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Identification of Subterranean Termite Infestation in Residential Areas in Bogor Regency, West Java

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Abstract

Identification of Subterranean Termite Infestation in Residential Areas in Bogor Regency, West Java*. Subterranean termites are one of the pests that attack buildings. The interaction between termites and buildings significantly affects the durability, safety, and comfort of residential structures. This study aimed to identify the types of termites found in residential environments and determine the intensity of damage and frequency of termite attacks on pine wood (*Pinus merkusii*). Wood samples cut into 2 cm x 2 cm x 46 cm were conducted using the graveyard test for three months. The identified termite species was Macrotermes gilvus (M. Gilvus). The attack intensity obtained showed that 55% of the wood samples experienced damage due to subterranean termite attacks near the residential building, 30% remained unaffected, and 15% showed damage with penetration ranging from 3% to 75% of the cross-section. These results were reinforced by the high frequency of termite attacks on bait wood, which reached 70% (>40%). These findings are useful for homeowners if the area is later used for building construction. Therefore, preliminary measures are needed to address termite infestations in the area before using it for future building construction.*

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INTRODUCTION

Termites are insects belonging to the order Isoptera. They live in colonies and have a caste system within their colony. A termite colony consists of three castes with clearly defined roles (Khan *et al.*, 2018). In Indonesia, there are three termite families: Kalotermitidae, Rhinotermitidae, and Termitidae. These termites are known as pests that extensively attack wood and damage buildings. The interaction between termites and buildings significantly affects the durability, safety, and comfort of residential structures. The longer a building is infested by termites, the more its structural integrity declines. This deterioration can increase the risk associated with using the building, especially when low-durability wood is used for construction (Maisarah *et al.*, 2022).

Termites play an important role as decomposers in maintaining the sustainability of the ecosystem. However, as the human population increases, termite habitats have been transformed into residential buildings, leading to a shrinking living environment and reduced food sources for termites. To survive, termites expand their foraging areas, attacking any potential food sources they encounter (Saputra et *al.*, 2022). The detection of termite infestations is a challenging task, as their cryptic behavior and the subtlety of their initial signs can often delay identification, allowing the infestation to escalate unchecked (Nanda *et al*., 2019).

Bogor Regency is one of the areas experiencing significant population growth and urban development. According to the Bogor Regency Central Bureau of Statistics, in the past three years (2022–2024), the population growth rate has been 1.08% (BPS, 2024). This population growth can influence the expansion of residential areas such as apartments, boarding houses, and other housing developments. Bogor Regency has a relatively humid environmental condition, which is highly favorable for termites, enabling them to reproduce and form colonies. It is known that the annual rainfall in Dramaga, Bogor Regency, ranges between 4,000–5,000 mm (Hidayat & Farihah, 2020). This makes termites a potential threat to residential area development in Bogor.

Although no specific research has been conducted on the total economic losses caused by termite infestations in Bogor, previous studies indicate that termite attacks can result in significant economic losses to buildings and residential structures. Research by Rust and Su (2012) reported that termite damage in 2010 amounted to US$40 billion. Furthermore, a study by Nandika *et al*. (2015) estimated losses of approximately Rp 8.68 trillion, with an increasing trend each year. Rentokil (2018) also reported that US$3.4 billion of the pest control market was dominated by termite control activities. These losses are undoubtedly significant for the general public.

Therefore, this research serves as an effort to prevent structural damage caused by termite infestations. One preventive measure is selecting locations that are relatively safe and less susceptible to aggressive termite species. This study aims to identify termite species found in residential environments and assess the intensity of damage and frequency of termite attacks. Conducting this research is crucial to enable the public to take preventive measures against potential termite infestations in their buildings.

