Drywood termites preferences of seven species of community wood on various moisture content values

by Sulaeha Thamrin

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Drywood Termites Preferences of Seven Species of Community Wood on Various Moisture Content Values

Arinana[1,a)], Aulina Ruth Emmisari Silalahi[1,b)], Riska Afrilia[1,c)], Istie Sekartining Rahayu[1,d)], Dodi Nandika[1,e)], and Sulaeha[2,f)]

[1]*Forest Product Department, Faculty of Forestry and Environment, IPB University, Bogor, 16880, West Java, Indonesia*
[2]*Faculty of Agriculture, Universitas Hasanuddin, Makassar, South of Sulawesi, Indonesia*

[a)] arinana@apps.ipb.ac.id
[b)] Corresponding author: aulinasilalahi.orc@gmail.com
[c)] riskaafrilia@gmail.com
[d)] istiesr@apps.ipb.ac.id
[e)] dodina@apps.ipb.ac.id
[f)] sulaeha_t@yahoo.com

Abstract. Wood from community forests is generally classified into durable class IV-V. One of the woods destroying organism is dry wood termites. Environmental conditions such as moisture content (MC) affect the preferences of dry wood termites. Still, the ideal MC is not yet known, which is suitable for the life of the dry wood termites. This study aims to determine the preferences and mortality of dry wood termite on various MC values for seven species of community wood, namely manii wood, acacia wood, jabon wood, rubberwood, mahogany wood, pine wood, and sengon wood, at various moisture content values, namely green MC (>70%), 40-45% MC, air-dry MC (11-12%), and kiln-dry MC (0%) and knowing the mortality of dry-wood termite. The testing method is based on SNI 01-7207 (2014). The results showed that jabon wood was preferred by dry wood termites compared to other wood species in various MC tests. In addition, dry wood termite tends to prefer wood on air-dry MC and kiln-dry MC. Meanwhile, the mortality of dry wood termites in green MC, 40-45% MC, air-dry MC, and kiln-dry MC sequence is 78-100%, 30-100%, 24-100%. and 16-100%.

INTRODUCTION

Wood from community forests is an important alternative source of wood suppliers in meeting the increasing demand for wood. The production of logs community forest from year to year has increased quite well. In 2016 the production of logs in Indonesia was 42.45 million m^3 and in 2017 increased to 57.93 million m^3 [1,2]. Some species of community wood that people widely use include acacia (*Acacia mangium*), sengon (*Falcataria moluccana*), jabon (*Anthocephalus cadamba*), manii (*Maesopsis eminii*), mahogany (*Swietenia mahagoni*), rubberwood (*Hevea brasiliensis*), and pine (*Pinus merkusii*). Those woods are included into Indonesian trade timber species [3]. Community wood has a low durability class and resistance, so it is susceptible to attack by wood-destroying organisms such as bacteria, insects, fungi, powderpost beetles, marine borers, and termites [4].

Termites are destructive organism that causes a lot of damage to wood buildings. One type of termite that attacks the wood is dry wood termites. Drywood termites are part of the Kalotermitidae family, which consists of 21 genus and 456 species [5]. One of them is *Cryptotermes cynocephalus.* This termite has a small number of colonies and can be differentiated from its soldier caste but does not have a true worker caste. Drywood termites make burrows in wood and form them into nests [6]. Drywood termite attack can only be known after the wood becomes porous without any damage to the surface. This termite attack can be recognized by the presence of small oval-shaped

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grains that fall on the floor or the outside of the wood, slightly notched and brown [7]. Environmental factors such as temperature, humidity, and water greatly affect the life of termites.

Moisture affects the water content in wood because wood is hygroscopic. The hygroscopic of wood is the ability to absorb and release water. This condition is closely related to the type of wood and the surrounding environmental conditions [8]. This difference in moisture content is thought to affect the eating preferences of dry wood termites to wood due to termite behavior. Therefore, this research was conducted to determine preferences and calculate drywood termite mortality values for several wood species at various moisture content values.

MATERIALS AND METHODS

Time and Location

The research was carried out from November 2020 - July 2021. The preparation of raw materials was carried out in the Workshop Department of Forest Products, physical properties testing was carried out at the Wood Physical Properties Laboratory, and dry wood termite preference testing was carried out at the Termite Laboratory, Department of Forest Products, Faculty of Forestry and Environment, IPB University. Meanwhile, observations of the anatomical structure of wood were carried out at the Forest Products Research and Development Center, Ministry of Environment and Forestry, Bogor.

