



**Government of the Union of Myanmar**  
**Ministry of Forestry**  
**Forest Department**



## **The Morphological and Anatomical Characteristics of Woody Leguminosae I**

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1993

**Leguminosae အုပ်စုဝင်သစ်မာပင်များ၏ ပြင်ပရုပ်သွင် နှင့်  
သစ်အင်္ဂါပေဒ လက္ခဏာများစူးစမ်း လေ့လာခြင်း အပိုင်း (၁)  
မျိုးစု Albizzia**

ဒေါ်ခင်သန်းထွေး ( M.Sc. (Ygn) )  
သရုပ်ပြ ဆရာမ ရုက္ခဗေဒဌာန၊ ရန်ကုန်တက္ကသိုလ်  
နှင့်  
ဦးသိန်းကြွယ် (M.Sc (Rgn)) , M.S. (SUNY, CESF),  
လက်ထောက်ညွှန်ကြားရေးမှူး  
သစ်တောသုတေသနဌာန

**စာတမ်းအကျဉ်းချုပ်**

မြန်မာပြည်အနှံ့အပြားမှ စုဆောင်းထားသော Leguminosae အုပ်စုဝင် Albizzia မျိုးစုမှ၊ မျိုးစိတ် (၇) ခုတို့၏ ပြင်ပရုပ်သွင်နှင့်သစ်အင်္ဂါပေဒ လက္ခဏာကို လေ့လာ၍ တင်ပြထားပြီး၊ မျိုးစိတ်တို့၏ ထူးခြားထင်ရှားသော ပြင်ပ လက္ခဏာများနှင့် သစ်အင်္ဂါပေဒ လက္ခဏာများကို၊ မျိုးစိတ်တစ်ခုနှင့် တစ်ခု နှိုင်းယှဉ် တင်ပြထားပါသည်။ ပန်းပွင့် လက္ခဏာများသည် မျိုးစိတ်များခွဲခြားမှုတွင် အသုံးဝင်သည်ကို တွေ့ရှိရပြီး သစ်အင်္ဂါပေဒ လက္ခဏာများမှာမူ မျိုးစိတ်များအတွင်း နီးစပ်တူညီသည်ကို တွေ့ရသော်လည်း အချို့လက္ခဏာများမှာ ကွဲပြားလျှက် ရှိသည်ကို တွေ့ရှိရပါသည်။

# **The Morphological and Anatomical Characteristics of Woody Leguminosae I Genus Albizzia**

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## **Abstracts**

The morphology of both the vegetative and reproductive parts and the anatomy of the wood of the stems of the seven species of leguminosae of the genus *Albizzia* collected from different localities in the Union of Myanmar have been studied and described. The important morphological and anatomical characteristics of the species studied in this work have been compared and presented. The floral characteristics were found to be useful in the identification of the species. The anatomical characters of the species were found to be very closely similar within the genus, except for a few differences.

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## 1. Introduction

*Albizzia*, one of the economically important genera of the family Mimosaceae, has more than 100 species. Some author treat the family Mimosaceae as a subfamily, Mimosoideae and place it under the family Leguminosae since the Leguminous tract is the unique character of the family. The reported Mimosoideae includes 40 genera division among 5 tribes (Lawrence, 1969). But some authors promoted it to family rank, due to the possession of bipinnately compound leaves, small spicate, racemose or capitate, bisporangiate, actinomorphic flower with valvate aestivation of calyx and corolla.

The wood of *A. lucida* is used for making carts those of *A. procera* for sugarcane crushers, rice-pounders, wheels and agricultural implements, those of *A. chinensis* for cabinet work, and those of *A. Lebbeck* and *A. odoratissima* for parquet and string flooring, paneling, carriage work and furniture. Apart from such utilization, they are also of great value for decorative work, interior decorations and for making veneers and glocoal.

The poultice of leaves are applied to ulcers, and skin diseases, and the barks are used in leprosy, syphilis and scabies and also as tanning material. The leaves and anjan from seeds are used for opthalmic diseases.

Although a considerable amount of anatomical data available for *Albizzia*, limited attempts has been made to distinguish the species anatomically within the genus and that a comparative study on the morphology and anatomy of this genus in Myanmar, has been totally lacking.

There are seventeen species, reported by Hundley (1987), which grow wild throughout Myanmar, especially in subtropical, tropical and dry region. In the present work, a comparative and reproductive parts and of the anatomy of the wood of the seven species. viz., *A. myriophylla*, *A. lucida*, *A. procera*, *A. Lebbeck*, *A. chinensis*, *A. lebbekoides*, and *A. odoratissima* which grow commonly in Myanmar.

It is sincerely hoped that this research will promote and give clearer knowledge of these economically important Myanmar species of the genus *Albizzia* in the world of timber trade, and that it would also provide reliable morphological and anatomical diagnostic characters to distinguish among the species of the genus.

## 2. Literature Review

The genus *Albizzia* belongs to the tribe Acacieae, under suborder Mimoseae of the order Leguminosae as stated by Hooker (1885). Ridley (1922) included this genus under sub-order Mimosae of the order Leguminosa. But Hutchinson (1964) classified this genus under the family Mimosaceae of the order Leguminales. Lawrence (1964) placed this genus under the sub-family Mimosoideae, of the family Leguminosae belonging to the order Rosales.

This genus was named, in honour of *Albizzia*, an Italian naturalist in the 18<sup>th</sup> century (Parker, 1918. Collett, 1971). Lyman and Benson (1957) revealed that *Albizzia* is also known as silk tree as well as woman's tongue-tree.

*Albizzia lebbeck* was known as East India walnut (Wealth of India, 1950) in Europe. The Myanmar name for *A. myriophylla* Benth. was New-cho for *A. lucida* Benth. was Than-that; for *A. procera* Benth. was Sit or Thit-pyu; for *A. lebbeck* Benth. was A-nya-kokko or Kokko; for *A. chinensis* (Osbeck) Merr. was Ramona for *A. lebbekoides* Benth. was A-nya-kokko or Thitmagyi; for *A. odoratissima* Benth. was Thitmagyi or Taungmagyi. (Hundley, 1987).

In general, all the species of the genus *Albizzia* were large trees as described by Kurz (1877), Hooker (1885), Gamble (1902), Cook (1903), Brandis (1906), Parker (1918), Ridley (1922), Haines (1922), Parkinson (1923), Bailey (1928), Kirtukar and Basu (1933), Rehder (1951), Backer (1963) and Brandis (1972). But Kurz (1877) and Hooker (1885) mentioned that *A. myriophylla* as a small tree and according to Brandis (1906), Ridley (1922) and Bor (1953) it was recorded as a woody climber.

The anatomy of the wood of the genus *Albizzia* was given by Metcalfe and Chalk (1950), in their work on the study of the family of Mimosaceae.

Pearson and Brown (1932) revealed that the Indian species of *Albizzia* were difficult to distinguish, since the integrate in colour are remarkably similar in anatomical structures.

The wood of *A. lucida* was straight or broadly and shallowly interlocked-grained in Bands, those of *A. procera* straight or broadly and shallowly interlocked-grained: those of *A. chinensis* straight or shallowly interlocked-grained: those of *A. Lebbek* straight or shallowly interlocked-grained in board bands and those of *A. lebbek* straight or shallowly and interlocked-grained in board bands and those of *A. odoratissima* shallowly and broadly interlocked-grained. (Pearson and Brown, 1932).

Pearson and Brown (1932) revealed that wood of *A. lucida* was moderately heavy to heavy: those of *A. procera* was light to moderately heavy those of *A. lebbek* was light: those of *A. chinensis* was very light those to light and of *A. odoratissima* was moderately heavy to heavy.

The wood texture of *A. lucida* was very coarse: those of *A. procera* and *A. lebbek* were very coarse and even, and those of *A. chinensis* and *A. odoratissima* were coarse (Pearson and Brown, 1932).

Pearson and Brown (1932) stated that the vessel pores of *A. lucida* were very large to medium-sized or small, absence of tyloses and presence of deposits of reddish-brown gum. Gamble (1902) and Talbot (1909) explained that the pores of *A. procera* were moderate-sized and large in longitudinal section. Pearson and Brown (1932) also mentioned that they were extremely large to large or medium-sized, thin-walled, tyloses wanting, and copious deposits of reddish-brown gum present.

Gamble (1902), Talbot (1909) and Pearson and Brown (1932) described that the vessel pores of *A. lebbek* were scanty, large to rings of soft-tissue and they were extremely large to large or medium-size, thin-walled, and copious deposits of dark reddish-brown gum present.

The vessel pores of *A. chinensis* were large, often oval and subdivided, very prominent on a longitudinal section (Gamble, 1902) and very large to medium-sized or small, thin-walled, deposits of reddish-brown gum abundant (Pearson and Brown, 1932). Gamble (1902) mentioned that the pores of *A. lebbekoides* were very scanty large and often subdivided.

Talbot (1909) described that the vessels pores of *A. odoratissima* contained a dark gum, large, single or double, surrounded with a very narrow ring of white tissue. Pearson and Brown (1932) also assured that they were very large to medium-sized or small, quite thin-walled and that deposits of reddish-brown gum were very abundant.

