Government of the Union of Myanmar
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The Studies on the Morphology and the Anatomy of the Leaf and the Wood of the Myanmar species Thitya, *Shorea obtusa* Wall. and Myanmar Ingyin, *Shorea siamensis* Miq.

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မြန်မာ့သစ်ယာ *Shorea obtusa* Wall. နှင့် မြန်မာအင်ကြင်း *Shorea siamensis* Miq. တို့၏ ပြင်ပရုပ်သွင်နှင့် အရွက်နှင့်သစ်သားတို့၏ ခန္ဓာဗေဒလက္ခဏာတို့ကိုလေ့လာခြင်း

စာတမ်းအကျဉ်းချုပ်

သစ်ယာ *Shorea obtusa* နှင့် မြန်မာအင်ကြင်း *Shorea siamensis* ပင်တို့သည် မျိုးရင်း Dipterocarpaceae တွင် ပါဝင်ပါသည်။ မြန်မာနိုင်ငံ၏ သဘာဝတောကြီးများတွင် ပျံနှံ့စွာ ပေါက်ရောက်ကြသည်။ မြင့်မားသော အပင်မျိုးများ ဖြစ်ခြင်းကြောင့် ဖြောင့်စင်းရှည်လျားသည့် ပင်စည်လုံးရှိပြီး ထွားကြိုင်းသော လုံးပါတ်ရှိ၍ အသုံးခံပြီး အဖိုးတန်ဆောက်လုပ်ရေး သစ်မာရသည့်အပြင် အလွှာသား ထုတ်လုပ်ရန် လွန်စွာ အသုံးတည့်သည်။ မြန်မာ့သစ်ယာနှင့် မြန်မာအင်ကြင်းပင်တို့၏ ရုက္ခသိပ္ပံလက္ခဏာများဖြစ်သော ပြင်ပရုပ်သွင်နှင့် ခန္ဓာဗေဒရုပ်သွင်တို့ကို ဤစာတမ်းတွင် လေ့လာတင်ပြထားပါသည်။ ယခုစာတမ်းတွင် ယင်းအပင်တို့၏ ပင်ပိုင်းလက္ခဏာများ ရှင်းလင်းချက်ကို အရွက်များ၊ ပန်းပွင့်များနှင့် အသီးများကို လေ့လာတင်ပြ ထားပါသည်။ ခန္ဓာဗေဒပိုင်းတွင် အရွက်ရင့်ကို လေ့လာချက်နှင့် သစ်သားပိုင်း လေ့လာချက်များ ပြုစုတင်ပြထားပါသည်။ သစ်သားပိုင်း၏ ကန့်လန့်ဖြတ်ပိုင်း၊ အလျားလိုက်ဖြတ်ပိုင်းနှင့် ချင်းဝက်အလျားလိုက်ဖြတ်ပိုင်းများနှင့်အတူ သစ်အင်္ဂါရုပ်များ သစ်သားတွင် ပါဝင်ဖွဲ့စည်းထားသော ဆဲလ်များကို လက်ဆွဲပုံများနှင့် ဓါတ်ပုံများပါ တစ်ပါတည်း တင်ပြပါရှိပါသည်။ ယခုစာတမ်းအတွက် လေ့လာရန် အထက်ပါအပင်မျိုးစုတို့ကို ရမည်းသင်းခရိုင်၊ ငါးလိုက်ကြိုးဝိုင်းမသော်လည်းကောင်း၊ ရေဆင်းနယ်မြေမှ သော်လည်းကောင်း၊ ကသာမြို့နယ် ဖက်ဆွတ်ကြိုးဝိုင်းမှ သော်လည်းကောင်း၊ ကောက်ယူ စုဆောင်းပါသည်။ အပင်ဦးရေနည်းပါးခြင်းကြောင့် သဘာဝ မျိုးပေါက်ပွားမှုကို အားဖြည့်သော အနေအထားဖြင့် အသီးများကို စုဆောင်း၍ ပျိုးခင်းထောင်ပြီး စိုက်ခင်းများ ဖော်သင့်ခြင်းကြောင့် ပန်းပွင့်ချိန်၊ သီးချိန်နှင့် အသီး၊အစေ့များ ကောက်ယူသင့်သောအချိန်တို့ကို ဆွေးနွေးတင်ပြထားပါသည်။ မြန်မာသစ်ယာနှင့် မြန်မာအင်ကြင်းပင်များ ပေါက်ရောက်သည့် အရပ်ဒေသများနှင့် ယင်းသစ်သားတို့ကို အသုံးပြုပုံများကိုလည်း ဖော်ပြပါရှိပါသည်။

The Studies on the Morphology and the Anatomy of the Leaf and the Wood of the Myanmar species Thitya, *Shorea obtusa* Wall. and Myanmar Ingyin, *Shorea siamensis* Miq.

Abstract

Thitya (*Shorea obtusa*) and Myanmar Ingyin (*Shorea siamensis*) are the members of the family Dipterocarpaceae. They are natural forest trees growing widely throughout Myanmar. These lofty trees having long straight boles with a large girth yield durable valuable construction timbers and most suitable for peeling for the plywoods that detail studies on the morphology and anatomy of these two Myanmar species are made and presented in this research paper. The paper includes the explanations on the vegetative characters of the leaves, the flowers and the fruits. The anatomy or the internal characters of the mature leaves and the woods are also worked out and presented. The wood studies on the Transverse section, Tangential longitudinal section, Radial longitudinal section are explained with the hand drawings of wood elements and photomicrographic plates are also given in this paper. The species collected for this research are from Yamethin District forest reserves Ngalaik Forest Reserves, Yezin area and Katha Phetsut Forest Reserves, and the trees at present periods are scantily found that the natural regeneration should have been supplemented by planting out seedlings raised in nursery. The factors affecting the flowering and fruiting periods and time for collecting of the fruits and seeds are discussed in this paper. Distribution areas within the country and the uses of wood are also presented in the paper.

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1. Introduction

Scope of the research. Thitya (*Shorea obtusa*) and Myanmar Ingyin (*Shorea siamensis*) are two of the twelve species of *Shoreas* grown in Myanmar forests. They belong to the family Dipterocarpaceae and are good timber trees, yield wood and non wood products. The compilation of notes on Myanmar *Shoreas* is a need for the learners researchers, the students and also for those who have interests in Myanmar woody trees. Thus the objective of this work is to give information and to contribute the knowledge on the *Shoreas* from the field of botanical studies of the two Myanmar *Shoreas* grown on natural forest of Pyinmana and nearby areas are studied and presented.

The distribution, the common names, and the botanical names are given as a guide for those who are investigating for these species. The characters of the trees include the boles, the bark, the leaves, the flowers and the fruits are explained in simple terms. The anatomical of the leaf, the petiole and wood studies are presented together with the photographic plates and the hand drawings of macerated vascular elements.

Brief reviews on the silviculture and economics of the two species are also provided in this work.

Objective

- To give information about the distribution and the habitat of the two species in Myanmar.
- To contribute the interesting characters of Myanmar Ingyin and Thitya to Myanmar people.
- To give notice to revere the valuable standard timber trees, and to take more conservation measures of the forest zone.

