Termite Resistance of The Less Known Tropical Woods Species Grown in West Java, Indonesia

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Termite Resistance of The Less Known Tropical Woods Species Grown in West Java, Indonesia[1]

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ABSTRACT

This research focused on the natural durability of twenty one lesser known tropical wood species planted in West Java, Indonesia against subterranean termite (*Coptotermes curvignathus*). It was observed that both heartwood and sapwood of Kiara payung (*Filicium decipiens*); heartwoods of Nangka (*Arthocarpus heterophyllus*), Mahoni (*Swietenia macrophylla*) and Simpur (*Dillenia grandifolia*); and sapwood of Bungur (*Lagerstroemia speciosa*) were rated as resistant (natural durability class Ⅱ) according to Indonesian standard SNI 01.7207.2006 (BSN 2006). Both heartwood and sapwood of Salam (*Syzigium polyanthum*), Pasang (*Lithocarpus sundaicus*), Bisbul (*Diospyros discolor*), Rukam (*Flacourtia rukam*) and Trembesi (*Samanea saman*); heartwood of Puspa (*Schima walichii*), Bungur, Tanjung (*Mimusops elangi*) and Angsana (*Pterocarpus indicus*) were rated as moderately resistant (natural durability class Ⅲ). Both heartwood and sapwood of Sungkai (*Peronema canescens*), Pine (*Pinus merkusii*), Mangium (*Acacia mangium*) and Afrika (*Maesopsis eminii*); sapwoods of Mahoni, Puspa and Tanjung were rated as poorly resistant (natural durability class Ⅳ). Both heartwood and sapwood of Agathis (*Agathis dammara*), Durian (*Durio zibethinus*), Ki sampang (*Evodia latifolia*) and Jabon (*Anthocephalus cadamba*); sapwoods of Nangka and Angsana were rated as very poorly resistant (natural durability class Ⅴ). This reserach showed that woods with lower resistance against *C. curvignathus* attack (natural durability class Ⅳ and Ⅴ) tend to have lower termite mortality values compared to woods with higher resistance against *C. curvignathus* attack (natural durability class Ⅱ and Ⅲ). Results of the study will provide some valuable information on termite resistance of twenty one lesser known tropical wood species planted in Indonesia.

Keywords : natural durability, subterranean termite, termite mortality, tropical wood, heartwood, sapwood

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1. INTRODUCTION

It was reported that the demand for housing in Indonesia is 2.9 million houses per year and each house takes around 2.97 m^3 of wood (Supriana *et al*. 2003). On the other hand, timber supply from natural rain forest decreased sharply in the last decade due to forest degradation. In 2007, the production of timber from natural forest (natural forest concessionaires and license for timber utilization), plantation forest (state own enterprise and plantation forest concessionaires) and other sources is around 32.20 million m^3 and increased to become 47.43 million m^3 in 2011. Contribution of timber from natural forest at the same period decreased from 10.83 million m^3 to 5.69 m^3. At the same time, contribution of timber supplied from plantation forest more or less constant around 19.95-20.65 million m^3 (Indonesia Ministry of Forestry 2012). This indicates that now and in the near future timber supply for wood industry in Indonesia will be dominated by timber supplied from plantation forest. Furthermore, total areas of industrial forest plantation in Indonesia also increased year by year. In 2007, the accumulation of plantation area was recorded around 4.01 million hectares and increased to become 5.38 million hectares in 2011. However, there is no exact data regarding areas of community forest in Indonesia. It was informed that in 2011 total areas of community forest is around 3.5 million hectares (Indonesia Ministry of Forestry 2012).

In general the quality of timber harvested from industrial forest plantation and community forest was lower compared to timber harvested from natural forest due to its lower density, smaller diameter, contains more juvenile wood, lower dimensional stability, lower natural durability and contain more defects (Febrianto *et al.* 2010). On the other hand, the price of sawn timber harvested from industrial forest plantation and community forest was much cheaper compared to sawn timber harvested from natural forest which made this timber an interesting choice for most people in Indonesia to use it as housing material.