According to Pearson and Brown (1932) the parenchyma of *A. lucida* were paratracheal, in cambiform rows of 2-4 (mostly 4) unit along the grain or divided into crystal locules, and deposits of reddish-brown gum occasional in the parenchyma and crystals were abundant in the marginal cells. They also enumerated that the parenchyma of *A. procera* were also paratracheal in cambiform rows of 2-4 (mostly 4),

deposits of reddish-brown gum scanty in the parenchyma and that crystals were abundant.

As described by Pearson and Brown (1932), the parenchyma of *A. lebbek* were paratracheal, in cambiform rows of 2-4 (mostly 4), deposits of dark reddish-brown gum scanty in the parenchyma and that crystals were occasional in the marginal cell. They also mentioned that the parenchyma of *A. chinensis* were paratracheal, in cambiform rows of 2-4 units along the grain or occasionally further divided into crystal locules, deposits of reddish-brown gum scanty in all types of parenchyma, and crystals were infrequent.

They also revealed that parenchyma of *A. odoratissima* were paratracheal, in cambiform rows of 2-4 (mostly 4) unite along the grain or further divided into series of crystal locules, deposits of reddish-brown gum scanty in the parenchyma and that crystals were extremely abundant in the marginal cells.

Pearson and Brown (1932) stated that the fibers of *A. lucida* were non-libriform to semi-libriform, in part septate and deposits of reddish-brown gum present, which generally forming plugs at the septa. In *A. procera*, the fiber were non-libriform, in part at the septate, infiltration not observed. The fibers of *A. lebbek* were non-libriform, in part septate, dark reddish-brown gummy infiltration occasional in the fiber lumina, especially in the last few rows and usually in a parietal layer. The fibers of *A. chinensis* were non-libriform to semi-libriform, in part septate, and sparse reddish-brown gummy infiltration present.

Pearson and Brown (1932) also revealed that the rays of *A. lucida* were homogeneous, 1-6 (mostly 3-4) seriate, reddish-brown gummy infiltration relatively abundant and crystals wanting. The rays of *A. procera* were homogeneous, 1-4 (mostly 2-3) seriate, reddish-brown gummy infiltration abundant and crystal wanting. The rays of *A. lebbek* were also homogeneous, 1-4 (mostly 3-4) seriate, dark reddish-brown gummy infiltration confined to occasional cells, and crystals wanting.

The rays of *A. chinensis* were homogeneous, 1-5 (mostly 2-3) seriate, and reddish-brown organic infiltration copious. Pith flecks relatively abundant, traceable to included insect mines. The rays of *A. odoratissima* were homogeneous. 1-6 (mostly 3-4) seriate, reddish-brown gummy infiltration copious and crystals wanting.

### 3. Materials and Methods

The specimens of the *Albizzia* species for the present research work were collected throughout the country, mainly from the areas of Yangon Division and some from Mandalay Division and Shan State. The specimens included in this study were found to grow throughout Myanmar, particularly in the tropical and moist upper mixed forests. They were collected especially during the flowering and fruiting periods, which occur from March to September.

For morphological studies, both fresh and preserved specimens of the vegetative and reproductive parts were used.

For anatomical studies on wood, a portion of the stem with bark intact, having a dimension of 9" x 6" x 1" was taken. The wood sample includes the bark, the sapwood and a portion of the heartwood.

For selection of representative samples the heartwood only was for microscopic investigations.

In this work, the microscopic sections of the wood samples were prepared according to the methods as given by Jeffery (1917).

Materials for maceration were prepared by heating them in equal volume of 30% hydrogen peroxide and glacial acetic according to Franklains (1946).

The photomicrographs were taken by using the Olympus Universal was an given by Anon, (1937: 1938: 1964) and Chattway (1932).

For microscopic descriptions, the terminology used in this work was an given by Anon, ( 1937; 1938; 1964 ) and Chattway ( 1932 ).

## 4. Observations

### 4.1 Morphology

The species of the genus *Albizzia* found in Myanmar are deciduous and unarmed trees which are large or moderate-sized or may be woody climbers. Among the seven species observed in this study, *A. myriophylla* Benth. is a woody climber reaching 10-12 meters. The species *A. lucida* Benth, *A. procera* Benth, *A. lebbek* Benth, *A. chinensis* Merr., *A. lebbekoides* Benth., and *A. odoratissima* Benth., are moderate-sized to large and unarmed trees. They usually reach a height of 15-25 meters.

The root systems of the species have well developed tap root systems. The stems are all woody, cylindrical, terete, solid and are usually glabrous. The lenticels are conspicuous and numerous and are found on young branches.

The leaves are bipinnately compound, paripinnate and alternate in all the species. The rachae or primary rachae are usually cylindrical and are canaliculated at the adaxial sides, but are angular in *A. myriophylla*, *A. procera* and *A. odoratissima*. The rachae of *A. myriophylla* are found to be the longest among the species possessing 20.5-24.0 cm in length and those of *A. lucida* the shortest with 2.0-4.5 cm in length. They are usually pubescent.

The rachillae or secondary rachae are usually cylindrical and canaliculated at the adaxial sides, but are angular in *A. myriophylla*, *A. procera* and *A. odoratissima*. They vary from 6-12 pairs in *A. myriophylla*, only one pair in *A. lucida*, 3-5 pairs in *A. procera*, 2-4 pairs in *A. lebbek*. 3-12 pairs in *A. chinensis*, 4-7 pairs in *A. lebbekoides* and 2-6 pairs in *A. odoratissima*. They are usually pubescent. In most of the species, one to five small glands are interpetiolular, which are usually found between the uppermost pairs of petiolules or slightly beyond their bases. The leaflet pairs are opposite or may be nearly opposite in all the species. The leaflets are reticulate and are linear-oblong, slightly falcate in *A. myriophylla*, *A. chinensis* and *A. lebbekoides*, elliptic oblong in *A. lucida*, ovate to ovate- oblong in *A. lebbek* and oblong in *A. odoratissima*. The tips are acute in *A. myriophylla*, *A. chinensis*, *A. lebbekoides*, acuminate in *A. lucida*, round in *A. chinensis* and obtuse in *A. lebbek* and *A. odoratissima*. The margins are usually entire in all the species, but the hairs are dense at the margins in *A. myriophylla*, *A. chinensis* and *A. lebbekoides*, and slightly so in *A. odoratissima*. The bases are rounded and oblique. The variation in the size of the leaflets are very pronounced among the species. The uppermost pairs are usually found to be the largest. *A. lucida* possessed the largest side with 2-5-11.0 cm in length and 1.5-5.5 cm in width, while *A. lebbekoides* has the smallest with 0.7-1.0 cm in length and 2.5-3.0 cm in width. The number of leaflets vary from 14-42 pairs in *A. myriophylla*, 1-2 pairs in *A. lucida*, 6-10 pairs in *A. procera*, 3-8 pairs in *A. lebbek*, 13-34 pairs in *A. chinensis*, 16-30 pairs in *A. lebbekoides* and 13-23 pairs in *A. odoratissima*. The surfaces are pubescent in *A. myriophylla*, *A. chinensis*, *A. lebbekoides* and pubescent or glabrous in *A. lucida*, *A. procera*, *A. lebbek* and *A. odoratissima*.



Most of the species are petiolulate, but are sub-sessile in *A.odoratissima*, *A.chinensis* and *A.lebbekoides*. The petiolules are cylindrical and pubescent, and range in length from 0.8 - 1.0 mm in *A. myriophylla* and 2-3 in *A.lucida* and 1.5-2.0 mm in *A.procera* and *A.lebbek*.

The petioles are cylindrical and pubescent, but are glabrous in *A.lucida* and *A. Lebbek*. The pulvin are usually cylindrical in all the species. A prominent gland is usually found on the petiole about the middle of its length.

The stipules are present in all the species, with the exception of *A.lucida*. They are usually filiform, but are ovate with prolong acuminate tips, undulate margins and obliquely cordate bases in *A.chinensis*. They are usually green in all the species but are reddish-green in *A.chinensis*, and are usually pubescent and caducous.

The inflorescences are usually terminal and axillary, and only axillary in *A.lebbek*. The flowers are borne in heads, and they vary in number. The head bearing peduncles arise fascicled either on the primary or secondary peduncles or may arise fascicled at the axile. The terminal primary peduncle laterally bears 5 secondary ones in *A.myriophylla*, 2-6 in *A.procera*, 1-3 in *A.chinensis*, 4-5 in *A.lebbekoides* and 4-6 in *A.odoratissima*. The axillary peduncles directly bear the head bearing ones in *A.myriophylla*, *A.chinensis*, *A.lebbekoides*, and *A.odoratissima*. In *A.lucida*, the axillary peduncles are two in number and arise together at the axills, while those of *A.lebbekoides* bear 2 secondary peduncles and also head bearing ones. The head bearing peduncles are 2-5 in *A. myriophylla*, *A. chinensis*, and *A.lebbekoides*, and 2-4 in *A. lucida*, *A. procera*, *A.lebbek*, and *A.odoratissima*. The heads are 30 to 45 flowered in *A.lebbek*, 15 to 28 flowered in *A.procera*, 15 to 25 flowered in *A. chinensis*, 13 to 20 flowered in *A.myriophylla*, 15 to 20 flowered in *A. lebbekoides*, 12 to 15 flowered in *A.odoratissima* and 10 to 20 flowered in *A. lucida*.

The bracts are usually present in all the species, but vary from 0.7-3.5 mm in length. They are minute and oblong with slightly curved tips. They are usually tomentose and caducous in all the species.

