

EFFECTIVENESS OF BOTANICAL BIOPESTICIDES WITH DIFFERENT CONCENTRATIONS OF TERMITE MORTALITY

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ABSTRACT

*This study aimed to determine the effect of botanical biopesticide extracts and concentrations on soil termite mortality of *Coptotermes curvignathus*, Holmgren. This research was an experimental study using a fully randomized design (CRD) consisting of 2 3-level treatments repeated three times. Treatment was a type of botanical biopesticide consisting of three levels, namely are A1 (papaya leaf), A2 (soursop leaf), A3 (lemongrass leaf). In comparison, the concentration of botanical biopesticide consists of three levels: B0 (without or as a control biopesticide), B1 (500 grams), B2 (1,000 grams) and B3 (1,500 grams) which have repeated three times. The data analyzed using Variant Analysis, and if there was any influence, the difference test at 5 % and %. The results showed that the treatment of biopesticides did not significantly affect the mortality of subterranean termites (*Coptotermes curvignathus*, Holmgren). Three plants contain chemical compounds or extractive materials. However, from the three types of biopesticide treatment, the best one is papaya leaf biopesticide (A1) because the mortality is 92%. It found that at 60.28% soursop leaves (A2) and 22.22% lemongrass leaves (A3). The treatment of biopesticide concentrations was significantly different for all subterranean termite mortality (*Coptotermes curvignathus*, Holmgren). At the same time, the interaction does not have a real effect. Although it did not have a significant effect, the highest intake was the type of papaya leaf biopesticide with a concentration of 1,500 grams (A1B3).*

Keywords; *Biopesticides; Extract; Lemongrass Leaves; Papaya Leaves; Soursop Leaves; Termite Mortality.*

INTRODUCTION

The use of plants as active biopesticide ingredients has begun to be widely used by the community and farmers in controlling pests and diseases in crops and forest plants. Termites are social insects that eat cellulose, which is very hazardous to buildings, and products derived from wood like particleboard, fiberboard, plywood, blockboard and laminate board. Termites also attack trees and plants in such a way that they become potential pests, especially in oil palm, rubber and other industrial plantations. Termites that attack trees or plants result in a decline in yield and significant economic losses. (Subekti et al. 2008). According to (Oliver et al. 2016), termites can attack the roots and stems of plants in such a way that the translocation of water and soil nutrients is disrupted so that the plants die. (Sari et al. 2014)

One alternative effort is to use biopesticides. Biopesticide is a plant-based pesticide. Biopesticides act as repellents, attractors, anti-fertility, and killers and other forms. Ingredients of botanical pesticides from plants such as alkaloids, terpenoids, phenolic

matter and other secondary chemical substances. Each plant contains active compounds which can be used as raw materials for pesticides. (Wattimena et al. 2020). Content of botanical pesticides such as alkaloids, terpenoids, phenolic substances and other secondary chemicals. Each plant contains active compounds are the raw material for making pesticides. (Irfan 2016) According to (Garden and Cogreg 2012) the use of botanical pesticides has several advantages, which are at the same time weak. The advantages are environmentally friendly, inexpensive and easy to obtain, does not poison plants or agricultural products and does not cause pest immunity. Meanwhile, the weaknesses are that working power is relatively slow, does not kill target pests directly, does not resist sunlight, is less practical, does not hold back and sometimes needs to be sprayed repeatedly. (F. S. Latumahina, Masauana, and Marasabessy 2020)

This relates to its nature, which can kill, repel and inhibit insect pests from eating and controlling the disease. Some plants are known to contain chemicals that have the potential to control plant pests (Garden and Cogreg 2012) The use of plants as pesticide active ingredients to control pests and diseases because plants are a potential source of chemicals. Papaya leaves, soursop leaves and lemongrass leaves are local plants that can be found around the environment, which contain active compounds and can be used as substitutes for synthetic pesticides as an alternative to the control of environmentally friendly pests and diseases. (Kendalpayak and Timur 2017). Furthermore, it was also explained by based on the results of their research, it showed that papaya leaf pesticides were very effective in killing termite pests with the fastest death time obtained by 10 minutes in detergent-modified pesticides: kerosene: 1: 5: 1 pesticide, immersion time 18 hours. Toxic effect test showed that modified pesticides could eliminate termite pests up to 100 %, caterpillars and aphids 80 %, while without modification only 40% for the three types of pests. There has been little use of botanical biopesticides from papaya leaves, soursop leaves and lemongrass leaves to control soil termites. (IRFAN 2016)

Research purposes are to know the effect of botanical biopesticide extracts on the mortality of termites of *Coptotermes curvignathus* and to know the correct concentration of botanical biopesticide extracts against soil termite mortality of *Coptotermes curvignathus*.

METHOD

Research Site.

Research at Silviculture Laboratory of the Department of Forestry, Faculty of Agriculture, University of Pattimura Ambon, in January - February 2020. Equipment and materials needed were glass jars, cotton, sprayer, soft cloth, blender/mortar, scales, camera and stationery. In contrast, the materials used were papaya leaves, soursop leaves, lemongrass leaves, termites, cotton, alcohol 70 %, equates, tissues, knives and gauze.