Materials and Equipment

The material used in this study is logs of seven species of community wood such as manii (*Maesopsis eminii*), acacia (*Acacia* sp.), jabon (*Anthocephalus* sp.), rubberwood (*Hevea* sp.), mahogany (*Swietenia* sp.), pine (*Pinus* sp.), sengon (*Falcataria moluccana*) obtained from Ciherang Village, Darmaga, Bogor, West Java. The diameter of the logs obtained ranged from 20-40 cm. The other material used is dry wood termites *Cryptotermes cynocephalus*, plasticine, cotton, distilled water, ethanol, glyceryl, safranin, and ethylene. The equipment used in this research is table saws, compressed vacuum tubes, electric scales, calipers, ovens, desiccator, tubes acrylic with a diameter of 1.8 cm and a height of 3 cm, moisture meter, fan, microtome, light microscope, digital microscope Keyence VHX-7000 series, water bath, camera, and stationery.

Methods

Raw Material Preparation and Treatment of the Test Sample

Logs from each type of wood were cut into the tangential board (200 cm x 25 cm x 3 cm). The board is then treated with solar-assisted air-drying until the moisture content reaches air-dry (11-15%). Furthermore, the board is cut to the size of the test sample, including wood density measurement (2 cm x 2 cm x 2 cm), dry wood termite preferences (5 cm x 2.5 cm x 2.5 cm), and microscopic observation (2.5 cm x 2.5 cm x 2.5 cm). Then the test sample is given moisture content (MC) treatment which consisted of four different conditions of MC, namely green MC (>70%), 40-45% MC, air-dry MC (11-14%), and kiln-dry MC (0%).

a. Green MC (>70%);

The test sample was put in a compressed vacuum tube and given pressure (2.5 kg/cm^2) for three hours. After that, the test sample was weighed (W_1) and then put into the oven (103 ± 2°C) for 48 hours. Then the sample was put in a desiccator for 15 minutes and weighed (W_2).

b. 40-45% MC

The test sample was put into a compressed vacuum tube and given pressure (2.5 kg/cm^2) for three hours. After that, the test sample was dried using the fan for 30 minutes. Furthermore, the test sample is weighed (W_1). The test sample was then put into the oven at temperature 103 ± 2°C for 48 hours. After that, the test sample was put in a desiccator for 15 minutes and weighed (W_2).

c. Air-dry MC (11-14%)

The test sample was not given pretreatment because the condition of the test sample had reached an air-dry condition. Measurements were carried out using a moisture meter by piercing one side of the test sample.

d. Kiln-dry MC (0%)

The test sample was first weighed (W_1) then put into an oven at a temperature of 103 ± 2°C for 48 hours until the constant weight. After that, the test sample was placed in a desiccator for 15 minutes. Next, the test sample was weighed to obtain the dry weight of the kiln (W_2).

The value of moisture content for green, 40-45%, and kiln-dry MC were calculated using the gravimetric method. The following gravimetric formula used is:

$$MC\ (\%) = \frac{W1 - W2}{W2} \quad (1)$$

Wood Density Measurement

Measurement of wood density based on BS-373 [9]. The value of wood density (WD) was obtained from measuring the dimensions and weight of the test sample in kiln-dry conditions. The test sample was placed in the oven until its constant weight (W). After that, the dimensions are measured to get the volume (V). The measurement of wood density is calculated using the following equation:

$$WD(\%) = \frac{W}{V} \quad (2)$$

Drywood Termites Species Identification

The drywood termite species were identified by taking pictures of specimens using microscope digital Keyence VHX-7000 series. Termite species were identified based on their external morphology without dividing, such as body shape, color, termite head length, and the number of termite antennae. The morphological identification of dry wood termite species was based on Tho (1992) and Ahmad (1985) [6, 10].

Drywood Termite C. cynocephalus Preference Test

Drywood termite preference testing *C. cynocephalus* on seven species of community wood based on SNI 01-7207 [11]. The test sample (5 cm x 2.5 cm x 2.5 cm) reached the desired moisture content then fed into dry wood termites *C. cynocephalus.* Feeding was carried out by installing an acrylic tube (diameter 1.8 cm, height 3 cm). The bottom of the acrylic tube is glued using plasticine. Furthermore, 50 healthy and active dry wood termite worker of *C. cynocephalus* was put into an acrylic tube and covered with cotton (Fig. 1). The test samples were then placed in a dark room for 12 weeks and observed every week. The number of repetitions in each treatment was five times.

