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The Effectiveness of Various Insecticides Against Bagworm Pests (*Mahesa corbetti*) Mortality in Oil Palm Produtive Plants in Marbau District, Pernatian Village, PT Umada Plantation

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ABSTRACT

Palm oil plays a crucial role in the vegetable oil industry, particularly in palm oil production. Bagworms, a major pest affecting oil palm plants, cause significant harm to leaves and decrease plant productivity. These caterpillars can rapidly reproduce and spread extensively if not effectively managed. Sipermetrin and Dimehipo are two types of insecticides utilized to combat bagworm pests on oil palm plants. This study employs a descriptive analysis approach, involving the collection of primary data through field observations and pest censuses, as well as secondary data from previous pest censuses within the company. Data collection was conducted meticulously to ensure precision and relevance to actual field conditions. The objective of this study is to assess the extent of bagworm pest infestation and evaluate the efficacy of Sipermetrin and Dimehipo insecticides in controlling these pests on oil palm plants at PT Plantations in Umada Pernantian "A", Marbau sub-district, North Labuhan Batu Regency. The findings of the study revealed that the application of Sipermetrin was more successful in managing bagworm pests compared to Dimehipo. The mortality rate of bagworm pests with Sipermetrin usage ranged from 80-90%, while with Dimehipo, it only reached 40-50%. Therefore, Sipermetrin has demonstrated greater efficiency in controlling bagworm populations and preserving the health of oil palm plants, offering a superior solution to the pest issue in these plantations.

Keywords: *Bagworm Pest, Cypermethrin, Dimehipo, Mortality, Oil Palm*

1. INTRODUCTION

The oil palm (*Elaeis guineensis*) holds significant economic importance in numerous tropical nations, particularly Southeast Asia and West Africa. According to Khairuddin et al. (2024), palm oil is derived from the fruit of the oil palm and is utilized in various industries, including food, cosmetics, and biodiesel production. The production of palm oil also plays a substantial role in the global economy, offering employment opportunities for millions of individuals working in the plantation industry. Nevertheless, the palm oil industry faces obstacles in the realm of environmental and sustainability concerns (Pangondian Sihaan et al., 2023). Pests are living organisms that cause harm to plants, resulting in reduced crop yields and interference with the plant's growth and development. The existence of agricultural pests poses a considerable obstacle for farmers as it can lead to substantial financial detriment. Several typical forms of pests consist of insects, rodents, and plant illnesses brought on by bacteria, viruses, or fungi. Efforts to control pests encompass various techniques, including applying pesticides, biological control measures, crop rotation, and adherence to sound agronomic practices. Utilizing an interconnected strategy is frequently the most successful method for controlling pest populations and reducing agricultural yield losses.

The bagworm species Mahesa corbetti is a significant pest known for causing damage to various plantation crops, with a notable impact on oil palm plants. This particular pest is recognized for its distinctive behavior of creating pouches using leaf fibers or alternative materials to both shelter and consume the foliage of its host plant. The feeding behavior of bagworms is known to cause substantial reduction in crop yields due to the damage they incur on plant leaf tissue (Ronny et al., 2014). In addition, bagworms can serve as disease carriers due to their tendency to migrate between different plants. Managing bagworms presents a difficulty in pest control within oil palm plantations and other crops (Syahputra, 2011).

Various control methods are frequently utilized, including applying chemical insecticides, introducing natural predators, such as birds that feed on caterpillars, and implementing integrated agricultural practices that comprehensively incorporate multiple pest control techniques. Studies have been carried out to examine the impact of bagworm pests (Mahesa corbetti) on oil palm plants, with a focus on the use of parasitoids for biological control, the efficacy of insecticides, mechanical control techniques such as manual pruning, and investigations into the life cycle and behavior of bagworms. Effectively managing bagworms is crucial for preserving plant productivity and promoting environmental sustainability and human health by minimizing potentially harmful chemicals (Anggraeni & Ismanto, 2017).

