



COMPARATIVE STUDY ON NATURAL DURABILITY OF MANGO (*MANGIFERA INDICA*) AND RAINTREE (*ALBIZIA SAMAN*) WOOD IN FUNGAL AND FIELD TEST

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Abstract: This paper deals with intended to determine the decay resistance of mango (*Mangifera indica*) and raintree (*Albizia saman*) wood in fungal and field test. In fungal test, a white rot fungus (*Schizophyllum commune*) was used in laboratory. The average weight loss of *Mangifera indica* and *Albizia saman* wood blocks inoculated with a white rot fungus (*Schizophyllum commune*) for 16 weeks were 35.28% and 23.80% respectively. In field test the average weight loss were 42.36% and 28.54% respectively for *M. indica* and *A. saman* wood. In both test, degradation was higher in *M. indica* wood compared to *A. saman* wood. Thus, natural durability of *A. saman* wood is higher than that of *M. indica* wood. It is evident that *M. indica* wood under perishable class and *A. saman* wood falls under non-durable class according to natural durability classification.

Key words: *Mangifera indica*, *Albizia saman*, *Schizophyllum commune*, weight loss, natural durability

Introduction

Timber species differ markedly in performance when exposed to decay risks. The heartwood of some species e.g., teak (*Tectona grandis*) will last for decades even in areas of high decay risk, other species need rapid conversion and drying after felling if the hazards of spoilage and decay are to be avoided. Subsequent exposure of perishable species is high risk in-service situations can result in total destruction in a matter of months rather than years. The ability of the heartwood of any wood species to resist decay is said to be its 'natural durability' or alternatively its 'decay resistance' (Eaton and Hale, 1993). In many species inner heartwood shows lower durability than outer heartwood; outer heartwood is less durable from the base of the tree upward, while the opposite occurs with inner heartwood. At the base of the tree these differences are most extreme, further up the tree the resistance is intermediate. The larger the tree the greater is the differences at the base (Scheffer and Cowling, 1966).

The natural durability of heartwood is usually due to the presence of accessory substances in the wood known as extractives, but in addition, dense impermeable timbers tend to be more resistant than light porous species (Shrivastava, 1997). Extractives are recognized as important in determining decay resistance to fungi, a range of insects (Rudman and Gay, 1963) and to marine borers (Bultman, 1976). Extractives may act generally as toxicants to micro-organisms but may also be repellent to insects. The toxic substances vary between species and genera and vary in their chemical properties (Eaton and Hale, 1993). Natural durability of timber is often assumed to refer

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decay resistance only, as fungi are the principal cause of timber deterioration in ground contact or under damp conditions, and the basis of the natural durability classification described below is resistance to decay (Shrivastava, 1997). The Building Research Establishment (UK) defined five durability classes (Shrivastava, 1997; Eaton and Hale, 1993).

Table 1. Natural durability classification of timber.

Durability class	Life expectancy in ground contact (years)	Laboratory conditions (% weight loss) ^a
Perishable	< 5	> 30
Non-durable	5 – 10	10 – 30
Moderately durable	10 – 15	5 – 10
Durable	15 – 25	1 – 5
Very durable	> 25	< 1

^a 16 weeks incubation at 22^oC temperature with decay fungus.

Schizophyllum commune is a white rot fungus which occurs on standing trees of both hardwoods and softwoods, commonly on logs, stumps and timbers in ground contact. Colonization of this fungus is rapid in tropical climates (Eaton and Hale, 1993). Mango (*Mangifera indica*) and raintree (*Albizia saman*) are available in Bangladesh and widely used as low cost timber species. However, this two species have little natural resistance ability against decay under exposed condition. In general, natural durability has been evaluated by exposing wood samples to the decay agents for various periods and rating the resultant degree of degradation. The objective of this study is to determine the natural durability of these two species against *Schizophyllum commune* in laboratory and against a decay hazardous condition in the field and thus to make a comparison of their decay resistance.

Materials and Methods

Collection and preparation of wood samples: Wood samples of *Mangifera indica* and *Albizia saman* were collected from a sawmill nearby Khulna University campus. For each tree species, twenty wood blocks of 1.9 × 1.9 × 1.9 cm. were prepared to test against decay fungus (*Schizophyllum commune*) in the laboratory and twenty wood samples of 15 × 5 × 2.5 cm were prepared for field test.

