Anatomical characterization and Mechanical properties of two endemic thin-walled bamboos used for mat weaving in the Western Ghats

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INTRODUCTION

Bamboo, belonging to the Bambusoideae subfamily in the Poaceae (Gramineae) family, occurs in tropical, subtropical, and temperate regions around the world. This "poor man's timber" is a versatile non-timber forest product and serves as an appealing wood alternative. It is an important resource for indigenous communities. Tribal handicrafts are simple, with natural designs that represent the cultural, artistic, and creative expressions of these communities. Thin-walled, suberect or straggling, medium-sized bamboo, with sympodial, short-necked culms, forms extensive natural populations in the forests of the Western Ghats. It is commonly found as undergrowth in evergreen and semi-evergreen forests. These bamboo species are ecologically and economically valuable and are primarily used for crafting mats with diverse designs, especially by tribal communities such as the Urali, Mannan, Muthuvar, Malayar, and Kadar in the Western Ghats.

Fig.1: Designs of mats woven by tribal communities

OBJECTIVES

- Identifying the common bamboo preferred for mat weaving by indigenous communities
- Studying the physical and anatomical characteristics of these bamboos
- Determination of the mechanical properties of these species

METHODS

- Field visits were conducted in selected tribal settlements to identify the bamboo species preferred for mat weaving
- Physical properties were measured using IS 6874 (2008). Moisture content and density were determined by the water displacement method.

$$\text{Basic density} = \frac{\text{Oven dry weight(g)}}{\text{Green volume(cm}^3\text{)}}$$

- Samples were collected from the Bottom, Middle, and Top portions of the culm and fixed in Formalin: Acetic acid: Alcohol in (8.5:10:5) for 48 hrs. and stored in 70% alcohol (Soderstrom and Young, 1983). Sectioned using Leica SM 2000 R Sledge Microtome; stained using Safranine and observed under the microscope.
- Mechanical properties like MOE and MOR of the dried splits were studied using IS 8242 (1976). Samples were split and smoothened. The density of the splits was determined. Samples bought to 8-10% moisture content by conditioning. MOE and MOR were calculated for the splits using UTM

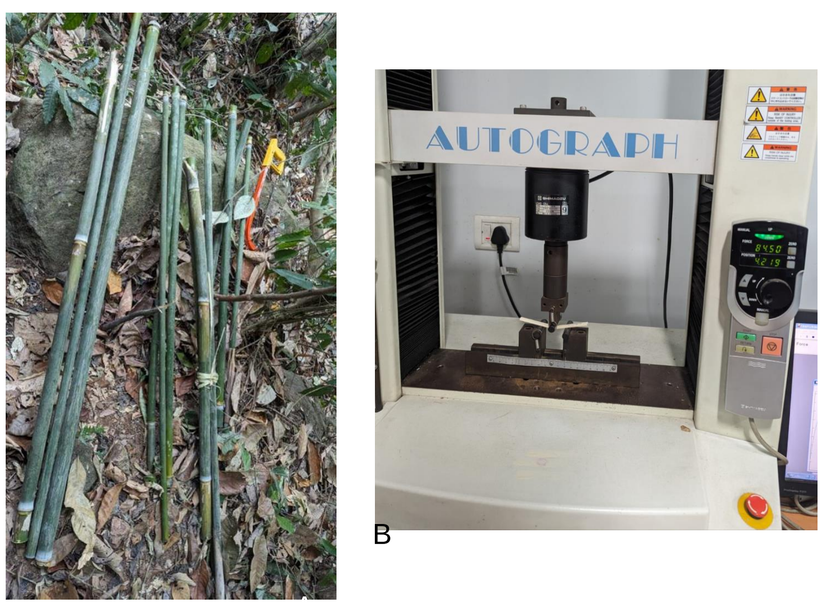

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Fig 2: A- Harvested culms B – Measurement of mechanical properties using UTM

RESULTS & DISCUSSION

Two endemic thin-walled bamboos; *Teinostachyum wightii* Bedd. & *Ochlandra travancorica* (Bedd.) Benth of one-year-old are used for mat weaving by the communities with the former being the most preferred species.

Fig 3: Habit - A- *T. wightii* B – *O. travancorica*

Physical properties :

Middle part of the culm is generally preferred for slivering. The internodal length of *T. wightii* was found to be more (120 cm) in the middle reducing the need for joining the slivers; an important parameter of mat weaving. Density increased with increasing height levels in both species. Density of the middle part of the culm showed variation in both the species - 0.46 g/cm^3 *T. wightii* and 0.53 g/cm^3 for *O. travancorica.*

Culm anatomy :

Epidermis with axially elongated cells, cork cells, silica cells and stomata. 3-4 layers of sclerenchymatous cells in the hypodermis. Cortex with thin and thick-walled parenchyma cells. Ground tissue consists of parenchyma cells in which Type I and II vascular bundles are embedded (Liese 1998). Vascular bundle frequency increased with height. Overall vascular bundle frequency was found to be higher in *T. wightii.*

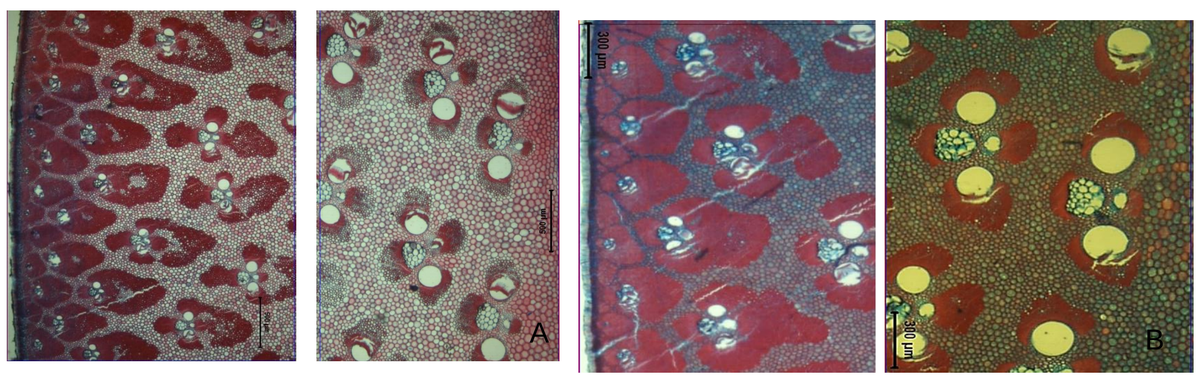

Fig 4: Culm anatomy in outer and inner regions of A- *T. wightii* B – *O. travancorica*

Mechanical properties:

MOE & MOR increase with drying (Huangferi et al., 2018). MOE was found to be 6563.045±529 N/mm^2 for the middle splits of *T. wightii* while 8334±648 N/mm^2 for *O. travancorica.* The smaller the Modulus Of Elasticity more pliable the material. The average MOR of *O. travancorica* was found to be greater making it difficult to break.

CONCLUSION

Both the species showed similar anatomical characteristics. The study revealed that *T. wightii* splits had better MOE compared to *O. travancorica* which could explain the reason why it is the preferred choice of indigenous communities for weaving the highly flexible bamboo mats with various designs.

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