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THE EFFECTIVENESS OF INSECTICIDE APPLICATION WITH ACTIVE INGREDIENT CYPERMETHRIN ON THE INTENSITY OF ATTACKS *BY Oryctes rhinoceros* L. ON OIL PALM PLANTS (*Elaeis guineensis* Jacq.) HAS NOT YET PRODUCED RESULTS

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Abstract

The rhinoceros beetle (*Oryctes rhinoceros* L.) is one of the main pests in oil palm plants that can cause serious damage, especially in the Immature Plant (IMPACT) phase. This pest attack causes damage to the growing point, thus inhibiting vegetative growth, reducing plant vigor, and potentially delaying the plant entering the productive phase. One of the control efforts commonly applied in oil palm plantations is the use of insecticides containing the active ingredient cypermethrin. This study aims to evaluate the effectiveness of cypermethrin application in reducing the intensity of *O. rhinoceros attacks* on IMPACT phase oil palm plants at PTPN IV Regional 1 Rantauprapat Plantation. The study was conducted in January–February 2026 using a field observation method with a quantitative approach and a paired observation design . A total of 114 sample plants from Blocks N07, N09, and O07 were observed before and after cypermethrin application at a dose of 1.6 cc per plant. Data were analyzed descriptively and tested using *a Paired Sample t-test* at a significance level of 5%. The results showed that the average attack intensity decreased from 78.07% before application to 20.18% after application, with a control efficiency of 74.15%. The results of statistical tests showed that cypermethrin application had a significant effect on reducing the intensity of *O. rhinoceros attacks* ($p < 0.05$). Thus, cypermethrin is effective as a control measure against active attacks *of O. rhinoceros* on oil palm plants in the TBM phase. However, its use still needs to be combined with the implementation of Integrated Pest Management (IPM) to increase control effectiveness and reduce the risk of insecticide resistance.

Keywords: *Elaeis guineensis* , effectiveness, attack intensity, *Oryctes rhinoceros* , cypermethrin.

INTRODUCTION

Oil palm (*Elaeis guineensis* Jacq.) is a strategic plantation commodity that plays a vital role in meeting global vegetable oil demand. As the largest palm oil producer, Indonesia contributes significantly to the global market, making increasing crop productivity and quality a crucial aspect of plantation management (Central Bureau of Statistics, 2025; Directorate General of Plantations, 2024). Oil palm productivity is influenced by various factors, such as the use of superior planting materials, plant maintenance, environmental conditions, and the presence of plant pests (OPT). Among these factors, pest attacks are a major cause of decreased growth and productivity, particularly during the immature plant (TBM) phase (Putra & Santoso, 2023). The TBM phase is a critical period in the oil palm growth cycle because during this stage, the plant is forming its root system, stem, and crown, which will determine productivity in the yield phase. Disturbances to the growing point during this phase can inhibit vegetative development and reduce future production potential. Therefore, proper and continuous pest and disease control in TBM plants is essential for optimal plant growth (Saidah, 2021). One of the main pests that causes a lot of damage to TBM oil palm plants is the rhinoceros beetle (*Oryctes rhinoceros) L.*). This pest attacks plant shoots by boring into young tissue around the growing point, causing characteristic V *-shaped cuts* on newly opened fronds. Continuous attacks can reduce the number of productive fronds, inhibit plant growth, cause crown deformation, and even result in plant death if the growing point is severely damaged (Bedford, 2014; Saidah, 2021).

In addition to reducing plant growth, *O. rhinoceros* attacks also increase maintenance costs due to the need for intensive replanting, monitoring, and pest control (Bangun & Apriliya, 2025). Control of *O. rhinoceros* can be achieved through various approaches, including garden sanitation, the use of biological agents, the use of pheromone traps, and insecticide application. Sanitation aims to reduce larval breeding sites by clearing stems or decaying organic matter. Biological control utilizes natural enemies such as entomopathogenic fungi and *Oryctes rhinoceros nudivirus* (OrNV), while pheromone traps are used to reduce adult populations (Moslim et al., 2006; Sinaga & Santi, 2021; Arief et al., 2024). However, under conditions of high infestation, the use of insecticides remains a widely used alternative due to its relatively rapid control effect. One of the insecticides commonly used to control *O. rhinoceros* is cypermethrin. Cypermethrin is a synthetic pyrethroid insecticide that acts as a contact and stomach poison by disrupting the function of sodium channels in the insect's nervous system. This mechanism causes the insect to experience impaired coordination, paralysis (*knockdown*), and even death (Soderlund, 2012). According to Ahamad and Kumar (2023), cypermethrin has a broad control spectrum, works relatively quickly, and is widely used to control various pests in agricultural and plantation commodities.