The flowers may be pedicellate or sessile and are complete, bisexual, regular, actinomorphic, pentamerous, cyclic and are hypogynous. The size of the flower varies from 1.0-3.5 cm in length and 3.0-4.5 mm in diameter. The largest ones are found in *A.lebbek* from 3.0-3.5 cm in length and 3.5-4.0 mm in diameter, and the smallest ones are *A. procera* and *A.lebbekoides* from 1.0-1.4 cm in length and 3.5-4.0 mm in diameter. Flower of *A.chinensis* and *A.lebbke* are pedicellate, while those of *A.myriophylla*, *A. lucida*, *A. lebbekoides* and *A. odoratissima* are sub-sessile and those of *A.procera* are sessile. They are usually pubescent. The central flowers in the head are larger than those of the peripheral, but all are found to be equal in size in *A.procera*. They are white or pale green in colour. Bracteoles are absent in all the species.

The calyces are generally synsepalous and companulate in all the species. The tubes of *A. chinensis* and *A. lebbek* are slightly longer than those of the other species. The lobes are shortly toothed and are usually pubescent on the outer surfaces.

The corollas are synpetalous; infundibuliform and are minutely 5-lobed from 4-9 mm in length and 2.0-3.5 mm across. The lobes are small, pubescent with hairy margins and are pale green in colour.

The stamens are monadelphous, numerous and exserted. The staminal tubes of the central flowers were longer than those of the peripheral ones ranging from 0.8-1.5 cm in length. They are usually exserted except in *A. procera*. The staminal tubes of the peripheral flowers are usually inserted in the corolla tubes. The free portions of the filaments are filiform ranging from 0.5-3.2 cm in length. They are wholly white

in *A. myriophylla*, *A. lucida*, *A. procera*, *A. lebbekoides* and *A. chinensis* with greenish upper half. The anthers are minute, rhomboid, ditheous, dorsifixed introse and the dehiscence is longitudinal.

The pistils are monocarpellary and the ovaries are oblongoid and obscurely compressed. They are unilocular with many ovules on the marginal placenta. They vary in size from 1.5-2.5 mm in length and 0.6-1.0 mm in diameter. They are tomentose in *A. chinensis*, and sparsely so in *A. lebbekoides*, and glabrous in *A. lebbek*. The styles are generally terminal, cylindrical and slightly curved. The stigmas are capitate in all the species. The presence of a gynophore is a common character in all the species. The central flowers usually consist of a disc in all the species, except *A. procera*.

The fruits are legumes or pods which are commonly linear-oblong-oid, compressed, this with a simple suture and glabrous. The largest pods are found in *A. lebbek* ranging from 13-28 cm in length and 2.5-4.0 mm in diameter and the smallest ones in *A. chinensis* from 8-13 cm in length and 1.5-2.5 cm in diameter. They are yellowish or pale brown or begin in *A. lucida*, *A. lebbek* and *A. chinensis*, but are reddish brown in *A. procera* and *A. lebbekoides*, brown in *A. myriophylla* and darker in *A. odoratissima*.

The seeds are ovoid or globose, compressed and are 1-13 per pod and glabrous. They are usually exalbuminous. Seed of *A. lucida* are found to be the largest among the species, with 0.8-1.1 cm in length, 0.9-1.0 cm in diameter and the smallest in *A. chinensis* with 5-6 mm in length and 3-4 mm in diameter. They are usually greenish brown, but are pale brown in *A. lucida* and *A. lebbek*. The seed coats are smooth, hard and are usually glabrous.

## 4.2 Anatomy

### Key to the species

1. Aliform or confluent parenchyma form tangential bands, connect many pores; wood coarse-textured..... 2
1. Aliform or confluent parenchyma connect few pores, tangential bands not formed; wood very or extremely coarse-textured. .... 3
2. Pores scatted; multiseriate rays maximum height less than 22 cells and 350 um: wood very light to light ; specific gravity 0.45 green to 0.49 oven dry ----- *Albizia lucida* (1)
2. Pores in oblique pattern: multiseriate rays maximum height more than 30 cells and 400 um wood light to moderately heavy; specific gravity 0.60 oven dry ----- *A. lebbekoides* (2)
3. Fiber septate: wood always moderately heavy ----- 4
3. Fiber non-septate ; wood very light, light to moderately heavy -----6
4. Rays 1-3, mostly 2 cells wide: prismatic crystals absent in axial parenchyma; wood sweet taste -----*A. myriophylla* (3)
4. Ray 1-  $\infty$ , mostly 3-6 cells wide; prismatic crystal present in axial parenchyma; wood no taste ----- 5
5. Maximum length of fiber less than 1320 um; paratracheal parenchyma also vsicentric, aliform confluent very occasional; gum fairly abundant ----- *A. odoratissima* (4)

5. Maximum length of fiber more than 1500 um; pareatracheal parenchyma not vasicentric, aliform confluent moderate: gum sparse -----*A. lebbek* (5)
6. Maximum tangential diameter of vessel pores less than 270 um; sapwood light brown, heartwood dark brown with lighter coloured bands; vessel pores with gum deposits-----*A procera* (6)
6. Maximum tangential diameter of vessel pores more than 330 um; sapwood white, heartwood dark brown with dark streaks; vessel pores with no gum deposits----- *A . chinensis* (7)

### ***A. myrio[hylla Benth.***

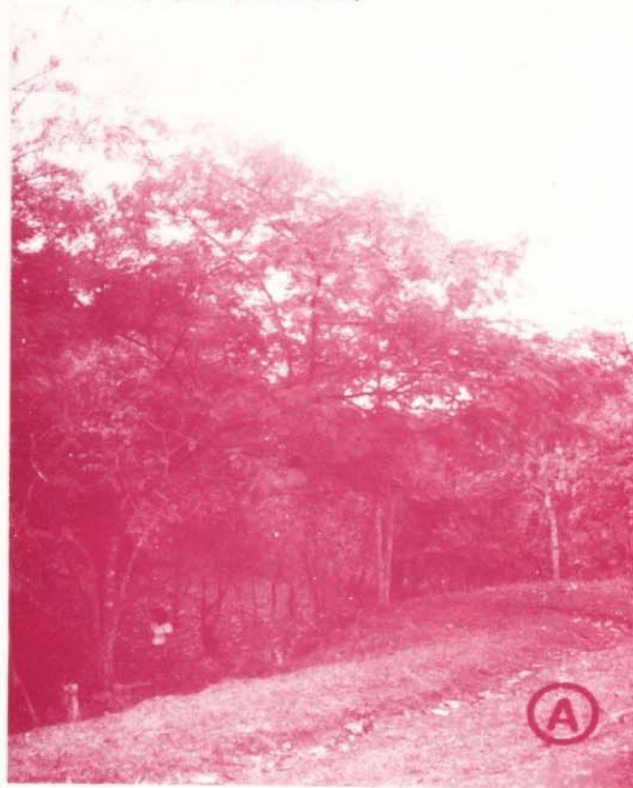
#### General Characteristics and properties of the Wood

Sapwood yellowish-white, heartwood brown, odor not distinct and taste sweet; moderately heavy (specific gravity 0.65 green, 0.73 oven dry): hard: very coarse-textured, fairly straight-grained; diffuse porous wood: growth rings distinct.

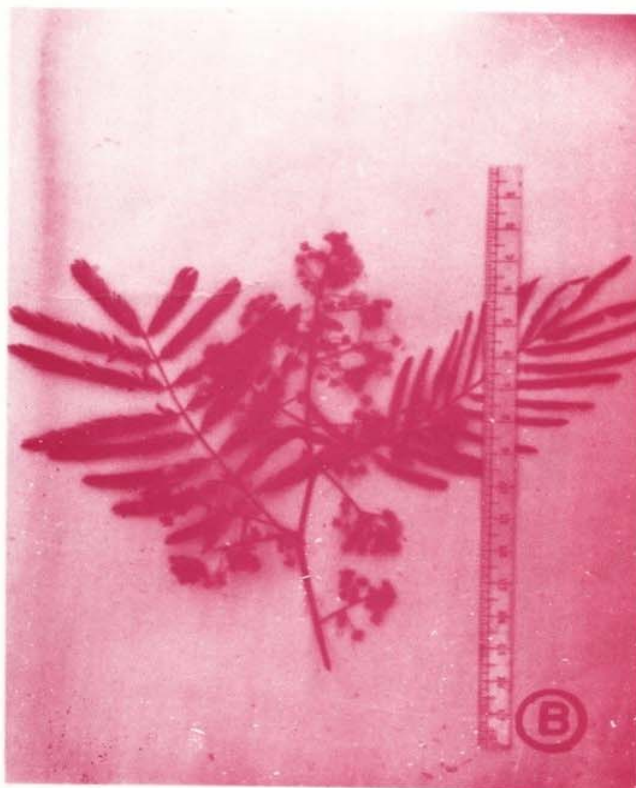
#### Microscopic Characteristics

**Vessel elements:** Diffuse porous: pores very small to moderately large; mean tangential diameter 91 um (range 40-300 um); number per sq. mm very few to few (range 40-10); pores solitary or as radial pore multiples of 2-5 and sometimes as pore clusters: circular or oval in cross section: thin-walled: lumen with gum deposits, tyloses absent: perforation plates simple: end walls of elements oblique or transverse; intervascular pitting alternate, crowded, oval or elliptic, vestured, chambers with mean diameter 4-6 um vessel elements extremely short to medium-sized, mean length 315 um (150-547 um).