Research Procedures.

The raw materials used were papaya leaves, soursop leaves and lemongrass leaves. Papaya leaves used were fresh green papaya leaves and soursop leaves while the lemongrass leaves used were leaves and stems of lemongrass. After the raw material was obtained, washed thoroughly in running water and allowed to dry. Then finely chopped, weighed according to the concentration and mashed until smooth.

Application Of Treatment Of Biopesticide And Concentration

Papaya Leaves.

Papaya leaves as much as 500 grams, 1,000 grams and 1,500 grams were finely ground and mixed with equates as much as 5 litres and soaked for 24 hours, then filtered

using a soft cloth, to obtain an extract of botanical biopesticides with various concentrations.

Soursop Leaves.

Soursop Leaves and Papaya leaves as much as 500 grams, 1,000 grams and 1,500 grams were finely ground and mixed with distilled water as much as 5 litres and soaked for 24 hours, then filtered using a soft cloth, to obtain botanical biopesticide extracts with various concentrations.

Lemongrass Leaves.

Lemongrass leaves and Papaya leaves as much as 500 grams, 1,000 grams and 1,500 grams were finely ground and mixed with distilled water as much as 5 litres and soaked for 24 hours, then filtered using a soft cloth, to obtain botanical biopesticide extracts with various concentrations.



Figure 1. Basic ingredients of vegetable biopesticides

Application Of Botanical Biopesticide Extract

Prepare a sterile glass jar, then, the bottom of the jar was covered with a gauze cloth that had been moistened with equates. Subsequently, a piece of Samama wood (*Anthocepallus macrophylus*) measuring 2 x 2 x 2 was inserted before the termites taken from trees samama were inputted and left for 3 (three) days, for each treatment after the termites 90 individual, inserted into a glass jar. It was covered with gauze cloth and tied with a rubber band, afterwards, for three days with the aim that the termites could adapt to the local environment. At the fourth day, a new application of biopesticide put on the termites, and the observations were carried out every afternoon for a week and each treatment use 90 termites.

Data analysis

The parameters observed were termite mortality according to Mulyani *et al.*, 2017 as follows:

$$P = \frac{a}{b} \times 100 \%$$

Where:

- P = Percentage of termite mortality
- a = Number of dead termites
- b = Amount of living soil termites

Research was an experimental study using a Completely Randomized Design (CRD) consisting of 2 treatments with three levels repeated three times. The treatments were botanical biopesticides consisting of 3 levels, namely are, A1 (papaya leaf), A2 (soursop leaf), A3 (lemongrass leaves) while the concentration of botanical biopesticides consists of 4 levels, are B0 (control), B1 (500 grams), B2 (1,000 grams), B3 (1,500 grams) in three times.

RESULTS AND DISCUSSION

Results of the research found factor A (a type of biopesticide), factor B (concentration of biopesticide) and interaction between type of biopesticide and the concentration of biopesticide (AB) is a very significant effect on subterranean termite mortality. Results of research on three days, found fourth, the fifth and sixth day of the mortality of subterranean termites (*Coptotermes curvignathus*, Holmgren) with various treatments, can be seen in Tables 1, 2 and 3. While the different test for factor A (the type of biopesticide), factor B (biopesticide concentrations) and their interactions (AB) in Tables 4, 5 and 6.

Table 1. Mortality of Termites (*Coptotermes Curvignathus*, Holmgren) with Various Treatments, On Four Day

Treatment		Total	Termite Mortality (%)
Types of Biopesticides	Concentration of Biopesticides		
A1 (Papaya leaf)	B0	5	5.56
	B1	24	26.67
	B2	34	37.78
	B3	66	73.33
A2 (Soursop leaf)	B0	7	7.78
	B1	23	25.56
	B2	30	33.33
	B3	39	43.33
A3 (Lemongrass leaves)	B0	7	7.78
	B1	30	33.33
	B2	33	36.67
	B3	33	36.67

Table 2. Mortality of Termites (*Coptotermes Curvignathus*, Holmgren) with Various Treatments, On Five Day

Treatment		Total	Termite Mortality (%)
Types of Biopesticides	Concentration of Biopesticides		
A1 (Papaya leaf)	B0	6	6.67
	B1	22	24.44
	B2	22	24.44
	B3	24	26.67
A2 (Soursop leaf)	B0	6	6.67
	B1	28	31.11
	B2	25	27.78
	B3	35	38.89
A3 (Lemongrass leaves)	B0	8	8.89
	B1	16	17.78
	B2	17	18.89
	B3	17	18.89

Table 3. Mortality of Termites (*Coptotermes Curvignathus, Holmgren*) with Various Treatments, On Six Day

Treatment		Total	Termite Mortality (%)
Types of Biopesticides	Concentration of Biopesticides		
A1 (Papaya Leaf)	B0	7	7.78
	B1	9	10.00
	B2	8	8.89
	B3	0	0.00
A2 (Soursop leaf)	B0	9	10.00
	B1	5	5.56
	B2	6	6.67
	B3	9	10.00
A3 (Lemongrass Leaves)	B0	9	10.00
	B1	2	2.22
	B2	1	1.11
	B3	15	16.67