Although the use of cypermethrin has become a common pest control practice in various oil palm plantations, information on its effectiveness under operational conditions remains relatively limited. Most studies focus on the bioecology *of O. rhinoceros* , the use of pheromones, and biological agents (Farida et al., 2021; Tarigan et al., 2024), while quantitative evaluations of the reduction in pest intensity following cypermethrin application in the field are still scarce. This information is crucial for determining control effectiveness and developing more efficient pest management strategies. This study aims to analyze the effectiveness of the application of insecticides containing the active ingredient cypermethrin in reducing the intensity of *Oryctes rhinoceros attacks* on oil palm plants in the Immature Plant phase at PTPN IV Regional 1 Rantauprapat Plantation. The results of this study are expected to provide scientific information regarding the effectiveness of cypermethrin as an alternative pest control and become a consideration in the implementation of Integrated Pest Management (IPM) in oil palm plantations.

RESEARCH METHODS

Time and Location of Research

The research was conducted from January to February 2026 in the Immature Plantation (TBM) area of PTPN IV Regional 1 Rantauprapat Plantation, Labuhanbatu Regency, North Sumatra. Observations were made in Afdeling V, which includes Blocks N07, N09, and O07. This location was chosen because it is an area experiencing active *Oryctes rhinoceros infestation* and is the location for implementing control using an insecticide containing the active ingredient cypermethrin, in accordance with company operational standards.

Materials and tools

The materials used in this study include insecticide with the active ingredient cypermethrin in Emulsifiable Concentrate (EC) formulation, water as a solvent, and oil palm plants in the Immature Plant Phase (TBM 2) as research objects.

The equipment used consists of a 15 L capacity *knapsack sprayer* , measuring cup, Global Positioning System (GPS), digital camera, tally sheet, and stationery.

Research methods

The research used a field observation method with a quantitative approach and a paired observation design . Observations were made on the same plants before and after insecticide application so that changes in attack intensity could be directly observed.

The study population was all TBM oil palm plants in Blocks N07, N09, and O07 in Afdeling V PTPN IV Regional 1 Rantauprapat Plantation. The study sample consisted of 114 plants, consisting of 38 plants in each block. The sample was determined by purposive sampling, selecting plants that represented the *O. rhinoceros attack conditions* at the study site.

Research Procedures

The study began with a field survey to identify plants showing symptoms of *O. rhinoceros infestation* . Observations were made for damage to growing points, borer holes, borer powder, and V *-shaped cuts* on young fronds. All observations were recorded using a tally sheet.

After the initial observation was completed, the insecticide cypermethrin was applied using *a knapsack sprayer* . The application followed the Standard Operating Procedure (SOP) of PTPN IV Regional 1 Rantauprapat Plantation with a dose of 1.6 cc per plant or equivalent to 240 cc/ha, using a concentration of 25 cc of insecticide in

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15 L of water. The solution was sprayed directly on the growing point and the base of the young fronds as the main location of *O. rhinoceros imago activity* .

Follow-up observations were conducted weekly, 7, 14, 21, and 28 days after application, to determine changes in attack intensity on the same plants. All observation data was summarized for further analysis.

Observation Variables

The variables observed in this study include:

1. *O. rhinoceros* attack before cypermethrin application.
2. *O. rhinoceros* attacks after cypermethrin application.
3. Control efficiency based on reducing attack intensity.

Data analysis

The intensity of the attack is calculated based on the percentage of plants showing symptoms of attack using the equation:

$$I = \frac{n}{N} \times 100\%$$

with:
I = attack intensity (%)
n = number of plants attacked
N = number of plants observed

Control efficiency is calculated using the equation:

$$P = \frac{A - B}{A} \times 100\%$$

with:
EP = control efficiency (%)
A = attack intensity before application
B = intensity of attack after application

Data were analyzed descriptively to describe changes in attack intensity before and after treatment. Furthermore, a Paired Sample t-test was conducted using IBM SPSS Statistics at a significance level of 5% (α = 0.05) to determine the effect of cypermethrin application on the intensity of *O. rhinoceros attacks* . Differences were declared significant if the *p value* < 0.05.