2. Literature Review

The genus *Shorea obtusa* and *S. siamensis* belongs to the family Dipterocerpaceae. *Shorea* Roxb. which is the largest and economically most important genus of the *Dipterocarpaceae,* occurs from India and Ceylon, throughout Western Malaysia, to the Philippines and the Moluccas.

The genus s*horea* was originally described in 1805 by Gaertner being based on the well known S*al* of India (S. *robusta* Gaertn. f.) Since Gaertner's time may species have been added to S*horea* by various botanists..

The number of the species of the genus *Shorea* had been variously reported. This genus was known to comprise 9 species (Symington 1943); 10 species (RAPA monograph 1985/4). Hundley and Chit Ko Ko (1987) listed 12 Spps. + 1 planted found to be growing in Myanmar.

Shorea siamensis was described in earlier literatures as *Pentacme siamensis, P. suavis.* It has been reported that *Shorea siamensis* is a small genus of three known species with an unusual geographical distribution in South East Asia. The common name for *Shorea siamensis* in Myanmar is Ingyin, *&* in Thailand Rang. (Symington 1943).

Shorea obtusa was a tall tree, 80 ft. in height or more with a girth of 10.ft. and over. (Troup 1921) Distribution of *S. obtusa* mainly in the Chindwin and Rubymines, Southward in the Pegu Yoma and commonly associated with *Dipterocarpus tuberculatus* and *S.siamensis* in the "Indaing" type of forest. Common in the Pyinmana, Taungoo, West Salween, and Shwegyin divisions. (Pearson & Brown 1932)

S. siamensis is distributed in "Indaing" and dry deciduous forests of Myanmar, Indo-china, and Thailand. Its distribution extends into Peninsular Thailand and touches the north of Malay Peninsular in Malay. It occurs typically, as a gnarled tree on rocky-headlands, which are mainly lime-stone.

S. siamensis is a large gregarious deciduous tree, with a tall cylindrical bole, yielding fine logs, reaching a height of 80. ft. or more and a girth of 10 ft. or over. commonly associated with *Dipterocorpus tuberculatus* and *shorea obtusa.* The tree occurs throughout Myanmar especially in Upper Myanmar and northern portions of the Pegu Yomas, and also in the Shan States. The regions with annual rainfall below 40 inches the trees are some what stunted. (Pearson & Brown 1932). Bark thick, rough with deep vertical fissures and with transverse cracks, dark grey, reddish brown inside. Wood very hard and durable, much in demand for building purpose. Lac is sometimes produced on this tree. (Troup 1921, Pearson & Brown 1932 and Rodger 1936.)

Ingyin and Thitya are often found without In (*Dipterocarpus tuberculatus*) particularly on ridges and other dry localities, for they appear to be able to survive in less favourable situations than the latter species. (Troup 1921).

Ingyin and Thitya occur on sandy, often shallow soil, associated with oaks (*Quercus spicata* and *Q. brandisiwa) Buchanania latifolia, Strychnos nux-blanda , Garuga pinnata, Gardenia erythroclada* and *cycas siamensis.* In parts of the dry zone of upper Burma, they occur on sandstone formations, in which silicified wood (Burmese *Ingyin-kyauk*) is

sometimes found, the soil often being poor or shallow. *Ingyin* and *Thitya* of rather small dimensions are found associated with other trees of *Terminalia tomentosa, Diospyros burmaniica , Phyllanthus emblica, Acacia leucophloac, A. catechu, Buchanania latiforlia, Tectona hamiltoniana , Xylia dolabriformis, Odina wodier, Schleichera trijuga, Dalbergia paniculata and Cassra renigera.* In the driest places Ingyin and Thitya give place to *Tectona hamiltoniana, Terminalia oliveri, Acacia leucophloea , A. catechu* and other species typical of the dry zone. *Ingyin & Thitya* occurs along the ridges in the drier types of mixed deciduous forest in the Pegu Yoma. Associated with them in such localities are *Pterocarpus macrocarpus, Terminalia tomentosa, Odina wodier* with rather stunted teak and *Xylia dolabriformis,* and often *Dipterocarpus tuberculatus.* and in some habitats (or places) bamboos are present the commonest species are *Dendrocalamus strictus* in the driest situations. (Troup 1921)

As a climatic conditions I*ngyin* and T*hity*a in their natural habitats occupy regions where the absolute maximum shade temperature varies from 100˚ F to 110˚ F, the absolute minimum from 35˚ to 50˚ F., and the normal rainfall from 30 to 100 in. or more. Where the rainfall is below 40 in. the trees are somewhat stunted .(Troup 1921)

S. *siamensis* is the most deciduous of all the dipterocarps. In fertile localities it is leafless for a comparatively short time or may be scarcely quite leafless, but in dry situations it may drop its leaves towards the end of January or early in February and remain leafless till April. The large inflorescences of showy yellow fragrant flowers appear in March, where the tree is leafless or nearly so and the fruits ripen in May and June. The fruit is five-winged, three of the wings being larges than the other two, the larger wings are about 7.62 – 8.89 cm in. long.

Both *S. siamensis* and *S. obtusa* are the xerophilous types. Occuring on poorer soil and more rocky ground together with the other dipterocarpus. (Troup 1921)

According to Pearson & Brown (1932) general characteristics of the *Shorea* wood is light yellowish-brown to pale greyish or russet-brown, with the white tangential lines (resin canals) at irregular intervals, rather dull, medium smooth. The wood was without characteristics odour or taste, moderately heavy to heavy, interlocked-grained, even and medium coarse-textured; growth rings wanting.

Shorea wood vessels fairly large, scattered, open or filled with tyloses. Parenchyma abundant, sometimes vasicentric and diffuse. Rays distinctly heterogeneous. Resin canals irregularly distributed. Sapwood yellowish white, heartwood yellow to yellowish brown, heavy, coarse textured. (RAPA monograph 1985.)

Vessels of the *S. siamensis* was large to medium sized, the heartwood completely plugged with tyloses; the majority solitary or radially paired; thin-walled; perforation simple; the wood was diffuse porous.

Tracheids abundant; the axial parenchyma were paratracheal and metracheal parenchyma very abundant; crystals occasional in the marginal cells of the parenchyma.

The fibres were libriform and non-septate. The rays were heterogeneous, 1 – 5 (mostly 4) seriate; crystals occasional, solitary in enlarged, cyst like cells.

Resin-canals visible, solitary or 2 – 3 contiguous, embedded in parenchyma (Pearson & Brown 1932). (Gamble 1931)

The timber seasons slowly, a common feature of many of the Dipterocarps. (Pearson & Brown 1932)

A very durable timber working qualities were very hard, should be sawn green, works with some difficulty to a good surface and then takes a high polish.

For economic uses it was a fine constructional timber. It is also used locally for a variety of purposes, such as for all parts of carts, bridge construction, piles, dugouts, ploughs, and by the Burmans as for bows. It should be a first class timber for railway carriage and wagon construction. (Pearson & Brown 1932), (Rodger 1936.)

General characteristics of the wood of *S. obtusa* has a sapwood pale brownish-white, narrow, perishable; heartwood brown, turning to dark brown or dark reddish-brown, often with darker marking, with light tangential lines (resin canals) at irregular intervals; dull, working quite smooth, without characteristics odour or taste, very heavy, interlocked-grained, even and medium textured. (Pearson & Brown 1932.) & (Kurz 1877.)

