EFFECTIVENESS TEST OF PAPAYA LEAF EXTRACT (*Carica papaya* L)

ON THE INTENSITY OF ATTACKS OF FIREWORM PESTS (*Setothosea asigna*)

ON OIL PALM PLANTS (*Elaeis guineensis* Jacq.)

**ABSTRACT**

Fireworm pests can reduce the productivity of oil palm plants, causing significant economic losses for farmers and oil palm plantation companies, so fireworm pest control needs to be carried out. Pest control using chemical pesticides can pollute the environment and disrupt human health, the use of plant pesticides is more environmentally friendly, easily decomposed, and safe for humans and animals and does not cause immunity in insects. The purpose of this study was to determine the intensity of fireworm pest attacks on oil palm plants (*Elaeis guineensis* Jacq.) in oil palm plantations. And to determine the effectiveness of papaya leaf extract (*Carica papaya* L.) on fireworm mortality in the laboratory. Field research was arranged in an exploration and purposive sampling method by taking 150 samples from 3 different Afdeling (III, IV, and V). Observations include the characteristics of pest attacks, identification of symptoms and signs of attacks, and observation of surrounding conditions. Laboratory research used an experimental method consisting of 4 replications and 5 treatments of papaya leaf extract with concentrations of 0%, 15%, 20%, and 25% with the observed parameters being the mortality of fireworm pests calculated for 8 days. The results of the field study showed that the intensity of the fireworm pest attack in Afdeling V was 38% (moderate category); in Afdeling IV it was 20% (moderate category), and in Afdeling III was 8% (light category). Giving papaya leaf extract with a concentration of 25% for 3 days was effective in controlling fireworm pests with a mortality rate of 100%.

Keywords: Fireworm Pest, Papaya Leaves, Oil Palm

**1. INTRODUCTION**

Problems that often occur in oil palm plants that can reduce production, in general, are due to attacks by plant pests, one of which is the fireworm pest (*Setothosea asigna*). Fireworm attacks will have an impact on reducing plant productivity because they disrupt the photosynthesis process which disrupts the flower and fruit formation process. Based on observations made by several companies, fireworm attacks can reduce production by 25% in the first year, and reduce production by 50% - 75% in the second and third years. Four types of fireworms usually attack oil palms, namely: *Setothosea asigna*, *Setora nitens*, *Darna trima*, and *Parasa lepida* (Directorate General of Plantations, Ministry of Agriculture, 2021).

According to Priwiratama et al., (2020), the level of attack by Setothosea asigna larvae can cause a decrease in production of up to 40%, this occurs due to damage to the leaves of the plant caused by leaf-eating pests. Sahari (2012) stated that the occurrence of an impact of problems such as population explosions from time to time caused by attacks by fireworm pests on oil palm leaves starting from nurseries, immature plants (TBM) and productive plants (TM).

Fireworms (*Setothosea asigna*) are more commonly found in oil palm plants less than three years old. Fireworm pest attacks can reduce oil palm production. Pests that attack oil palms in each region are not always the same. Some of these pests are permanent and some are temporary. In general, fireworm pests are the 3rd main pest in oil palm plants and attacks by this pest can lose up to 70-90% of leaves (Saragih, et al., 2019).

There needs to be control measures against these main pests. Generally, control of fireworm pest uses synthetic insecticides where the use of synthetic insecticides can have negative impacts on environmental sustainability, namely soil and water pollution, causing pest resistance, resurgence, second pest explosions, killing non-target insects, such as natural enemies and flower pollinating insects, and leaving residues on agricultural products (Anggraini and Purba, 2021).

One alternative effort to suppress and control fireworm pest attacks is by utilizing plant pesticides made from papaya leaf extract (*Carica papaya*). Papaya is a plant that has the potential as a plant insecticide to control insect pests because papaya sap contains a group of cysteine ​​protease enzymes such as papain and chymopapain, and produces compounds of the alkaloid, terpenoid, flavonoid, and amino acid groups that are very toxic to plant-eating insects. These compounds can be contact poisons, respiratory poisons, and stomach poisons for pests. The papain enzyme is a contact poison that enters the pest's body through natural holes in its body (Christian, et al., 2019).