Incubation of wood blocks into culture bottles: The fungus was collected from the pure culture in the laboratory. Growth of *S. commune* was developed on to malt agar (2% MA) medium on Petri dishes and the test fungus was then grown up in sterilized bottles on same media to establish an active mycelium (Fig. 1). The wood blocks of each species were dried in oven at 103°C ± 2°C until constant weight to determine dry weight (initial weight, Mo). Then the wood blocks were sterilized (autoclaved) and exposed to actively growing pure culture of *S. commune* in bottles. The bottles were incubated for 16 weeks at 25°C and 70% relative humidity (RH).



Fig. 1. Pure culture of *S. commune* in a sterilized bottle.

Installation of wood samples for field test: The wood samples of each species were oven dried and installed in the test yard for 16 weeks. Termite activity and level of damage to the test samples was recorded at the intervals of 4 weeks by visual observation. Samples were reinstalled in their respective positions after each inspection.

Calculation of weight loss: At the end of the exposure (after 16 weeks), the samples were withdrawn both from the culture bottles and the field. The test blocks were carefully brushed off the fungal mats (mycelia) and the test samples were properly washed, and then oven dried to constant weight (final weight, M). The weight loss due to decay was calculated as the difference between dry weight of each wood sample before and after the tests. The weight loss was expressed as a percentage of dry weight loss using the following formula-

$$\text{Loss of weight in wood (\%)} = [(M_o - M) / M_o] \times 100 \quad (\text{Amusant et al., 2005}).$$

M_o = Oven dry weight of wood prior to the decay test

M = Oven dry weight of wood after the decay test.

Results

The decay resistance of mango (*M. indica*) and raintree (*A. saman*) wood samples in fungal and field test was analyzed by measuring the weight loss. Average weight loss of *M. indica* and *A. saman* wood blocks against *S. commune* were found 35.28% and 23.80% respectively. In field test it was found 42.36% and 28.54% respectively for *M. indica* and *A. saman* wood samples (Fig. 2).

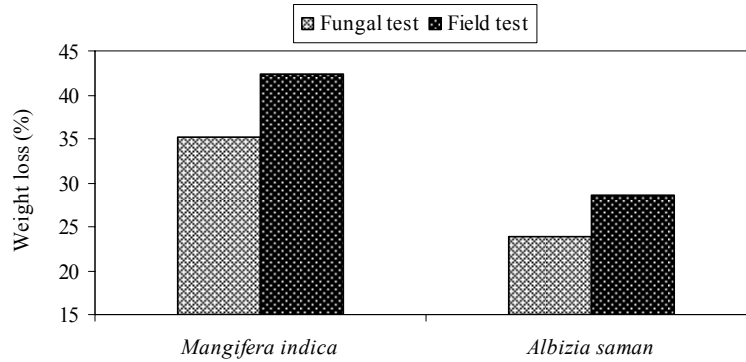


Fig. 2. Weight loss (%) of *M. indica* and *A. saman* wood in fungal and field test.

Analysis of variance showed that weight loss was significantly higher in *M. indica* wood compared to *A. saman* wood in both fungal and field test (Table 2). Weight loss was also found statistically different between the tests within the species (Table 3). Higher weight loss was found in field test rather than fungal test in both species due to presence of more decaying agents in the soil.

Table 2. ANOVA for weight loss in fungal and field test between the species.

Test	Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Fungal	Between Groups	1317.904	1	1317.904	7414.303*	0.000
	Within Groups	6.755	38	0.178		
	Total	1324.659	39			
Field	Between Groups	1908.404	1	1908.404	8913.178*	0.000
	Within Groups	8.136	38	0.214		
	Total	1916.540	39			

* Significant at 5% level.

Table 3. ANOVA for weight loss in fungal and field test within the species.

Species	Source of variation	Sum of Squares	df	Mean Square	F	Sig.
<i>Mangifera indica</i>	Between Groups	500.273	1	500.273	2726.872*	0.000
	Within Groups	6.972	38	0.183		
	Total	507.245	39			
<i>Albizia saman</i>	Between Groups	224.534	1	224.534	1077.410*	0.000
	Within Groups	7.919	38	0.208		
	Total	232.453	39			

* Significant at 5% level.