Cypermethrin blocks crucial enzymes involved in nerve signal transmission, leading to paralysis and eventual mortality in the affected insects. Cypermethrin offers the benefit of quick and efficient pest population control and its versatility in application methods such as foliar spraying or direct soil application, depending on the specific pest species and agricultural circumstances. Applying cypermethrin in agricultural practices has a beneficial effect on preserving plant productivity by reducing losses caused by pest infestations. Agricultural productivity and crop quality can be enhanced by successfully managing pests such as aphids, caterpillars, and other leaf-sucking insects. This aspect of pest management can lead to consistent and high yields from one planting season to the next. Nevertheless, similar to other chemical insecticides, the application of cypermethrin also gives rise to apprehensions about resistance to pests,

unintended harm to beneficial insects like predators and parasitoids, and the potential presence of residues that may have adverse effects on human health and the environment if not handled appropriately and in line with prescribed usage instructions (Siallagan et al., 2022).

Dimehipo disrupts the nervous system of insects, leading to paralysis and eventual death upon exposure. Its key advantage lies in its quick knockdown effect on insects, making it a favored option in pest management scenarios where immediate action is required to prevent plant damage (Amran Jaenudin and Mastari, 2017). The application of Dimehipo in agriculture offers substantial advantages in reducing losses caused by pest infestations, particularly in major crops like rice, corn, and fruit crops. By effectively controlling pest populations, Dimehipo contributes to enhanced plant productivity and crop quality. Nevertheless, similar to other chemical insecticides, the use of Dimehipo necessitates careful handling to prevent potential adverse effects on the environment and human health. Overuse or improper application can lead to pest resistance, environmental contamination, and the risk of exposure to insecticide residues in agricultural produce, posing risks to consumer health. Hence, the utilization of Dimehipo should be combined with a sustainable integrated pest management approach to achieve optimal outcomes while minimizing environmental and health hazards (Saputra & Aluyah, 2019).

The primary issue in cultivating oil palm plants at PT remains the main concern. Umada Pernantian "A" in the Marbau District of the North Labuhan Batu Regency is experiencing a significant nuisance from plant pest organisms, particularly pests. The Bagworm (Mahesa corbetti) is considered a primary pest species presenting a significant threat. This study aims to assess the extent of bagworm infestation and identify effective strategies for their management within PT Plantations. "Umada Pernantian "A" is located in the Marbau District of the North Labuhan Batu Regency." This research employs criteria including bagworm population, bagworm infestation intensity, and bagworm damage assessment.

2. MATERIAL AND METHODS

2.1 Research Site and Time

This research was conducted in the palm oil plantation area of PT. Umada, located in the village of Pernantian, Marbau District, North Labuhanbatu Regency, North Sumatra. The plantation is situated at coordinates 2˚14'45.4" N and 99˚48'16.7" E, on Jl. Dusun 1, Pernantian. The research site is in block 3 of Division I, covering an area of 101.33 hectares and consisting of 14,569 trees, of which approximately 60 trees were utilized for this study. The plantation was established in 2019.

2.2 Tools and Materials

The tools used in this research include writing instruments and a camera. The materials utilized are oil palm trees located in the plantation area of PT— Umada Pernantian "A" in the Marbau district of North Labuhanbatu regency. The tools and materials employed are owned by the plantation, which include organophosphate 100EC, neurotoxin 400SL, and a blower with a capacity of 14 ml/L.

2.3 Research Method

The method employed in this research is data analysis using a descriptive approach involving collecting primary and secondary data (Suyanto, 2015). Primary data is obtained from field observations through pest census. Secondary data consists of data from previous pest censuses conducted within the company. To acquire accurate plant data that reflects the actual conditions in the field, meticulous tree census activities are required.