METHODS

1. Materials and Equipment

The materials used in this study included pine wood **(***Pinus merkusii***)** measuring 2 cm × 2 cm × 46 cm**,** following the standards of the American Society for Testing and Materials (ASTM) D 1758-06 (2008)**,** 70% alcohol**,** and red paint. The equipment used in this study included a chainsaw**,** electric fan**,** digital microscope, collection bottles, brushes**,** and stationery**.**

2. Research Procedure

a) Selection of Research Location

This study was conducted in a residential building with an area of approximately 2,365m^2 in Balumbang Jaya Urban Village, West Bogor, West Java. The selected study site was the researcher's residence during the study period. The criteria for selecting this location included the fact that it was a boarding house consisting of three main buildings, with open land, a garden, and a yard that facilitated the research activities.

The placement of the bait wood was carefully aranged to avoid disrupting the activities of the building's occupants. The bait wood was positioned in a U-shape, as illustrated in Figure 1. The study was conducted using a graveyard test for three months, followed by the identification of termite species in the laboratory at the Division of Wood Quality Improvement Technology, Department of Forest Products, Faculty of Forestry and Environment, IPB University.

Figure 1. Sketch of bait wood placement in a U-shape

b) Bait Wood Installation

Bait wood is required to identify termite species present at the study site and to assess the level of damage caused by their attacks (attack frequency and damage intensity). The wood used is of the pine type, measuring 2 cm x 2 cm x 46 cm, in air-dried conditions. This size refers to the ASTM-D 1758-06 (2008) standard. The top part of the wood is painted red to facilitate sample retrieval after three months of placement. The bait wood is installed vertically into the soil, with approximately half of it buried beneath the surface, as shown in Figure 2. A total of 20 bait wood pieces were planted, and monitoring was conducted every two weeks. After three months, the wood was removed, cleaned of dirt and soil, and then further examined to observe the frequency and intensity of the damage.

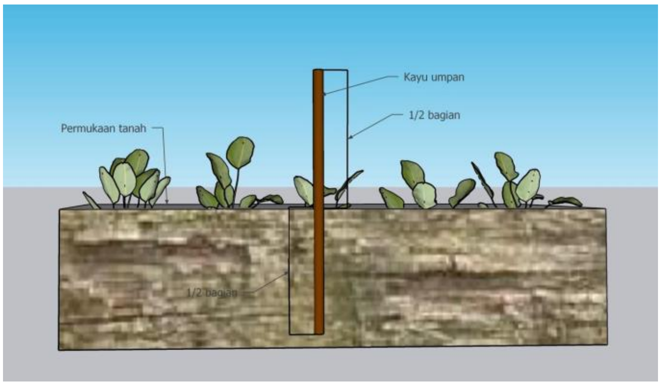

Figure 2. Sketch of bait wood installation at the research site

c) Identification of Termite Species

Termite specimens collected from the research site were identified using a microscope with 10x magnification. The identification procedure was conducted by examining the morphological characteristics of the soldier caste, referring to Nandika *et al.* (2015). Soldier caste termites that attacked the bait wood were collected and placed in specimen bottles containing 70% alcohol. Subsequently, the specimens were observed under a digital microscope with 10x magnification using an 800x LED endoscope camera magnifier.

3. Bait Wood Damage Intensity

The intensity of wood damage refers to the amount of damage occurring based on the percentage of the cross-sectional area of the bait wood lost due to subterranean termite attacks, following ASRM D 1758-06 (2008) standards. This damage is classified into seven categories. Severe damage caused by subterranean termites is indicated by highly deteriorated bait wood (score 0), whereas wood in good condition (score 10) indicates a low level of damage. The complete classification of wood damage due to termite attacks can be found in Table 1.

Table 1. Classification of Wood Damage Due to Subterranean Termite Attacks

Score	Damage Condition

10	No attack; 1 to 2 minor attacks
9	Attack up to 3% of the cross-section
8	Penetration 3 – 10% of the cross-section
7	Penetration 10 - 30% of the cross-section
6	Penetration 30 - 50% of the cross-section
4	Penetration 50 - 75% of the cross-section
0	Wood completely destroyed

4. Frequency of Subterranean Termite Attacks

Attack frequency is the ratio between the number of test wood samples attacked by subterranean termites at the research site and the total wood samples planted at the site, expressed as a percentage. The classification of subterranean termite attack frequency on bait wood can be seen in Table 2.