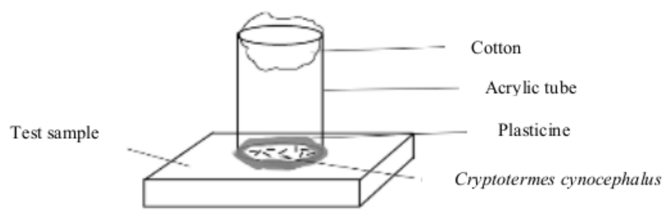


FIGURE 1. Drywood termite *C. cynocephalus* preference testing.
(Source: Designed by author)

After 21 days, the test sample was dismantled and counted for still alive termites to get the mortality rate. The following equation calculates termite mortality (M):

$$M(\%) = \frac{D}{50} \times 100 \quad (3)$$

Where
D = Number of termites that died at the end of testing
50 = Number of at the beginning of feeding

Furthermore, the test sample was split into two parts to see the damage to the wood and visually observed the durability of the wood based on SNI 01-7207 [11]. The durability test result is listed in Table 1.

TABLE 1. Durable class of seven wood species to dry wood termite *C. cynocephalus* attack by visually observing.

Class	Durable	Level of Damage	Score
I	Very durable	Undamaged, or very light attack: ≤5%	0
II	Durable	Light attack: 6-15%	40
III	Moderately durable	Moderate attack, shallow and narrow channels: 16-31%	70
IV	Slightly durable	Heavy attack, deep and wide channels: 31-50%	90
V	Not durable	Enormous attack: >50%	100

Microscopic Observation of Seven Species of Community Wood

Observations of seven species of community wood were carried out microscopically by observing the cross-section, radial, and tangential sections of the wood using a light microscope. Preparation of microtome preparations refers to [12]. Microscopic images of the wood at cross-sections, radial and tangential, were obtained through a microscope camera and axiovision software. Anatomical features were observed based on the International Association of Wood Anatomists (IAWA) [13].

Data Analysis

Qualitative data was presented in the histogram and described qualitatively. Meanwhile, the quantitative data were calculated using Microsoft Excel 2016 and analyzed using IBM SPSS Statistics 22. If the result of the variance analysis at the 95% confidence interval were significant, the analyzing process would be continued using the Duncan test.

RESULTS AND DISCUSSIONS

Wood Density

The results showed that the average density value of each wood species ranged from 0.318-0.660 g/cm^3. The wood density with the lowest value was jabon wood, and the highest was pine wood. The wood density value is presented in Fig. 2. Wood density is the most important factor for grading wood quality [14]. This is because wood density is related to moisture content, where wood with a large moisture content generally has a lower density [15]. The wood density depends on the amount of composting wood substances, cell cavity, pores, moisture content contained in wood, and extractive substances [16]. The density values of seven different species of community wood were influenced by the portion of the test sample in one tree, growing conditions, anatomical variations, moisture content, and the ratio of sapwood and heartwood. The highest wood density value is pine wood. The high-density value of pine wood is influenced by the content of wood substances in the cell walls. A high density of wood will result in the ability of wood to absorb water will decrease.

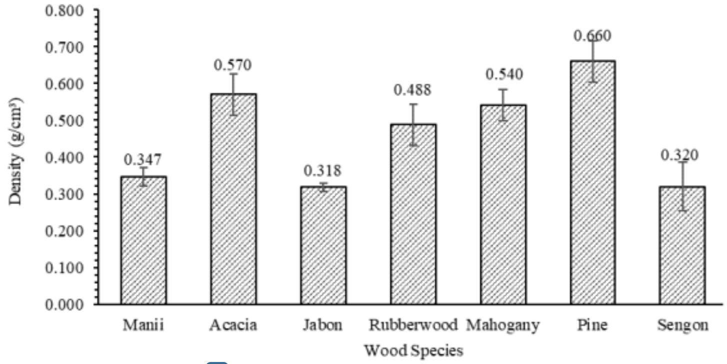


FIGURE 2. The density of seven wood species.