Knowledge about basic properties including natural durability of timber harvesting from industrial forest plantation is very important for timber user to optimize its utilization. The natural durability of timber may be defined as the inherent resistance of timber to attack by wood destroying organisms such as fungi, marine borers, insects and bacteria (Bowyer *et al*. 1982; Hunt and Garrat 1986; Kim *et al*. 1996; Lee 2004; Kim 2013; Yu and Cao 2009). The natural durability of wood related to toxic extractives substance in wood particularly in heartwood part (Sjöström 1995). Up to now, there is no comprehensive information about natural durability of wood harvesting from industrial forest plantation and community forest in Indonesia. Therfore the resistance of twenty one lesser known tropical wood species planted in West Java Indonesia, against subterranean termite attack was explored in this publication.

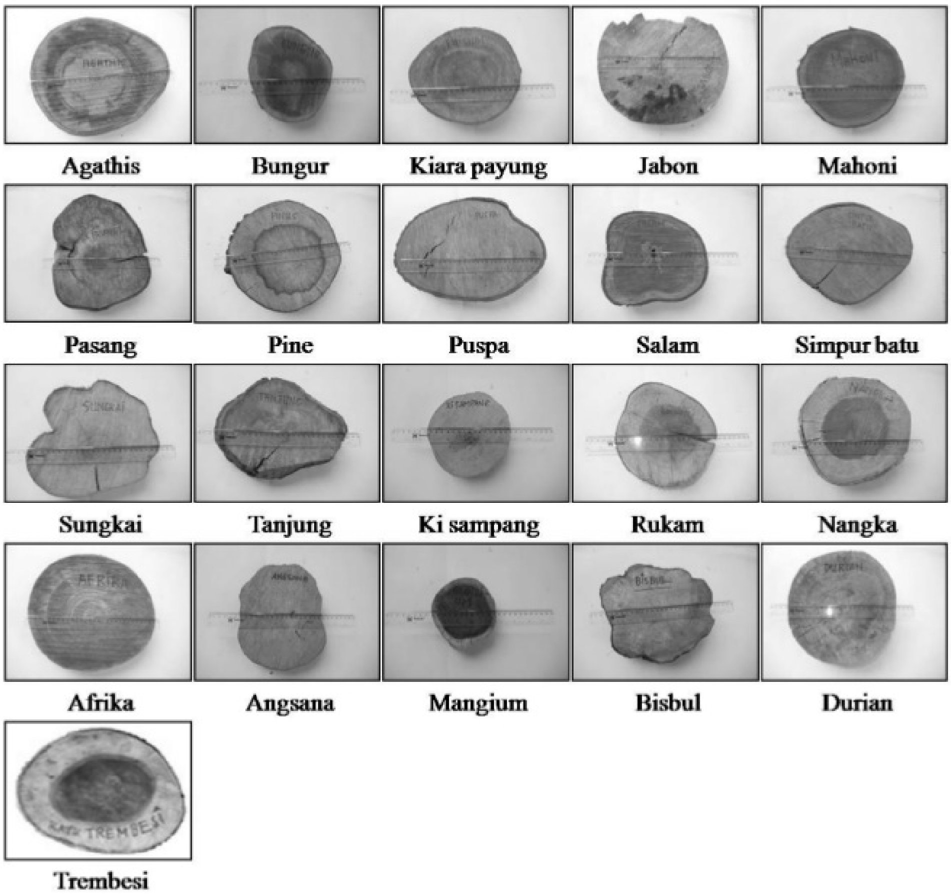


Fig. 1. Discs of wood samples used in this experiment.

2. MATERIALS and METHODS

2.1. Materials

2.1.1. Test wood blocks

Twenty one lesser known tropical wood species were harvested from two plantation sites in West Java, Indonesia, i.e: Mount Walat Education Forest in District of Sukabumi and Campus Forest at Bogor Agricultural University in District of Bogor. The wood species were including Agathis (*Agathis dammara*), Bungur (*Lagerstroemia speciosa*), Kiara payung (*Filicium decipiens*), Jabon (*Anthocephalus cadamba*), Mahoni (*Swietenia macrophylla*), Puspa (*Schima walichii*), Pasang (*Lithocarpus sundaicus*), Pine (*Pinus merkusii*), Salam (*Syzigium polyanthum*), Simpur (*Dillenia grandifolia*), Sungkai (*Peronema canescens*), Tanjung (*Mimusops elangi*), Mangium (*Acacia mangium*), Durian (*Durio zibethinus*), Nangka (*Arthocarpus heterophyllus*), Angsana (*Pterocarpus indicus*),