Table 2. Classification of Subterranean Termite Attack Frequency on Samples

Class	Frequency (%)	Description
1	0	No attack
2	1-10	Very Low
3	11-20	Low
4	21-30	Moderate
5	31-40	High
6	>40	Very High

5. Analysis Data

The descriptive method is the method used in this research, which involves problem-solving through procedures based on actual facts in the field. The conclusion describes the current condition of the research subject/object (Nawawi, 1993). Observations in this research were conducted on residential building land using bait wood and by collecting/obtaining termite species found on the planted bait wood that showed damage. The termites were placed in glass bottles and later identified through microscopic and macroscopic observations to describe the termite species attacking the bait wood (Alvinda, 2018).

RESULTS AND DISCUSSION

1. Identification of Termite Species Responsible for the Attack

The identification results of subterranean termites found attacking the wood bait revealed only the species *Macrotermes* sp. This result differs from the study by Arinana *et al.* (2023), which found only *Microtermes* sp. in the same subdistrict, Balumbangjaya. This indicates that different residential areas may have distinct soil characteristics, which influence the types of termite habitats present. According to Sumarni and Ismanto (1988), *Macrotermes gilvus* termites have a wide habitat range and can thrive in various soil types, including complex red-yellow podzolic soils, yellow podzolic soils, regosols, red latosol associations, reddish-brown latosols, and lateritic soils. This aligns with the findings of this study, as the research location predominantly consists of latosol soil, which provides a suitable environment for *M. gilvus* termites to nest and develop effectively. The placement of the research sample is shown in Figure 3.

As we know, latosol soil is characterized by yellowish-red color soil, soft texture, and contains high levels of organic material, iron, and aluminum (Mubin *et al.* 2019). De Lima et al. (2018) also reported that this soil performed higher clay content and acidity (around pH level of 5), so that many mounds are found as termite nests. *M. gilvus* prefers the soil type that contain clay like this kind of soil due to its high organic matter which has a high carrying capacity for the life of termite colonies. In addition, this termite is also tend to be intolerant to sunlight, therefore, they are more oftern found in places that are higher shade (Mubin *et al.* 2019).


Figure 3. Research sample placement location

However, this study did not conduct specific tests on soil content characteristics. This is because, referring to the research results of Pranoto and Latifah (2016), the habitat of subterranean termites is not significantly affected by soil pH. However, this is suspected to be different if the research is conducted in an open area with an ecosystem that has little vegetation cover. The same results were also shown by the research of Arinana *et al.* (2023), which found that organic carbon (C-organic) content does not have a significant relationship with the increase in damage intensity of bait wood due to termite attacks. This is suspected to be because the C-organic content between different areas does not differ significantly.

The morphological characteristics of *Macrotermes* sp. according to Arinana *et al.* (2019) include having a reddish-brown head, a head length with mandibles of 4.80-5.00 mm, a head length without mandibles of 3.40-3.60 mm, and 17 antenna segments. These termites have mandibles that curve at the tip and are used for gripping. They live in large, complex, and highly organized colonies with socially divided tasks. *Macrotermes gilvus (M. gilvus)* typically builds its nests in the soil and is commonly found in tropical regions such as Southeast Asia and surrounding areas (Subekti & Maret'ah, 2019). The species of *M. gilvus* is a subterranean termite with a high adaptability and an extensive foraging range (up to 140.5 meters). Its nests are frequently found in Indonesia (Subekti, 2010). These mentioned characteristics of *M. gilvus* are suitable with the termite identified in this study, the termite morphology can be seen in Figure 4.