Drywood Termite Species

Based on the observations, it was found that the frontal ridge of the head is V-shaped, and the lateral side looks like a thick mound. The head color is dark reddish-brown with 11-12 segments antennae. The second segment is longer than the other segments. The antennae and labrum are yellowish-brown. Meanwhile, the mandibles are reddish-brown. The length of the head with mandible and the length of the head without mandible was 1.20-1.23 mm and 0.88-0.92 mm [12]. Based on the observation of the dry wood termite morphology of the soldier caste, it can be identified that the termite used for this study is *Cryptotermes cynocephalus* (Fig. 3).

FIGURE 3. Drywood termite *C. cynocephalus* soldier caste morphology.

Drywood Termite *C. cynocephalus* Preference

The results showed that the dry wood termite *C. cynocephalus* preferred the test samples with air-dry and kiln-dry MC with varying resistance classes than other moisture content variations. The details are presented in Table 2.

TABLE 2. Classification of the durable class of seven wood species to dry wood termite *C. cynocephalus* by visual observation.

No.	Species of wood	Replication	Moisture content (%)							
			Green		40-45%		Air-dry		Kiln-dry	
			Score	Class	Score	Class	Score	Class	Score	Class
1	Manii	1	40	II	90	IV	70	III	90	IV
		2	0	I	90	IV	90	IV	90	IV
		3	0	I	90	IV	90	IV	90	IV
		4	0	I	40	II	90	IV	40	II
		5	0	I	90	IV	90	IV	0	I
2	Acacia	1	0	I	0	I	0	I	0	I
		2	0	I	0	I	0	I	0	I
		3	0	I	0	I	0	I	0	I
		4	0	I	0	I	0	I	0	I
		5	0	I	0	I	0	I	0	I
3	Jabon	1	40	II	90	IV	90	IV	90	IV
		2	70	III	90	IV	90	IV	90	IV
		3	0	I	40	II	40	II	90	IV
		4	90	IV	40	II	90	IV	90	IV
		5	90	IV	70	III	90	IV	90	IV
4	Rubberwood	1	0	I	90	IV	90	IV	90	IV
		2	0	I	90	IV	40	II	90	IV
		3	0	I	90	IV	0	I	90	IV
		4	0	I	90	IV	40	II	90	IV
		5	70	III	90	IV	90	IV	90	IV
5	Mahogany	1	40	II	0	I	40	II	90	IV
		2	0	I	0	I	90	IV	90	IV
		3	0	I	40	II	70	III	90	IV
		4	40	II	40	II	90	IV	90	IV
		5	40	II	0	I	90	IV	90	IV
6	Pine	1	40	II	0	I	90	IV	90	IV
		2	0	I	0	I	40	II	70	III
		4	90	IV	0	I	90	IV	90	IV
		5	0	I	90	IV	90	IV	90	IV
7	Sengon	1	0	I	40	II	0	I	90	IV
		2	40	II	90	IV	70	III	70	III
		3	40	II	90	IV	0	I	90	IV
		4	70	III	90	IV	0	I	40	II
		5	0	I	0	I	90	IV	40	II

Note I: very durable; II: durable; III: moderately durable; IV: slightly durable; V: not durable

Table 3 shows that green MC is the most durable class I – II wood. Only jabon wood is included in class IV. Wood sample with 40-45% MC mostly has durable class II-IV, except for acacia and mahogany, included in class I-II. Wood with air-dry and kiln-dry MC are mostly classified into durable class IV, and only acacia wood is included in class I. Acacia wood has a higher-level durable class than others. The cellulose content affects the durable class of wood because cellulose is the main food for termites. In addition, according to Nuriyatin et al. (2003), the content of extractive substances in wood that are toxic will inhibit termite attacks, affecting the preference of dry wood termites on wood [17].

The presence of extractive substances in certain parts of the wood in an amount that is in accordance with conditions that termites do not favor caused the termites to eat less of the test sample. Termites that cannot adapt to their new environment generally will die [18]. In contrast to acacia wood, jabon wood is a type of wood that is susceptible to dry-wood termites at all moisture levels. The low density of jabon wood causes this compared to other wood species. The greater the density and specific gravity, the stronger the wood, making the termites have difficulty eating wood [19]. The proportion of cell cavities also affects the speed of removing or entering the water process into the wood. The proportion of cell cavities affects the movement of water in the wood. The more and larger the cell cavities, the easier it will be for water to enter and remove from the wood. The low density of jabon wood indicates that the proportion of jabon wood cell cavities is quite large. So, this is what causes dry wood termites to prefer jabon wood compared to other wood species and can survive in various water levels [20].