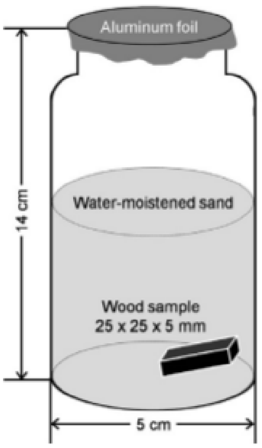


Fig. 2. Diagram of the SNI 01.7207-2006 test method with termites.

Afrika (*Maesopsis eminii*), Rukam (*Flacourtia rukam*), Trembesi (*Samanea saman*), Bisbul (*Diospyros discolor*) and Ki sampang (*Evodia latifolia*) as shown in Fig. 1. The age of trees were more than ten years with diameter ranging between 13-30 cm. Wood discs were obtained from the bottom part of trunk. Three replicates of heartwood and sapwood samples were obtained from wood disc of each species.

2.1.2. Test termite

Workers termites of subterranean termites (*Coptotermes curvignathus*) were gift from Wood Quality Improvement Laboratory, Bogor Agricultural University, Indonesia. Termite resistance of twenty one lesser known tropical wood species was performed in accordance to Indonesia standard SNI 01.7207.2006 as a standard test to determine the resistance of wood and wood products against wood destroying organism attacks (BSN 2006) in the laboratory of Wood Science of Bogor Agricultural University, Indonesia.

2.2. Methods

2.2.1. Natural durability to termites

Indonesian standard SNI 01.7207.2006 describes a 4-week, no-choice laboratory test using 200 g of sand matrix, 50 mL of distilled water and 200 workers of *C. curvignathus*. Test specimens (25 × 25 × 5 mm) were placed upright position within a glass jar. We performed this research in three replicates. Full details of the test method are given in SNI 01.7207-2006 (BSN 2006). A diagram of the test method according to SNI 01.7207-2006 is provided in Fig. 2. Weight loss of wood sample and termite mortality were calculated using the following formulas:

$$WL(\%) = (W_1 - W_2)/W_1 \times 100$$

WL: weight loss (%), W_1: oven dried sample before baited to termites (g), W_2: oven dried sample after baited to termites (g)

$$MR(\%) = D/200 \times 100$$

MR: termite mortality (%), D: number of termite died, 200: initial number of termite

Natural durability classification of wood against subterranean termite based on weight loss was presented in Table 1.

2.2.2. Data analysis

To assess natural durability properties (weight loss and termite mortality parameters), all multiple comparisons were subjected to an analysis of variance (ANOVA). Highly significant (α

Table 1. Natural durability classification of wood against subterranean termites according to SNI 01.7202.2006

Natural durability class	Resistance	Weight loss (%)
I	very resistant	<3.52
II	resistant	3.52-7.50
III	moderate	7.50-10.96
IV	poor	10.96-18.94
V	very poor	18.94-31.89

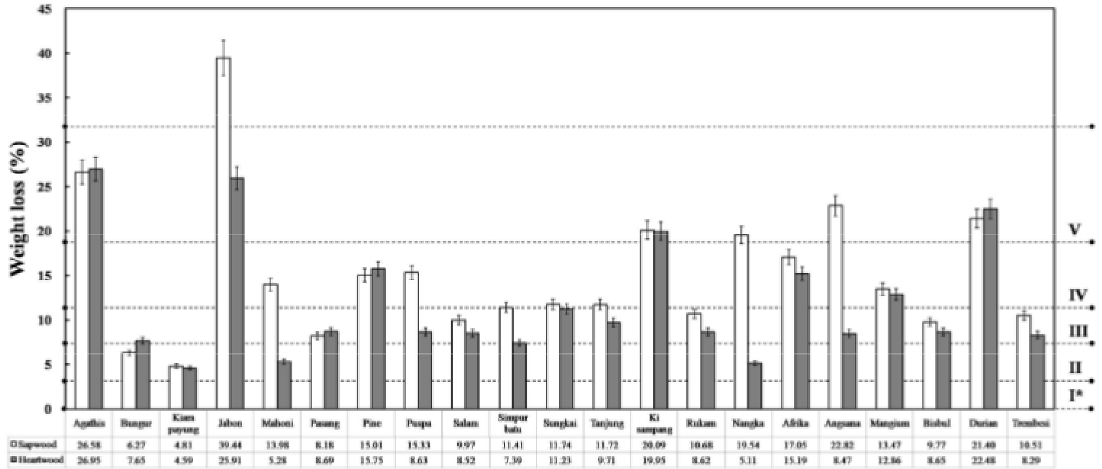
$\leq$ 0.01) and significant (α $\leq$ 0.05) differences between the mean values of the untreated and treated specimens were determined using Duncan's multiple range tests.