*Albizzia myriophylla* (Nwe-cho)

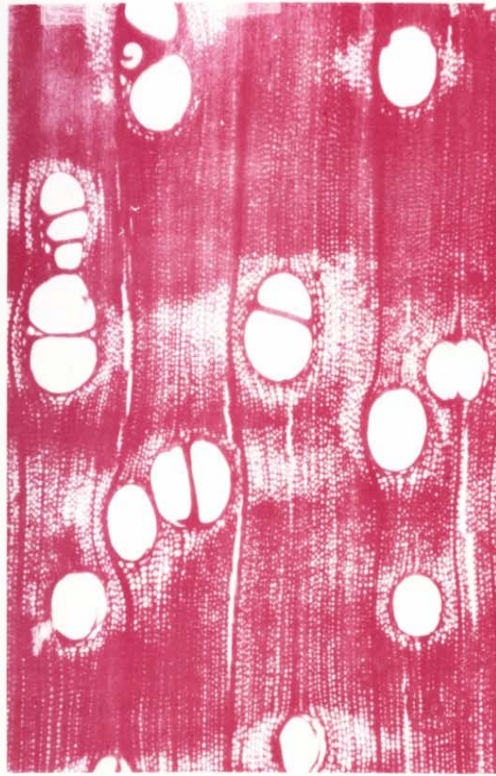


A. Habit as seen.



B. Inflorescence as seen.

*Albizia myriophylla* (Nwe-cho)



A. Transverse section (X 53).



B. Tangential and longitudinal section (X 125).

**Fibers:** Librifrom, very short to medium-sized, mean length 1040 µm (range 570-1450 µm): fine to medium fine with mean tangential diameter 19 µm (range 12.0-25.0 µm): septate, thin-walled, 3.7 - 5.0 µm thick: inter-fiber pits minute, simple, slit-like; gum deposits present; crystals present.

**Rays:** Homocellular, 1-3 cells wide, mostly biseriate: 5-12 per mm tangentially, moderately numerous to very numerous: uniseriate rays extremely fine, mean width 11 µm (range 7.0 -15.0 µm), mean height 126 µm (range 37 -352 µm), 2 - 27 cells high: multiseriate rays extremely fine to moderately fine, mean width 18 µm (range 10 - 28 µm), mean height 211 µm (range 60 390 µm), 3 - 38 cells high: ray vessel pitting similar to intervascular pitting: alternate, rounded or oval in shape, simple, 2.5 - 7.5 µm in diameter gum deposits in ray cells: crystals absent.

**Axial parenchyma:** Abundant, typically paratracheal, usually aliform or confluent connecting 2-5 pores forming 9-16 (mostly 11) seriate tangential bands, crystals absent.

### ***A. lucida Benth***

General Characteristics and Properties of the Wood.

Sapwood white with a yellowish cast, the heartwood brown to dark brown: order and taste not distinct: very light to light (specific gravity 0.45 green, 0.49 oven dry): moderately hard; fairly straight-grained: very coarse-textured: diffuse porous wood; growth rings not distinct.

### **Microscopic Characteristics**

**Vessel element:** Diffuse porous: pores moderately small to very large: mean tangential diameter 169 µm (range 50-330 µm): number per sq. mm few to moderately numerous (range 3-11 µm): pores solitary or as radial pore multiples of 2-4, or sometimes as pore clusters: circular or oval in cross section: thin-walled gums absent; tyloses absent; perforation plates simple: end walls of elements oblique or transverse: intervascular pitting alternate, rounded oval or elliptic, vestured, chambers with mean diameter 4.5 µm (range 2.5 - 7.5 µm): vessel elements extremely short to medium-sized, mean length 156 µm ( range 140 -410 µm ).

**Fibers :** Librifrom, extremely short to medium 380-1250 µm ) fine to medium fine with mean tangential diameter 23 µm ( range 15 - 30 µm ) : non- septate, thin to thick-walled, 2.5-7.5 µm thick, inter-fiber pits minute, simple, slit-like: crystals present.

**Rays:** Homocellular, 1-5 cells wide, mostly triseriate and tetraseriate: 4-9 per mm tangentially, few to numerous; uniseriate rays extremely fine, mean width 9 µm (range 5-12 µm ) mean height 64 µm (range 30-130 µm ) 2-11 cells high: multiseriate rays extremely fine to medium-sized, mean width 31 µm (range 10-70 µm ) mean height 147 µm (range 50-350 µm ) 3-22 cells high: ray vessel pitting similar to intervascular pitting: alternate, rounded or oval in shape (5.0-7.5 µm ) in diameter, gum deposits in ray cell: crystals absent.

**Axial parenchyma:** Abundant, paratracheal aliform or confluent forming 5-22 ( mostly 14) seriate lines or banded, distinct; prismatic crystals abundant, solitary and frequently in 2-23 chambered axial parenchyma.



*Albizzia lucida* (Than-that)



A. Habit as seen.



B. Inflorescence as seen.

*Albizzia lucida* (Than-that)



A. Transverse section (X. 53)



B. Tangential and longitudinal section (X 125)



***A. procera Benth.*****General Characteristic and Properties of the Wood.**

Sapwood light brown, heartwood dark brown, with lighter coloured bands: odor and taste not distinct: light to moderately heavy (specific gravity 0.62 green, 0.67 oven dry); hard; fairly straight-grained; very coarse-textured; diffuse porous wood: growth rings distinct.

**Microscopic Characteristics**

**Vessel elements:** Diffuse porous: pores moderately small to moderately large, mean tangential diameter 188 µm (range 50-270 µm): number per sq. mm few to moderately few (range 2-8 µm): pores solitary or as radial pore multiples of 2-4 or sometimes as pore clusters: circular or oval in cross section: thin-walled; lumen with gum deposits, tyloses absent: perforation plates simple: end walls of elements oblique or transverse: intervacular pitting alternate, crowded, oval, vestured, chambers with mean diameter 5.7 µm ( range 2.5-7.5 µm); vessel elements extremely short to medium-sized; mean length 265 µm ( range 85-390 µm ).

**Fiber:** Liberiform, extremely short to moderately long, mean length 1193 µm ( range 390-1650 µm ) : medium fine with mean tangential diameter 23 µm ( range 15-30 µm ) ; non-septate: thin-walled, 2.5-5.0 µm thick: inter-fiber pits minute, simple, slit-like: gum deposits present: crystal present.

**Rays:** Homocellura, 1-4 cells wide: mostly triseriate and tetraseriate: 50-10 per mm tangentialy, moderately numerous to numerous: uniseriate ray extremely fine to very fine, mean width 11 µm (range 7-17 µm ) , mean height 97 µm ( range 50-210 µm), 2-8 cells high: multiseriate rays extremely fine to medium-sized, mean width 30 µm ( range 5.0-52 µm ) , mean height of 236 µm ( range 65-455 µm) 4-22 cells high, ray vessel pitting similar to intervacular pitting: alternate, rounded or oval in shape, (2.5-7.5 µm ) in diameter, gum deposits in ray cells: crystals absent.

**Axial parenchyma:** Moderately abundant, typically paratracheal, usually aliform or confluent connecting 2-4 pores forming 10-18 (mostly 14) seriate tangential bands, prismatic crystal frequently in 2-7 chambered axial parenchyma.

*Albizzia procera* (Sit, Thit-pyu)

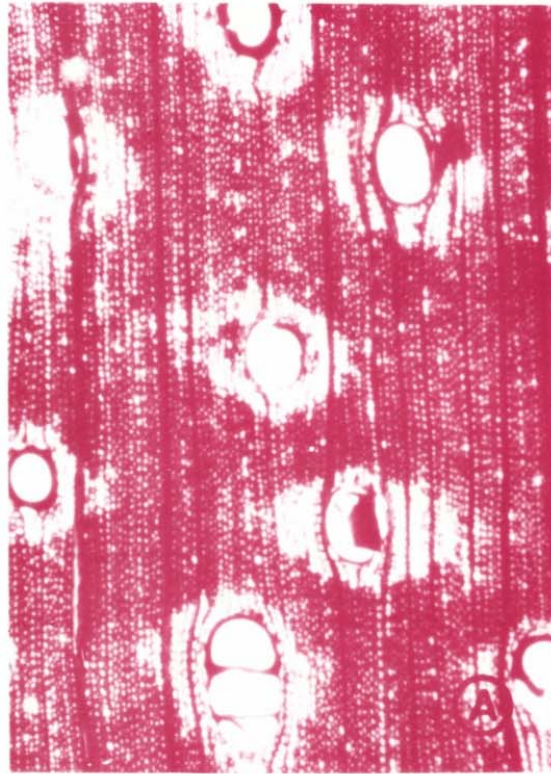


A. Habit as seen.



B. Inflorescence as seen.

*Albizzia procera* (Sit, Thit-pyu)



A. Transverse section (X 53).



B. Tangential and longitudinal section (X 125)

***A.lebbek Benth.*****General Characteristics and Properties of the Wood.**

Sapwood yellowish white, heartwood dark brown lighter coloured bands: odor and taste not distinct: moderately heavy (specific gravity 0.73 green, 0.81 oven dry): hard: fairly straight-grained: very coarse-textured: diffuse porous wood: growth rings obscurely distinct.