2.4 Research Implementation

This research commenced with the initial step of assembling the necessary

tools and materials. This involved the identification of oil palm plantations affected by bagworm infestations, as well as the procurement and preparation of spray equipment, cypermethrin insecticide, and dimehipo insecticide. Insecticide treatment was implemented by applying cypermethrin and dimehipo, utilizing the recommended dosage in the designated experimental areas. Periodic observations document the mortality rate of bagworms and the extent of damage to oil palm foliage. The information gathered was examined using suitable statistical techniques to compare the efficacy of the two insecticides. The analysis of the findings involves evaluating the extent of mortality among bagworms, mitigating harm to plants, and determining the most efficient insecticide for controlling the pest. The diagram in Figure 1 illustrates the process of implementing research.

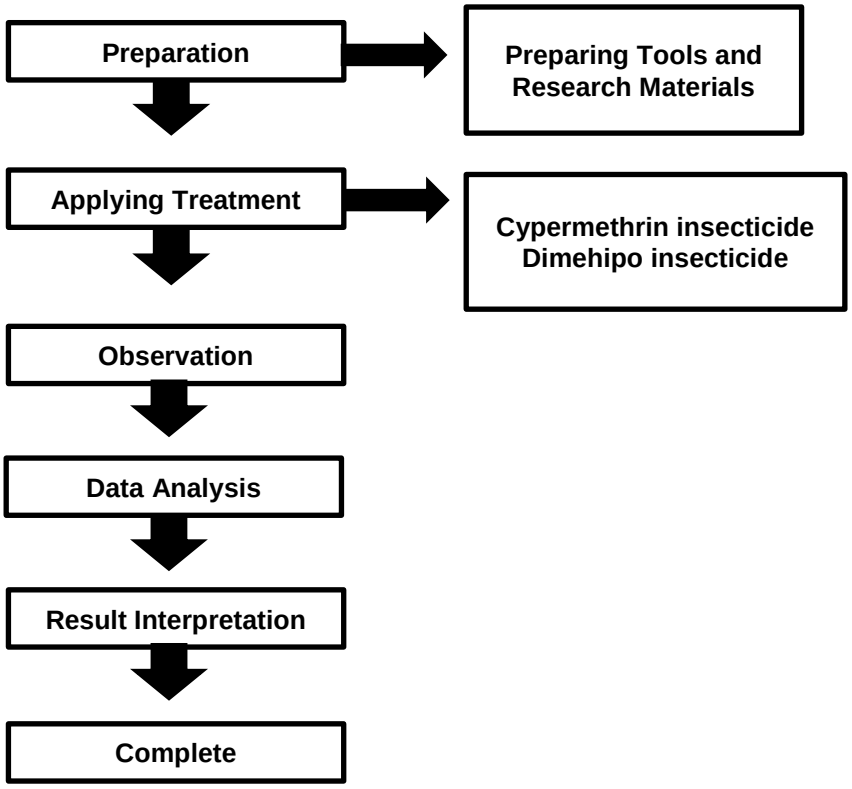

Figure 1. Research flow diagram

2.5 Observation Parameter

The parameters to be examined in this study are as follows:

a) Number of Mahesa corbetti Pests

Observations of the pest population will be conducted comprehensively on the sampled oil palm plants, which will then be consolidated into a single dataset representing the pest count. The calculated number of pests will serve as the initial data for assessing the level of pest infestation.

b) Mahesa Corbetti Attack Level

The attack level referred to here is based on the number of pests found on the stems of oil palm plants. The critical threshold for this bagworm pest is five individuals per plant.

c) Mahesa Corbetti Pest Attack Incident

The incidence of pest attacks is the percentage of the number of plants attacked by bagworm pests compared to the total number of plants sampled.

Calculating the incidence of pest attacks is done using a formula:

$$K=\frac{n}{N}\ x\ 100\%$$

Notes:

K : Incidents of attacks by certain pests

n : The number of plants attacked by a particular pest

N : Number of plants in one plot/block

2.5 Data Analysis

Data analysis was conducted using descriptive methods, such as primary and secondary data collection (Suyanto, 2015). Primary data was obtained from field observations through pest censuses, while secondary data comprised information from previous pest censuses conducted at the company. A meticulous tree census is necessary to acquire accurate plant data that reflects actual field conditions.