Vessels of the *S. obtusa* was large to medium sized, the heartwood occluded with tyloses; the majority solitary or paired; thick-walled; perforation simple; the wood diffuse porous. (Pearson & Brown 1932 and Metcalfe & chalk 1957)

Tracheids sparse; the axial parenchyma were paratracheal and metatracheal and sunounding all resin canals. The fibres were libriform and non-septate.

The rays were nearly homogeneous, mostly 3 – 5 seriate, crystals wanting.

Resin-canals present, longitudinal, embedded in parenchyma, solitary or 2 – several contiguous. (Pearson & Brown 1932 and Metcalfe & chalk 1957)

Thitya is a very slow-drying wood of a refractory character.

The timber is extremely durable, its very hard, should be sawn green, working with difficulty to a really smooth surface.

Used for construction, bridges, piles and is a really valuable sleeper wood. It is used locally for a variety purposes, such as boat building, canoes, carts, wells, tool handles, ploughs & rough furniture. (Pearson & Brown 1932.) & (Rodger 1936.)

The timbers of *Shoreas* show a great range of variation in structure and properties, thus making them suitable for a number of end uses. A comparison of the properties of some of the important *Shoreas* with Teak helps in the understanding of their qualities as timber.

Properties of Important *Shoreas* Expressed as Percentage of the Same Properties of Teak given in RAPA Monograph (1985)

Sr. No	Name of species	Weight	Strength as a beam	Stiffness as a beam	Suitability as a post	Shock resistance	Retention of shape	Shear	Hardness
1.	Shorea *assamica*	81	67	83	75	67	71	93	67
2.	Shorea *obtuse*	155	140	158	143	140	58	131	180
3.	Shorea *robusta*	120-130	105-20	110-30	105-20	115-45	55-60	110-50	120-70
4.	Shorea *siamensis*	135	117	132	116	113	62	113	142

3. Materials and Methods

Shorea species (*S. siamensis* and *S. obtusa*) family of Dipterocarpaceae for the present research work were collected from Forest Research Institute Campus, Yezin, Ngalaik Forest Reserves of Yemethin district and Katha Phetsut Reserves, Sagaing Division. These specimens were collected respectively during their flowering and fruiting periods.

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

To study the anatomical characteristics the wood samples measured 8" x 6" x 1" were taken from the main trunk particularly breast height level of stem. Each wood sample includes the bark, the sapwood and a portion of heartwood.

For the microscopic studies of the wood specimens Jefferyls method (1917) was used.

For anatomical observation, specimens with heartwood were selected and cut into small cubes of 1 cm x 1 cm x 2 cm. Transverse, tangential and radial sections. These sample blocks were boiled with water for softening. After boiling, transverse, tangential and radial sections of 25 to 30 µm thickness were cut on sliding microtome. These sections were storied in Safranin, dehydrated and mounted on slide for microscopic observation.

To study individual elements, wood specimens were macerated with a mixture of equal volume of 30% hydrogen peroxide and glacial acetic acid by Franklin's method (1940).

Terminology of microscopic description was wood according to Chattaway (1932), Whealer, Baas & Gaason (1929).

Photomicrographs were also made by use of Olympus Universal Research Microscope, Vanox model.

The specimens were authenticated at the Wood Anatomy Research Section, Forest Research Institute, Yezin.

4. Observation

4. 1. Morphology

4.1.1. Scientific Name : *Shorea obtusa* Wall.
Family : Dipterocarpaceae
Syn : *Shorea leucobotrya* Miq.
Myanmar : Thitya

A large deciduous tree attaining a height of 25-30 m with a clear bole of 15-16 m and a girth of 2.5 m. Bark dark grey, rough with deep irregular fissures. Young branches covered by fugaceous stellate tomentum. Leave 10-14 cm length and 5-10 cm width, elliptic to elliptic oblong, tips blunt or occasionally apiculate, rounded at the base, but usually glabrous when mature, lateral nerves 10-14 pairs; venation scalariform, petiole 1.5-1.8 cm long. Inflorescence panicle terminal and axillary, tomentose, 4-6 cm long. Flowers greenish-yellow, subsessile on short racemes, fragrant. Calyx lobes 0.3 cm long, tomentose. Petal 5, 1.3 cm long, linear to linear lanceolate, pale yellow, pubescent outside. Stamen 20-25: anther 4 lobed oblong, with bearded appendage, connective terminating in a long filiform naked appendage, filament very short, 2.0 mm long: anther 3.2 mm long, basifixed, dithecous. Ovary rounded or ovate, pubescent, stylopodium large and hairy: style short: glabrous:stigma minute. Fruit ovate-oblong, pubescent: base of fruiting calyx shorter than the capsule. Nut pubescent calyx lobe enlarge into wings slightly puberulous, the three larger ones about 3.5 - 3.9 cm length, 0.4 - 0.6 cm width, somewhat oblanceolate, 9 nerved the two smaller ones about 2.4 - 3.1 cm length, 0.1 - 0.4 cm width, linear to linear - lanceolate.

Flowers appear in March to April and fruits ripen in May.

The species has a fairly wide distribution. It occurs in Poppa, Inwa, Taungoo, Aunglan, Pyay, Mottama and Taninthayi.

The species is fairly common in the Dry Tropical Semi - Indaing and Indaing Scrub Forest. In the Semi - Indaing Forest, the stand is mixed, though more or less pure associate of some of the dipterocarps are occasionally seen. Bamboo are frequent.

Seed germinate soon after falling and will not keep anytime.

Lac is occasionally production this tree.

The species is xerophilous. Unlike the majority of dipterocarps, it can be survive even or poor soil and rocky areas.

4.1.2.	Scientific Name	:	*Shorea siamensis* Miq.
	Family	:	Dipterocarpaceae
	Syn:	:	*Pentacme malayana* King.
			P. siamensis Kurz.
			P. siamensis (Miq.) Kurz.
			P. siamensis Var. Mekongensis Craib.
			P. suavis A.Dc.
			P. tomentosa Craib.
	Myanmar	:	Ingyin, Eng-Kyn, Thitya-ingyin.
	Thailand	:	Rang

A large sized deciduous tree attaining a height of 15m - 20m with a clear bole of 10 - 13m and a girth of 1-2 m. Young shoots covered by a fugaceous, greyish or whitish stellate tomentum, branchlets with smooth greyish bark; bole light grey or blackish grey or dark grey, fissure longitudinal and deep sometimes with transverse cracks, outer bark about 5.0 cm or more thick, inner barks yellowish pink or yellowish brown. Leave 5.9 cm - 26.9 cm length and 3.1 cm – 20.7 cm width oblong or ovate-oblong. Obtuse or subacute, base truncate or cordate, hairy on upper surface, tomentose, lower fugaceous pubescence, lateral nerves 10 to 17 pairs; the margin entire, venation scalariform, stipules ovate- subfalcate, up to 0.7-1.4 cm long, caducous; withering yellow, petiole 3.1 cm to 8.3 cm long, hairy, pulvinate. Inflorescences axillary and terminal racemose panicle, 8.5 to 25.0 cm long, the peduncle red in some form or mostly pale yellow. Flower small yellowish, fragrant, almost sessile. Calyx lobes 0.5 cm long, ovate-acuminate, glabrous, margin ciliate, the three outer slightly larger than the two inner. Petals 5, 1 cm long, linear to linear-lanceolate or elliptic, acuminate, valvety outside, white, turning yellowish. Stamens 15 or variable lesser up to 9, filaments very short, 0.2 cm long, broad at the base, anther 5 - 7 mm long, linear oblong, basifixed, dithecous, cells 4, subequal, each prolonged to a filiform points; connective awl-shaped, recurved, barely exceeding the apices of the anther cells. Ovary ovate, glabrous, tapering to the filiform style, stigma minute. Fruit essentially as in the section Anthoshorea of Shorea, glabrous. Stalk about 0.4 cm long. Nut subovate, shining, tapering to a long, thin point, closely embraced on the lower portion by the woody sepal bases. Sepals developed in to many nerved wings; 3 outer wings up to about 7.4 -11.0 cm length, 1.1 - 1.9 cm width. Outer wings linear oblanceolate, tips obtuse about 2-10 nerved.