The sapwood of all species demonstrates high susceptibility to decay regardless of durability status of the heartwood (Zabel and Morrell, 1992). White rot is generally more virulent than brown rot fungi in hardwood species (Eaton and Hale, 1993), and relative virulence in *M. indica* and *A. saman* wood was not exceptional. Invasion of *S. commune* in *M. indica* wood block was more severe than that of *A. saman* wood block (Fig. 3 and Fig. 4).

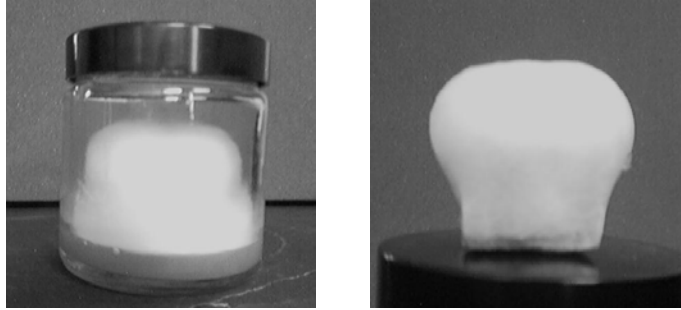


Fig. 3. Invasion of *S. commune* in *M. indica* wood block.

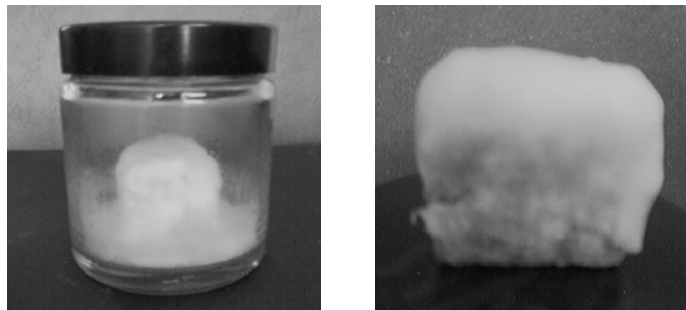


Fig. 4. Invasion of *S. commune* in *A. saman* wood block.

The durability classes of *M. indica* and *A. saman* wood according to laboratory conditions are shown in Table 4.

Table 4. Durability classes of *M. indica* and *A. saman* wood in laboratory conditions.

Durability class	Laboratory conditions (% weight loss)	<i>M. indica</i> (% weight loss)	<i>A. saman</i> (% weight loss)
Perishable	> 30	35.28	-
Non-durable	10 – 30	-	23.80

Discussion

According to The Building Research Establishment (UK) classification based on the laboratory conditions, the weight loss of *M. indica* wood is higher than 30% which indicates *M. indica* wood as a perishable wood (naturally durable up to 5 years). Anon (1970) reported that average natural

durability of *M. indica* wood is 25 months, which supports the present investigation. On the contrary, the weight loss of *A. saman* wood is in between 10-30%, which is classified as a non-durable wood (naturally durable 5 to 10 years). Similar classification based on field test for a comparison could not be traced. However, the weight loss percentages in field test satisfy the similar durability classification of the species based on laboratory condition.

Wood consists of several natural polymers and a wide range of cell-wall extractives, which are primarily localized in the heartwood. Heartwood durability, as with that of any natural product, is characterized by wide variability between species and individual trees of the same species (Scheffer and Cowling, 1966). Thus heartwood durability of a species may vary dramatically, as with the differences exhibited between two distinctive growth period i.e., highly durable old-growth and moderately durable second-growth timber of the same species (Clark and Scheffer, 1983). In addition, wood may be naturally durable for a number of other reasons, depending on the environment and organisms to which it is subjected. For example, many species exhibit extreme hardness or contain large quantities of silica or calcium carbonate (Taniguchi *et al.*, 1986). Therefore it is evident that natural durability of wood is dependent on its natural toxic constituents, heartwood proportion, growth stage etc. which impart decay resistance.

Conclusion

The natural durability of *A. saman* wood blocks is higher than that of *M. indica* wood in both fungal and field test. *M. indica* wood is particularly susceptible to decay which can be classed as perishable and *A. saman* can be treated as non-durable wood. The natural durability of *A. saman* wood in comparison to *M. indica* wood is higher may be due to the presence of a wide variety of toxic extraneous materials in *A. saman* wood. Therefore, to maximize the service life of these two species, preservative treatment must be given before end uses.

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