow of bile by the liver
<b>ciliate</b>	having short but numerous hairs arranged in rows
<b>clustered</b>	(leaves) arising close together from axis
<b>coagulant</b>	a substance which helps to change rubber fluid to a solid state
<b>colic</b>	pains in the stomach
<b>compound</b>	leaves with more than one axis, with several midribs, and two or more leaflets
<b>conjunctivitis</b>	inflammation of the conjunctiva
<b>contoured</b>	a pattern of curved parallel lines displayed when the bark of species with layers is slashed
<b>convulsion</b>	violent uncontrollable body movement due to muscle contraction
<b>cordate</b>	leaf base, which curves backwards from petiole attachment; "heart-shaped"
<b>coriaceous</b>	tough, like leather or firm card
<b>cork</b>	soft woody light material used in wine-bottle tops formed from the cambium as part of the bark tissue
<b>corolla</b>	inner whorl of perianth leaves (petals), often coloured
<b>cotyledon</b>	the first pair of leaves sometimes hidden in seed; usually unlike fully matured leaves
<b>crawcraw</b>	a skin disease accompanied by itching, which may lead to ulceration
<b>crown</b>	a system of branches forming the top of the tree bearing the leaves
<b>cuneate</b>	a leaf base shaped like a wedge or leaf that becomes gradually thinner towards the petiole
<b>cyme</b>	a branched inflorescence with many axes ending in flowers
<b>dbh</b>	an abbreviation for "diameter at breast height" (1.30 m height level of a tree from the ground)

<b>dead bark</b>	the outer part of the bark in which no living tissue is present
<b>deciduous</b>	a tree that sheds leaves in dry season
<b>decoction</b>	a liquid obtained from boiling leaves, barks or branches of a plant in water
<b>decurrent</b>	when the edges of a leaf are raised as lines or narrow wings
<b>defoliator</b>	a type of insect that strips trees of its leaves and may eventually kill it
<b>dehiscent</b>	splitting of dry fruit to release seeds (see indehiscent capsule)
<b>dentate</b>	having a leaf with a toothed margin
<b>depressed</b>	flattened from above, as if pressed down
<b>dermatitis</b>	an inflammation of the skin making it itchy with development of blisters
<b>diarrhoea</b>	an uncontrollable, frequent and watery discharge from the bowels
<b>dichotomous</b>	branching successively into smaller halves
<b>dicotyledon</b>	a plant with two seedling leaves; all trees apart from the monocotyledonous trees or ferns
<b>diffuse-porous</b>	a type of wood in which the pores show little or no significant variation in size at the cross section; (see ring-porous wood)
<b>dioecious</b>	flowers with male and female parts on different plants
<b>diuretic</b>	a substance that increases the volume of urine secreted by the kidneys
<b>dropsy</b>	leakage of a fluid into any tissue or cavities of the body
<b>drupe</b>	a fruit with a fleshy part surrounded by hard, central, single stony seed (e.g. mango, plum)
<b>dysmenorrhoea</b>	abnormal pains and disorders associated with the menstrual cycle
<b>dystocia</b>	difficulty in delivery or giving birth
<b>earlywood</b>	that portion of the growth increment produced at the beginning of the growing season
<b>ectotrophic</b>	an organism that gets its nutrients from the outside surface of its host
<b>elephantiasis</b>	a chronic enlargement of the cutaneous and sub-cutaneous tissues
<b>elliptic</b>	a leaf which is broadest around middle with smoothly curving edges
<b>ellipsoid</b>	an object with elliptic outline
<b>emarginate</b>	a tip of a leaf with a slight notch
<b>emetic</b>	a substance or drug that induces vomiting
<b>emmenagogue</b>	a drug or drug agent that stimulates menstrual flow
<b>endemic</b>	any substance or plant which occurs in a restricted area
<b>enema</b>	a herbal preparation injected into the rectum to empty the bowels instantly
<b>entire</b>	smooth, evenly curved or straight margin of a leaf without teeth or undulations
<b>erogenic</b>	being sensitive to sexual stimulation
<b>expectorant</b>	promoting the ejection of mucous from respiratory tract or mouth

