

# Effect of biopesticides against stem borer (*Lophobaris piperis*) and *Thrips* sp. on pepper (*Piper nigrum*)

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**Abstract.** One of the pepper crop production obstacles is the presence of pests. Several pests that often attack pepper plants in the Sukamulya Experimental Station is pepper stem borer (*Lophobaris piperis*) and *Thrips* sp. We studied the effect of biopesticides of botanical pesticides and biological pesticides at the Sukamulya Experimental Station, Sukabumi – West Java in 2020 against the pepper stem borer *L. piperis* and *Thrips* sp. in pepper plantation. The research was designed in a randomized block with three treatments, namely (1) botanical pesticides, (2) biological pesticides and (3) control (water), and nine replications. The treatment application is carried out once a month, done immediately after observing the intensity of the pest attack. The results showed that the attack of pepper stem borer was low (below 10%), so the effect of the treatment could not be seen significantly. The *Thrips* attack was high enough, it was seen that there was the ability of botanical pesticides to reduce the intensity of the attack. Meanwhile, the biological pesticide had not yet shown its ability to reduce the intensity of *Thrips* sp.

## 1 Introduction

The problems faced by pepper farming in Indonesia are low productivity of pepper (less than 1 ton/ha), significant yield losses due to pests and diseases, and uncertain income due to fluctuation pepper prices [1,2]. The pests that often attack pepper plants in the traditionally pepper producing areas in Indonesia is stem borer (*L. piperis*) and *Thrips* sp. To control those pests, synthetic insecticides are usually used. But their continuous use causes environmental pollution and pest resistance: hence it is necessary to find out other eco-friendly technologies that are effective in controlling pests in pepper plants. One of which is using biopesticides such as *B. bassiana* and botanical pesticides derived from plants such as neem (*Azadirachta indica*), citronella grass (*Cymbopogon nardus*) or cloves (*Syzygium aromaticum*) [3,4].

*B. bassiana* is an entomopathogenic fungus that can be widely used as a biological control for plant pests. Recorded more than a hundred species of insects that can be infected

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with this fungus [5]. This fungus grows naturally in the soil and is accordingly used for biological control for soil dwelling insect pests [6]. *Beauveria* (Moniliales; Moniliaeaceae) has been reported to produce secondary metabolites such as bassianin, bassiacridin, beauvericin, bassianolide, beauverolides, tenellin and oosporein, which can paralyze and cause insect death [7,8]. Insects infected with *B. bassiana* are characterized on the insect's body covered in white hyphae, and the insect's squashed body hardens or mummies. *B. bassiana* can reduce *Locusta migratoria*, *Helopeltis antonii*, and *Diconocoris Hewetti* [6,9,10].

Botanical pesticides use their secondary metabolites products as their active ingredients. This compound functions as a repellent, attractant, and poison, as well as an antifeedant [11]. Some examples of plant secondary metabolites products are eugenol, citronellal, and azadirachtin [12]. Citronellal contained in citronella oil (*Andropogon nardus*), eugenol compounds contained in clove oil (*S. aromaticum* L.), and Azadirachtin compounds from the neem plant, (*A. indica* A. Juss.) are reported effective in controlling several types of pests in several ways [13,14,15]. The objective of the study was to determine the potential of biopesticides (botanical pesticides and biological pesticides) in controlling *L. piperis* and *Thrips* sp.

## 2 Materials and methods

The research was conducted at the Sukamulya Experimental Station, Sukabumi – West Java, in 2020 against the pepper stem borer *L. piperis* and *Thrips* sp. in three years old pepper plants. The research was designed in a randomized block design with 3 treatments, namely (1) botanical pesticides (a mixture of neem oil: citronella oil: clove oil) with the ratio of 1: 1: 1; (2) biological pesticides from *B. bassiana* and (3) control (water) and nine replications. *B. bassiana*, first being propagated or grown on Potato Dextrose Agar (PDA) medium, then on corn medium for about two weeks [16,17]. Meanwhile, the botanical pesticide formulation is carried out by mixing neem oil, citronella essential oil, clove essential oil in the ratio of 1: 1: 1 and was added with 2% emulsifier (Tween 80), in order to be a water soluble solution. The observations were carried out every month from April to August 2020. The biopesticides were also applied once a month immediately after observing the intensity of the pest attack. The attack intensity of *L. piperis* was done by calculating the estimated number of stems attacked compared to the total stem of the plant. Meanwhile, for *Thrips* sp., the attack intensity was done by calculating the estimated number of curled leaves compared to the total leaves of the plant. The concentration of botanical pesticides is 5 cc/liter, while the biological pesticides concentration is 20 gr/liter. Attack intensity is calculated based on scoring:

$$I = \frac{\sum \{n \times v\}}{N \times V} \times 100 \% \quad (1)$$

I = intensity of attack;

n = number of plants included in a particular symptom score;

v = value of certain symptoms;

N = number of plants observed;

V = highest attack value)

Scoring of attack is categorized as: 0 (no attack); 1 (1 - 15%); 2 (16 - 30 %); 3 (31 - 45%); 4 (46 - 60%); 5 (61 - 75%); 6 (76 - 90%); 7 (> 90%).