The results of the observations in Tables 1, 2 and 3 show that application of biopesticides with different concentrations does not cause direct death to subterranean termites (*Coptotermes Curvignathus, Holmgren*) but on the immune system, nervous system and respiratory system disruption. When spraying the extras on subterranean termites (*Coptotermes Curvignathus, Holmgren*), the response is seen trying to defend themselves not to be contaminated by avoiding extracts by trying to climb the walls of the containers/jars provided. Working principle of vegetable pesticides, namely inhibiting, destroying and resisting. According to (Mahendra 2020) the advantages of using vegetable pesticides are: non-poisonous or non-toxic, easy to decompose in nature so that it does not contaminate the environment, it is relatively safe for humans and pets, easy to obtain in nature, relatively painless and profitable way of manufacture for small farmers.(F. S. Latumahina, Mardiatmoko, and Sahusilawane 2020)

Table 4. Results of Different Tests for Vegetable Biopesticides Against Mortality of Ground Termites (*Coptotermes Curvignathus, Holmgren*)

Types of Biopesticides	Average	Symbol
A1	19.17	a
A2	18.08	a
A3	16.67	b

Based on the results of different tests in Table 4, it shows that A1 treatment does not have a significant effect on A2, but A3 has a significant effect on A1 and A2 This is because the chemical compounds or extractive ingredients from papaya leaves contain the active ingredient "Papain", making it useful in controlling caterpillars and sucking pests. Soursop leaves contain chemical compounds in the form of annanoin and resin. This compound controls leafworm pests and sucking pests while the lemongrass leaves contain the main compound is an essential oil. Lemongrass Leaves essential oil consists of citral compounds, citronella, geraniol, mirsena, nerol, farnesol, methyl heptenol and dipentene (Rosmana Untung; Sjam, Sylvia; Vien, Satika Dewi; Melina, . 2017), Mortality for each treatment level of the type of biopesticide was as follows: papaya leaf biopesticide (A1) 95.83%, soursop leaf biopesticide (A2) 90.47% and lemongrass leaf biopesticide (A3) 83.33%. Biopesticides to be effective if they can kill insects more than 90 %.(Astuti and Widyastuti 2016)(F. Latumahina et al. 2015)

Table 5. Test Results of Biopesticide Concentrations Mortality of *Coptotermes Curvignathus*, Holmgren

Concentration of Biopesticides	Average	Symbol
B3	27.22	a
B2	19.56	b
B1	18.00	b
B0	7.11	c

Based on the different test results in Table 5, B2 treatment did not have a significant effect on B1 treatment, but B3 treatment had a significant effect on B1 and B2. The higher the concentration of biopesticides, the greater the extractive content so that the higher the toxic substances released by the plant. According to (M.A Wattimena, Latumahina, and Khomsah Kartikawati 2020) plants that contain toxins have different concentrations, where the higher the concentration, the higher the toxins released, so that more pest deaths. (Acharya, Mir, and Nayak 2017) emphasized that the higher the concentration, the more the amount of poison that hits the insect's skin, so that the death rate will be higher.

Table 6. Interactions of Biopesticide Types and Concentrations on Mortality of *Coptotermes Curvignathus*, Holmgren

Interaction of Biopesticide Types and Concentrations	Average	Symbol
A1B3	30.00	a
A2B3	26.00	a
A3B3	25.67	a
A1B2	21.33	b
A2B2	20.33	b
A1B1	19.33	c
A2B1	18.67	c
A3B2	17.00	c
A3B1	16.00	c
A3B0	8.00	d
A2B0	7.33	d
A1B0	6.00	d

Based on the research results in Table 5, papaya, soursop, and lemongrass leaf biopesticides can be used to control subterranean termites, even with low concentrations, even without concentration (control). Extractive substances or toxins in each plant are different and highly dependent on the plants' weight or weight used with the amount of diluent used. The heavier the plant weight used with, the less diluent will affect the biopesticide extract produced, and vice versa. If a little plant is used, but much diluent will affect the biopesticide extract's content. According to (Ariyanti Rani, Elvi Yenie 2017) that general, vegetable pesticides have advantages and disadvantages, including in a plant extract and some of the main active compounds, there are usually many other, less active compounds. However, their existence can increase the overall extract activity (synergy). The weakness is that it has a short persistence, so it is not profitable from an economic point of view. At a high population level, it requires repeated applications to achieve maximum control effectiveness. (Safe'i et al. 2020)



Figure 2. The termite that attacks at Samama Tree



Figure 3. Termite death after biopesticide application



Figure 4. Lemongrass leaves, Soursop and papaya leaves that have been processed into biopesticides.

CONCLUSIONS AND RECOMMENDATIONS

All plants can be used as biopesticides to control subterranean termites, but the fastest mortality rate is papaya leaves (A1) with a biopesticide concentration of 1,500 grams (B3).

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