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# Inventory of Termite Species in The Area of Islam Riau University and Efficiency of Fungus (*Metarhiziumanisopliae*) Against Terms in The Laboratory

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## ABSTRACT

Termites have a great potential to cause damage to plants and other woody materials because these insects live in colonies. Termites' preferences and potential for harm vary depending on the species. Surveys related to termite species, estimates of damage that occurred, as well as preferences of plants and woody trees attacked in the Riau Islamic University Area were carried out as an initial step to avoid the impact of a greater termite attack. The survey results showed that termites were found in 9 of the 25 plots observed, namely Fisipol (3), Law (3), PKM Building (1), FKIP B (1), Mosque (1), Agriculture (3), Experimental Gardens (2), Student Dormitory (14), and Postgraduate (4). The types of termites that attack the Riau Islamic University area were obtained as many as four different termite species, namely Microcerotermes sp. (Family: Termitidae), Macrotermes sp. (Family: Termitidae), Schedorhinotermes sp (Family: Rhinotermitidae), and Coptotermes curvignathus (Family: Rhinotermitidae). Captotermes is one of the main pests in the Riau Islamic University area because it has been known to attack several plants for a long time. Laboratory tests using the fungus Metarhizium anisopliae showed the potential to cause mortality in termites at a spore density of 1.65 x 108 with a spore viability of 82.8%, resulting in a death time of 1.65 x 108. The best was 1.50 days and the mortality percentage was 99.17%. The spore density of Metarhizium anisopliae added with 10% zeolite was 3.5 x 107 with 90.3% spore viability (M2) resulting in a death time of 2.50 days and a mortality percentage of 75. .12%. Meanwhile, without treatment, the time of death was 5.25 days and the mortality percentage was 20.00%.

**Keywords*:*** *Metarhizium anisopliae, Coptotermes curvignathus, Microcerotermes* sp., *Macrotermes sp., Schedorhinotermes sp*

## 1. INTRODUCTION

Damage to woody plants in urban areas (*urban tree*) is currently considered a global problem (Zorzenon and Campos, 2015). The roles of woody plants in urban areas include as protective plants, as ornamental plants, and as producers of nutrients with nutritional value, for example fruit plants.

Conditions where forest function shifts cannot be avoided, the role of woody plants in urban environments deserves serious attention to be able to contribute to reducing the impact of environmental damage. Many campuses are involved in the effort to "green the earth" with the motto "green campus", because this helps create a comfortable atmosphere for a better academic climate.

Damage that commonly occurs in woody plants is caused by termite attacks. There are two main groups of termites in terms of the type of wood they attack. There are termites that damage wood products (dead plants), building materials, furniture and there are also termites that attack living plants causing damage and even death to plants (Chouvenc and Foley, 2018; Jalaludin, Rahim and Yaakop, 2018). The composition of termites is reported to be an indicator of environmental change. (Ningsih, Dahelmi Rahayu, 2015). In an industrial plantation forest in Riau, Sagitarianto, (2019) reports that there are differences in the type and dominance of termites between peatland and mineral land. Four types of termites were found on peatlands, namely Longipeditermes longipes, Coptotermes curvignathus, Microcerotermes sp., and Schedorhinotermes. Coptotermes species are the most common pest termites found in A. crassicarpa plants on peatlands.

Meanwhile, on mineral soil, five species were found, namely *Microcerotermes sp., Macrotermes, Capritermes, Procapritermes, Microtermes sp. Microcerotermes* is the most destructive termite genus in E. pellita in mineral soils. Rubber plants in South Sumatra were reported to be attacked by *Coptotermes curvignathus* with an attack rate of 0.67% (Herlinda et al., 2010).

The termite attack on the UIR campus environment which caused damage and death of plants was the reason for the mapping of the attack and identification of the type of termites carried out in the Riau Islamic University campus environment. In addition, efficacy testing of the entomopathogenic fungus *Metharizium anisopliae* was also carried out to assess its potential against the dominant termite species found.

## 2. MATERIAL AND METHOD

The research that was conducted consisted of 2 stages. The termite attack mapping survey was conducted in the Islam Riau University campus area, Bukit Raya District, Pekanbaru City. Meanwhile, testing the effectiveness of Metarhizium anisopliae in controlling termites was carried out at the Entomology *Central Plantation Services* laboratory, Panam, Pekanbaru City.

The termite attack mapping survey in the Islam Riau University campus was carried out by collecting data on plants suspected of being attacked by termites in 25 plots based on the Riau Islamic University map (Figure 1). Each termite colony found was sampled to be identified using an identification "*Key to The Indomalayan Termites"* (Ahmad 1958).