Papain is a proteolytic enzyme, an enzyme that can break down and break down proteins, and has the potential to be a pesticide. After entering, the poison will spread throughout the body and attack the nervous system so that it can interfere with pest activity. (Robert & Bryony 2010). The papain compound works as a stomach poison that enters through the mouthparts of insects so it is suspected that giving papaya leaf extract is very good for controlling aphid pests (Yudiawati and Hapis, 2016). The results of the study reported by Desita et al. (2011) using papaya leaf extract at a concentration of 2.70% showed the right concentration of papaya leaf extract because it was able to kill *Aphis gossypii* aphids by 95%. Furthermore, it was reported by Epi. (2016) that giving papaya leaf extract affected the mortality of leaf caterpillars, namely at a concentration of 75% papaya leaf extract with a very maximum mortality rate of *Plutella xylostella* caterpillars with a percentage of death approaching 100%, namely with a concentration treatment of 92.5%.

The purpose of this study was to determine the intensity of fireworm pest attacks on oil palm plants (*Elaeis guineensis* Jacq.) in oil palm plantations. And to determine the effectiveness of papaya leaf extract (*Carica papaya* L.) on fireworm mortality in the laboratory.

**2. MATERIALS AND METHODS**

Field research was conducted on an 8-year-old oil palm plantation (producing plants) located in East Kutai Regency, Long Mesangat District, namely PT. Gemilang Sejahtera Abadi Long Mesangat Estate, East Kutai Regency, and research in the laboratory of the Faculty of Agriculture, Widya Gama Mahakam University, Samarinda.

The materials used in this study include: papaya leaves, water, oil palm leaves, and fire worms. The tools used in this study include: a blender, sieve, stopwatch, ruler, book, jar, gauze, measuring cup, scissors, knife, dodos/egrek, stationery, tweezers, scales, and gloves.

The implementation of the research began with a survey to determine the location of the research. The determination of the location was based on the similarity of the age of the plants, which was 8 years in Afdeling 3, Afdeling 4, and Afdeling 5. In each Afdeling, 5 sample research plots were determined. Each plot was determined with 10 sample plants. Determination of the sampling point (plant samples) was carried out using the systematic sampling method. Observations on each sample plant included identification of the fireworm pests that attacked, the number/population of pests, and parts of the plant that were attacked such as perforated and eroded leaves. Field census activities were carried out including observations of the characteristics of pest attacks, identification of symptoms and signs of attacks (for example, pest droppings were around the sample tree and perforated oil palm leaves), and observations of the surrounding environmental conditions.

The first sampling was carried out on fresh papaya leaves by cutting the papaya leaf stalks. The papaya leaves were then separated from the leaf stalks, then cleaned from dirt with running water. Then the papaya leaves were aired by leaving them for some time until they looked dry, then cut into several parts. The papaya leaves that had been cut were then blended without water, and then ground to make them smooth. Then weighed according to the extract concentration and diluted using distilled water according to the treatment to obtain papaya leaf extract concentrations of 0% (p0), 15% (p1), 20% (p2), and 25% (p3).

The taking of oil palm seedling leaves on the third leaf stalk aged 1.5 years after planting weighing 4 grams (5 leaves) dipped into papaya leaf extract that had been placed in a plastic tray as much as 30 ml, 40 ml, and 50 ml for 30 seconds. After that, the leaves were dried and weighed. Oil palm leaves were placed in a plastic box measuring 14 cm x 14 cm x 5 cm. Furthermore, *Setothosea asigna* was invested as much as 1 for each treatment, then the plastic box was closed and ventilated with gauze. The next day the leaves were replaced with new leaves that had been given concentration, and so on for 8 days. Papaya leaf extract testing was carried out in the laboratory. The total experimental units obtained were 20 experimental units. Each treatment consisted of 1 fireworm pest.