Deterioration Pattern of Wood Sample

Based on visual observations, test samples of manii wood with green MC have less damage than the test samples on other variations of MC. The test samples with green MC are included in durable class I, while the test samples with 40-45% MC, air-dry MC, and kiln-dry MC are included in class IV. The damage caused by dry wood termites has drill holes which can be seen in Fig. 4.

(a) (b) (c) (d)

FIGURE 4. Deterioration pattern of manii wood in green MC (a), 40-45% MC (b), Air-Dry MC (c), and Kiln-Dry MC (d).

Visual observations showed that acacia wood belongs to the durable class I (Fig. 5). No damage was seen in the various MC tested in the acacia wood test sample.

FIGURE 5. Deterioration pattern of acacia wood in green MC (a), 40-45% MC (b), Air-Dry MC (c), and Kiln-Dry MC (d).

Jabon wood used as a test sample has a large level of damage to all MC tested and is included in the durable class IV. The number of boreholes due to drywood termite attack is shown in Fig. 6.

(a) (b) (c) (d)

FIGURE 6. Deterioration pattern of jabon wood in green MC (A), 40-45% MC (B), Air-Dry MC (C), and Kiln-Dry MC (d).

Rubberwood wood with green MC had less damage than the test sample for other variations of MC. The test samples with green MC are included in durable class I, while the test samples with 40-45% MC, air-dry MC, and kiln-dry MC are included in durable class IV. The borehole due to drywood termite attack is shown in Fig. 7.

(a) (b) (c) (d)

FIGURE 7. Deterioration pattern of rubberwood in green MC (a), 40-45% MC (b), Air-Dry MC (c), and Kiln-Dry MC (d).

The results of visual observations on the mahogany test samples with green MC and 40-45% MC had fewer damage rates than the test samples with air-dry MC and kiln-dry MC. The test samples with green MC and 40-45% MC are included in durable class I, while the test samples with air-dry MC and kill-dry MC are included in durable class IV. The borehole due to drywood termite attack is shown in Fig. 8.

(a) (b) (c) (d)

FIGURE 8. Deterioration Pattern of Mahogany Wood in Green MC (a), 40-45% MC (b), Air-Dry MC (c), and Kiln-Dry MC (d).

The test samples of pinewood with green MC had less damage than the test samples for other variations of MC. The test samples with green MC are included in durable class I, while the test samples with 40-45% MC, air-dry MC, and kiln-dry MC are included in durable class IV. The borehole due to the termite attack is shown in Fig. 9.

(a) (b) (c) (d)

FIGURE 9. Deterioration pattern of pine wood in green MC (a), 40-45% MC (b), Air-Dry MC (c), and Kiln-Dry MC (d).

Based on the results of visually observing the sample of sengon wood, it was obtained that green MC had less damage than the test samples for other variations of MC. The test samples with green MC are included in durable class I, while the test samples with 40-45% MC, air-dry MC, and kiln-dry MC are included in durable class IV. The damage caused by dry wood termites can be seen from the drill holes presented in Fig. 10.

(a) (b) (c) (d)

FIGURE 10. Deterioration pattern of sengon wood in Green MC (a), 40-45% MC (b), Air-Dry MC (c), And Kiln-Dry MC (d).

Termite Mortality

The results showed that the average mortality value differed for each moisture content. The dry-wood termite mortality of *C. cynocephalus* on green MC ranged from 78-100%, on MC 40-45% ranged from 30-100%, on air-dry MC ranged from 24-100%, and on MC kiln-dry ranged from 16-100%. More details are presented in Figure 11. The analysis of variance at the 95% confidence interval showed that the MC value influenced the mortality of dry wood termites *C. cynocephalus*. The results of Duncan's test showed that the dry wood termite mortality value on green MC and 40-45% MC treated wood was significantly different from the air-dry MC treatment except for sengon wood. This is in accordance with the statement of Jasni and Rulliaty (2015) that dry wood termites will attack wood when it has reached the air-dry moisture content (around 12-14%) [21]. Based on Fig. 11, the dry wood termite mortality of *C. cynocephalus* in green MC treated jabon wood was not significantly different from 40-45% MC treatment but significantly different from air-dry MC and kiln-dry MC treatment. This can be caused in the feeding process. There is a decrease in MC due to changes in environmental conditions and treatment when termites are transferred from the colony to the observation medium. This is in accordance with the statement of Febrianto et al. (2013) that the process of transferring termites from the colony to the observation media can cause stress to termites due to light [18]. According to Haygreen and Bowyer (1989) [8] and Herianto (2019), changes in environmental conditions and temperature cause changes in the moisture content of the wood [8, 22]. The wood has hygroscopic properties, absorbing and releasing water to adapt to environmental conditions.

