Feeding rate as a consideration factor for successful termite wood preference tests

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Abstract

Percent weight loss (WL) of a wood sample and termite mortality are mostly used as indicators for termite wood preference test consideration. Apparently WL is affected by the density of wood, even though the same WL values for wood of different densities provides different amounts of wood mass loss. Feeding rate also can be considered as a factor for interpretingtest results regarding termite wood preference. The wood species used for this study were sengon (*Paraserianthes falcataria*), pulai (*Peronema* sp), and mindi (*Melia azedarach*) which had densities of 0.27, 0.30 and 0.43 g/cm^3 respectively.These sample woods were tested against the subterranean termite (*Coptotermes curvignathus* Holmgren) according to the Indonesian standard SNI 01-7207-2006. The results showed that WL of sengon, pulai and mindi were 37.3, 36.4, and 10.3 % respectively; termite mortality on these wood species were 24.2, 18.8, and 61.3 % respectively and the feeding rates were 270, 132, and 42 µg/termite/day respectively. The resistance class relative to the Indonesian standard was V for sengon and pulai or very poor resistance, and III for mindi termed moderate resistance. Considering these three wood species, the higher wood density tended to be more resistant to subterranean termite attack which was indicated by a lower wood weight loss percentage, higher termite mortality, and lower termite feeding rate.

Keywords: Wood density, feeding rate, weight loss, mortality, subterranean termite.

Introduction

Applied sylviculture tends to produce short rotation forest stands by planting fast growing tree species to obtain a high volume of logs in short time period. The trees cut in between 5-10 years of age and the logs contain a lot of juvenile wood which has inferior physical-mechanical properties and also is more susceptible to biodeterioration. Subterranean termites are the most severe biodeteriorating agent ofwood and wood products especially in tropical areas.

To evaluate the resistant of wood to subterranean termite attack, one reference is the Indonesian standard SNI 01-7207-2006 to conduct atest. To evaluate the resistance class of wood, percent

weight loss (WL) of the wood sample is an indicator, such that a higher WL results in a lower resistant class where class I corresponds to a WL of less than 1.2% and is classified in the very resistant class, while class V with a WL of more than 18.9% is placedin the very poor resistant class.

If we look at WL deeply, it is affected by the initial weight and wood density. A certain WL value from a low density wood results in lower total wood weight compared to a high density wood because the is calculation based on the initial wood weight. On the other side, termite feeding capacity is limited to its stomach volume and the calories needed., A termite will not feed more than needed even when there is a lot of available feeding resources. In the test, a wood sample is described by a certain size or volume, and consequently a low density wood has lower weight comparing to a higher density wood.

During the test termites will feed for certain wood weight, and this matter will result in a higher value WL on lower density wood and the consequences may be a lower resistance class, and inversely higher wood density might produce a lower WL resulting in a higher resistance class. Feeding capacity of a termite can not increase even though food is still available because the feeding rate or feeding capacity of a termite is limited to a certain value. Another reference, the Japanese standard JIS K 1571-2004 mentions that termite mortality is required for evaluating a wood preference test, if the termite mortality of a reference wood is below the standard indicating that the test is not valid, it must be repeated to get a better result relative to termite mortality.

Feeding rate is a number describing how much wood weight is consumed by each termite per day, and the value is affected by the termites living environment, wood availability, and other factors affecting termite survival. Arinana et al. (2011) mentioned feeding rates of five woods species namely *Acacia mangium*, *Hevea brasiliensis*, *Paraserianthes falcataria*, *Pinus merkusii*, and *Cryptomeria japonica* varied from 43-82 µg/termite/day usingthe Indonesian standard test, and 55-129 µg/termite/day usinging the Japanese standard test. Other researcher Hadi et al. (2011) mentioned that termite feeding rates on *Anthocephalus cadamba*, *Peronema canescens*, and *Acacia mangium* had a range of 29-90 µg/termite/day with theIndonesian standard test, and particleboard made from those species and additional mixture of those species resulting in feeding rates of 54-101 µg/termite/day, indicating that the particleboard had a higher feeding rate than its solid wood.

This study tried to look at feeding rate, percent wood weight loss, and termite mortality as factors for subterranean termite tests by comparing three wood species of different density.