Picture 1. Floor plan of Islam Riau University

For testing the efficacy of the fungus *Methariziumanisopliae*, the design used was a Completely Randomized Design (CRD) which was statistically analyzed with One-way Anova (one-way design) followed by *Duncan's Multiple Range Test* (DMRT) at a 5% significance level.

The treatment efficacy of the fungus *Metarhizium anisopliae* are:

M0 = Control + sawdust
M1 = *Metarhizium anisopliae* + sawdust
M2 = *Metarhizium anisopliae* + zeolit (90%:10%) + sawdust

Each experimental unit consisted of 15 termites with eight replications for each treatment. The termites were put in a large jar filled with 500g of sterilized sawdust as a food source for termites. Then the termites were sprayed with a formulation according to the treatment and the control was sprayed with distilled water. Termite mortality was monitored 6 days after application. Observations were made for six days after application.

## 3. RESULTS AND DISCUSSION

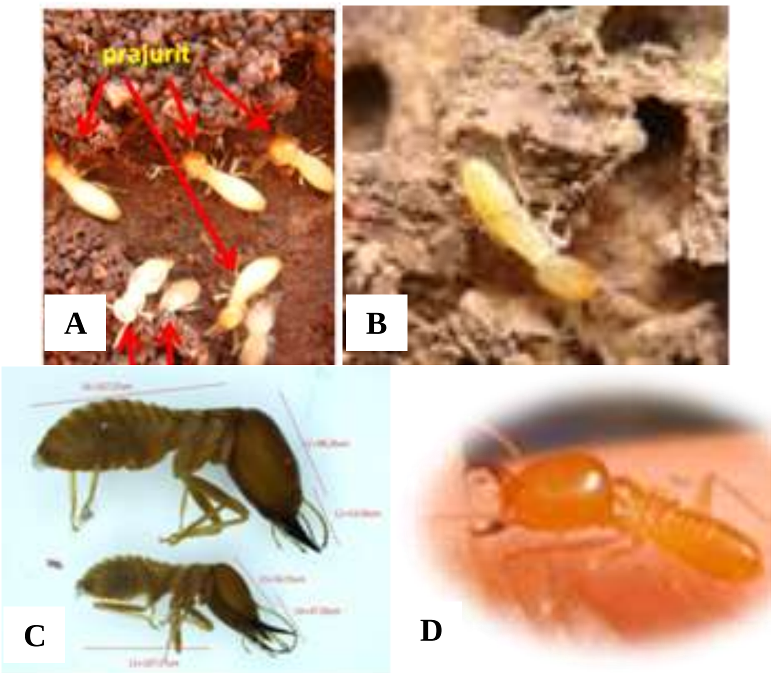
The results of the termite attack mapping survey showed that there were 9 plots that were attacked by termites, namely Fisipol (3), Law (3), PKM Building (1), FKIP B (1), Mosque (1), Agriculture (3), Experimental Gardens (2), Student Dormitory (14), and Postgraduate (4).

Identification of termite attacks (Figure 2) in Fisipol was found on kapok and mango plants with the termite *Coptotermes curvignathus Holmgren,* at the Faculty of Law it was on palm and banyan plants with Microcerotermes sp species, while on mango plants *Coptotermes curvignathus Holmgren*, PKM Building on termite mango plants that attacks Coptotermes curvignathus Holmgren, FKIP on mango plant species of termites that attack Coptotermes curvignathus Holmgren, Mosque on mango plant species of termites that attack Coptotermes curvignathus Holmgren, Agriculture on mango plant species of termites that attack Coptotermes curvignathus Holmgren, Experimental garden on mango species of termites attack *Coptotermes* curvignathus Holmgren, student dormitories on teak and ficus species of termites that attack *Macrotermes sp*, while on mahogany and eucalyptus plants, termites that attack *Schedorhinotermes sp*, and Postgraduate on mango plants of termites that attack Coptotermes s curvignathus Holmgren.

The results of termite identification using Ahmad (1958) in the Riau Islamic University area were obtained as many as four different termite species, namely Microcerotermes sp. (Family: Termitidae) on palms, Macrotermes (Family: *Termitidae*) on ficus and teak plants, *Schedorhinotermessp (Schedorhinotermes* (Family: Rhinotermitidae) on eucalyptus and mahogany, and *Coptotermes curvignathus* (Family: *Rhinotermitidae*) on mango, banyan, saga, and kapok.

The termite species *Coptotermescurvignathus* Holmgren was found scattered in almost all affected plants in the Riau Islamic University area with a relatively higher attack area on mango plants, compared to *Macrotermes sp type* termites on teak. According to (Vats, Aggarwal and Bhardwaj, 2009), wood from manganese plants is the most preferred type by termites of the eight species of woody plants tested. *Coptotermes curvignathus Holmgren* has a higher preference for soils with higher organic matter content so they are easy to find (Perbadi, Raffiudin and Harahap, 2011).