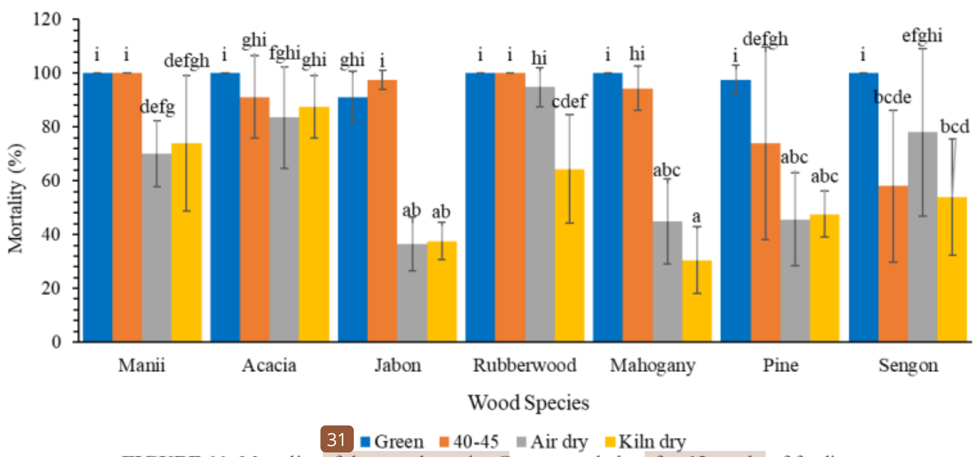
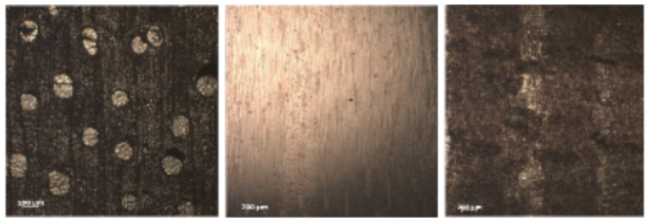


FIGURE 11. Mortality of dry wood termite *C. cynoc;ephalus* after 12 weeks of feeding.

Anatomical Structures of Seven Species of Community Wood

Manii Wood

Microscopic characteristics of manii wood (*Maesopsis eminii*) do not have a clear growth circle boundary. Diffuse porous with multiple radially arranged vessels of 4 or more. Simple perforation and have alternating recesses between vessels. Indentations of the rays with a clear page, similar in size and shape to the recesses between the vessels. Fibers without vessels were found. The fiber walls are very thin. Axial parenchyma in the form of vaskicentric, aliform (lozenge), and confluent. The rays are 1-3 series and all lying cells. Prismatic crystals are found in the reverse axial parenchyma. A microscopic photo of a cross-section of manii wood in three sections is presented in Fig. 12.

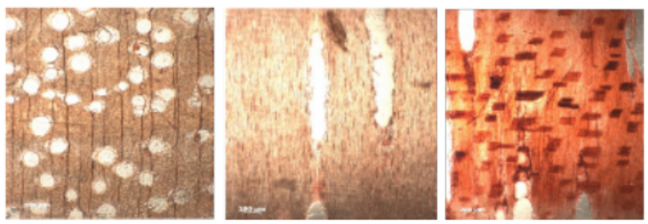


(a) (b) (c)

FIGURE 12. Microscopic photos of manii wood in Cross-section (a), Radial section (b), and Tangential section (c).

