

PHYSICAL PROPERTIES AND GROSS FEATURES OF *Dipterocarpus turbinatus* C.F.GAERTN. AND *PHOEBE GOALPARENSIS* HUTCH. WOOD COLLECTED FROM NORTHEAST INDIA.

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Abstract

The study was conducted to analyse quality parameters of two timbers species namely *Dipterocarpus turbinatus* C.F.Gaertn. and *Phoebe goalparensis* Hutch. from different locations of Northeast India. *D. turbinatus* samples from Assam, Nagaland, Manipur and *P. goalparensis* from Arunachal Pradesh, Nagaland and Manipur. In this paper, gross diagnostic features and physical properties are presented. Both the species showed clear distinction between heartwood and sapwood with *D. turbinatus* showing pale brown heartwood with dull lustre and *P. goalparensis* having dark brown heartwood and moderately shiny. Between the species, more decorative features were found in *P. goalparensis*. Density was higher in *D. turbinatus* ranging from 701.414 (Kg/m³) to 819.629 (Kg/m³) and 465.84 (Kg/m³) to 535.64 (Kg/m³) for *P. goalparensis* across the locations. Both the species showed slightly interlocked grain pattern and diffuse porous in nature. Hardness Indentation values showed higher in *D. turbinatus* as compared to *P. goalparensis*. While shrinkage test results found *P. goalparensis* samples collected from Arunachal Pradesh showed lowest shrinkage and *D. turbinatus* from Manipur showed least shrinkage values across location.

Key words: *Dipterocarpus turbinatus* C.F.Gaertn., *Phoebe goalparensis* Hutch., Heartwood, sapwood, shrinkage, Hardness indentation.

Introduction

The northeastern region of India falling under the Indo-Burma Hotspot among the 4 Hot-spots in India of the total 36 hotspots in the world is well-known for its rich biodiversity (Nagaraj *et al.*, 2019). and extensive forest cover, harbours abundant valuable timber species that play a crucial role in regional economies and ecosystems. The region contributes approximately 23.75% India's total forest cover, wherein the states cover only about 7.98% of India's total geographical area. The total forest cover in the region is estimated at 169,521 sq. km. accounting for 64.66% of the region's land area. As per ISFR 2021 report, the region experienced a net loss of 1,020 sq. km. of forest cover between 2019 and 2021, highlighting growing environmental pressures.

Although India is one of the world's top producers of tropical logs, it ranks as the second-largest importer of timber (FAO,2011) and third largest importer (Sharma *et al.*, 2025) of illegally logged timber (IUFRO,2010) due to inability to meet domestic demand through local supply. Northeast India is home to a rich diversity of timber resources, influenced by its unique climatic conditions and varied topography (Poffenberger *et al.*, 2007). The region is characterized by a wide array of tree species, many of which are valued for their timber quality (Poffenberger *et al.*, 2006) as such the timber industry primarily relies on indigenous species that are well-suited to local environmental conditions (ITTO, 2005). In recent years, the increased demand has led to widespread logging, both legally and illegally for commercially valuable tree species (FAO,2011) like *Dipterocarpus turbinatus* Gaertn. f. and *Phoebe goalparensis* Hutch. both of which have high Commercial value and suffer significant population declines.

Research into wood properties is critical for improving timber utilization (Rajaram *et al.*, 2024). A lack of understanding often leads to the use of inferior or mismatched timbers, resulting in structural inefficiencies and economic losses during construction and furniture making. Hence, studying the anatomical, structural, and strength properties of lesser-known indigenous trees and plantation-grown timber species is essential (Sharma *et al.*, 2017). Such research enhances effective application of diverse wood types but also relieves pressure on traditionally overexploited species like Teak (*Tectona grandis*) and Sal (*Shorea robusta*) (Nagaraj *et al.*, 2019). Recent policy frameworks as the revised National Working Plan Code, provides guidelines to promote biodiversity conservation, carbon sequestration, and livelihood security for forest-dependent communities (Anoop *et al.*, 2011). Therefore, the study aims for Scientific understanding of *Dipterocarpus turbinatus* Gaertn. f. and *Phoebe goalparensis* Hutch. timber characteristics to unlock alternative uses for the species, support sustainable forest management, and conserve primary forest ecosystems. The species were selected for the study after exhaustive research to identify the most common exploited timber species in Northeast region considering its availability and conservation status. These species are commercially important yet under immense pressure

from overexploitation, making scientific evaluation vital for sustainable utilization and conservation planning. Detailed anatomical and physical characterization is vital for a resilient and resource-efficient timber use.

Materials and method

Species description:

Dipterocarpus turbinatus Gaertn. f. – Also called “Khangra/Yangou” in Manipur and commonly known as “gurjan” belongs to the family Dipterocarpaceae which is native to Northeast India and mainland southeast Asia. It is indigenous to Manipur, Meghalaya, Assam, Tripura, Arunachal Pradesh, Andaman and Nicobar Island in India including regions like Bangladesh, Myanmar, and Thailand and has been categorised as “Vulnerable” species (IUCN 2017) Although it is considered a good timber species it is valued for its resin (kanyin oil). It is a tall deciduous tree that can reach heights of up to 60 meters and is characterized by its straight trunk and valuable hardwood. Gurjun can thrive from elevation as low as 300 m to 1100 m above sea level.