Flowers from end of February to March, and fruit mature in April to May.

The species is flourished throughout Upper Myanmar. Most frequent occurence has been observed in central Yoma from Ava to Pyay, eastern sides of the Bago Yoma to Yezin.

The Species occurs in a wide variety of forest types from normal Indaing forest through various forms of Semi-Indaing to Dry Deciduous Mixed Forest. It is occasionally found in fairly moist types of forest also. It is associated with *Dipterocarpus turbinatus* and *Dipterocarpus alatus*. Bamboos are present. The species is typically xerophilous. It grows even in drier situations on poor soil.

■ General Characteristic of leaf anatomy

Anatomy of *Shorea* spp. (*Shorea obtusa* & *S. siamensis*)

- **Leaf** - Dorsiventral.

Epidermis - Epidermal cells small, thin-walled, polygonal in surface view. Hairs 3 types (i) Simple unbranched unicellular, long or short, thin or thick walled, (ii) Tufted hairs and (iii) Pellate glands with a stalk and a circular head. Stomata confined to the lower surface or both surfaces; abundant, scattered, anamocytic and paracytic types.

Mesophyll - Palisade mesophyll in transverse section of lamina 2-3 layered, 37.5 – 60.0 µm thick, compact, cells 7.0 µm (5.0 – 12.5 µm) in breadth, 20.5 µm (15 – 27.5 µm) in depth; spongy mesophyll cells oval to rounded. Druses crystal in the idioblasts distinct.

- **Vascular System** - Lateral veins and smaller veins vertically transcurrent type; the bundles collateral, bundle sheath thin walled, parenchymatous sheath extensions toward both epidermises. In transverse sections the midrib bundles embedded in the ground tissue form in to an closely placed are open or broken at the adaxial side with a fused mass of vascular strands in between, the resin canals accompanied the vascular bundles, the fibre sheath present on the phloem side of each bundle forming an arc of the vascular bundles. Mucilage cells in the ground and medullary regions. Idioblast containing various sizes of druses scattered at in all parenchyma tissues of mesophyll.

- **Petiole** - In transverse sections through the distal ends of the petiole the distribution of vascular tissues reveals a very complex structure, composed of outer ring of vascular bundles surrounding the several additional bundles in the medullary region; the outer bundles various sizes, closely placed or fused variously into larger strands accompanied to each by a resin canal at the outer part of xylem tissues forming a ring of 9-10 in number, the medullary bundles may form 2-3 or more complete or incomplete smaller rings. Mucilage cells occur in the ground tissue. Idioblast with druses of various sizes abundant in the parenchyma cells in the cortex and the medullary regions.

➢ 4.2 Anatomy of leaf

I. *Shorea obtusa* Wall. (Thitya)

Leaf - Dorsiventral. Epidermal cells small, thin walled, polygonal in surface view, upper epidermal cells 24.25 µm (15.0 – 35.0 µm) in length, 15.25 µm (10.0 - 20.0 µm) in breadth; lower epidermal cells 11 µm (15.0 – 30.0 µm) in length, 9.5 µm (5 – 15.0 µm) in breadth.

Hairs 3 types, (i) simple, unbranched, unicellular, thin walled, (ii) tufted hairs and (iii) pellate glands with a stalk and a circular head, trichomes (hair) present on lower surface, unicellular, simple trichomes 68.1 µm (51.25 - 102.5 µm) in length and tufted hairs (trichomes) 158.25 µm (112.5 - 212.5 µm) in length. Stomata on both surfaces of the leaf, scattered, abundant on the lower surface, both paracytic and anomocytic types occur, paracytic type usually accompanied on either side by one to two subsidiary cells parallel to the pore and the guard cells, stomata cells 8.75 µm (7.5 -10.0 µm) in length, 17 µm (15.0 - 20.0 µm) in breadth, stomatal index 43.8 - 57.5 µm on lower surface, stomata on upper surface generally confined closer to the larger veins.

Mesophyll – Palisade mesophyll 2 - 3 layered, the layers 37.5 - 45.0 µm thick, compact as seen in the transections; cells 9.75 µm (5.0 - 12.5 µm) in breadth, 20.5 µm (15.0 - 27.5 µm) in depth; spongy parenchyma 5-6 layered, the layers 97.5 - 115.0 µm thick, spongy mesophyll cells angularly elongated to irregularly ovoid, cells 17.5 µm (12.5 - 25.0 µm) in diameter, intercellular spaces present, idioblast with druses occur in the mesophyll.

Vascular System - Mid veins and lateral veins transcurrent type, the bundles collateral the vascular bundles of lateral veins surrounded by thin-walled parenchyma sheath with sheath extensions toward both epidermises. The parenchyma and collenchyma cells surrounding the midrib bundle lack of chloroplast; resin canals always occur at the outer poles of xylem cells. Musilage cells occur in the ground tissue of midrib.

Petiole - In transverse sections, the distribution of vascular tissues, through the distal ends of the petiole exhibit a very complex structure; composed of outer ring of vascular bundles surrounding the several additional bundles in the medullary region, the outer bundles various sizes, closely placed or fused variously in to larger strands accompanied by a resin canal at the outer part of the each xylem group; forming a ring of 9 - 10 canals, resin canals 76.87 µm (41 – 112.75 µm) in length, 59.45 µm (30.75 – 92.25 µm) in breadth, the medullary bundles form 3 - 4 or more complete or incomplete separate inner rings; sclerenchyma sheath present outside and close to the phloem cells of each vascular bundles of the outer ring, distinct as an almost complete ring. Mucilage cells occur in the ground tissue, idioblast with druses crystals of various sizes abundant in the parenchyma cells, druses cells 21.0 µm (12.5 – 30.0 µm) in length, 15 µm (10.0 – 20.0 µm) in breadth. Macerated of petiole are; vessels 211.75 µm (137.5 - 352.0 µm) in length, 20.25 µm (15.0 - 27.5 µm) in breadth; tracheids 199.75 µm (105 -337.5 µm) in length, 10.25 µm (7.5 - 22.5 µm) in breadth; fibre tracheids 326.25 µm (212.5 - 525.0 µm) in length, 12.75 µm (7.5 - 17.5 µm) in breadth; fibres 640.75 µm (312.5 - 1450.0 µm) in length, 12.5 µm (10.0 - 17.5 µm) in breadth.