**Microscopic Characteristics**

**Vessel elements:** Diffuse pores: pores moderately small to very large: mean tangential diameter 166 µm (range 40-310 µm): numbers per sq. mm very few (range 2-7); Pore solitary or as radial pore multiples of 2-4 and sometimes as pore clusters: circular or oval in cross section: thin-walled: lumen with gum deposits: tyloses absent: perforation plates simple: end walls of elements oblique or transverse: intervascular pitting alternate, oval vestured, chambers with mean diameter 5.6 µm; vessel elements extremely short to medium-sized, mean length 270 µm ( range 155-507 µm ).

**Fibers:** Libriform, extremely short to moderately long, mean length 1122 µm (range 420-1600 µm), fine to medium fine with mean tangential diameter 21 µm ( 12-27 µm ): septate: thin-to thick-walled, 2.5-7.5 µm thick inter fiber pits minute, simple, slit-like; crystals present.

**Rays:** Homocellular, 1-6 cells wide, mostly pentaseriate and multiseriate 3-8 per mm tangentially, few to numerous: extremely fine, mean width 11 µm (range 5-15 µm), mean height of uniseriate rays 62 µm (range 25-102.5 µm), 2-8 cells high, extremely fine to medium-sized, mean width 36 µm (range 12-80.0 µm), mean height of multiseriate ray 173 µm (range 50-350 µm), 4-23 cells high: ray vessel pitting similar to the intervascular pitting: alternate, rounded or oval shaped (5.0-7.5 µm), in diameter, gum deposits in ray cells.

**Axial parenchyma:** Abundant, typically paratracheal, usually aliform, vasientric or confluent connecting 2-6 pores forming 6-28 (mostly 10) seriate lines or banded, prismatic crystals abundant, frequently in 2-17 chambered axial parenchyma.

*Albizzia lebbek* (A-nya-kokko, Kokko)



A. Habit as seen.



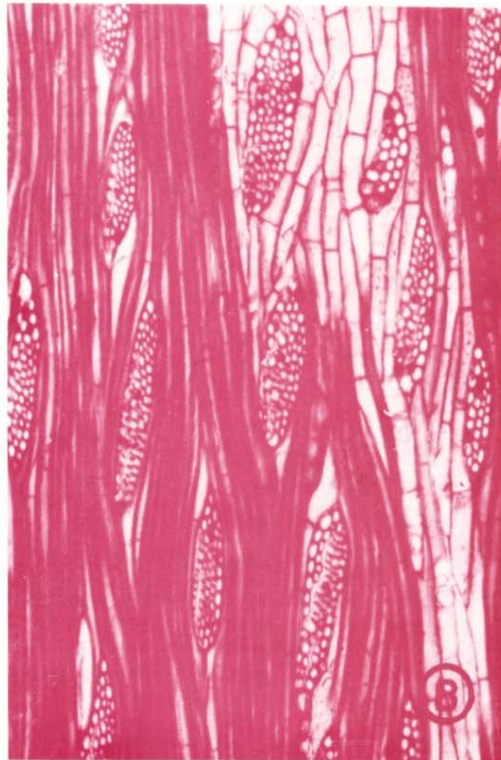
B. Inflorescence as seen.



*Albizzia lebbek* (A-nya-kokka, Kokko)



A. Transverse section (X 53).



B. Tangential and longitudinal section (X 125).

**A. chinensis (Osbeck) Merr.****General Characteristic and Properties of the Wood.**

Sapwood white, heartwood brown with slightly darker streaks: odor and taste not distinct: very light to light ( specific gravity 0.4 green, 0.44 oven dry) : moderately hard: fairly straight-grained: extremely coarse-textured: diffuse porous wood: growth rings not distinct.

**Microscopic Characteristics**

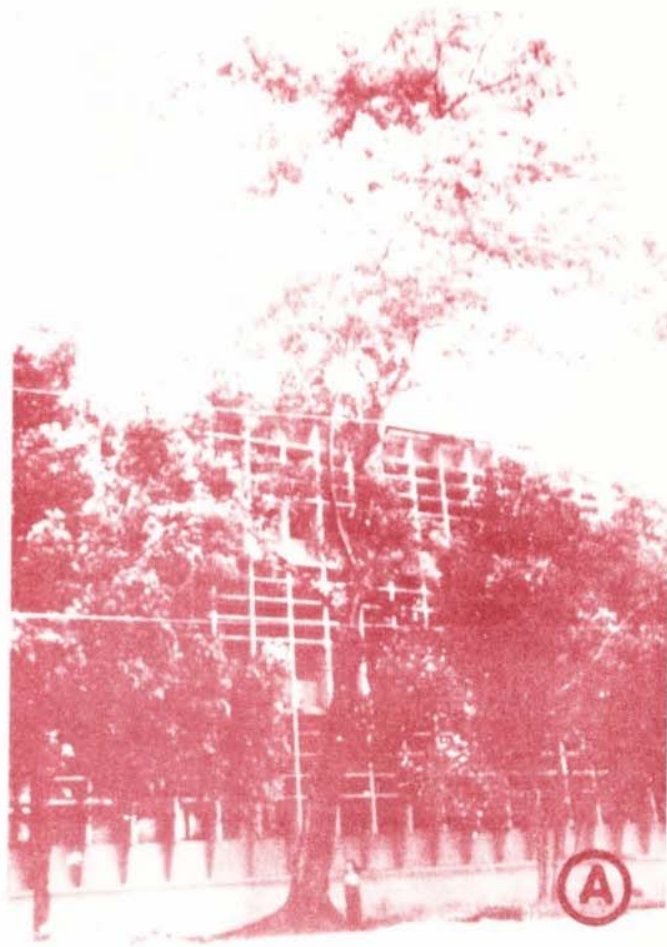
**Vessel elements:** Diffuse pores: pores moderately small to very large: mean tangential diameter 164  $\mu\text{m}$  ( range 50-130  $\mu\text{m}$  ) : numbers per sq. mm very few ( range 2-7 ) ; pore solitary or as radial pore multiples of 2-3 or sometimes as pore clusters: circular or oval in cross section: thin-walled: gum absent: tyloses absent: perforation plates simple: end walls of elements oblique or transverse: intervascular pitting alternate, oval vestured, chambers with mean diameter 4.6  $\mu\text{m}$  (range 2.5-7.5  $\mu\text{m}$ ); vessel elements extremely short to medium-sized, mean length 339  $\mu\text{m}$  ( range 130-540  $\mu\text{m}$  ).

**Fibers:** Libriform, extremely short to medium-sized; mean length 1194  $\mu\text{m}$  (range 400-1590  $\mu\text{m}$ ) fine to medium fine with mean tangential diameter 26  $\mu\text{m}$  ( range 17-32  $\mu\text{m}$  ): non-septate: thin-to thick-walled, 2.5-5.0  $\mu\text{m}$ ) thick; inter fiber pits minute, simple, slit-like; crystals present.

**Rays:** Homocellular, 1-4 cells wide, mostly biseriate and triseriate, 5-10 per mm tangentially; moderately numerous to numbers: extremely fine, mean width 12  $\mu\text{m}$  (range 7.5-15.0  $\mu\text{m}$ ), mean height of uniseriate rays 114  $\mu\text{m}$  (range 30-290  $\mu\text{m}$ ), 2-15 cells high, extremely fine to moderately fine, mean width 31  $\mu\text{m}$  (range 12-50  $\mu\text{m}$ ), mean height of multivariate ray 242  $\mu\text{m}$  (range 60-540  $\mu\text{m}$ ), 5-25 cells high: ray vessel pitting similar to the intervascular pitting: alternate, rounded or oval in shaped (2.5-5  $\mu\text{m}$ ), in diameter, gum deposits in ray cells.

**Axial parenchyma:** Moderately abundant, typically paratracheal, usually aliform, vascioentric or confluent connecting 2-4 pores forming 8-17 (mostly 9) seriate lines or banded, prismatic crystals in 4-14 chambered axial parenchyma.

*Albizzia chinensis* (Bonmeza)



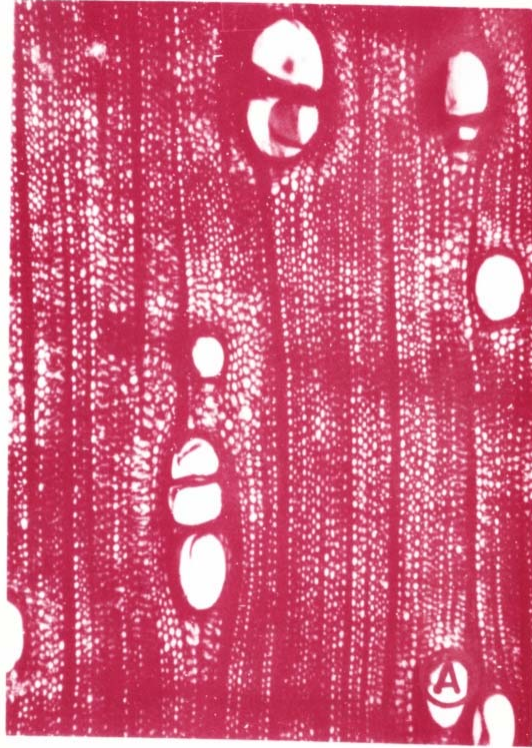
A. Habit as seen.