Phoebe goalparensis Hutch. – commonly known as “Bonsum” belongs to the family Lauraceae is an evergreen slow growing timber which is an endemic forest species primarily found in Northeast India (Mudoi *et al.*, 2023). *Phoebe goalparensis* is currently categorized as "Endangered" due to various threats to its population and habitat. It is used in construction and other wood works but mostly prized for cabinet work. The distribution is closely tied to various ecological factors, including soil quality, moisture levels, and competition from other flora. It flourishes under a wide range of rainfall from 1,500 mm to 5,000 mm or more.

Dipterocarpus turbinatus and *Phoebe goalparensis* represent critical components of the ecological and economic landscape in Northeast India, hence continued research and conservation efforts to protect their populations and the biodiversity they support.

Sample collection:

Logs / blocks of selected timber species were identified and extracted through Forest Depot logbook and samples were collected from 3 different states depending on its availability as such *Dipterocarpus turbinatus* Gaertn. f. blocks were collected from Assam, Manipur and Nagaland while *Phoebe goalparensis* Hutch. was collected from Arunachal Pradesh, Manipur and Nagaland. From each location, blocks from 3 individual tree logs were procured and composite sample was made to conduct tests for various quality parameters as well as recording general diagnostic features. The Blocks were air dry in shade for 6 months to attain equilibrium moisture content. Further, these blocks/logs were converted to scantlings and billets with no or any defects. For testing of different properties small clear specimens of different dimensions were cut as mentioned in the IS 1708 (1986). detailed dimensions of the test specimens are as mentioned below.

Gross features - : 2 cm × 2 cm × 6 cm (N=9 per species)

Moisture content - : 2 cm × 2 cm × 6 cm (N=45 per species)

Basic density - 2 cm × 2 cm × 6 cm (N=45 per species)

Shrinkage- 2 cm × 2 cm × 6 cm (N= 45 per species)
Hardness indentation test- : 2 cm × 2 cm × 10 cm (N=27 per species)

Results

Physical Properties

Moisture content and Basic density

Moisture content (%) did not vary significantly with the locations in both the species. Density is considered as the most important property

which influences most of the strength properties as well as other factors affecting the utility of the timber. In the current study, density of *P. goalparensis* varied from 465.84 (Kg/m³) to 535.64 (Kg/m³) across the locations, highest being recorded from Nagaland and lowest from Manipur (**Table 1**). Density values for *D. turbinatus* ranged from 701.414 (Kg/m³) to 819.629 (Kg/m³) across the locations. Lowest was recorded in Nagaland and highest was in Manipur (**Table 1**).

Species	Location	Moisture content %	Density (kg/m ³)
<i>Phoebe goalparensis</i>	Nagaland	19.347±0.894	535.643±9.212
	Manipur	19.475±0.471	465.844 ±1.297
	Arunachal Pradesh	18.949±0.032	513.626 ±5.097
CD@0.05		N/A	21.605
<i>Dipterocarpus turbinatus</i>	Nagaland	19.909±0.455	701.414 ±5.133
	Manipur	20.003±0.197	819.629 ±9.755
	Assam	17.72±1.025	762.029 ±18.063
CD@0.05		N/A	43.099
Standard (Teak)			650 – 750

Shrinkage property of selected timber species

In both the timber species radial shrinkage was least, followed by tangential shrinkage and volumetric shrinkage. In case of *P. goalparensis* tangential shrinkage varied across the locations from 2.06 (%) to 5.74 (%), radial shrinkage from 1.4 % to 3 % and volumetric

from 5.17% to 8.53% (**Table 2**). Similarly, *D. turbinatus* showed lower shrinkage in radial direction (1.7% to 3.5 %) as compared to Tangential direction (2.25 % to 6.07%). *P. goalparensis* collected from Arunachal Pradesh showed lowest shrinkage and *D. turbinatus* from Manipur showed least shrinkage values (**Table 2**).

	Location	Tangential (%)	Radial (%)	Volumetric (%)
<i>Phoebe goalparensis</i>	Nagaland	5.735±0.71	3.093± 0.488	8.539±1.22
	Manipur	4.368±0.893	3.752±0.578	8.653±0.77
	Arunachal Pradesh	2.061±0.871	1.453±0.189	5.17±0.929
CD@0.05		N/A	1.588	N/A
<i>Dipterocarpus turbinatus</i>	Nagaland	5.591±0.673	3.507±0.813	9.92±0.997
	Manipur	2.25±0.632	3.194±0.863	5.904±0.181
	Assam	6.075±0.628	1.683±0.114	8.17±0.799
CD@0.05		2.275	N/A	2.627

Hardness indentation test

Indentation test is conducted for testing the relative hardness or softness of the timber. Among the species *D. turbinatus* was found to be harder than the *P. goalparensis*. However, location wise significant difference was found only in *D. turbinatus*, hardest sample being from Manipur (**Table 3**).