II. S*horea siamensis* (Miq.) Kurz. (Ingyin)

Leaf - Dorsiventral. Epidermal cells small, thin - walled, mucilagenous, polygonal in surface view, upper epidermal cells 19.63 µm (12.5 - 27.5 µm) in length, 16.87 µm (10.0 - 25.0 µm) in breadth; lower epidermal cells 16.0 µm (10.0 -25.00 µm) in length, 7.5 µm (5 - 10 µm) in breadth.

Hairs types (i) simple branched, unicellular, thick-walled with narrow lumen, cells 613.71µm (216.25 - 973.75 µm) in length, (ii) tufted hairs 317.75µm (153.75 –461.25 µm) in length, (iii) pellate glands with a stalk and a circular head. Stoma confined to the lower surface, abundant, scattered, chiefly anomocytic, paracytic rare or less distinct, cells 16.0 µm (15.0 - 17.5 µm) in length, 8.0 µm (7.5 - 10.0 µm) in breadth, stomatal index 40.0 – 53.62 µm, on lower surface.

Mesophyll – Palisade mesophyll 2 - 3 layered, the layers 40.0 - 60.0 µm thick, compact, cells 7.0 µm (5.0 - 10.0 µm) in breadth, 21.5 µm (15.0 - 27.5 µm) in depth; spongy mesophyll cells rounded, 3-4 layered, the layers 45.0 – 70.0 µm thick, cells 13.5 µm (10.0 - 17.5 µm) in diameter, intercellular spaces present, druses crystals in the idioblast distinct.

Vascular System - Midveins, Lateral veins and small veins vertically transcurrent type; the bundles collateral bundle sheath extensions toward both epidermises. In transversections the midrib bundles embedded in the parenchymatous ground tissue, form in to an arc open toward the adaxial side with a fused mass of vascular strands in between, vascular bundles closely placed or distinctly spaced by interfascicular parenchyma, accompanied by sclerenchyma sheath at the phloem side, a large resin canal occur in the central region of the medullary region, the ground tissue surrounding the midvein absent of chloroplast; mucilage cells and idioblasts of druses scattered in the tissue.

Petiole - In transverse sections through the distal end the cortical cells surrounding the vascular bundles 5 - 7 layers, the outer most 3 - 4 layers collenchymatous, cells angular, followed by rather thin-walled parenchyma cells rounded to oval, the cortical tissue contains chloroplasts. The distribution of vascular tissues complex, outer bundles closely placed, sizes various, forming a ring with several additional bundles in the pith, the orientation of the vascular bundle accordingly to the outer ring or in a random; sclerenchyma sheath occur to all the bundles, the sheath of the outer bundles continuous as a close cylinder. Mucilage cell occur in the ground tissue. Idioblasts with druses crystals abundant throughout the cortical tissues and the medullary region, druses cells 19.5 µm (10.0 – 30.0 µm) in length, 18.75 µm (12.5 – 30.0 µm) in breadth. Resin canals accompanied the outer ring of bundles distinctly wide, smaller to small becoming in the medullary bundles, resin canals 54.12 µm (41.0 - 61.5 µm) in length, 41.0 µm (30.75 - 41.0 µm) in breadth. Macerated of petiole are; vessels 234.72 µm (133.25 - 348.5 µm) in length, 12.5 µm (7.5 - 20.0 µm) in breadth; tracheids 289.05 µm (164 -461.25 µm) in length, 13.75 µm (7.5 - 17.5 µm) in breadth; fibre tracheids 349.52 µm (194.75 - 461.25 µm) in length, 13.5 µm (10.0 - 17.5 µm) in breadth; fibres 1257.67 µm (891.75 - 1486.25 µm) in length, 16.75 µm (12.5 - 25.0 µm) in breadth.

Out standing features of *Shorea obtusa* Wall. (Thitya)

Leaf - (i) Simple unicellular hairs thin-walled with wide lumen, 68.1 µm (51.25 – 102.5 µm) in length.

(ii) Tufted hairs with a stalk abundant on the lower surface, 158.25 µm (112.5 – 212.5 µm) in length, scarce on the upper surface,

(iii) Peltate glands with a stalk occur on both surfaces abundant. Stomata paracytic and anomocytic types abundant, scattered on the lower surface, those on the upper surface rare confined to the venial regions only .

Mesophyll- Palisade cells 9.75 µm (5.0 – 12.5 µm) in breadth, 20.5 µm (15.0 – 27.5 µm) in depth, spongy cells angularly elongated to irregularly ovoid.

Vascular system - Complete to nearly in complete arc open toward the adaxial side with the adaxial vascular strands separately form by fusion of 2 - 3 vascular bundles.

Petiole - Outer ring of vascular bundles closely placed or variously fused in to larger strands. Resin canals distinct in a ring, the medullary bundles form 3 - 4 complete or incomplete separate inner rings containing 3 - 4 -5 vascular bundles, or a single bundle with odd orientation occur.

Out standing features of *Shorea siamensis* (Miq.) Kurz. (Ingyin)

Leaf - (i) Simple, long unicellular hairs thick-walled with narrow lumen, contain mucilage, 613.71 µm (256.25 – 973.75 µm) in length.

(ii) Tufted hairs long, 317.75 µm (153.75 – 461.25 µm) in length, walls not thick as in simple hairs.

(iii) Peltate glands on both surfaces present. Stomata confined to the lower surface, abundant, scattered; paracytic and chiefly anomocytic, very rarely present on the upper surface.

Mesophyll - Palisade cells 2 - 3 layers, cells 7.0 µm (5.0 – 10.0 µm) in breadth, 21.5 µm (15.0 – 27.5 µm) in depth; spongy cells rounded, mucilage cells present.

Vascular System - Incomplete arc open toward the adaxial side with a fused vascular strand in between surrounding the central resin canal in the pith, the sclerenchyma sheath distinct on the outside of the phloem tissue.

Petiole - Outer vascular bundles closely placed, forming a ring encircling the second to third rings in the medullary region, the medullary bundles reveal as several separate bundles. Chloroplasts present in the cortical parenchyma. Mucilage cells in the ground tissue.

Field characters based on bole; bark and leaf

Shorea obtusa Wall. (Thitya)

Bole - Tall, straight, clear bole 45 feet or more and a girth 10.ft.and over.

Bark - Dark grey, rough, deeply fissured, the fissures irregular. Cut surface of outer bark very thick, inner bark pale brown or yellow, sapwood very hard, close-textured, rays not visible on tangential surface.

Leaf - Elliptic to elliptic-oblong, 10.16 – 15.24 cm by 5.08 – 7.62 cm. tip blunt or apiculate, base rounded, both surfaces fugaceous - hairy. Lateral nerves 10- 14 pairs; petioles about 0.75 cm or 1 cm long, fugaceous.

Field characters based on Flowers and Fruits

Flower - Buds subglobose, about 1.27 cm long, open flowers about 2.54 cm. across, yellow, on short racemes, the panicles axillary, the peduncles greenish. Calyx lobes ovate-acuminate, tomentose.

Petals yellow, linear to linear lanceolate, not separating as they fall. Stamens 20-25; staminal appendaged hairy or bearded, ovary ovoid, large stylopodium, hairy, style short, stigma minute.