Coptotermes is a group of subterranean termites with the main nest in the ground and capable of making secondary nests far from the ground. Therefore, his attacks can reach high parts. This type of termite has a great potential to become a destructive pest on plants, so its existence should be watched out for. Very humid conditions can be a suitable habitat for the development of Coptotermes, because the tropical area with 80% humidity is a very favorable habitat for its development (Haneda et al., 2017).




Picture 2. Termite species found in the Campus area of Islam Riau University;
A: *Coptotermes curvignatus,* B: *Microcerotermes* sp., C: *Macrotermes* sp
D: *Schdorhinotermes* sp

The termite species *Macrotermes sp* was found in teak plants at the age of ≤ 6 months in large numbers. This is thought to occur because in relatively younger plants (< 30 years), the plant size is smaller, both in diameter and plant height, so that at a younger plant age, termites require a larger number of trees to meet their life needs, so termites are killed. *Macrotermes sp* species are spread in several teak plants. According to (Sagittarianto, 2019) larger plants have a better carrying capacity (sufficient for feeding and nesting needs) for termites in a higher population than smaller plants, so that in plots with larger plants (older plant age) ), termite attack is lower.

The results of observations on the time of death in termites after analysis of variance showed that the spores of *Metarhizium anisopliae* had a significant effect on the time of death. The average result of observing the time of death after the DMRT test at the 5% level can be seen in Table 5.

The data in Table 5 shows that the administration of spores of *Metarhizium anisopliae* gave a significant effect on the time of death in termites with the best treatment being the administration of pure Metarhizium anisopliae (M1) with a density of 1.65 x 108 ie 1.50 days. Significantly different with the administration of *Metarhizium anisopliae* plus Zeolite 10% (M2) with a density of 3.5 x 107 which is 2.50 days and followed by treatment without *Metarhizium anisopliae* (M0) which is 5.25 days.

The difference in the time of death was thought to be caused by the number of fungal conidia attached to the larval body. The higher the concentration level of the fungus applied and the greater the number of conidia attached to the larva's body, the faster and higher the mortality rate of the larvae. According to (Birnbaum et al., 2021) the more fungal conidia

Table 5. Average time of death of termites by testing of spores *Metarhizium anisopliae.*

| Mushroom *Metarhizium anisopliae)* | Average |
|---|---|
| M0 (Control) | 5,25 c |
| M1 *(Metarhizium anisopliae)* | 1,50 a |
| M2 *(Metarhizium anisopliae* + Zeolit 90%:10%*)* | 2,50 b |
| KK = 32,82% BNJ M = 1,26 | |

The numbers in the columns and rows followed by unequal lowercase letters were significantly different according to Duncan's Multiple Range Test (DMRT) at the 5% level.

attached to the larval body, the faster the time of death and the higher the density of infected conidia, the higher the chance of contact between the pathogen and the host.

Treatment without giving *Metarhizium anisopliae* (M0) is 5.25 days because of the control factor, mechanically the termites that will be counted in each treatment box will be dismantled directly by hand which causes the termites without *Metarhizium anisopliae* (M0) to die one by one at 5.25 days.

The ability of fungal conidia to control insects is strongly influenced by the chemical composition of the insect.

*Entomopathogenic fungi* will produce degrading enzymes such as chitinase, lipase and protease in the host which has suitable conditions for the growth of *entomopathogenic fungi*. Generally, *entomopathogenic fungi* produce toxins in insect control such as the *destruction* produced by the fungus *Metarhizium anisopliae*. Destructive toxins are known to be very effective in controlling various types of insects.

This toxin causes disruption of cell work that has an impact on insect immune system disorders, digestive function disorders, *malpighian tabulus* and muscles in insects (Kim et al., 2020; Yin et al., 2021).

The use of *entomopathogenic* fungi in the time of death in pests is determined, among others, by the concentration/density and germination of spores. The ability of sporulation can also be used as the ability of isolates to penetrate into the target host. The virulent isolate had better sporulation ability than the avirulent isolate.

According to (Manurung et al., 2012) the fungus *Metarhizium anisopliae* requires several stages to infect insects. The time difference for each of these stages varies depending on the type of fungus, host, and environment. In addition, the difference in time from infection to insect death is also influenced by the virulence of the fungus.

Contact between termites that have been infected with termites that are still healthy will make the fungus stick to the bodies of other termites. Transmission of spores from infected termites to healthy termites is caused by interactions between individuals, such as the behavior of termites feeding on each other (*trophallaxis*) and touching each other (Mirabito and Rosengaus, 2016).