Acacia Wood

The microscopic structure of acacia wood (*Acacia* sp.) does not have a clear growth circle, porous mixed arrangement. Simple perforation, inter-vessel recesses alternate and tufted inter-vessel grooves, recesses of rays with clear pages, similar in size and shape to niches between vessels. Fiber without a barrier is found. The fiber walls are thin to thick. The axial parenchyma is vascicentric, aliform, and confluent. Rays 1-3 series are all lying cells. Prismatic crystals are found in the axial parenchyma of the chambers. A cross-sectional microscopic photo of acacia wood in three planes is presented in Fig. 13.



(a) (b) (c)

FIGURE 13. Microscopic photos of acacia wood in Cross-section (a), Radial section (b), and Tangential section (c).

Jabon Wood

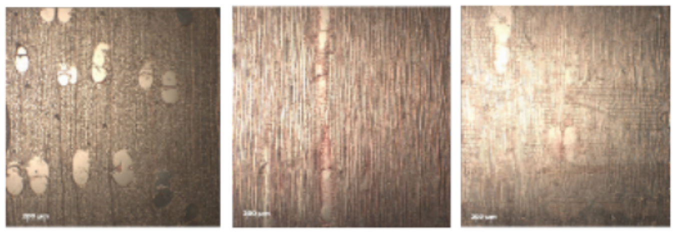
The microscopic structure of jabon wood (*Anthocephalus* sp.) does not have a clear growing circle boundary. Diffuse porous with multiple radially arranged vessels of 4 or more. Simple perforation. The recesses between the vessels alternate. Indentations of the rays with a clear page, similar in size and shape to the recesses between the vessels. Basic fiber network with simple niches to very small yards. Fiber without a barrier is found. The fiber walls are very thin. Axial parenchyma in aporacrea is scattered in groups, and axial parenchyma cells are 5-8 or more than 8 cells per strand. The rays are 1-3 series, but generally 4-10 series. The height of the ray is more than 1 mm. The composition of lying cells with one or more lanes of 4 upright cells or marginal square cells and the sand are crystals. A microscopic photo of a cross-section of jabon wood on three planes is presented in Fig. 14.

(a) (b) (c)

FIGURE 14. Microscopic photos of jabon wood in Cross-section (a), Radial section (b), and Tangential section (c).

Rubberwood

The characteristic of the microscopic structure of rubberwood (*Hevea* sp.) does not have a clear growth circle boundary. Diffuse porous with multiple radially arranged vessels of 4 or more (clusters). Simple perforation. Alternating recesses between vessels. Alternating rays with narrow to simple pages are round and angular. Basic fiber network with simple niches to very small yards. Fiber without a barrier is found. Cell walls are thin to thick. Axial parenchyma in the apotracheal is scattered in clusters and paratracheal sparse: Narrowband parenchyma, 3 layers of cells and mesh shaped. The rays are 1-3 series, but generally 4-10 series. The composition of lying cells with one or more lanes of 4 upright cells or marginal square cells. Prismatic crystals are found in chambered upright cells and in non-chambered axial parenchyma. There are crystals in tilosis. A microscopic photo of a cross-section of rubberwood wood on three planes is presented in Fig. 15.

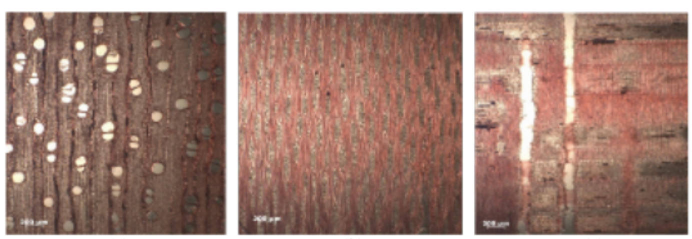


(a) (b) (c)

FIGURE 15. Microscopic photos of rubberwood in cross-section (a), Radial section (b), and Tangential section (c).

Mahogany

The microscopic structure of mahogany (*Swietenia* sp.) does not have a clear growing circle. Porous layout. Simple perforation. The recesses between the alternating vessels are multi-faceted. Indentations of the radius with clear pages, similar in size and shape to the inter-vessel recesses. Tilosis and deposits in the vessels are from sap and deposits. Basic fiber network with simple to very small niches. Insulated fibers are found. The fiber walls are thin to thick. The axial parenchyma is sparsely paratracheal with parenchymal cells of 5-8 cells per strand. The rays are 1-3 series, but generally 4-10 series. They were lying cell composition with one line of upright cells or marginal square cells. The arrangement of the tiered rays is irregular. A microscopic photo of a mahogany wood cross-section in three planes is presented in Fig. 16.