Data collection, consisting of:

1. Attack intensity

The intensity of pest attacks is observed by comparing oil palm plants that are suspected of being damaged, especially on the leaves, due to fireworm pest attacks with the number of plants observed. The level of pest attack intensity is calculated using the formula below:



Description: I = intensity of pest attacks (%); n = number of plants attacked by pests; and

 N = number of plants observed

Table 1. Criteria for the Level of Damage to Oil Palm Plants

|  |  |
| --- | --- |
| Attack Intensity  | Damage Level (%) |
| Healthy | 0 |
| Light | 1 – 20 |
| Moderate | 21 – 40 |
| Heavy | 41 – 60 |
| Very Heavy | 61 – 100 |
| Dead | 100 |

2. Mortality

Mortality indicates the level of ability or number of pest deaths caused by the botanical pesticides used and is expressed in percent. Observations of the number of dead fireworm pest are carried out every day starting from 24 hours after pesticide application by counting the number of pests that die every 24 hours for seven days and expressed in percent. The data obtained are then used to calculate the total daily mortality (Rahmadiyanti, 2018). Mortality is calculated using a modified formula by Epi (2016) as follows:

Mortality = [number of pests killed : number of pests observed] x 100%

**3. RESULTS AND DISCUSSION**

**3..1. Intensity of Attacks on Research Plots**

The research was conducted in Afdeling III with a land area of ​​332.96 hectares with a total of 26 blocks; Afdeling IV with a land area of ​​475.81 hectares with a total of 43 blocks, and Afdeling V with a land area of ​​250.99 hectares with 36 blocks. Afdeling III block E044, Afdeling IV block M023, and Afdeling V block O023 were selected as research locations. Observations on the research plot of the oil palm census results at PT Gemilang Sejahtera Abadi were due to the determination of research on the block determined as a research plot, pest observations (census) had been carried out 1 month before the research. According to Purba and Sipayung (2017), the occurrence of pest explosions needs to be watched out for even though the chances are relatively lower due to the dominance of the main pests. Some steps that can be taken as a strategy for managing these pests include monitoring activities, and conservation of natural enemies as a preventive measure for pest explosions below the economic threshold quickly. Monitoring activities must be carried out as an effort to prevent early outbreaks of pest populations in general.

The results of the study on the intensity of fireworm pest attacks on research plots are presented in Table 2.

Table 2. Intensity of Fireworm Pest Attacks on Research Plots

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Afdeling(Plots) | Number of trees observed | Number of trees attacked | Attack intensity (%) | Attack Category |
| III | 50 | 4 | 8 | Light |
| IV | 50 | 10 | 20 | Medium |
| V | 50 | 19 | 38 | Medium |

Source: Processed primary data.

Based on the research results in Table 2. above which were carried out using the exploration method (exploring or searching), by identifying symptoms of attacks in 3 Afdeling (observation plots), namely the highest number of fronds attacked was in the plot in Afdeling V block O023 with the number of trees attacked 19 out of 50 trees observed with an attacking intensity of 38% (moderate category); in Afdeling IV block MO23 with the number of trees attacked 10 out of 50 trees observed with an attacking intensity of 20% (moderate category), and in Afdeling III block E044 with the number of trees attacked 4 out of 50 trees observed with an attack intensity of 8% (light category). The high and low intensity of fireworm pest attacks is related to the number of fireworm pests on oil palm trees. In section V block O023 and section IV block MO23, 2-3 fireworms were found per tree, while in section III block E044 only 1 fireworm was found per tree. The fireworm attack resulted in damage to the leaves, namely holes and erosion, and was found on several stems and was not severely damaged. As stated by the Directorate General of Plantations of the Ministry of Agriculture (2021), fire caterpillars attack the leaves of oil palms and can destroy the leaves until the leaf blades have holes or are gone, leaving the part close to the leaf veins. Leaf loss can reach 90% per leaf sheath. Furthermore, Agustina (2021) stated that the cause of the high and low intensity of fireworm attacks can be influenced by climate factors such as air temperature, rainfall intensity, and high humidity. In addition, other causes could be because fireworm pests (*Setothosea asigna*) are easily spread by the wind and carried by humans, predator attacks, or fall to other places. Pribadi (2010) stated that lack of nutrients and water during the dry season can reduce plant resistance to pest attacks. Leaf-eating fireworm pest attacks occur when plants are experiencing stress as a result of low nutrition.