B. Inflorescence as seen.



*Albizzia chinensis* (Bonmeza)



A. Transverse section (X 53).



B. Tangential and longitudinal section (X 125).

### ***A. Lebbekoides* Benth.**

#### General Characteristic and Properties of the Wood.

Sapwood light brown, heartwood darker brown; odor and taste not distinct: light to moderately heavy (specific gravity 0.60 green, 0.66 oven dry): moderately hard: fairly straight-grained: coarse-textured: diffuse porous wood: growth rings not distinct.

#### Microscopic Characteristics

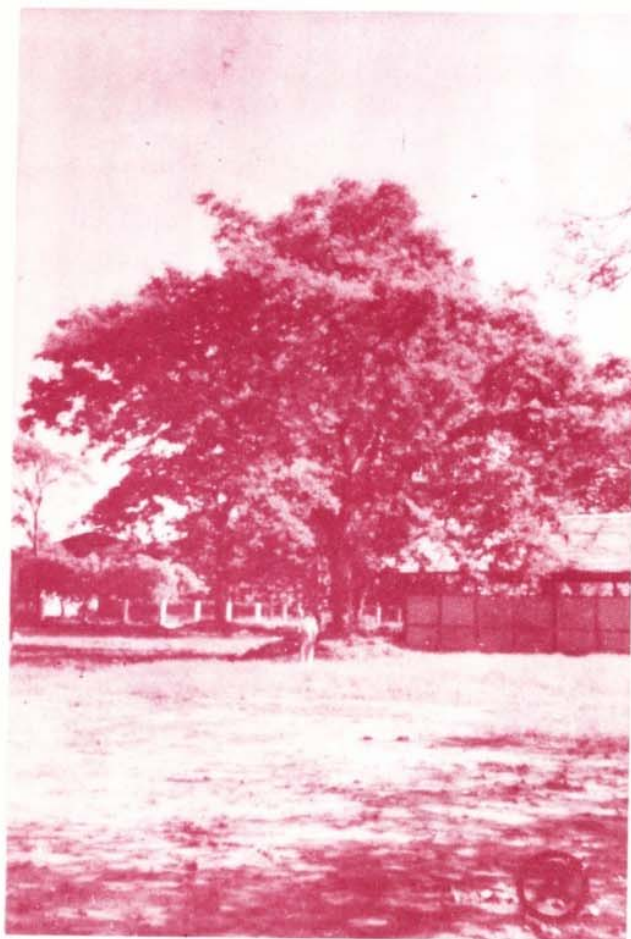
**Vessel elements:** Diffuse pores: pores moderately small to very large: mean tangential diameter 178  $\mu\text{m}$  ( range 50-310  $\mu\text{m}$  ); numbers per sq. mm few to moderately numerous ( range 3-16 ); pore solitary arranged in oblique pattern or as radial pore multiples of 2-5 and sometimes as pore clusters: circular or oval in cross section; thin-walled: lumen with gum deposits, tyloses absent; perforation plates simple: end walls of elements oblique or transverse: intervascular pitting alternate, crowded, oval vestured, chambers with mean diameter 5.5  $\mu\text{m}$  vessel elements extremely short to medium-sized, mean length 339  $\mu\text{m}$  ( range 120-450  $\mu\text{m}$  ).

**Fibers:** Libriform, very short to medium-sized; mean length 949  $\mu\text{m}$  ( range 300-1260  $\mu\text{m}$  ) fine to medium fine with mean tangential diameter 20  $\mu\text{m}$  ( range 15.0-27  $\mu\text{m}$  ): septate, thin-walled, 2.5-5  $\mu\text{m}$  thick; inter-fiber pits minute, simple, slit-like; crystals present,

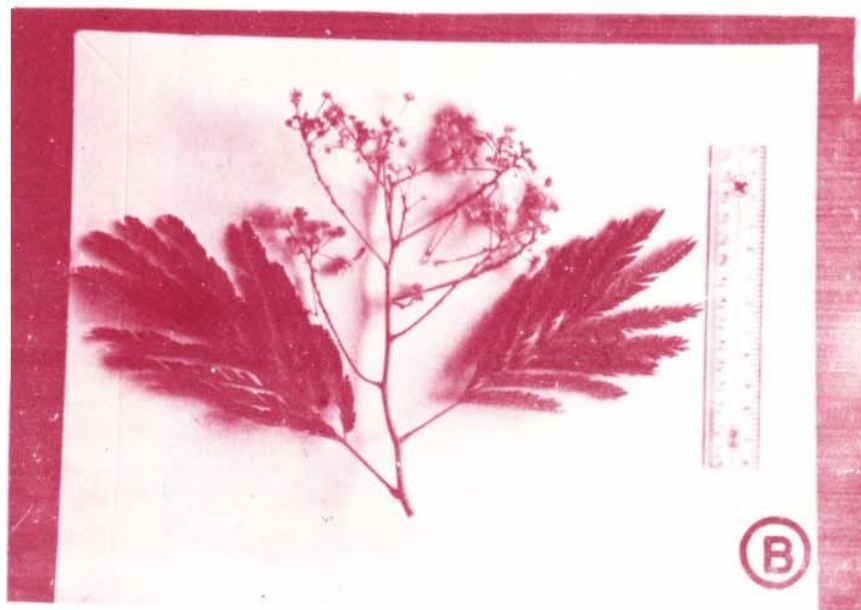
**Rays:** Homocellular, 1-5 cells wide, mostly tetraseriate, 3-13 per mm tangentially mm tangentially, few to very numerous, extremely fine, mean width 9  $\mu\text{m}$  (range 5.0-12  $\mu\text{m}$ ), mean height of uniseriate rays 67  $\mu\text{m}$  (range 30-110  $\mu\text{m}$ ), 2-9 cells high, extremely fine to moderately fine, mean width 27  $\mu\text{m}$  (range 10-50  $\mu\text{m}$ ), mean height of multivariate ray 175  $\mu\text{m}$  ( range 40-590  $\mu\text{m}$  ), 3-32 cells high: ray vessel pitting similar to the intervascular pitting; alternate, rounded or oval in shaped (5.0-7.5  $\mu\text{m}$ ), in diameter, gum deposits in ray cells.

**Axial parenchyma:** Abundant, typically paratracheal, aliform, or confluent 5-21 (mostly 12) seriate lines or bands; prismatic crystals solitary or frequently in 3-9 chambered axial parenchyma.

*Albizzia lebbekoides* (A-nya-kokko, Thitmagyi)



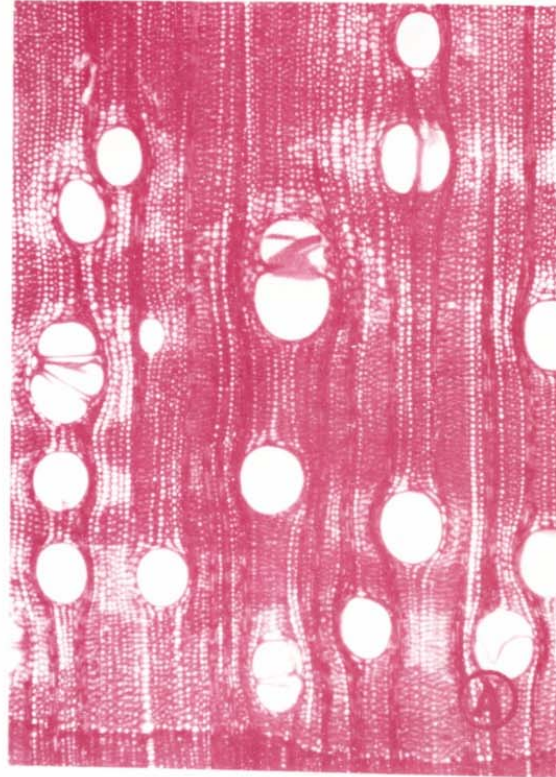
A. Habit as seen.



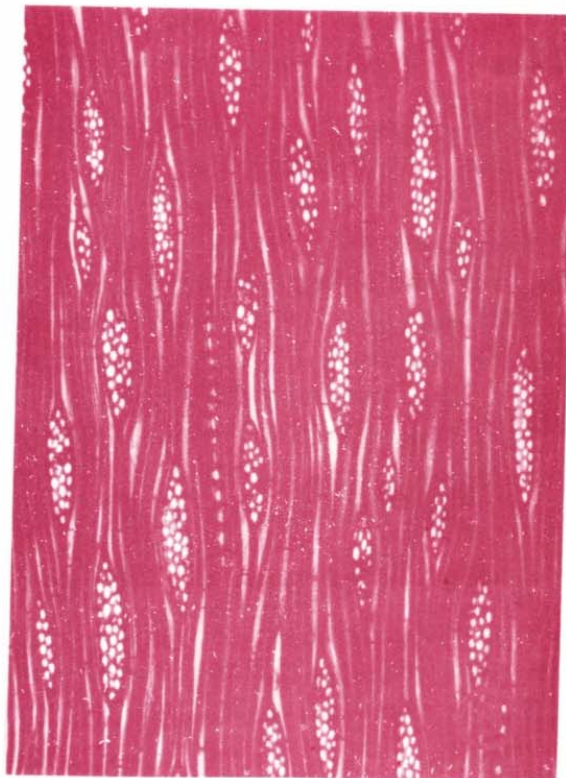
B. Inflorescence as seen.