Fruit - ovoid, three outer wings larger about 5.08 – 6.25 cm long, oblanceolate, the two smaller wings 2.5 – 3.81cm long, linear to linear lanceolate.

Habitat - Commonly grow in dry deciduous forests where rainfall is low. It can survive on shallow soils and rocky areas.

Distribution - Fairly wide occurance in the Dry Tropical Semi-Indaing forests and Indaing Scrub Forest areas between Bago Yoma and Sittaung River. It occurs in Pyay, Yemathin and Inwa in the middle regions, Mottama and Taninthayi areas in Southern regions of Myanmar. It also spread in the upper Chindwin regions.

Field characters based on bole; bark and leaf

Shorea siamensis Miq. (Ingyin)

Bole - Tall, straight, clear bole 40 feet or more.

Bark - Blackish grey, deeply fissured vertically and horizontally. Cut surface of outer bark thick, inner bark arrange or reddish brown; sapwood very hard without ripple marks, i.e not a glistening on tangential surface of a chip of sapwood.

Leaf - Ovate-oblong or oblong, 64 – 38.1 cm or more by 10.16 – 12.7 cm, tip obtuse or subacute, base truncate or cordate, whitish tomentose on both surfaces. Lateral nerves 12 - 15 pairs; petioles about 1in. or 1/6 of the lamina, pulvinate, hairy.

Field characters based on Flowers and Fruits

Flower - Buds ovate-lanceolate, about 15.24cm long, open flowers when expanded about 1.9 cm across. Yellowish, fragrant; the panicles peduncles axillary; the yellowish green or red. Calyx lobes ovate-acuminate, margin ciliate. Petals pale yellow. Stamens 15, or 9 to 12 in filaments very short, anther lobes linear oblong, 4 - celled, each prolonged into a filiform tips, appendage to connective subulate bent outwards. Ovary ovoid, style filiform, stigma minute.

Fruit - Ovoid, enclosed by the thickened bases of the enlarged woody calyx-lobes. Calyx-lobes distinctly unequally developed into wings, 3 outer wings larger or spathulate 7.62 x 1.27 cm long about 10 nerved, 2 inner wings linear lanceolate or spathulate, up to 3.81 cm about 5- nerved.

Habitat - Best development on sandy alluvium in river valleys of Indaing Forest with rainfall below 110 cm; gravelly or sandy soil in semi - indaing forests with about 120 cm rainfall.

Distribution - Gregarious throughout Upper Myanmar eg. Katha, Kantbalu - Indaing Scrub Forests and Indaing high Forests. Most frequently occur between Inwa and Pyay. Scattered in the In forest (Eng forests) of lower Myanmar.

4.3 Anatomy of Wood

4.3.1. *Shorea obtusa* Wall. (Thitya)

General characteristics of the wood;

Sapwood is about 3-5 cm thick, pale yellow in coloured and marked of from the pale reddish-brown heartwood, texture fine to very fine, cross grained, odour and taste absent, diffuse porous, growth-ring present or inconspicuous, pores small to very small, indistinct to distinct to the eye, but visible with a hand len, rays inconspicuous but visible with a hand len.

Microscopic characters;

Vessel diffuse porous, 4-11/ mm², few to moderately numerous, solitary pores 56 %, in radial multiples pores of 2-3 (-5) and 41% and the rest are clusters, solitary pores mostly oval and rounded, mean tangential diameter 132 µm (range 41-236 µm), very small to moderately large, mean length of vessel elements 268 µm (range 123-420 µm), extremely short to medium-sized, perforation plates simple, end walls horizontal or slightly inclined, intervascular pit small (about 5 µm in diameter), ray vessel pitting similar intervessel pit, tyloses abundant, gum deposit present in vessels and ray cells.

Axial parenchyma aliform, aliform confluent, diffuse and diffuse in aggregates, apart from those associated with the intercellular canal, commonly 2-4 celled, prismatic crystals abundant in parenchyma.

Rays heterogeneous, 8-14/mm, numerous to very numerous, multiseriate rays up to 6 cells wide mostly (2-6), (-8)seriate, mean width 61µm (range 21-101 µm), Very fine to moderately broad, 8-39 cells high, mean height 420 µm (range123-871 µm), extremely low to very low, multiseriate rays 84% and uniseriate rays cells few.

Fibres very short to moderately long, mean length 1146µm (range 707 - 1896µm), mean fibre width 18µm(range 12 - 22 µm), mean fibre walled thickness 8 µm (range 6 - 11 µm), thick walled, libriform, non-septate, slit-like, tracheids are with conspicuous bordered pits, extremely short, mean length 268 µm (range 154 - 379 µm), mean width 29µm (range 15 - 43 µm), usually observed in macerated material.

Resin canals present, longitudinal, solitary or 2 - 4 contiguous and tangential row, embedded in parenchyma, angular, 88 µm wide, epithelium cells 1 - 2 layer, the cells arching into the canal cavity.

Uses;

It is used for construction, bridges, pile, sleeper and locally for a variety of purposes, such as boat building, canoes, carts, wells, tool handles, ploughs, and rough furniture. Occasionally it is a host for lac insect.

4.3.2 *Shorea siamensis* Miq. (Ingyin)

General characteristics of the wood;

Sapwood is about 2-3 cm thick, pale yellow in coloured and marked of from light to reddish-brown heartwood, texture fine to very fine, cross grained, odour and taste absent, diffuse porous, growth-ring present or inconspicuous, pores small to very small, indistinct to distinct to the eye, but visible with a hand len, rays inconspicuous but visible with a hand len.

Microscopic characters;

Vessels diffuse porous, 3-9/ mm², few to moderately few, solitary pores 58 %, in radial multiples pores of 2-3 (-5) and 31% and the rest are clusters, solitary pores mostly oval and rounded, mean tangential diameter 138 µm (range 41-226 µm), very small to moderately large, mean length of vessel elements 251 µm (range 113-349 µm), extremely short to moderately short, perforation plates simple, end walls horizontal or slightly inclined, intervascular pit small (about 6 µm in diameter), alternate, rays vessels pitting small (about 3 µm in diameter), occasionally tyloses present, gum deposit present in vessels and ray cells.

Axial parenchyma aliform, aliform confluent, diffuse, apart from those associated with the intercellular canal, commonly 2 - 4 celled strand, prismatic crystals present in parenchyma.

Rays heterogeneous, 5-10/mm, moderately numerous to numerous, multiseriate rays up to 6 cells wide (mostly (2-6) (-7)seriate, mean width 54µm (range 21-78 µm), very fine to medium-sized, 6 - 45 cells high, mean height 525 µm (range103-1025 µm), extremely low to low, multiseriate rays 95% and uniseriate rays cells few.

Fibres very short to moderately long, mean length 1317µm (range 564 - 1999 µm), mean fibre width 19µm(range 13-21 µm), mean fibre walled thickness 8 µm(range 5 - 10 µm), thick walled, libriform, non-septate, slit-like, tracheids are with conspicuous bordered pits, extremely short, mean length 295 µm (range 164 - 420 µm), mean width 31µm(range 20 - 48 µm), usually observed in macerated material.

Resin canals present, longitudinal, solitary, embedded in parenchyma, angular or oval shaped, 45 µm wide, epithelium cells single layer, thin, usually observed in macerated material.