3. RESULT AND DISCUSSION

In October 2022, a survey of bagworm infestations was conducted in the third agricultural plot for the 2019 planting season.

Out of 14,596 trees within the block, a subset of 30 trees were chosen as representative samples for analysis. The population of bagworms infesting the sample trees was recorded at 4,999 individuals, resulting in an average of over 5 individuals per midrib. The data indicates a significant infestation level and underscores the necessity of implementing efficient pest control strategies to mitigate the adverse effects on oil palm yields.

Table 1. Data on bagworm pest attacks in October 2022 on the PT. Umada Pernantian Plantation before spraying

Insecticide	Planting year blocks	Number of trees (ha)	Sample tree (pkk)	Total number of pests (heads)	Level of pest attack	Average caterpillar/frond	Percentage of pest attacks(%)
Sipermetrin	3/2019	14,596	30	2,500	>5	7	81%
Dimehipo	3/2019	14,596	30	2,499	>5	8	81%

Figure 2. Bagworm pest control

Based on the observations, data was obtained regarding bagworm pest attacks in block 3 of oil palm plantations on PT plantations. Umada Pernantian "A", Marbau District, North Labuhan Batu Regency.

Control is implemented on units in which the level of attack exceeds a specific threshold, specifically when there are more than 5 individuals per frond. The elevated levels of pests in block 3 can be attributed to the absence of indigenous predators, who typically serve as natural adversaries to bagworms. The existence of indigenous predators plays a vital role in controlling the population of bagworm pests and preventing outbreaks. Block 3 is comprised of recently matured TM 1 plants with short tree heights and closely spaced plant fronds, facilitating the movement of bagworm larvae from one plant to another. In addition, wind can also aid in the dispersion of instar larvae from diseased plants to neighboring plants. In order to manage the population of Mahesa corbetti in block 3, the insecticides Cypermethrin and Dimehipo are utilized. The two insecticides described are contact and stomach insecticides, available in emulsifiable concentrate form.

3.1 Sipermetrin

The application of contact and stomach insecticides, in the form of a concentrate with the active ingredient cypermethrin 100 EC, can be used to control bagworm pests on oil palm plants. Pest control in block 3 was conducted using cypermethrin insecticide over one month, with three observations made during the study. This research was carried out in block 3, with the planting year of 2019, covering an area of 14,596 hectares of oil palm trees. From this total, 30 trees were selected for observation sampling. The dosage used for cypermethrin was 30 cc per 14 liters of water, and the results of this study are presented in Table 2.

Table 2. From the results of spraying cypermethrin for pests in block 3

Weeks	Insecticide	Total number of pests (heads)	Level of pest attack	Average caterpillar/frond	Percentage of pest attacks(%)
1	*Sipermetrin*	70	<5	2	0.028%
2	*Sipermetrin*	53	<5	2	0.021%
3	*Sipermetrin*	35	<5	1	0.014%

Based on the data collected, using the insecticide cypermethrin for pest control through spraying using a Mist Blower has effectively reduced pest populations. In the initial week of observation, the bagworm mortality rate indicated an average of 2 individuals per frond, falling within the light attack category (<5 individuals per frond). Similar results were observed in the second week, with an average of 2 caterpillars per frond and the attack criteria remaining light. By the third week, mortality increased by an average of 1 individual per frond, still categorized as a light attack. The census results demonstrate that the application of cypermethrin successfully manages bagworm pest attacks, with an average attack of 2 individuals per frond, which falls within the light category (<5 caterpillars per frond). Using the Mist Blower spraying method with cypermethrin effectively reduced bagworm mortality, with an 80-90% death rate. However, it is important to note that using cypermethrin has a drawback, as it leads to the death of pollinators and other insects affected by this insecticide. The percentage of pest attacks in block 3 experienced a significant decrease, reaching 0.014%. Additionally, the highest number of pests decreased to 35 individuals in block 3, with the attack category remaining in the light criteria (<5 individuals per midrib). This effectiveness can be attributed to the active cypermethrin in cypermethrin, which functions as a contact and gastric insecticide, causing the death of bagworms through direct contact or consuming contaminated plant parts.