*Albizzia lebbekoides* (A-nya-kokko, Thitmagyi)



A. Transverse section (X 53).



B. Tangential and longitudinal section (X 125).

***A. adoratissima* Benth.****General Characteristic and Properties of the Wood.**

Sapwood white, heartwood brown with darker streak; odor taste not distinct: moderately heavy (specific gravity 0.66 green, 0.73 oven dry): hard straight-grain; extremely coarse-textured: diffuse porous wood: growth rings fairly distinct.

**Microscopic Characteristics**

**Vessel elements:** Diffuse porous: pores moderately small to very large: mean tangential diameter 181  $\mu\text{m}$  (range 50-340  $\mu\text{m}$ ): numbers per sq. mm few to moderately few ( range 2-8 ); pores solitary or as radial pore multiples of 2-4 and sometimes as pore clusters: circular or oval in cross section: thin-walled: lumen with gum deposits, tyloses absent: perforation plates simple: end walls of elements oblique or transverse: intervascular pitting alternate, crowded, oval vestured, chambers with mean diameter 5.8  $\mu\text{m}$  vessel elements extremely short to medium-sized, mean length 279  $\mu\text{m}$  ( range 140-490  $\mu\text{m}$  ).

**Fibers:** Libriform, very short to medium-sized; mean length 1018  $\mu\text{m}$  ( range 580-1320  $\mu\text{m}$  ) fine to medium fine with-mean tangential diameter 20  $\mu\text{m}$  ( range 12-27  $\mu\text{m}$  ): septate, thin-walled, 2.5-6.5  $\mu\text{m}$  thick; inter-fiber pits minute, simple, slit-like; crystals present,

**Rays:** Homocellular, 1-4 cells wide, mostly triseriate and tetraseriate, 4-10 per mm tangentially mm tangentially, few to numerous, extremely fine, mean width 11  $\mu\text{m}$  (range 17-110  $\mu\text{m}$ ), mean height of uniseriate rays 64  $\mu\text{m}$  (range 17-110  $\mu\text{m}$ ) 2-8 cells very fine to moderate fine, mean with 29.0  $\mu\text{m}$  (range 15-50  $\mu\text{m}$ ), mean height of multiseriate ray 227  $\mu\text{m}$  (range 70-510  $\mu\text{m}$ ), 4-33 cells high: ray vessel pitting similar to the intervascular pitting; alternate, rounded or oval in shaped (3.75-7.5  $\mu\text{m}$ ), in diameter, gum deposits in ray cells.

**Axial parenchyma:** Moderately abundant, typically paratracheal, usually aliform, vasicentric or occasionally 2-3 pores forming 6-14 seriate tangential bands; prismatic crystals solitary and frequently in 2-10 chambered axial parenchyma.

*Albizzia odoratissima* (Thitmagyi, Taungmagyi)



A. Habit as seen.



B. Inflorescence as seen.



*Albizzia odoratissima* (Thitmagyi, Taungmagyi)



A. Transverse section (X 53).



B. Tangential and longitudinal section (X 125).

## 5. Discussion

Seven Myanmar species of the genus *Albizzia* have been studied in this research.

Previously, Hundley (1987) listed (17) species in belonging to the genus *Albizzia*.

All the species studied in this work were found to be growing wild throughout the country. In generally, all the species of the genus *Albizzia* were large trees as described by many authors. But Kurz (1877) and Hooker (1885) mentioned that *A. myriophylla* was small tree, whereas, Brandis (1906), Ridley (1922), and Ber (1953) recorded it as a woody climber. The species *A. myriophylla* studied in the present work was found to be a woody climber.

All the general characteristics of wood such as the colour, density, grain and texture of the species studied are found to be similar to reach other. Relatively few differences are seen as shown in Table 4.1.

As observed in the present study, the oclour of the wood of *A. myriophylla* is yellowish-white to brown, and those of *A. lucida* white to brown or dark brown, which agree with Kurz (1877). However, according to Pearson and Brown (1932) it is white with a yellowish cast to brown with lighter and darker bands. Gamble (1902) also mentioned that it was white to brown with dark streaks with alternate dark and light coloured concentric bands.

The sapwood of *A. procera* is found to be light brown and the heart-wood dark brown with alternate lighter coloured bands. However, Gamble (1902) and Talbot (1909) mentioned that it is yellowish-white to dark brown with alternate bands of darker and lighter, while Kurz (1877) also described as white or brownish to brown or blackish-brown.

*A. lebbek* wood is yellowish-white to dark brown streaked with lighter and darker bands. Which agrees with Gamble (1902) and Pearson and Brown (1932), but Kurz (1877) stated as blackish-brown.

The wood colour of *A. chinensis* in this study is white to brown with slightly darker streaks which agrees with Pearson and Brown (1932), while Kurz (1877), Gamble (1902) and Talbot (1909) also described it as white to brown and dark brown.

The wood of *A. lebbekoides* is found to be light brown to dark brown, which is in agreement with Gamble (1902), While *A. odoratissima* is white to brown with darker streaks which agrees with Gamble (1902), Talbot (1909) and Pearson and Brown (1932), but according to Kurz (1877) it is dark coloured.

It is found that in all the species the odour and taste of the wood is not characteristic, with the exception of *A. myriophylla*, with a sweet taste but no odour.

Table 4.1 Comparison of macroscopic characteristics of woods for *Albizzia*.



Species	Colour	Odor and taste	Density	Grain	Texture
<i>A. myriophylla</i>	yellowish-white to brown	odor not distinct, sweet taste	moderately heavy	fairly straight grained	very coarse-textured
<i>A. lucida</i>	white to brown or dark brown	odor and taste not distinct,	very light to light	fairly straight grained	coarse-textured
<i>A. procera</i>	light brown to dark brown with alternative bands of lighter or darker coloured	odor and taste not distinct,	light to moderately heavy	fairly straight grained	very coarse-textured
<i>A. chinensis</i>	white to brown with slightly darker streaks	odor and taste not distinct,	very light to light	fairly straight grained	extremely coarse-textured
<i>A. lebbek</i>	yellowish-white to dark brown streaked with lighter and darker bands	odor and taste not distinct,	moderately heavy	fairly straight grained	very coarse-textured
<i>A. lebbekoides</i>	light brown to darker brown	odor and taste not distinct,	light to moderately heavy	fairly straight grained	coarse-textured
<i>A. odoratissima</i>	white to brown with darker streaks	odor and taste not distinct,	moderately heavy	straight-grained	extremely coarse-textured

In the present study, it is found that variation in the weights of the woods is slight. The weights of *A.myriophylla* and *A.odoratissima* are found to be moderately heavy, those of *A.procera*, very light to light, which is in agreement with Pearson and Brown (1932).

The weight of the wood of *A. lebbek* is moderately heavy in this work, but Pearson and Brown (1932) mentioned that it was light. *A. lucida* and *A.chinensis* are very light to light which agree with Pearson and Brown (1932).

In the present work, it is observed that all the species of *Albizzia* are fairly straight-grained, but Pearson and Brown (1932) mentioned that *A.procera* and *A. lebbek* are shallowly interlocked-grained and *A.lucida* and *A. odoratissima* are broadly and shallowly interlocked-grained.

In the present study, it is observed that the woods of *A.myriophylla*, *A.procera* and *A. lebbek* are very coarse-textured, which agrees with Pearson and Brown (1932). The woods of *A. lucida* and *A. lebbekoides* are coarse-textured, but Pearson and Brown (1932) stated that *A.lucida* is very coarse-textured. *A.chinensis* and *A. odoratissima* are extremely coarse-textured, but Pearson and Brown (1932) stated it to be only coarse-textured.

The anatomical characteristics for these woods studied are in agreement with the descriptions of the species given in the literature and secondary xylem characteristics observed for all the species are shown in Table 4.2. Growth rings are fairly distinct to distinct or not at all distinct for all the species studied.

All the species studied have diffuse porous wood, and the vessels are solitary, as well as radial multiples and in clusters, which are in agreement with Pearson and Brown (1932).

The pores of *A.lucida* are found to be moderately small to very large in this work. But, according to Pearson and Brown (1932), they are very large to medium-sized or small. Gamble (1902) stated that they are moderately sized.

**Table. 4.2 Results and measurements of wood anatomical properties.**

	<i>A.myriophylla</i>	<i>A. lucida</i>	<i>A. procera</i>	<i>A. chinensis</i>	<i>A. lebbek</i>	<i>A.lebbekoides</i>	<i>A.odoratissium</i>
Mean pores frequency (per mm <sup>2</sup> )	6	6	4	4	5	8	5
mean vessel diameter (um)	91	169	188	164	166	178	181
mean vessel length (um)	315	256	265	339	278	273	279
mean ray frequency (per mm)	8	7	7	8	6	8	7
mean uniseriate ray height (um)	126	64	97	114	62	67	64
mean number of cell	11	4	5	7	4	4	5
mean multiseriate ray height (um)	211	147	236	242	173	175	227
mean number of cell	16	9	12	14	12	11	14
mean uniseriate ray width (um)	11	9	11	12	11	9	11
mean multiseriate width (um)	18	31	30	31	36	27	29
mean fiber length (um)	1040	1004	1193	1194	1122	949	1018
mean fiber diameter (um)	19	23	23	26	21	20	20

The pores of *A. procera* are observed as moderately small to moderately large, but they are moderate-sized and large as given by Gamble (1902), large and medium-sized by Talbot (1909) and extremely large to large or medium-sized by Pearson and Brown (1932).