Table 3. Hardness indentation values of *Dipterocarpus turbinatus* and *Phoebe goalparensis* from different locations of NE India

	Location	Hardness	Density
<i>Phoebe goalparensis</i>	Nagaland	928.64±47.836	535.643±9.212
	Manipur	929.43±3.006	465.844 ±1.297
	Arunachal Pradesh	929.25±19.273	513.626 ±5.097
CD@0.05		N/A	N/A
<i>Dipterocarpus turbinatus</i>	Nagaland	3,556.64±86.487	701.414 ±5.133
	Manipur	5,050.43±251.619	819.629 ±9.755
	Assam	4,746.42±20.414	762.029 ±18.063
CD@0.05		543.99	602.273
Standard (Teak)		5138.68	4922.94

General diagnostic features

The wood samples collected for *Dipterocarpus turbinatus* and *Phoebe goalparensis* were observed from naked eye as well as under hand lens (5x) for recording various diagnostic features. Common gross features include color, weight, grain, texture, lustre, hardness and special features if any. Across the locations the gross features remained same as these are the species-specific characters. These characters are summarized in **Table 4**. Among the species *D. turbinatus* showed pale brown heartwood colour whereas *P. goalparensis* heartwood appeared to be dark brown. There was clear distinction between heartwood and sapwood for both the species. *D. turbinatus* showed dull lustre and *P.*

High density was noted in *D. turbinatus* as compared to *P. goalparensis*. *D. turbinatus* was observed to be having characteristic radial grain pattern. Hardness was greater in *D. turbinatus* as compared to *P. goalparensis*. Both the species were observed to be diffuse porous in nature.

Discussion

Wood is a highly anisotropic raw material showing differential characters of different stages of maturity, different locality and species to species.

. There has been limited work on the wood quality parameters of *Dipterocarpus turbinatus*. The density was reported to be 705 kg/m³ and hardness was measured to be 3575 N for sides and 4250 N at the end grain (Chowdhury & Ghosh, 1958). However, for the other species *Dipterocarpus indicus* significant variations occurs in density and moisture content among different populations (Al-Sagheer and Prasad, 2010). Reports from near by Myanmar have shown the density of *Dipterocarpus tuberculatus* to be as high as 897 Kg/m³. Wood properties studies of *P. goalparensis* has been very limited. Singh *et al.* (2015) studied the anatomical properties of members of family Lauraceae, including *P. goalparensis*. They gave the ray, vessel, parenchyma and fibre percentages for the species.

Conclusion

Wood as a raw material is in short supply. It is important to use the right timber for the right utility to achieve sustainability, for which it is required to know the quality parameters or different properties of wood. In this paper an effort has been made to understand the diagnostic features and physical properties of *D. turbinatus* and *P. goalparensis* wood samples of which were collected from Assam, Arunachal Pradesh, Manipur and Nagaland. The outcome adds to the otherwise limited database of wood properties of this region.

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Table 4. General diagnostic features of wood of *Dipterocarpus turbinatus* and *Phoebe goalparensis* from different locations of NE India

Species→	<i>Dipterocarpus turbinatus</i>			<i>Phoebe goalparensis</i>		
Location→ Properties↓	Assam	Nagaland	Manipur	Arunachal Pradesh	Nagaland	Manipur
Colour	Sapwood & Heartwood well demarcated; Pale yellowish-brown (Sapwood), Pale red to reddish brown (Heartwood)	Sapwood & Heartwood well demarcated; Pale yellowish-brown (Sapwood), Pale red to reddish brown (Heartwood)	Sapwood & Heartwood well demarcated; Pale yellowish-brown (Sapwood), Pale red to reddish brown (Heartwood)	Sapwood and heartwood distinction with rich-brown heartwood and lighter (Yellow) sapwood	Sapwood and heartwood distinction with rich-brown heartwood and lighter (Yellow) sapwood	Sapwood and heartwood distinction with rich-brown heartwood and lighter (Yellow) sapwood
Lustre	Dull	Dull	Dull	Moderate Lustre	Moderate Lustre	Moderate Lustre
Texture	Medium coarse	Medium coarse	Medium coarse	Fine to very fine	Fine to very fine	Fine to very fine
Weight	Heavy to very heavy (>Kg/m ³)	Heavy to very heavy (>Kg/m ³)	Heavy to very heavy (>Kg/m ³)	Medium to moderately heavy (450-800 Kg/m ³)	Medium to moderately heavy (450-800 Kg/m ³)	Medium to moderately heavy (450-800 Kg/m ³)
Odor	Resinous Characteristic smell	Resinous Characteristic smell	Resinous Characteristic smell	No characteristic odor	No characteristic odor	No characteristic odor
Grain	Straight to interlocked	Straight to interlocked	Straight to interlocked	Fine to Slightly interlocked	Fine to Slightly interlocked	Fine to Slightly interlocked
Hardness	Hard to very hard	Hard to very hard	Hard to very hard	Moderately hard to hard	Moderately hard to hard	Moderately hard to hard
Special Feature/s	Diffuse Porous	Diffuse Porous	Diffuse Porous	Diffuse Porous	Diffuse Porous	Diffuse Porous