RESULTS AND DISCUSSION

Based on initial observations, infected plants exhibited typical symptoms of boreholes at the growing point, borehole powder, and V-shaped cuts *on* newly opened young fronds. These symptoms indicate the activity of *O. rhinoceros adults* attacking young plant tissue. Attacks on the growing point disrupt the formation of new fronds, potentially inhibiting vegetative growth if not promptly controlled.

Attack Intensity Before and After Cypermethrin Application

Application of the insecticide containing the active ingredient cypermethrin resulted in significant changes in the intensity of *O. rhinoceros attacks* across all observation blocks. A comparison of attack intensity before and after application is presented in Table 1.

Table 1. Intensity of *Oryctes rhinoceros attacks* before and after cypermethrin application

Block	Before (%)	After (%)
N07	81.57	18.42
N09	73.68	26.31
O07	78.94	15.78
Average	**78.07**	**20.18**

Prior to insecticide application, the average attack intensity reached 78.07%, indicating that most of the sampled plants were actively attacked *by O. rhinoceros* . This high attack intensity indicates that the pest population has reached a level that has the potential to cause economic damage if not immediately controlled. After applying cypermethrin at a dose of 1.6 cc per plant, the average attack intensity decreased to 20.18%. This decrease indicates that cypermethrin application was effective in suppressing *O. rhinoceros attack activity* in all three observation blocks. A decrease in attack intensity occurred across all study blocks. Block O07 showed the lowest attack intensity after application, at 15.78%, while Block N09 still had a relatively higher attack intensity compared to the other blocks. This difference is thought to be influenced by environmental conditions, initial pest population levels,

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and the presence of infestation sources around the study area. Nevertheless, all blocks showed a consistent pattern of decline, indicating that cypermethrin application provided a good control response. The results of this study indicate that cypermethrin application can reduce the level of active *O. rhinoceros attacks* on oil palm plants in the TBM phase. The reduced attack intensity indicates reduced adult feeding activity at the plant's growing point, thus increasing the plant's opportunity for continued vegetative growth.

Control Efficiency

The effectiveness of cypermethrin application can also be seen from the control efficiency value based on changes in the number of plants that experienced attacks before and after application.

Table 2. Control efficiency based on the number of plants affected

Block	Plants were attacked before	Plants are attacked after	Efficiency (%)
N07	31	7	77.42
N09	28	10	64.29
O07	30	6	80
Total	**89**	**23**	**74.15**

The number of plants showing symptoms of infection decreased from 89 before application to 23 after application. These results showed a control efficiency of 74.15%, indicating that cypermethrin was able to reduce *O. rhinoceros infestation* on most of the sample plants.

Block O07 had the highest control efficiency, at 80%, while Block N09 showed the lowest efficiency at 64.29%. Nevertheless, all blocks still demonstrated high efficiency values, thus concluding that cypermethrin application provided relatively consistent control results at the study sites.

Differences in efficiency between blocks are likely influenced by several factors, such as initial infestation levels, microclimate conditions, garden sanitation, and the presence of larval breeding media near the observation area. These factors can influence control success in the field, even if the same insecticide dosage is used.

Paired Sample t-Test Results

The analysis results showed that there was a significant difference between the intensity of attacks before and after the application of cypermethrin. The significance value obtained was smaller than the 5% level of significance ($p < 0.05$), so the null hypothesis (H0) was rejected and the alternative hypothesis (H1) was accepted. Thus, the application of cypermethrin was proven to have a significant effect on reducing the intensity of *O. rhinoceros attacks* on oil palm plants in the Immature Plant phase.

The results showed that the application of an insecticide containing the active ingredient cypermethrin reduced the intensity of *O. rhinoceros attacks* on oil palm plants in the immature phase (TBM). The average attack intensity decreased from 78.07% before application to 20.18% after application, with a control efficiency of 74.15%.