### 3 Result and discussion

Before applying the treatment, preliminary observations were made on the intensity of pest attacks on all experimental plots, both stem borer and *Thrips*. The results showed that the intensity of the attacks was relatively uniform and did not differ significantly among the experimental plots.

#### 3.1 Intensity of Stem Borer attack

At the beginning of the observation, from April to July, there was a tendency that the pepper stem borer attack intensity in the control treatment was higher compared to the biological pesticide treatment. Still, it did not show significantly different results. However, in August, it was seen that the intensity of the pepper stem borer attack decreased so that the effect of the treatment still not visible significantly (Table 1).

**Table 1.** The intensity of pepper stem borer attack

Treatments	Attack Intensity (%)				
	April	May	June	July	August
Botanical pesticide (5 cc/ltr water)	1.6 a	2.0 a	1.6 a	1.2 a	0.4 a
Bioverin (20 gram/ltr water)	2.8 a	2.8 a	2.8 a	2.0 a	1.2 a
Control (water)	4.0 a	6.8 a	6.0 a	6.4 a	2.0 a

Note: numbers followed by the same letter at the same column are not significantly different at 5% DMRT

The results showed that the attack of pepper stem borer at the time of the study was low (below 10%), so the effect of the treatment could not be seen significantly. There was an increase in the attack of pepper stem borer on the control treatment plot from April to July, but it still did not make a significant difference when compared to the biopesticide treatment. This probably happened because the frequency of biopesticide treatment was only done once a month.

#### 3.2 The intensity of *Thrips* attack

The intensity of *Thrips* attack was seen to be relatively high and increased from time to time. In the control treatment intensity of *Thrips* attack in April was 11.2% in April, and reached 39.7% in August (Table 2). The damage to the plants is visible, with leaf margins roll upward bend on both sides.

**Table 2.** The intensity of *Thrips* attack

Treatments	Attack Intensity (%)				
	April	May	June	July	August
Botanical pesticide (5 cc/ltr water)	6.4 a	13.9 a	16.7 a	28.1 a	25.3 a
Bioverin (20 gram/ltr water)	6.4 a	13.1 a	18.3 a	30.5 a	33.1 ab
Control (water)	11.2 a	17.4 a	21.4 a	36.5 a	39.7 b

Note: numbers followed by the same letter at the same column are not significantly different at 5% DMRT

The result showed that there was the ability of a botanical pesticide to reduce the intensity of the attack, but biological pesticides had not yet shown its ability to reduce the intensity of *Thrips* sp. However, if we observed the results from April to July, there was an increase in the attack of *Thrips* on the control treatment plot, however it still did not make a significant difference compared to the biopesticide treatment. Even though it took five

months of observation to show that biopesticides, especially the botanical pesticide, have the potential to control the Thrips. This data quite compatible with other research that stated neem, as one of the main ingredients of the botanical pesticide, can be a good alternative to synthetic insecticides to control *Thrips* in several crops like mango [18], cotton [19], cardamom [20], cowpea [21], and pummelo [22]. All three of the botanical pesticide ingredients (neem oil, citronella oil, and clove oil) are also stated by other research as potential biopesticides to control *Spodoptera frugiperda* [23] and fly species [24]. So, this data shows that botanical pesticides has the potential to control the pest quite well.

Overall, although most of the results did not significantly point out the effect, they did show the potential of the biopesticides to control the pepper stem borer and the *Thrips*. This probably happened because the frequency of biopesticide treatments was only done once a month and was being done for only five months of observation. Meanwhile, biopesticides need a longer time than synthetic pesticides to make a significant effect, especially in the field. Increase in the number of biopesticides applications (twice a month) and the longer time of observation (up to one year) are expected to give better visible results in further research.

## 4 Conclusion and recommendation

The attack of pepper stem borer (*L. piperis*) at the time the research was conducted was low (below 10%), so the effect of biopesticide could not be seen significantly. But the botanical pesticide effect for *Thrips* sp. can be seen more clearly. From the data, it can be seen that botanical pesticide has the potential to control *Thrips* sp. To get more clearer and significant data, it can be done by increasing the number of biopesticides applications (twice a month) and the time of observation (up to one year).

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