The results of observations on the percentage of mortality in termites after analysis of variance showed that the spores of *Metarhizium anisopliae* had a significant effect on the percentage of mortality. The average time of death observation after DMRT test at 5% level can be seen in Table 6.

Table 6. The average percentage of termite mortality by testing from spores *Metarhizium anisopliae.*

| Mushroom *Metarhizium anisopliae)* | Average |
|---|---|
| M0 (Control) | 20,00 c |
| M1 *(Metarhizium anisopliae)* | 99,17 a |
| M2*(Metarhizium anisopliae*+Zeolit 90%:10%*)* | 75,12 b |
| KK = 13,90% BNJ M = 11,24 | |

The numbers in the columns and rows followed by unequal lowercase letters were significantly different according to *Duncan's Multiple Range Test (DMRT) at the 5%* level. the best treatment was giving pure *Metarhizium anisopliae* (M1) with a density of 1.65 x 108, namely 99.17%. Significantly different with the administration of *Metarhizium anisopliae* plus Zeolite 10% (M2) with a density of 3.5 x 107 which is 75.12% and followed by treatment without Metarhizium anisopliae (M0) which is 20.00%.

Insect mortality was largely determined by the conidia density of the fungus *Metarhizium anisopliae* applied. The higher the conidia density of the fungus *Metarhizium anisopliae*, the higher the mortality. This is supported by the opinion (Clifton et al., 2020) which states that the more conidia attached to the cuticle of insect larvae, the more conidia that penetrate the cuticle so that resulting in a lot of dead larvae, it will increase the percentage rate of insect mortality.

*Metarhizium anisopliae* can infect termites by making contact between propagules and insect bodies. Then there is attachment and germination of fungal propagules on the insect integuments. The fungus will use the compounds found in the insect's integument. Furthermore, penetration will occur and penetrate the integument to form a sprout tube. The last stage is destruction at the point of penetration and the formation of blastospores which will attack other tissues. In general, all the tissues in the insect's body and body fluids are used up by the fungus, so the insect will die with a hardened body like a mummy. This is because the termite body is covered with fungal mycelium.

The mechanism of insect infection by the fungus *Metarhizium anisopliae* where the ability of the conidia of Metarhizium anisopliae to penetrate the insect cuticle is strongly influenced by the chemical composition of the insect cuticle. *Metarhizium anisopliae* will produce cuticle degrading enzymes such as chitinase, lipase and protease in the host that has the body. Then this fungus produces *cyclopeptides, destruxin* A, B, C, D, E and *desmethyl destruxin* B. *Destruxin* will have an effect on target cell organelles (mitochondrion, endoplasmic reticulum and nuclear membrane) causing cell paralysis and dysfunction of the middle stomach, *malpighian tubules. , hemocyt* and *muscle tissue* (Aw and Hue, 2017).

## 4. CONCLUSION

The types of termites that attack the Riau Islamic University area were obtained as many as four different termite species, namely *Microcerotermes sp.* (Family: *Termitidae*), Macrotermes (Family: Termitidae), Schedorhinotermes sp (Schedorhinotermes (Family: Rhinotermitidae), and Coptotermes curvignathus (Family: *Rhinotermitidae*).

The types and number of plants attacked by termites were 9 plots that were attacked by termites including Fisipol on Ceiba pentandra L. (2) and *Mangifera indica L*. (1) with an attack frequency of 70-100%, Hukum on *Mangifera indica L* (2) and Roystonea regia L. (1) attack frequency 30-70% and Ficus benjamina L. (1) attack frequency 70-100%. PKM building on Andenanthera pavonina L. (1) attack frequency 30-70%, FKIP B on *Mangifera indica* L (1) attack frequency 10-30%, Mosque on *Mangifera indica* L (1) attack frequency 10-30% , Agriculture on Mangifera indica L (3) attack frequency 30-70%, Experimental Garden on Mangifera indica L. (1) attack frequency 10-30%, Student Dormitory on Tectona grandis L. (11) attack frequency 10-30%, *Swetenia mahagoni L.* (1) attack frequency 30-70%, Melaleuca leucadendra L. (1) and Ficus benjamina L. (1) attack frequency 70-100%, Postgraduate on *Mangifera indica* L. (4) attack frequency 70-100%.

The spore density of *Metarhizium anisopliae* was 1.65 x 108 with 82.8% spore viability resulting in the best death time of 1.50 days and mortality percentage of 99.17%. The spore density of *Metarhizium anisopliae* added with 10% zeolite was 3.5 x 107 with 90.3% spore viability resulted in a time of death of 2.50 days and a mortality percentage of 75.12%. Meanwhile, without treatment, the time of death was 5.25 days and the mortality percentage was 20.00%.

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