Uses;

It is used for construction, sleeper and used locally for a variety of purposes, such as carts, bridges construction, pile, dugouts, ploughs, etc. Popularly used as mine shafts and in oil wells.

5. Discussion

5.1. Morphology

Morphology characters of *Shorea obtusa* and *S. siamensis* are in agreement with the references used for this work.

In this work, the leaves size of *Shorea obtusa* are 10 - 14 cm. in length and 5 - 10 cm in width; *Shorea siamensis* leaves are 5.9 - 26.9 cm length and 3.1 - 20.7 cm width; the leaves shape are elliptic to elliptic oblong in *S. obtusa* and oblong or ovate-oblong in *S. siamensis*; tips are blunt or occasionally apiculate in *S. obtusa* and obtuse or subacute in *S. siamensis*; margin are entire in *S. obtusa* and entire or emarginate in *S .siamensis*; in *S. obtusa* base are rounded and in *S. sismensis* base are truncate or cordate; lateral nerves are 10 - 14 pairs in *S. obtusa* and 15 - 17 pairs in *S. sismensis*; petiole are 1.5 - 1.8 cm long in *S. obtusa* and 3.1 - 8.3 cm long in *S. siamensis*, more over pulvinate in *S. siamensis* petiole.

Inflorescences are panicle terminal and axillary, tomentose 4 - 6 cm long in *S. obtusa* and in *S. sismensis* axillary, terminal racemose panicle 8.5 - 25.0 cm long, peducle greenish-yellow in *S. obtusa* and red in some form or mostly pale yellow in *S. siamensis*.

The flowers are greenish - yellow, and bud ovate - lanceolate 4 - 8 mm long in *S. obtusa* and yellowish colour in *S. siamensis* and bud ovate lanceolate, 5 - 14 mm long; the calyx lobes are 0.3 cm long, tomentose in *S. obtusa* and 0.5 cm long, ovate acuminate, glabrous, margin ciliate, in *S. siamensis*; petals linear to linear lanceolate, pale yellow in *S. obtusa* and petals linear to linear lanceolate or elliptic, acuminate, white turning yellowish all over to yellow with red tint in the base of the short throat in *S. siamensis*; stamens are 20 - 25, in *S. obtusa*, 15 or variable lesser up to 9, in *S. siamensis*; anther oblong, with bearded appendage, basifixed , dithecous in *S. obtusa* and linear oblong, basifixed, dithecous, cells 4, sub equal each prolonged to a filiform points, connective awl-shaped, recurved, barely exceeding the apices of the anther cells in *S. siamensis*; in *S. obtusa* ovary rounded or ovate, pubescent and in *S. siamensis* ovary ovate, glabrous, tapering to the filiform style; fruit ovate-oblong, pubescent in *S. obtusa* and fruit belly ovoid glabrous in *S. siamensis*; wings 3 outer wings and 2 inner wings in two *Shorea* species.

Table 1. Comparison of habits of the two species of the genus *Shorea*.

No.	Characters	*Shorea obtusa*	*Shorea siamensis*
1.	Habits	a large tree	a large tree
2.	size	25 - 30 m. with a clear bole of 15 - 16 m. and a girth of 2 - 5 m.	15 - 20 m. in height with a clear bole of 10 - 15 m. and a girth of 1 - 2 m.
3.	Bark (colour) & shape	1.2 cm thick, light grey or blackish-grey or dark grey, tissue longitudinal & deep with transverse cracks	1.3 - 1.5 cm thick, dark grey, rough with deep irregular fissures
4.	Sapwood	3 -5 cm thick, pale yellow	2 -3 cm thick, pale yellow
5.	Heartwood	pale reddish-brown	reddish-brown

Table 2. Comparison of leaves of the two species of the genus *shorea*

No.	Characters	*Shorea obtusa*	*Shorea siamensis*
1.	Color	Green	green
2.	Shape	elliptic to elliptic oblong	oblong or ovate-oblong
3.	Size	10 - 14 cm. length 5 - 10 cm. width	5.9 - 26.9 cm. length 3.1 - 20.7 cm. width
4.	Tip	blunt or occasionally apiculate	obtuse or sub-acute
5.	Base	Rounded	cordate or rounded
6.	Lateral nerves	10 - 14 pairs	15 - 17 pairs
7.	Venation	Scalariform	Scalariform

Table 3. Comparison of inflorescences of the two species of the genus *shorea*

No.	Characters	*Shorea obtusa*	*Shorea siamensis*
1.	Position	Panicle terminal & axillary tomentose	axillary, terminal racemose panicle
2.	Size	4 - 6 cm. long	8.5 - 25.0 cm long
3.	Colour	greenish-yellow	Yellow
4.	Peduncle	greenish-yellow	Pale yellow, red in some form or mostly pale yellow

Table 4. Comparison of fruits of the two species of the genus *shorea*

No.	Characters	*Shorea obtusa*	*Shorea siamensis*
1.	Color	Brownish	brownish
2.	Shape	ovate - oblong, pubescent	belly ovoid, glabrous
3.	Size	2.8 cm. in diameter	5 cm. in diameter
4.	Wings	3 + 2, 3 larger one & 2 smaller, 1.9 - 3.8 cm.long, 0.2 - 1.0 cm. width, oblanceolate, the two linear to linear-lenceolate, about 9 nerved	3 + 2, 3 outer wings & 2 inner wings, up to about 7.5 - 11.0 cm. long, 1.1 - 1.9 cm. width, outer wings linear oblance-olate, tip obtuse about 2 - 10 nerved.

5.2 Anatomy

The anatomy of leaves, midrib and petiole of two shores species studied showed only some differences among themselves.

Leaves dorsiventral; epidermal cells, thin-walled, polygonal in surface view. Hair 3 types (i) simple un branched unicellular, long or short, thin or thick walled, (ii) Tufted hairs and (iii) pellate glands with a stalk and a circular head. Stomata confined to both surfaces, abundant, scattered, anomocytic and paracytic type.

The mesophyll was differentiate into palisade and spongy parenchyma. Palisade mesophyll was found to be 2 - 3 layered and 37.5 – 45.0 µm thick in *S. obtusa* and spongy cells angularly elongated to irregularly ovoid. In *S. siamensis* palisade cells 2-3 layered and 40.0 – 60.0 µm thick, spongy cells rounded.

The vascular system of lateral veins and midveins of two *shorea* species showed vertically transcurrent collateral bundles. The vascular system of as *S. obtusa* in the form of complete ring to nearly complete are open toward the adaxial side with the vascular strands of the adaxial the between the arc, formed by fusion of 2-3 vascular bundle; the vascular system of *S. siamensis* is distinctly open are toward the adaxial side with a large was of vascular strands in between the arm of arc. Vascular strands surrounding the central resin canals in the pith. Sclerenchyma sheath distinct outside of the phloem tissue. The medullary bundles also unsheathed by fibre cells.

Petioler bundle in transverse section through the distal ends are of complex structure. Composed of outer ring of vascular bundles surrounding the several additional bundles in the medullary region; the outer bundles various sized, closely placed or fused variously into larger strands accompanied to each by a resin canal at the outer part of xylem tissue forming a ring of canals.