Saragih et al. (2019) reported using cypermethrin-based insecticides effectively managed bagworm pest populations. However, their study observed a reduction rate that was not as rapid as the findings reported in the present study. According to their report, the average number of caterpillars per frond decreased to 3 in the third week, suggesting that the frequency and application method are significant factors in determining the efficacy of pest control methods. Furthermore, (Frandian, 2022) conducted a study indicating that insecticides utilizing alternative active ingredients, such as deltamethrin, are also proficient in managing bagworms. However, they necessitate larger quantities and an extended duration to attain similar outcomes. This comparison verifies that cypermethrin in cypermethrin offers an expedited and highly effective resolution in combatting bagworm infestations on oil palm crops.

3.2 Dimehipo

The insecticide dimehipo 400 SL, a contact, gastric, and systemic insecticide, is applied to manage

bagworms. The recommended dosage for oil palm plants is 2.5 ml/L. Dimehipo 400 g/l is the active ingredient in the insecticide, present in a water-based solution, and functions by inhibiting cholinergic transmission in the central nervous system of insects. The efficacy of Dimehipo insecticide in pest control was demonstrated in a one-month study with three observations in block 3. The research was conducted in block 3, planting year 2019, covering 14,596 hectares of trees, with 30 trees selected as observation samples. The outcomes of the application are detailed in Table 3.

Table 3. Results of spraying Dimehipo pests in block 3

Weeks	Insecticide	Total number of pests (heads)	Level of pest attack	Average caterpillar/frond	Percentage of pest attacks(%)
1	*Dimehipo*	284	>5	7	0.113%
2	*Dimehipo*	270	>5	6	0.108%
3	*Dimehipo*	277	>5	7	0.110%

The research findings indicated that the application of the insecticide Dimehipo at a dosage of 35 cc per 14 liters of water, sprayed using a Mist Blower on oil palm fronds, did not effectively reduce the population of the bagworm pest Mahesa corbetti. In block 3, the attack percentage was 81% and the number of pests reached 4,999, resulting in an average of more than 5 caterpillars per frond, which is classified as a heavy attack. After the first week of application, bagworm mortality rates only decreased to an average of 7 caterpillars per frond, still considered a heavy attack. In the second week, the average number of caterpillars per frond remained at 6, meeting the criteria for a heavy attack. By the third week, the average number of caterpillars per frond increased to 7, indicating that the application of the insecticide Dimehipo did not yield significant results in controlling bagworm pests. The low effectiveness of the Dimehipo insecticide may be attributed to several factors, including pest resistance to the active ingredient demehipo, which inhibits cholinergic transmission in the insect's central nervous system. This resistance may be due to repeated use of insecticides or inadequate doses (Khairiyati et al 2021). Furthermore, the Mist Blower application method may not uniformly distribute the insecticide, resulting in some parts of the plant not receiving adequate protection.

Research conducted by Achmad (2023) indicates that utilizing insecticides with varying active ingredients, such as chlorpyrifos, yields superior outcomes in managing bagworm pests. The study revealed a decrease of 3 caterpillars per frond in the third-week post-application, demonstrating enhanced efficacy compared to Dimehipo. Similarly, a study by Setiawati et al. (2019) demonstrated that insecticides containing dimehipo as the active ingredient delivered significant results in bagworm pest control, with the average number of caterpillars per frond decreasing to 2 individuals in the second week following application. Consequently, there is a pressing need for further assessment of Dimehipo insecticide usage and the potential development of more efficient pest control strategies. An integrated approach incorporating insecticide rotation, utilization of natural predators, and improved application techniques may be essential to address resistance issues and enhance the efficacy of bagworm pest management in oil palm plantations. The Integrated Pest Management (IPM) strategy integrates biological, chemical, and cultural methods to regulate pest populations and minimize adverse environmental impacts sustainably.