<b>exudate</b>	a sap that appears on a cut wood or bark surface
<b>evergreen</b>	a tree that always bears foliage or leaves; as in forest with canopy dominated by evergreen trees
<b>face veneer</b>	a veneer used at exposed surfaces in plywood manufacture
<b>falcate</b>	a leaf that is sickle-shaped
<b>fascicle</b>	an inflorescence without (obvious) stalk; a dense cluster of flowers arising in one place
<b>febrifuge</b>	a fever-reducing drug
<b>ferruginous</b>	being rust-coloured
<b>fibre</b>	an elongated cell with pointed ends, thick wall, and a narrow lumen or cavity
<b>figure</b>	any design or distinctive markings on the longitudinal surfaces of wood
<b>filament</b>	stalk of a stamen
<b>fissure</b>	a coarse, deep groove of the tree bark
<b>flaky</b>	large patches of dead bark falling off the trunk like scales
<b>flat-sawn</b>	a wood sawn to show the tangential surface; same as plain-sawn
<b>flint-bark</b>	a very hard, glass or stone-like bark of certain Diospyros spp.
<b>flush</b>	a foliage developing on trees
<b>fluted</b>	a non cylindrical bole with many parallel regular ascending channels
<b>foetid</b>	a disgusting smell, like rotten meat or egg
<b>foliaceous</b>	a leaf-like stipule or bract
<b>foliage</b>	all the leaves or leaflets on a tree or branch considered as a whole
<b>follicle</b>	a type of dehiscent fruit splitting along one line as occurs in some pods
<b>fragrant</b>	having a pleasant or sweet smell as in some flowers
<b>fusiform</b>	a leaf that is spindle-shaped
<b>gastro-intestinal</b>	pertaining to the stomach or intestines
<b>gbh</b>	an abbreviation for "girth at breast height", the circumference of a tree at 1.3 m height level
<b>genito-urinary</b>	relating to the functions of genital and urinary organs
<b>glabrous</b>	(leaf) having a smooth surface without hairs or scales
<b>glaucous</b>	having a greyish tinge, usually caused by a waxy layer
<b>glutinous</b>	being slightly sticky to touch or coated with thick viscous liquid
<b>grain</b>	a macroscopic arrangement or alignment of wood elements when considered en masse
<b>grain, cross</b>	a wood arrangement in which the fibre alignment deviates from the parallel axis of the stem
<b>grain, interlocked</b>	an arrangement in wood showing alternate orientation of fibers in the axis of the stem; the quarter-sawn face of such wood shows a ribbon figure

<b>grain, spiral</b>	a wood arrangement in which the fibres are aligned in a helical orientation around the axis of the stem
<b>grain, straight</b>	a wood arrangement in which the fibre alignment is straight or the grain orientation is parallel to the stem axis
<b>grain, wavy</b>	a wood arrangement in which the fibre alignment shows undulations in the direction of longitudinal axis, exposing a wavy surface when split radially
<b>gregarious</b>	occurring together in groups
<b>granule</b>	a small, rounded hard particle
<b>gonorrhoea</b>	a venereal disease caused by gonococcus that inflames the urethra
<b>growth ring</b>	a layer of wood seen as a ring on a transverse surface produced during a growing period
<b>growth stress</b>	an internal stress in the wood of a standing tree caused by cell growth, responsible for warping and twisting of boards as they are released when sawing the log
<b>guild</b>	ecological grouping of plants based on seed and seedling to light for sensitivity germination and growth
<b>gum copal</b>	a hardened aromatic exudate from plants
<b>gutta-percha</b>	a resinous, rubbery but elastic exudate
<b>haemorrhoid</b>	a painful swelling of a vein in the region of the anus often with bleeding
<b>haemostatic</b>	a drug or substance that arrests bleeding
<b>hardwood</b>	a wood produced by broad-leaved trees or angiosperms; same as porous wood
<b>heartwood</b>	a dead inner core of a woody stem (or a log), generally distinguishable from sapwood by its darker colour and usually more durable than sapwood
<b>hepatitis</b>	an inflammation of the liver
<b>hermaphrodite</b>	a flower made up of both sexes, the stamens and ovary
<b>hiccough</b>	a sudden involuntary stopping of breath with a sharp gulp-like sound
<b>hilum</b>	a scar left on a seed which marks the point of attachment to the stalk of the ovule
<b>hybrid</b>	the offspring of two different species, intermediate in character between the parent species
<b>hyperkeratosis</b>	a sickness that results in excessive thickening of the horny layer of the epidermis
<b>imparipinnate</b>	a compound leaf with pinnate leaflets and one apical leaflet
<b>impressed</b>	the nerves or veins of a leaf which are pressed to the surface
<b>incontinent</b>	unable to control bladder or bowel in passing waste matter
<b>indehiscent</b>	a fruit which does not split open at maturity, e.g., drupe or berry (see dehiscent)
<b>inflorescence</b>	an arrangement of many flowers on a single leafless axis of a plant