The pores of *A. lebbek* in this work are moderately small to very large, but large as mentioned by Gamble (1902), while Talbot (1909) stated as moderate-sized to large, and extremely large to large or medium-sized as stated by Pearson and Brown (1932).

The pores of *A. chinensis* in this study are moderately small to very large, but are described as large, by Gamble (1902), while Talbot (1909) stated as moderate-sized, and very large to medium-sized or small by Pearson and Brown (1932).

The pores of *A. lebbekoides* are moderately small to very large pores but Gamble (1902) revealed that it has large pores.

In this study the pores of *A. odoratissima* are small to very large, but according to Pearson and Brown (1932) they are very large to medium-sized or small. Talbot (1909) also described that they are large, and Gamble (1902) as moderate-sized to large.

Vessel elements are found to be extremely short to medium-sized in all the species. Average length of vessel elements of these species ranges from 256 to 339  $\mu\text{m}$ , with the largest occurring in *A. chinensis* as shown in Table 4.2.

Tangential pore diameters exhibit the wide range among the species, however, the maximum diameter occur in *A. lucida* and the minimum in *A. procera* as shown in Table 4.3

Variation in the wall thickness of vessel elements among the species is not discussible. In all the species studied, perforation plates are simple, intervascular pittings are alternate vested and similar to ray-vessel pitting.

Table 4.3 Comparison of pore diameters of *Albizzia*.

Species	mean	Pore diameter ( $\mu\text{m}$ )	
		minimum	maximum
<i>A. myriophylla</i>	91	40	300
<i>A. lucida</i>	169	50	330
<i>A. procera</i>	188	50	270
<i>A. chinensis</i>	164	50	310
<i>A. lebbek</i>	166	40	310
<i>A. lebbekoides</i>	179	50	310
<i>A. odoratissima</i>	181	50	310

Table 4.4 Comparison of rays number per millimeter for *Albizzia*.

Species	mean	Ray per millimeter	
		minimum	maximum
<i>A. myriophylla</i>	8	5	12
<i>A. lucida</i>	7	4	9
<i>A. procera</i>	7	5	10
<i>A. chinensis</i>	8	5	10
<i>A. lebbek</i>	6	3	8
<i>A. lebbekoides</i>	9	3	13
<i>A. odoratissima</i>	7	4	10

In the present work, the fibers of all the species are libriform to semi-libriform but Pearson and Brown (1932) revealed that they are non-libriform to semi-libriform. Inter-fiber pitting are inconspicuous, minute, simple, slit-like which agree with Pearson and Brown (1932). *A. myriophylla*, *A. lebbek*, *A. lebbekoides* and *A. odoratissima* possess septate fibers which is in agreement with Pearson and Brown (1932). The fibers in *A. lucida*, *A. procera* and *A. chinensis* are found to be non-septate, but Pearson and Brown (1932) stated that all the members had in part, septate fiber. The presence of crystals in the fibers are not revealed by Pearson and Brown (1932).

Axial parenchyma as seen in cross-section are variable among the species. Paratracheal are aliform, vascentric and confluent forming tangential bands.

Axial parenchyma cells are often with transverse septation resulting in multiple crystal chambers subdivided in all the species, except in *A. myriophylla*.

Rays vary from low to high and uniseriate to multiseriate, the minimum of ray per millimeter tangentially occur in *A. lebbek* and the maximum mean in *A. lebbekoides* and slight differences in the other species studies as shown in Table 4.4.

Rays are commonly homocellular and uniseriate to tetraseriate in *A. procera*, *A. chinensis* and *A. odoratissima* in this study, but Pearson and Brown (1932) stated that the rays of *A. chinensis* were uniseriate to pentaseriate. In this work rays of *A. lucida* are uniseriate to pentaseriate. In *A. lebbek* they are found to be uniseriate to multiseriate, but Pearson and Brown (1932) described them as uniseriate to tetraseriate. In this study, the presence of gum deposits in all the species and the absence of crystals in the ray cells agree with the description of Pearson and Brown (1932).

## Literature Cited

1. Anon, 1937. Standard Terms of Length of Vessel Members and Wood Fibers. Tropical Woods No. 51:21.
2. Anon, 1938. Standard Terms of Size for Vessel Diameter and Ray Width. Tropical Woods No. 59:51-52.
3. Anon, 1964. Multilingual Glossary of Terms Used in Wood Anatomy. International Association of Wood Anatomists, Committee in Nomenclature. Verlagsanstalt Buchdruckerei Konkordia Winterthur, Switzerland. 186 pp.
4. Backer, C.A. and R.C Backhuizer Var Den Brink Jr. (1963). Flora of Java. Vol. I. N.V.P. Noordhoff Groningen Company, The Netherlands.
5. Bailey, L. H. (1939). The standard syclopedis of Horticulture. Vol. I (A-F). Flora. The Macmillan Company, New York.
6. Black, J. M. (1948) Flora of South Australia. 2<sup>nd</sup> ed. K. M. Stevenson, Government Printer, Adelaide, Australia.
7. Bor, N. L. (1953). Manual of Indian Forest Botany. Geaffcey Cumnerlege Oxford University Press, Bombay.
8. Brandis (1906). Indian Trees. Archibald Constable & Co. Ltd., London.
9. Brandis (1972). The forest flora of North West and Central India. Bishen Singh Mahendra. Pal Singh 23-A, New Connaught Place, Dehra dum.
10. Brown, W. H. (1950). Useful plant of the Philippine. Vol. II. Acornpre Ball Areas, Australia.
11. Burkill, I. H. (1935). A Dictionary of the Economic Products of Malay Peninsula. Vol. I (A-H). Crown Agents for the Oxford University Press, New York.
12. Chattway, M. M. (1932) Proposed Standards for Numerical Values used in Describing Woods.
13. Chopra, R. N., and S.L Nayar and I. C. Chapra (1956). Glossary of Indian Medicinal Plants. Council of Scientific and Industrial Research, New Dehli.
14. Cooke, T (1903); (1958) The Flora of the Presidency of Bombay. Vol. I. Shri Gouranga Press, Private Ltd. Calcutta.
15. Dutta, A. C (1959). A. class-book of Botany. Oxford University Press. Printed in India.
16. Franklin, G. L (1946). A. rapid method of softening wood for microtome sectioning tropical woods. No. 88:35.
17. Gamble, J. S. (1902) A manual of India Timbers. 2<sup>nd</sup> ed. Sampson Low, Marston and Indian Company Limited, London.
18. Gamble, J. S. (1956), (1857). Flora of the presidency of Madras Vol. I Part III Shri Gouranga Press, Private Ltd., Calcutta.
19. Haines, H. H. (1922). The Botany of Bihar and Orissa Part III. Adlard and Son and Wet New management. Ltd., London.
20. Hooker, J. D. (1885). Flora of British India, Vol. II. L. Reeve and Company, London.
21. Hooker, J. D. and R. D. Jackson (1895). Index kewensis Vol. I (A. J.). The Clarendon Press, Oxford.
22. Hundley, H.G. (1987). List of trees, shrubs, herbs & principal climbers of Burma. 3<sup>rd</sup>. Ed., Government Printing Press, Rangun.
23. Hutchinson, J. (1924). The flora of the Malay Peninsula. Vol. III. Government of the Straits Settlements and Federated Malay Sates.
24. Hutchinson, J. (1926) The Families of Flowering Plants. Dicotyledons. Macmillan and Company Ltd., London.



25. Hutchinson, J. (1964). The Genera of Flowering Plants. At the Clarendon Press, Oxford.
26. Jeffery, F. G. (1917). The anatomy of woody plants; 1<sup>st</sup> Edition. Chicago, Illinois , University of Chicago Press. 478 pp.
27. Kirtikar and Basu (1933). Indian Medicinal Plants. Vol. II. Lalit Mohar Basu, M, 49, Leader Road, All a habad, India.
28. Kurz, S. (1877). Florest Flora of British Burma. Vol. I. Government Printing press, Calcutta.
29. Lawrence, G. H. M. (1964). Taxonomy of Vascular Plants. The Macmillan company. New York.
30. Lyman and Benson. (1957). Plant Classification D.C. Health and Company Boston. Printed in the United Stated of America.
31. Matchalfe and Chalk (1950). Anatomy of the Dictoyledons. Vol. I. The Clarendo Press, Oxford.
32. Parker, K. N. (1918) The Forest Flora of the Punjub with Printed by the Superintendent, Government Punjub.
33. Parkinson, C. E. (1923). A Forest Flora of the Andaman Island. Government Central Press, Calcutta.
34. Pearson and Brown (1932). Commercial timber of India. Vol. I. Government of India Central Publication Branch. Calcutta.
35. Ridley, H. N. (1922). The flora of the Malay Peninsula. Vol. I. L. Reeve and Company Limited, London.
36. Troups, R. S. (1921) The Silviculture of India tree. Vol. II. The Clarendon Press. Oxford.
37. Worsdell, W. C. (1941). Inxex Londinensis, At the Clarendon Press. Oxford.
38. Talbot, W.W.(1909). Forest flora of the Bombay. Presidency and sind Vol. I. Printed by Government at the photozincographic Department, Poona.
39. Wealth of India, (1950). A Dictionary of India Raw Material and Industrial Products. Vol. I. Council of Scientific and Industrial Research, New Delhi.