3. RESULTS and DISCUSSIONS

3.1. Weight loss

Every wood has its own specific natural durability against subterranean termite attacked. It is due to the toxic extractives deposited in the wood, particularly in heartwood part. After baited to *C. curvignathus* for 4 weeks, the average value of weight loss of the twenty one lesser known tropical wood species grown in plantation forest in West Java province, Indonesia, ranged between 4.85-39.44% and 4.59-26.95%, respectively, for sapwood and heartwood samples. The highest and the lowest weight loss of sapwood samples were achieved on Jabon and Kiara payung. On the other hand, the highest and the lowest weight loss of heartwood samples were achieved on Agathis and Kiara payung (Fig. 3).

Overall, the heartwood samples tend to have lower weight losses value compared to sapwood samples. The weight loss of wood after baited to *C. curvignathus* was much affected by wood species and wood part. Based on weight loss parameter presented in Fig 3, it was observed that among twenty one lesser known tropical wood species evaluated in this experiment none of them were rated as very resistant to *C. curvignathus* attack (natural durability class Ⅰ) according to Indonesian Standard SNI 01.7207.2006 (BSN 2006). Both heartwood and sapwood of Kiara payung, heartwoods of Nangka, Mahoni and Simpur, and sapwood of Bungur were rated as resistant to *C. curvignathus* attack (natural durability class Ⅱ). Both heartwood and sapwood of Salam, Pasang, Bisbul, Rukam and Trembesi, heartwoods of Puspa, Bungur, Tanjung and Angsana were rated as moderately resistant against *C. curvignathus* attack (natural durability class Ⅲ). Both heartwood and sapwood of Sungkai, Pine, Mangium and Afrika, and sapwood of Mahoni, Puspa and Tanjung were rated as poorly resistant to *C. curvignathus* attack (natural durability class Ⅳ). Both heartwood and sapwood of Agathis, Durian, Ki sampang and Jabon, and sapwood of Nangka and Angsana were rated as very poorly resistant *C. curvignathus* attack



(*Natural durability class by Indonesian standard SNI 01.7207.2006 : see in Table 1)

Fig. 3. Weight loss of woods after baited to *C. curvignathus* for 4 weeks.

(natural durability class Ⅴ).

Fig. 4 showed sapwood and heartwood samples before and after baited to *C. curvignathus* for 4 weeks. It is obvious that the weight loss of heartwood samples of Jabon, Mahoni, Puspa, Nangka and Angsana were much higher compared to their sapwood as shown in Fig. 3. However both heartwood and sapwood of Jabon were categorized as very poorly resistant against *C. curvignathus* attack. Natural durability against *C. curvignathus* attack of heartwood of Nangka wood was more than 3 times higher compared to its sapwood. Natural durability against *C. curvignathus* attack of heartwood of Angsana, Mahoni and Puspa were 2 times higher compared to their sapwood. In general, natural durability of heartwood is higher than sapwood due to most of extractives deposited in heartwood. The degree of natural resistance against biological agents by heartwood depend largely upon the nature and amount of toxic extractives in the species. The amount of extractives varies considerably within a species, location in the tree, age and rate of growth (Bowyer *et al*. 2003). However, not all chemical compounds in extractives have anti termite properties. It was reported that there are four major chemical compounds in extractives, i.e. aliphatic, fat, fatty acid, and terpene and terpeneoid compound (Sjöström 1995). Terpene and terpenenoid compounds belonged to toxic extractives. Presumably, extractives in heartwood of Jabon, Mahoni, Puspa, Nangka and Angsana belong to toxic components. Kininmonth and Whitehouse (1991) reported that the concentration of terpenes was found to be highest in samples of heartwood and decreased in samples nearer the outside of the radiata pine trees bole. Thompson *et al*. (2006) investigated the distribution of terpenes in heartwood and sapwood