<b>infusion</b>	a liquid or drink made from immersing herb in hot or cold water
<b>internode</b>	a segment of stem between nodes
<b>jaundice</b>	yellowness of the skin or eye ball due to deposition or secretion of bile pigments in the blood
<b>keeled</b>	a seed that is narrowly winged (seed)
<b>knob</b>	a hemispherical protrusion on the surface of a bole or stem
<b>knot</b>	a branch base that is embedded in the wood of a tree trunk or a larger branch
<b>lamina</b>	the flat, green, thin surface of a leaf or leaflet excluding the petiole or petiolule
<b>lanceolate</b>	a leaf shaped like a lance head more than three times long as broad and broadest below middle
<b>lateral</b>	a nerve branching along midrib like ribs
<b>latex</b>	a sticky or rubbery exudate from plants that looks opaque or milky white
<b>latex canal</b>	an opening or fleck on the transverse surface extending along the grain containing latex
<b>laticiferous</b>	a plant producing latex
<b>latewood</b>	that portion of growth increment which is produced during the latter part of the growing season in temperate trees
<b>leaflet</b>	the ultimate single unit of a compound leaf
<b>lenticel</b>	a small, usually corky structure with an enclosed space on the bark of trees or young twigs
<b>lenticular</b>	a lens-shaped leaf
<b>linear</b>	a line-shaped leaf
<b>lobed</b>	having deep irregularities in the margin of a simple leaf or leaflet
<b>lumbago</b>	a general term for backache in the lumbar region
<b>lumen</b>	the cavity of a cell (pl. lumina)
<b>macerate</b>	a liquid made from washing herbs in water
<b>margin</b>	edge of a leaf
<b>menorrhagia</b>	an excessive menstrual flow
<b>migraine</b>	a recurring, painful headache usually accompanied by vomiting, giddiness or dizziness
<b>midrib</b>	the main vein that runs down the middle of a leaf
<b>monoecious</b>	a flower with separate male and female parts on the same tree
<b>mottled figure</b>	a broken stripe figure interrupted by irregular and horizontal waves in the grain
<b>mucronate</b>	the tip of a leaf with a thread-like process at the end of the midrib
<b>mycorrhiza</b>	an intimate symbiotic association of the mycelium of certain fungi with the root cells of some vascular plants.