In general, the results of the study showed that the intensity of fireworm pest attacks on oil palm plants was classified as low to moderate. This is because, at the time of the study, the rainfall was relatively low (134.4 mm) with 12 rainy days. In addition, the planting distance used on plantations in Long Mesangat is 9 x 9 x 9 meters. A good planting distance is a triangle in land use and the absorption of sunlight will be maximized with a planting distance of 9 x 9 x 9 meters. With this planting pattern, the oil palm plants do not shade each other. As stated by Bakoh (2010) planting distance that is too close will cause pests to move quickly and develop, causing damage to plants. The maximum planting distance for oil palm plants is 9 × 9 × 9 meters.

**3.2. Testing Papaya Leaf Extract**

The results of the study on the giving of papaya leaf extract (*Carica papaya* L.) on the death (mortality) of fireworm pest (*setohosea asigna*) with different concentrations for 8 days gave different effects on each treatment (Figure 1)

5

4.6

4.4

4.2

4

3

3

2

1

0

 0% 15% 20% 25%

Average Mortality of Fireworm Pests (*Setothosea asigna*)

Figure 1. Mortality Diagram of Oil Palm Fireworms Pest in Various Concentrations

 of Papaya Leaf Extract

Based on the data in Figure 1, shows that the giving of various concentrations of papaya leaf extract at a concentration of 25% required an average of 3 days for the fireworms to experience mortality; at a concentration of 20% required an average of 4.2 days for the fireworms to experience mortality; at a concentration of 15% and an average of 4.4 days for the fireworms to experience mortality, while in the treatment without papaya leaf extract it took an average of 4.6 days for the fireworms to experience mortality. This condition indicates that the giving of the extract does not cause direct death to the fireworms but rather affects the body's immune system, nervous system, and disruption of the respiratory system. When the papaya leaf extract was first treatmented, the fireworms immediately responded by defending themselves by moving away from the food source (oil palm leaves that were given the extract) and then approaching the mouth of the preparation.

The number of fireworm pest mortality is influenced by several factors, namely (1) different instar levels, if the instar level is high, the level of immunity will take longer to respond to the poison of papaya leaf extract; (2) the level of food consumption, if the fireworm pest has consumed its food before being treated, it does not need to eat the leaves given during the experiment; and (3) the health level of the fireworm pest, if the fireworm pest is fresh or not stressed, then the fireworm pest will take longer to respond to the poison from the papaya leaf extract, compared to fireworm pest that are unhealthy or stressed. As stated by Rangga et al. (2018) in compounds that have toxic properties and enter the body of the larvae, biotransformation will occur in the body, energy is needed in the metabolic process, energy for the neutralization process is also large when large amounts of toxic compounds enter the insect's body. Toxic compounds that use large amounts of energy in their neutralization process, disrupt other metabolic processes and insects can die due to running out of energy. Ariyanti et al. (2017) stated that papain compounds disrupt insect feeding activities, and work as stomach poisons by passing through the insect's mouth or throat and then entering the digestive tract. The results of Epi's (2016) study showed that giving papaya leaf extract affected the mortality of leaf caterpillars, namely at a concentration of 75% papaya leaf extract with a very maximum mortality rate of *Plutella xylostella* caterpillars with deaths approaching 100%. Sylvia (2017) reported that control using papaya biopesticides to control fireworm caterpillars was more effective on medium-sized fire caterpillars (1 - 2 cm) with an average value of 6.16 compared to old caterpillars (> 2 cm) with an average value of 4.33. Fahruza (2022) reported that the concentration of papaya leaf extract that was effective in controlling *Setora nitens* Walk was a concentration of 14% EDP with an initial percentage of death of 16.5%, daily mortality of 86.9%, total mortality of 100% and a percentage decrease in *Setora nitens* Walk feeding activity. 86.1%.

**4. CONCLUSION AND SUGGESTIONS**

**4.1. Conclusion**

Based on the results of the study and discussion, it can be concluded that the average intensity of attacks on the research plot in the oil palm plantation in Long Mesangat due to fireworm pest attacks is 38% which is classified as moderate, and the use of papaya leaf extract with a concentration of 25% for 3 days of use effectively controls fireworm pests with 100% mortality.

**4.2. Suggestions**

The results of laboratory tests of papaya leaf extract with a concentration of 25% can kill fireworm pests (*Setothosea asigna*) within 3 days, for field applications further research is still needed. It is recommended to plant 8 o'clock flowers which are host plants for fireworm pests (*Setothosea asigna*).

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