The results of comparing controlling bagworms using cypermethrin and Dimehypo are presented in the form of a graphical diagram in Chart 1.

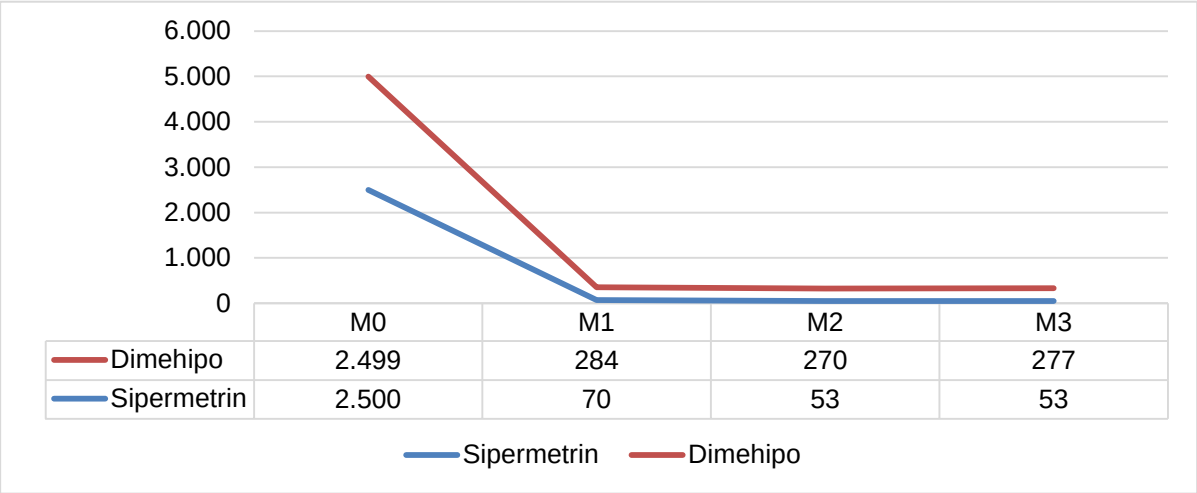

Chart 1. Data from observations of the bagworm pest Mahesa corbetti

According to the comparative analysis of the effectiveness of cypermethrin and Dimehipo insecticides in controlling bagworm pests, noteworthy disparities are evident. The variations in outcomes suggest that the selection of active components and application methods are significant factors in the efficacy of pest management. This study demonstrated that the insecticide cypermethrin, containing the active ingredient cypermethrin, exhibited greater efficacy than Dimehipo, resulting in higher mortality rates and a noteworthy decrease in pest populations. Hence, it is crucial to carefully evaluate the appropriate insecticide selection and an efficient application technique to attain the best possible outcomes in pest management. Incorporating a comprehensive strategy incorporating insecticide rotation, utilization of natural predators, and enhanced application techniques may be necessary in addressing resistance issues and enhancing the efficacy of bagworm pest management in oil palm plantations. The use of cypermethrin and Dimehipo insecticides in combination with blowers to chemically manage bagworm pests is depicted in Figure 3.

Figure 3. Controlling by Chemical

4. CONCLUSION

Using cypermethrin insecticide through the Mist Blower technique has proven successful in decreasing bagworm populations on oil palms, showing an average attack rate of 2 individuals per frond (light attack). Conversely, the effectiveness of the insecticide dimehipo was lower, as the average number of caterpillars per frond remained high (heavy attack). These findings underscore the significance of proper insecticide application and Integrated Pest Management (IPM) approaches, which involve insecticide rotation, utilization of natural predators, and effective application techniques to combat resistance and enhance bagworm pest management.

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