The effectiveness of cypermethrin in this study is related to its mechanism of action as a synthetic pyrethroid insecticide. Cypermethrin acts as a contact and stomach poison by disrupting the function of sodium channels in insect nerve cell membranes. This disruption causes continuous nerve impulses, resulting in loss of motor coordination, paralysis (*knockdown*), and eventual death. This mechanism of action allows cypermethrin to suppress the activity of *O. rhinoceros imago* relatively quickly (Soderlund, 2012; Du et al., 2020; Ahamad & Kumar, 2023).

The results of this study align with those of Kholiq et al. (2019), who reported that insecticide use on oil palm plantations significantly reduced *O. rhinoceros infestations when applied* according to the appropriate dosage and spraying target. Furthermore, Rafie and Amit (2024) also explained that insecticide control reduced rhinoceros beetle feeding activity, thereby minimizing damage to plant tissue. These similar results indicate that insecticide use remains an effective control alternative under high infestation conditions.

The success of control in this study was also influenced by the application technique, which was carried out according to company operational standards. Spraying was directed directly at the growing point and the base of young fronds, which are the primary activity sites for *O. rhinoceros adults* . Accurate application targeting increases the chance of contact between the insecticide and the pest, thus increasing control effectiveness. This indicates that the success of insecticide use is determined not only by the type of active ingredient, but also by the correct dosage, timing, and application technique in the field.

Although all study blocks showed a decrease in attack intensity, the level of control efficiency varied between blocks. Block O07 had the highest control efficiency (80.00%), while Block N09 showed a lower efficiency (64.29%). This difference is thought to be related to environmental conditions, initial pest population

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levels, garden sanitation, and the presence of decaying organic matter as a breeding ground for *O. rhinoceros larvae* . According to Bedford (2014) and Moslim et al. (2006), the presence of larval breeding media significantly influences the dynamics of rhinoceros beetle populations in the field and can therefore influence control success. In addition to insecticide use, the success of *O. rhinoceros control* is also influenced by the implementation of Integrated Pest Management (IPM) components. Arief et al. (2024) explained that rhinoceros beetle control will be more effective if insecticides are combined with plantation sanitation, the use of pheromone traps, and regular pest population monitoring. Similar findings were also reported by Sinaga and Santi (2021) and Farida et al. (2021), who showed that pheromone traps are effective in reducing adult populations, thereby reducing the likelihood of attacks on oil palm plantations. Continuous use of cypermethrin with the same active ingredient also requires attention because it has the potential to increase selection pressure on pest populations and trigger resistance. Sparks and Nauen (2020) explain that insecticide resistance management requires rotating active ingredients with different mechanisms of action and integrating them with non-chemical control methods. Therefore, cypermethrin application in this study should be positioned as one component of an IPM system, not the sole control method.

From an agronomic perspective, reducing the intensity of *O. rhinoceros attacks* has a positive impact on the growth of oil palm plants in the TBM phase. Reduced damage to growing points allows for better formation of new fronds, thus maintaining vegetative growth. This is expected to support plant development towards the productive phase and reduce losses due to pest attacks. Overall, the research results demonstrate that the application of an insecticide containing the active ingredient cypermethrin is an effective control method against active *O. rhinoceros attacks* on immature oil palm plants. However, control success will be more optimal if insecticide use is integrated with Integrated Pest Management components so that control can be carried out effectively, efficiently, and sustainably.

CONCLUSION

Based on the research results, the application of insecticides containing the active ingredient cypermethrin was proven effective in reducing the intensity of *O. rhinoceros attacks* on oil palm plants in the Immature Plant (TBM) phase at PTPN IV Regional 1 Rantauprapat Plantation. The average attack intensity decreased from 78.07% before application to 20.18% after application, with a control efficiency of 74.15%. The results of the analysis using *the Paired Sample t-test* showed that the decrease in attack intensity was significantly different ($p < 0.05$), so that the application of cypermethrin had a significant effect on controlling *O. rhinoceros* . However, cypermethrin should not be used continuously as the sole control method. To maintain effective control and reduce the risk of resistance, cypermethrin application should be combined with Integrated Pest Management (IPM) practices, such as garden sanitation, the use of pheromone traps, the use of biological agents, and the rotation of insecticide active ingredients.

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