<b>node</b>	a place on a stem where leaves arose or have fallen
<b>oblanceolate</b>	a lanceolate leaf with broadest part beyond middle portion
<b>oblique</b>	the blade of a leaf, leaflet, or fruit with unequal sides
<b>oblong</b>	a leaf which is broadest in the middle with almost parallel sides
<b>obovate</b>	reversed ovate leaf with greatest width above the middle
<b>obtuse</b>	a leaf which is blunt or rounded at the base or apex, at an angle of more than 90°– 90°
<b>ochrosol</b>	a reddish, slightly acidic, and nutrient-rich soil
<b>oedema</b>	a swelling from excessive accumulation of serous fluid in tissue
<b>opaque</b>	that which is 'murky', and not possible to see through
<b>ophthalmia</b>	a severe inflammation of the conjunctiva of the eye or eyeball
<b>opposite</b>	leaves which are arranged two per node facing each other
<b>ovary</b>	the part of a carpel containing the ovules and eventually becoming the fruit
<b>ovate</b>	a leaf with outline roughly of an egg, being broadest below the middle
<b>ovoid</b>	a leaf shaped like an egg
<b>oxysol</b>	a yellowish, very acidic, and highly leached nutrient-poor soil
<b>palmate</b>	a digitate, finger-like compound leaf
<b>panicle</b>	an inflorescence in which the main axis bears several side branches
<b>parenchyma</b>	tissue consisting of short, relatively thin-walled brick-shaped cells, generally with simple pits concerned primarily with storage and distribution of carbohydrates; may be visible with a hand lens on the transverse surface of wood as dots, as sheaths around pores, or as broken or continuous lines or bands.
<b>parenchyma aliform</b>	a type of paratracheal parenchyma that extends from the flanks of a pore, forming an eyelet or wing-like with it
<b>parenchyma apotracheal</b>	an axial parenchyma which is independent of the pores or vessels; this term includes marginal, diffuse, diffuse-in-aggregate, and banded parenchyma
<b>parenchyma axial</b>	parenchyma cells derived from fusiform cambial initials; also known as longitudinal parenchyma
<b>parenchyma banded</b>	an axial parenchyma forming straight or wavy concentric lines or bands, as seen in cross section; termed apotracheal banded, if independent of the pores, and paratracheal banded, if definitely associated with the pores
<b>parenchyma confluent</b>	a coalescent aliform parenchyma forming irregular tangential or diagonal bands, as seen in cross section

<b>parenchyma diffuse</b>	single apotracheal parenchyma strands or cells distributed irregularly among fibres, as seen in cross section
<b>parenchyma diffuse-in-aggregate</b>	apotracheal parenchyma cells that tend to be grouped in short tangential lines from ray to ray, as seen in cross section
<b>parenchyma paratracheal</b>	axial parenchyma obviously associated with pores (vessels)
<b>parenchyma marginal</b>	an apotracheal parenchyma in which the cells form more or less continuous layer of variable width at the close of the season's growth called terminal, or initial parenchyma if it is formed at the beginning of a growing season.
<b>parenchyma ray</b>	a parenchyma cell concerned with storage and distribution of carbohydrates in radial direction
<b>parenchyma vasicentric</b>	a paratracheal parenchyma forming a complete sheath around vessels or pores
<b>paripinnate</b>	a compound leaf with pinnate leaflets but no terminal leaf
<b>pedicel</b>	the stalk of a single flower
<b>peduncle</b>	the stalk of an inflorescence
<b>perianth</b>	the leaves of a flower including tepals, sepals and petals
<b>petals</b>	the leaf-like part of a flower or the inner whorl of often coloured perianth
<b>petiole</b>	the stalk of a leaf
<b>petiolule</b>	the stalk or petiole of a leaflet of a compound leaf
<b>phloem</b>	inner bark; principal tissue of the bark concerned with the distribution of food stuffs, characterized by the presence of sieve tissue
<b>phloem, included</b>	inner bark tissue usually found embedded in the sapwood
<b>piles</b>	a synonym for haemorrhoid
<b>pinnate</b>	a compound leaf with leaflets arranged along both sides of a common rachis
<b>pistil</b>	the female organ of a flower consisting of an ovary, style, and stigma
<b>pith</b>	the central core of a stem consisting of very soft and airy tissue of parenchyma cells
<b>pneumatophore</b>	an aerial root system of some trees growing in swampy habitat; it grows upward and out of the water and functions to assure adequate aeration