Methods

Wood species

Wood species used in this study were sengon (*Paraserianthes falcataria*), pulai (*Peronema* sp), and mindi (*Melia azedarach*), and the woods were from a community plantation forest in Bogor, West Java, Indonesia. Five replications of wood samples were prepared for the test.

Testing method according to SNI 01.7202-2006

The test method standard referred to a forced-feeding test using 200 g sand media, 50 ml aquadestilata, and 200 worker termites of *Coptotermes curvignathus* Holmgren for four weeks in a dark room. The wood samples were placed inside the jar withthe widest side leaned on to the jar wall. Details should be referred to the previous article (Hadi and Tsunoda 2010).

Evaluation of results

Percent weight loss of the individual wood sample was calculated by the difference in weights before and after the test period according to the following equation:

Percent weight loss = (W1- W2)/W1 x 100%
Whereas: W1 = weight of oven-dried wood before test (g),
W2 = weight of oven-dried wood after test (g).

Regarding percent weight loss, the resistance class of the wood can be classified as shown in Table 1.

Table 1. Resistance classes against the subterranean termites *Coptotermes curvignathus* (Indonesian Standard SNI 01.7207-2006)

Resistance class	Weight loss (%) range
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

In addition to percent weight loss, termite mortality was calculated according to the following equation:

Termite mortality (%) = (number of dead workers)/200 x 100%

The feeding (wood consumption) rate is thought to be helpful for comparing test results obtained with wood species of different densities. In order to calculate the feeding rate, we need to assume that termites die linearly over time. On the basis of the above assumption, feeding rates can be calculated according to the following equation:

Feeding rate (µg/termite/day) = (weight of wood eaten, µg) / (average number of living termites) / (number of days in the test period).

Result and Discussion

Wood densities of sengon, pulai, and mindi were 0.27 g/cm^3, 0.30 g/cm^3, and 0.43 g/cm^3 respectively, and the average termite mortality, wood weight loss percentage, and termite feeding rates are shown in Table 2.

Table 2. Density, mortality, weight loss, and feeding rate of each wood species

	Sengon	Pulai	Mindi
Density (g/cm^3)	0.27	0.30	0.43
Mortality (%)	24.2	18.8	61.3
Weight Loss (%)	37.3	36.4	10.3
Feeding Rate (µg/termite/day)	270	132	42
Resistance Class (SNI 2006)	V	V	III

Sengon had the lowest wood density and the fastest tree growth among the three wood species. Sengon logs are used for veneer production especially for core veneer in plywood manufacturing even though it provides asmall diameter log of 20-30 cm harvested from 4-6 year old forest stands. The other two wood species namely mindi and pulai are usually used for light construction or furniture. These three wood species are recently popular and planted by the people or community insupport of the wood industry (Ministry of Forestry 2011).

According to Table 2, mindi wood showed greater resistance to termite attack than the other two wood species, which was indicated by the lowest percent wood loss and higher termite mortality. With regard to percent weight loss mindi belongs to resistance class III indicating moderate resistance, and other two wood species belong to resistance class V indicating very poor resistance (SNI 2006). Referring to Martawijaya et al. (1981 and 1989) all three wood species belong to resistance class V or very poor resistant, which provided a different result only for mindi wood. This difference could happen because of differences in tree age, tree site, sylviculture treatment, and also part of the stem. As mentioned above mindi wood has a higher density than the other two wood species, with the result that mindi is potentially more resistant than the others. This finding also mentioned by Hadi et al. (2010) that higher wood density potentially was more resistant to subterranean and dry wood termite attacks.

The last parameter of the test is feeding rate which indicates how much wood weight was consumed by each termite per day. Mindi wood had the smallest feeding rate followed by pulai and

sengon, and this trends is inversely related to wood density and wood weight loss, or in other words higher wood density had lower percent wood weight loss and lower termite feeding rate as indicated at Figure 1.

If feeding rate is considered at a certain level, a lower WL for higher wood density is affected by higher initial weight of the sample, and this matter will dispute determination of wood resistance class according to SNI (2006). In this study the feeding rates of the three wood species varied broadly 42-270 µg/termite/day because of the different wood species embodied all aspects of physical, chemical and anatomical characteristics. For feeding rates, the calculation in this study was based on average of living termites at initial and end of the test, or the termite mortalilty is even throughtime during the test. The precise feeding rate should be calculated using average of actual living termites by determined how many living termites of each day instead of the average value.