Druses contain in both species. But more abundant in *S. siamensis* Presence the occurance of the mucilagerous epidermal cells of the leaves and the venal in the parenchyma tissue of the petiole is the outstanding character of *S. siamensis*.

In anatomy of wood studied, all the general characteristics such as the colour grain and texture of the species are found to be similar to each others. Relatively few difference are seen as shown in Table (5).

In *S. obtusa* bark dark grey, rough with deep irregular fissures, in the present study. It is agreed with Pearson & Brown (1932), Symington (972) and RAPA monograph (1985). Bark of *S. siamensis* is light grey or blackish grey or dark grey, fissure longitudinal & deep with transverse cracks.

In this study, *S. siamensis* sap wood is about 2 – 3 cm thick, pale yellow in coloured and light to reddish-brown heartwood. But as stated by Pearson & Brown (1932), it was light yellowish-brown to pale greyish or russet-brown; in RAPA mon0oraph (1985), sapwood dull grey to brown; heart wood brownish yellow turning to reddish brown or dark brown. The wood of *S. obtusa* is about 3 - 5 cm thick, pale yellow in coloured and heat wood reddish-brown. However Pearson & Brown (1932) stated that it was pale brownish-white, and heat wood brown, RAPA monograph (1985) described sapwood pale brownish-white, heartwood

brown, turning dark brown or dark reddish-brown, often will dark markings. The qualitative characteristics of wood structure of the two species studied in this work are described in Table (5).

Table 5. Qualitative characteristics of wood structure for two trees species

Sr.	Quantitative characters	*Shorea obtusa* (Thitya)	*Shorea siamensis* (Ingyin)
1.	Growth-ring	Present, inconspicuous	Present, inconspicuous
2.	Texture	Fine to very fine	Fine to very fine
3.	Grained	Cross grained	Cross grained
4.	Odour & taste	Absent	Absent
5.	Porosity	Diffuse	Diffuse
6.	Size of pores	Small to very small	Small to very small
7.	Shape of pores	Oval or rounded	Oval or rounded
8.	Perforation plate	Simple	Simple
9.	Axial parenchyma	Aliform, aliform confluent and diffuse	Aliform, aliform confluent and diffuse
10.	Ray type	Heterogeneous	Heterogeneous
11.	Spacing of rays	Normally space to fairly close	Widely space to fairly close
11.	Fibre septation	Non - septate	Non - septate
12.	Fibre type	Libriform	Libriform
13.	Tyloses	Abundant	Occasionally present
14.	Gum deposits	Present in vessels and rays	Present in vessels and rays
15.	Crystals	Abundant, chained in parenchyma	Few, in parenchyma
16.	Arrangement of resin canal	Concentric rows	Concentric rows
17.	Shape of resin canal	Angular	Angular or oval
18.	Layer of epithelium cells	1 - 2 Layer	Single

The anatomical characteristics of the woods studied in this work are in accordance with the description of the species given in the literature.

Growth ring of *S. obtusa & S. siamensis* are not distinct in the present work. The vessels are solitary, but in radial multiple pores of 2 -3 (-5) in these two species, the pores of *S. obtusa & S. siamensis* are found to be very small to moderately large, the number of pares per square millimeter is few to moderately numerous (4 -11 / mm^2) in *S. obtusa* and few to moderately few (3 - 9/mm^2) in *S. siamensis* . Vessel elements are found to be extremely short to medium-sized in *S. obtusa* and extremely short to moderately short in *S. siamensis* .

The fibres of all the species are libriform. The fibres in the wood of *S. obtusa & S. siamensis* are very short to moderately long.

In cross sectional, axial parenchyma are similar to each other. Paratracheal parenchyma are alifrom, aliform confluent, diffuse, and diffuse in aggregates, a part from those associated with the intercellular canal, commonly 2 - 4 celled, prismatic present in parenchyma.

The ray cells are found to be heterogeneous in this studied. Ray extremely fine to moderately broad and 8 - 39 cells high in *S. obtusa* and ray extremely fine to medium sized, 6 - 45 cells high in *S. siamensis.* In those two species multiseriate rays up to 6 cells wide and ray height extremely low to very low. The number of rays per square millimeter is numerous to very numerous in *S. obtusa* and moderately numerous to numerous in *S. siamensis.*

Resin canals embedded in parenchyma, tangential rows, and epithelium cells 1 - 2 layer in two *shorea* species.

Gum deposits present in the vessels and ray cells.

The quantitative characteristics of microscopic wood structure of the two species studied in this work are also described in Table (6).

Table 6. Quantitative characteristics of wood structure for two trees species

Sr. No.	Quantitative characters	*Shorea obtusta* (Thitya)	*Shorea siamensis* (Ingyin)
1.	Pores frequency (per sq mm)	4 - 11	3 - 9
2.	Pores solitary percentage (%)	56%	58%
3.	Pores multiples percentage (%)	41%	31%
4.	Vessel diameter (µm)	132 41 - 236	138 41 - 226
5.	Vessels length (µm)	268 123 - 420	251 113 - 349
6.	Fibre length (µm)	1146 707 - 1896	1317 564 - 1999
7.	Fibre width (µm)	18 12 - 22	19 13 - 21
8.	Fibre walled thickness (µm)	8 6 - 11	8 5 - 10
9.	Tracheid height (µm)	288 154 - 379	295 164 - 420
10.	Tracheid diameter (µm)	29 15 - 43	31 20 - 48
11.	Rays frequency (per mm)	8 - 14	5 - 10
12.	Rays width (µm)	61 21-101	54 21-78
13.	Rays height (µm)	420 123 - 871	525 103 - 1025
14.	Rays vessel pitting in diameter (µm)	5	3
15.	Intercellular pitting in diameter (µm)	5	6
16.	Multiseriate rays percentage (%)	84 %	93 %
17.	Resin canals(or) Intercellular canal width (µm)	88	45

This table shows that some of the characteristics are not much different between the two species such as pore frequency (per sq. mm.), pores solitary percentage, vessel length and diameter, fibre length, fibre width, Tracheid length & width, Rays frequency, Rays width height (µm).

Freshly collected seed of *S. obtusa* from the study field area, after screening out the seeds attack by insect sown in the nursery bag of Forest Research Institute Seed Department. Are found to be failure for germination the result showed that viability of germination of the seed is very low for natural generation.

6. Conclusion and Recommendations

Myanmar Thitya, *Shorea obtusa* and Myanmar Ingyin *Shorea siamensis* are standard heavy construction timber trees that this paper is intended as a contribution to the knowledge, and characters of Shoreas and to distinguish the species by observation on the nature of the flowers and fruits in particular. Except for Ingyin tree (*S. siamensis*) for its fragrance yellowish flowers much attention is not being paid to other Shoreas by most Myanmar people. These valuable forest trees flourished and distributed in upper Myanmar, through middle and southwards to Pyay. They are scantily found in the forests that the people even do not know or see the tree, nor ever seen the flowers. Whatever it may be the existence of these two species should be noted and conservations measures must be taken by the Forest Department. And if there were any project to do with natural forest conservation, the species should be taken into consideration. It must also be noted that those two species, have their specific ecological zones, and therefore it is more appropriate to use natural regeneration method, which is environment friendly. But all the same to fulfill the urgent need of saving and conservation of these species they should be artificially regenerated.

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