<b>pod</b>	a single many-seeded fruit which dehisces along margin when dry
<b>polyphagous</b>	a type of insect with excessive desire to eat different kinds of foodstuff
<b>pore chain</b>	several to many pores arranged in a radial line or series
<b>pore</b>	a vessel as it appears on the transverse surface or in a transverse section of wood
<b>pore cluster</b>	nested pores in an irregularly grouped arrangement
<b>pore multiple</b>	group of two or more contiguous pores radially flattened along the lines of contact so as to appear as subdivisions of a single pore
<b>porous wood</b>	a wood containing pores (vessels) as in hardwood
<b>poultice</b>	a plant preparation of powdered or wetted paste, moulded and dried
<b>prickle</b>	a sharp broad-based outgrowth from bark
<b>puberulous</b>	being covered with fine hairs
<b>pungent</b>	a strong usually sharp smell-like black pepper
<b>pustule</b>	a raised bump or wart-like spot
<b>putrid</b>	an unpleasant, disgusting foetid smell
<b>quarter sawn</b>	a sawn board in which the wide face represents the radial face of the log (same as edge grained)
<b>quarter surface</b>	a wide surface that is exposed when a log is cut along the grain in a radial direction (parallel to the wood rays)
<b>raceme</b>	an unbranched inflorescence; individual flowers with stalks
<b>rachis</b>	a central axis of pinnate leaf after first leaflet
<b>receptacle</b>	part of the stem from which all flower parts arise
<b>recessed</b>	(nerves) sunk below surface, but still raised above lowest part of channel
<b>recurved</b>	a margin leaf rolled over slightly
<b>reflexed</b>	bent downwards or backwards
<b>resin</b>	a sticky substance which oozes from some trees
<b>resin canal</b>	an intercellular space lined by secreting epithelial cells which contains resin
<b>resin canal, longitudinal</b>	a resin canal extending along the grain, appearing as an opening or fleck on the transverse surface with the naked eye or hand lens
<b>resin canal, transverse</b>	resin canals extending across the grain that are included in fusiform wood rays
<b>resin canal, traumatic</b>	resin canal supposedly formed as a result of injury
<b>resinous</b>	producing a thick, oily and aromatic resin
<b>reticulate</b>	arranged like strings in a net
<b>retuse</b>	the tip of a leaf with deep notch

<b>rheumatism</b>	a disease causing pain and stiffness of the muscles and joints
<b>ripple marks</b>	striations across the grain on the tangential surface of a wood, especially the sapwood formed by ray parenchyma cells (see storied deep rays)
<b>sapwood</b>	outer (younger) portion of living woody stem (or a log), usually distinguishable from the core (heartwood) by its lighter colour; usually less durable than heartwood
<b>scale</b>	tiny thin plates, less than 1mm, lying flat on leaf surface; thin sections of bark of varied size which break away as flakes from bole of a tree
<b>scaly</b>	being scale-like or made up of scales
<b>schistosomiasis</b>	a tropical disease of the urinary tract caused by flukes
<b>scurfy</b>	with fine flaky covering like rust or dandruff
<b>section, cross</b>	a section cut at right angles to the grain or axis (same as transverse)
<b>section, radial</b>	a section cut along the grain parallel to the wood rays and usually at right angles to the growth rings
<b>section, tangential</b>	a section of wood cut along the grain and at right angles to the wood rays (see radial section)
<b>section, transverse</b>	a section cut at right angles to the grain (see cross section)
<b>semi-diffuse-porous wood</b>	a wood which is intermediate between diffuse-porous and ring-porous wood (same as semi-ring-porous wood)
<b>semi-ring-porous wood</b>	semi-diffuse-porous wood
<b>sepals</b>	calyx leaves: outer whorl of usually green perianth leaves
<b>serrate</b>	toothed like a saw (leaf margin)
<b>serrulate</b>	finely serrate (leaf margin)
<b>sessile</b>	without stalk (flower, leaf)
<b>simple</b>	leaves with one axis
<b>sinewy</b>	bole with many rounded irregular channels
<b>slash</b>	the surface that becomes visible after a piece of bark has been chopped off
<b>spike</b>	an inflorescence with sessile flowers along an elongated axis
<b>spine</b>	a sharp, needle-like projection from the bark regularly arranged usually on the trunk of a tree
<b>stamen</b>	a male reproductive organ of a flower, consisting of a filament and an anther
<b>staminode</b>	a sterile stamen
<b>stellate</b>	being star-shaped (of hairs)
<b>stellate hair</b>	a star-shaped hair or cluster of hairs radiating from a point