Figure 4. Major soldier caste of M. Gilvus at 10x magnification

2. Grading of Graveyard Test Wood Samples

The grading of wood samples from the graveyard test in this study was conducted by periodically observing jabon wood specimens every month after the test began. The observations focused on assessing the depth of wood penetration into the soil surface. The percentage of wood sample damage caused by *M. gilvus* termite attacks over three months is presented in Figure 3.

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

Figure 3. Damage value of wood sample due to *M. gilvus* termite attacks (a) 0, (b) 4, (c) 7, (d) 9, and (e) 10

The research results show that the attack intensity values were 0, 4, 7, 9, and 10. Based on these data, the termite attack intensity was approximately 55% (11 samples) due to subterranean termite attacks near the building, 30% of the samples remained unaffected, and 15% showed damage with penetration ranging from 3% to 57% of the cross-section. These results align with the findings of Arinana *et al.* (2019), which stated that each termite species has its own characteristic attack pattern on bait wood. For *M. gilvus*, the attack type tends to be widespread and even, whereas for *C. curvignathus*, it is narrow and focused. Additionally, pine wood is a preferred food source for *M. gilvus*, as evidenced by a weight loss of up to 57.95% over three months, with an average consumption rate of *M. gilvus* on pine wood reaching 8.2 mg/day (Subekti *et al.*, 2010; Subekti *et al.,* 2012).

Meanwhile, the frequency of termite attacks on bait wood was 70% (>40%), which falls into class 6, indicating that the attack intensity of *M. gilvus* is very high. These results align with the findings of Subekti (2010), which stated that, in general, the Bogor area has a termite attack frequency of 41%, categorized as very high. The same finding also founded by Arinana *et al.,* (2023), 70.33% of wood samples were highly damaged by subterranean termites, especially by *Microtermes sp*. This can be concluded that the termite attacks in Bogor are very fast and high. The high frequency of termite attacks is suspected to be influenced by several factors, such as urban development levels, the abundance of subterranean termites, and environmental conditions that support termite survival.

The research site also contained leaf litter from surrounding plants, which contributed to an increase in organic matter, positively impacting soil fertility. The environmental conditions-high humidity, low temperature, and lack of sunlight penetration to the soil surface-created an optimal habitat for termite development, as their food sources were readily available. This finding aligns with the study by Sayuthi (2012), which states that high organic content, high humidity, and low surrounding temperatures are highly effective in supporting the colony growth of *M. gilvus* termites. The observed damage indicates that *M. gilvus* colonies have a significant ability to degrade wood, particularly in environmental conditions that favor their optimal improvement. Although 30% of the samples showed no damage or only minor attacks, this suggests that other factors may influence termite presence and activity. Therefore, understanding the interactions between these factors is crucial for developing more effective termite control strategies and protecting wooden structures from further damage.

CONCLUSION

Based on this study, it had been founded the subterranean termite (*M. gilvus*). This termite has highly intensity attack to pine wood because pine wood is their favorite food. The soil type in the research location was latosol soil which was a habitat of *M. gilvus*. A total of 55% of the wood samples experienced damage due to subterranean termite attacks near the residential building, 30% of the samples remained unaffected, and 15% showed damage with penetration ranging from 3% to 75% of the cross-section. These results are reinforced by the high frequency of termite attacks on bait wood, reaching 70% (>40%). The relatively high percentage of wood sample damage suggests that environmental conditions, including latosol soil type and the availability of organic matter, strongly support the development and activity of termite colonies. Therefore, preliminary measures are necessary to control termite attacks in the area before it is used for building construction in the future.

SUGGESTION

These findings are useful for homeowners if the area is later used for building construction. One of the preventive measures that can be taken is a pre-construction termite control procedure using the soil pre-treatment (SPT) method beneath the ground and around the concrete of residential buildings. Additionally, the wood used should also be termite-resistant. Resinous wood is naturally termite-resistant, and some other types of wood are chemically treated to prevent termites. This can protect the building from termite attacks for a certain period.

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