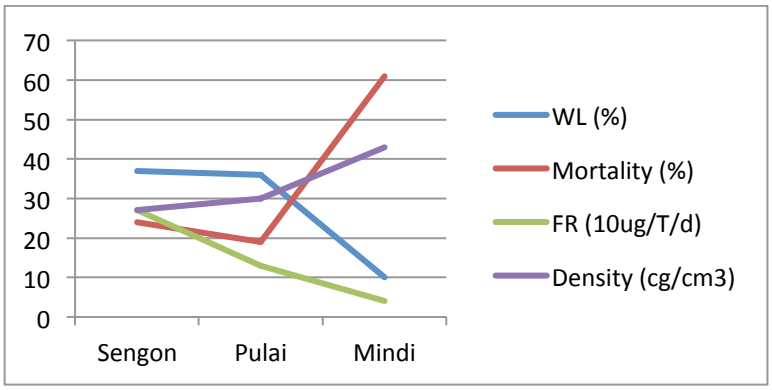

Figure 1. Density, feeding rate, weight loss and mortality of each wood species.

Conclusions

From the discusion above it can be concluded that percent weight loss of sengon, pulai and mindi wood species were 37.3, 36.4, and 10.3 % respectively; termite mortality on these wood species were 24.2, 18.8, and 61.3 % respectively; feeding rates were 270, 132, and 42 µg/termite/day respectively, and resistance class relative to the Indonesian standard were V, V or very poor resistance, and III or moderate resistance respectively. Higher wood density tended to result in more resistance to subterranean termite attack which was indicated by lower percent wood weight loss, higher termite mortality, and lower termite feeding rate.

References

Arinana, K. Tsunoda, E.N. Herliyana and Y.S. Hadi. 2011. Determination of Resistance of Woods against Subterranean Termites by Laboratory Tests Using Indonesian and Japanese Standards.

Proceedings The 8th Conference of the Pacific Rim Termite Research Group, Bangkok, 28 Feb-01 Mar 2011, p. 126-131.

Hadi Y.S., T. Nurhayati, Jasni, H. Yamamoto and N. Kamiya. 2010. Smoked Wood Resistance Against Termite. Journal of Tropical Forest Science 22(2): 127-132

Hadi, Y.S. and K. Tsunoda. 2010. Comparison of the Termite Test Methodology of Japanese and Indonesian National Standards. Proceedings of the Seventh Conference of the Pacific Rim Termite Rearch Group, Singapore, 1-2 March 2010, 143-146.

Hadi, Y.S., E. Fajriani, D. Hermawan, M.Y. Massijaya and N. Hadjib. 2011. Resistance of Particleboard Made from Fast Growing Species to Subterranean Termite Attack. Proceedings The 8th Conference of the Pacific Rim Termite Research Group, Bangkok, 28 Feb-01 Mar 2011, p. 142-145.

[JIS] Japanese Industrial Standard. 2004. Test Methods for Determining The Effectiveness of Wood Preservatives and their Performance Requirement. JIS K 1571-2004.

Martawijaya, A., I. Kartasujana, S.A. Prawira and K. Kadir. 1981. Atlas Kayu Indonesia (*Indonesian Wood Atlas*) Volume I. Forest Products Research Institute, Bogor, Indonesia.

Martawijaya, A., I. Kartasujana, Y.I. Mandang, K. Kadir and S.A. Prawira. 1989. Atlas Kayu Indonesia (*Indonesian Wood Atlas*) Volume II. Forest Products Research Institute, Bogor, Indonesia.

Ministry of Forestry. 2011. *Forestry Statistics of Indonesia 2010.* Ministry of Forestry, Jakarta, Indonesia.

[SNI] Standar Nasional Indonesia (*Indonesian National Standard*). 2006. Uji Ketahanan Kayu dan Produk Kayu Terhadap Organisme Perusak Kayu (*Test for resistance of wood and wood products on wood deterioration organism*). National Standardization Berau, Jakarta: SNI 01. 7207-2006.