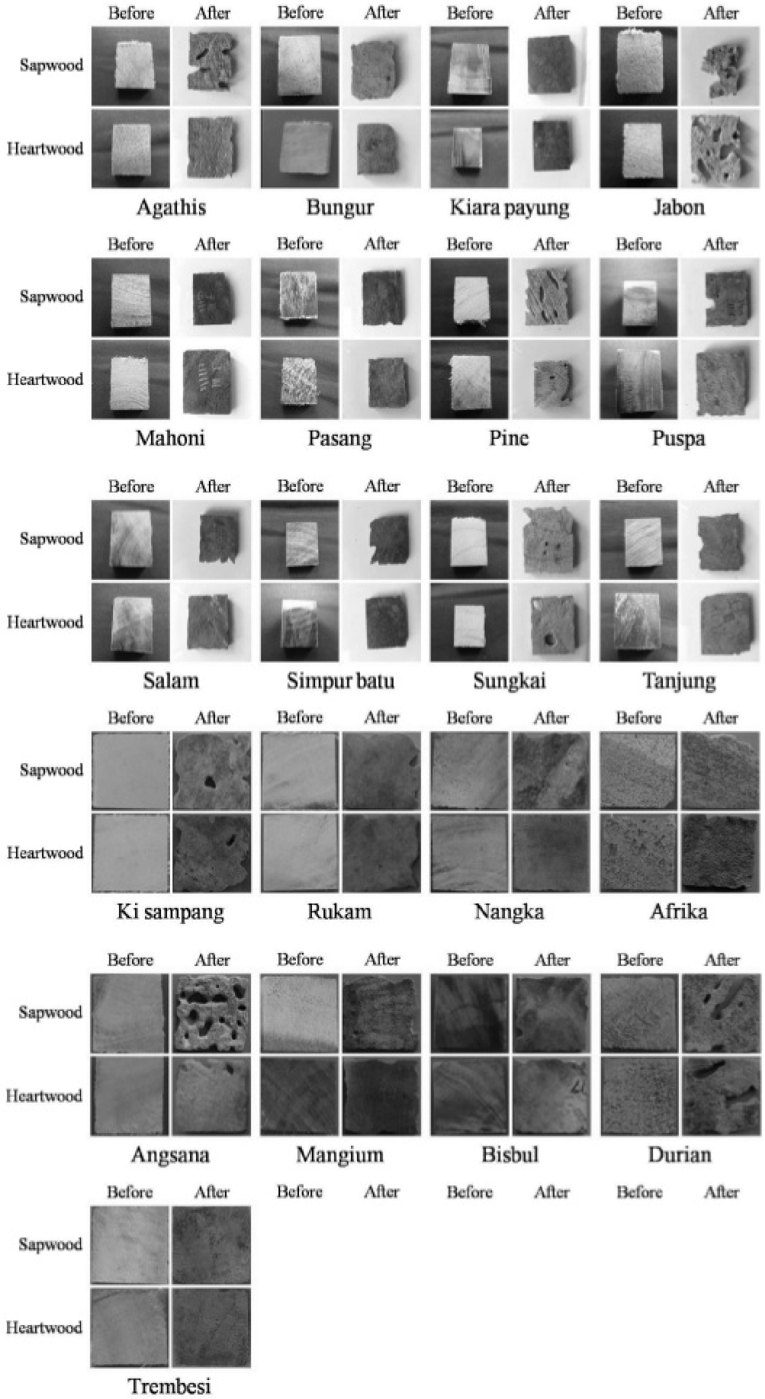


Fig. 4. Wood samples before and after baited to *C. curvignathus* for 4 weeks.