<b>stilt root</b>	a lateral root of the trunk arising above the ground and entering the soil at some distance from the trunk base
<b>stipe</b>	a short stalk of a fruit
<b>stipel</b>	stipule of a leaflet of a compound leaf
<b>stipule</b>	a leaf-like or scar-like appendage of a leaf, usually at both sides at the base of the petiole
<b>storied rays</b>	rays arranged in tiers or in echelons, as viewed on a tangential surface (see ripple marks)
<b>style</b>	an elongate part of a carpel at apex of ovary
<b>styptic</b>	an agent that checks bleeding by contracting blood vessels
<b>symmetrical</b>	having halves which are the same in size and shape
<b>syphilis</b>	a venereal disease caused by <i>Treponema pallidum</i>
<b>syphilitic chancres</b>	sores caused by syphilis
<b>terminal</b>	belonging to the tip or apex (of a leaf)
<b>thorn</b>	a spine or prickle
<b>thrush</b>	a disease of insects caused by a fungus and characterized by the formation of milky white lesions on the mouth, lips and throat
<b>tiers</b>	layers, storeys, like floors in a many-floored house
<b>tincture</b>	product of any soluble substance in alcohol
<b>tomentose</b>	with very dense, long hairs and soft texture
<b>translucent</b>	allowing light to pass through but not transparent
<b>transparent</b>	capable of being seen through
<b>trifoliate</b>	a compound leaves with three leaflets attached to end of petiole
<b>truncate</b>	a leaf which is more or less squarely cut off at the base or apex
<b>trunk</b>	a vertical part of tree supporting the crown and consisting of the bole, axis and branches
<b>tuberculosis</b>	an infectious disease of the lungs caused by <i>Tubercle bacillus</i>
<b>tuft</b>	a brush-like cluster of hairs
<b>tyloses</b>	outgrowths from adjacent rays or axial parenchyma cells into the vessel cavity, filling the lumen and blocking water transport (sing. tylosis)
<b>ulcer</b>	a chronic open sore on the skin
<b>umbel</b>	an inflorescence with rays or pedicels arising from the same point, like the ribs of an umbrella
<b>umbellate</b>	an umbel-like (inflorescence): an inflorescence shaped like an umbel
<b>undulate</b>	a wavy leaf margin
<b>vein</b>	a channel in a leaf

<b>velutinous</b>	being of velvety hair cover
<b>venation</b>	the system or pattern of veins
<b>veneer</b>	a thin sheet of wood, sawed, sliced, or rotary-cut from a log or a flitch
<b>venereal disease</b>	an ailment contracted through sexual contact
<b>ventral</b>	on the lower side (abaxial)
<b>vermifuge</b>	an agent that expels intestinal worms and parasites from the intestinal tract
<b>vertigo</b>	a sensation of being whirled around
<b>verrucose</b>	having wart-like elevations
<b>vessel</b>	an articulated tube-like structure in porous woods
<b>whorled</b>	an arrangement along the axis of more than two leaves or branches per node
<b>wood</b>	the principal strengthening and water-conducting tissue of the stems and roots of mainly trees
<b>yaws</b>	an infectious tropical skin disease caused by <i>Teponema pertinus</i>
<b>zygomorphic</b>	being divisible in equal parts in one plane only, as in flowers of Papilionaceae family

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