(a) (b) (c)

FIGURE 16. Microscopic photos of mahogany wood in Cross-section (a), Radial section (b), and Tangential section (c).

Pine Wood

Pinewood (*Pinus* sp.) does not have a clear growing circle boundary but has an axial channel. The transition from earlywood to latewood is gradual. Uniseriate ray shape. The wall thickness is small compared to the radial lumen diameter. Have dots crossed 1-3 holes. The average height of the rays is 5-15 series for and 16-30 series. A microscopic photo of pine wood is presented in Fig. 17.

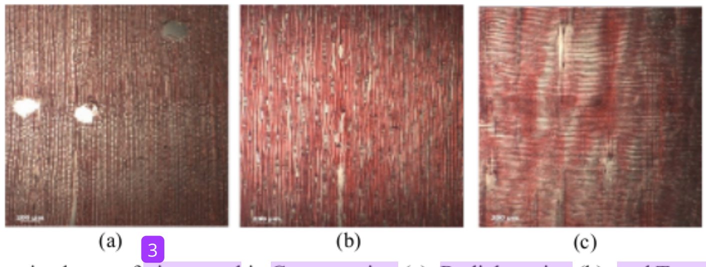


FIGURE 17. Microscopic photos of pine wood in Cross-section (a), Radial section (b), and Tangential section (c).

Sengon Wood

The characteristic of the microscopic structure of sengon wood (*Falcataria moluccana*) does not have a clear growing circle boundary. Diffuse porous with multiple radially arranged vessels of 4 or more (clusters). Simple perforation. Alternating recesses between vessels. The recesses of the rays with a clear page, similar in size and shape to the recesses between the vessels. Basic fiber network with simple to very small niches. Fiber without a barrier is found. Cell walls are very thin. Axial parenchyma in the form of scattered apotracheal and paratracheal sparse and have axial parenchyma paratracheal in the form of vascisentik, aliform, and conluent. Rays 1-3 series and lying down. Prismatic crystals are found in the chambered axial parenchyma. A microscopic photo of sengon wood on three planes is presented in Fig. 18.

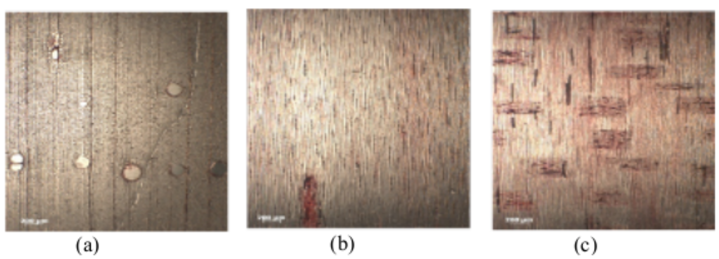


FIGURE 18. Microscopic photos of sengon wood in Cross-section (a), Radial section (b), and Tangential section (c).

Based on the observations, the growth circles of each type of wood are not clearly visible and have a diffused porous arrangement. The shape of the pore distribution in hardwood wood species also affects the growth circle [23]. Diffuse pore distribution showed no difference or a slight difference in the size and number of vessels in all growth circles and the proportions of early and latewood [24]. In addition, the thickness of the fiber wall also affects the density of the wood.

CONCLUSION

The dry-wood termite preference of *C. cynocephalus* against seven species of community wood indicated that jabon wood was preferred over six other wood species in various MC values tested. The resistance class of jabon wood is classified into durable class IV, while acacia wood is included in resistance class I. The average mortality of dry wood termite *C. cynocephalus* is in green MC, 40-45% MC, air-dry MC, and kiln-dry MC are ranged from 78-100%, 30-100%, 24-100%, and 16-100%. In general, it can be said that the dry wood termites *C. cynocephalus* tended to prefer wood in air-dry MC and kiln-dry MC. The results of the microscopic identification of wood, the community wood used in this study were manii (*Maesopsis eminii*), acacia (*Acacia* sp), jabon (*Anthocephalus* sp), rubberwood (*Hevea* sp), mahogany (*Swietenia* sp.), pine (*Pinus* sp.), and sengon (*Paraserianthes falcataria*).

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