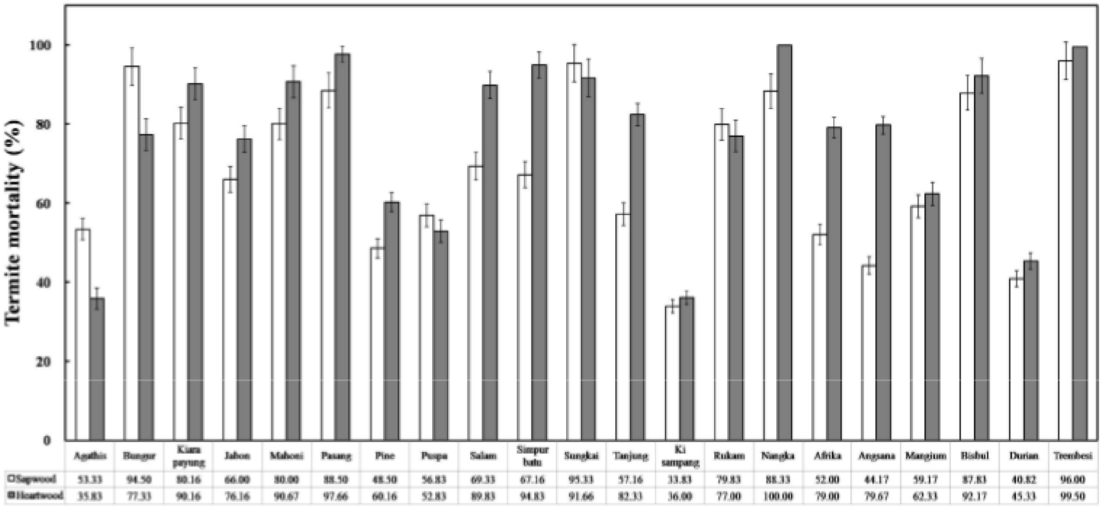


Fig. 5. Termites mortality at the end of test.

of loblolly pine. As a result, average percent terpenes of heartwood (2.3%) was higher than sapwood (0.35～0.77%).

It is interesting to note that the weight losses from heartwoods of Pasang, Agathis, Bungur and Durian were found slightly higher than those from their sapwoods. However, these values are not significantly different. Probably, extractives compounds in Pasang, Agathis, Bungur and Durian are not varied within sapwood and heartwood. The highest weight loss was achieved in Jabon. Jabon is a fast growing species. Rapidly grown second-growth timber often has a lower extractives content and thus lower natural resistance than older and slow-growth wood materials (Bowyer *et al.* 2003).

3.2. Termite mortality

Fig. 5 showed mortality of *C. curvignathus*. The average values of *C. curvignathus* mortality were varied from 33.83-88.33% and 45.33-92.17%, respectively, for sapwood and heartwood samples. The highest and the lowest termite mortality of both sapwood and heartwood samples were achieved on Trembesi and Ki sampang. The value of termite mortality was affected by wood species. It was observed that the value of the termite mortality in the heartwood tend to have higher values compared to sapwood. The highest the termite mortality tends to result in the lower the weight loss values, vice versa. Woods with lower resistance against *C. curvignathus* attack (natural durability class Ⅳ and Ⅴ) tend to have lower termite mortality values compare to woods with higher resistance against *C. curvignathus* attack (natural durability class Ⅱ and Ⅲ).

4. CONCLUSION

Natural durability of twenty one lesser known tropical wood species observed was affected by wood species and wood part. Both heartwood and sapwood of Kiara payung, heartwood of Nangka, Mahoni and Simpur, and sapwood of Bungur belonged to natural durability class Ⅱ. Both heartwood and sapwood of Salam, Pasang, Bisbul, Rukam and Trembesi, heartwood of Puspa, Bungur, Tanjung and Angsana were categorized to natural durability class Ⅲ. Both heartwood and sapwood of Sungkai, Pine, Mangium and Afrika, and sapwood of Mahoni, Puspa and Tanjung were classified into natural durability class Ⅳ. Both heartwood and sapwood of Agathis, Durian, Ki sampang and Jabon, and sapwood of Nangka and Angsana wood belonged to natural durability class Ⅴ. Woods with lower resistance against *C. curvignathus* attack tend to have lower termite mortality value compared to woods with higher resistance against *C. curvignathus* attack.

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