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Evaluation of the Effectiveness of *Oryctes rhinoceros* Control Methods Using *Fero Trap* and *Orynet Trap* At Brahma Bina Bakti Palm Oil Plantation, Muaro Jambi Regency

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Abstract

Oryctes rhinoceros is a major pest in oil palm plantations, particularly during the immature plant stage. This study evaluated the effectiveness of the *Fero Trap* and *Orynet Trap* in controlling *Oryctes rhinoceros* at Brahma Bina Bakti Plantation, Muaro Jambi Regency. The research was conducted from December 2025 to February 2026 using a quantitative comparative method with a descriptive approach. Observed parameters included the number of captured beetles, attack intensity, plant damage level, and the sex composition of captured adults. The results showed that *Orynet Trap* captured significantly more beetles (7,938 individuals) than *Fero Trap* (2,137 individuals). Captures peaked in December and gradually declined through February, indicating a decline in field populations. The average attack intensity was 2.96%, which was categorized as low. Plant damage was dominated by score 1 and score 2, while no severe damage (scores 4 and 5) was found. Male beetles were more abundant than females in both trapping methods, with overall sex ratios of 1.38:1 for Fero Trap and 1.29:1 for Orynet Trap. An independent-samples t-test indicated a significant difference between the two control methods ($P < 0.05$). The study concludes that *the Orynet Trap is more effective at suppressing O. rhinoceros populations. At the same time, the Fero Trap is better suited* as a monitoring tool within an Integrated Pest Management (IPM) program. Using the Fero Trap and Orynet Trap effectively reduced **O. rhinoceros** infestation in oil palm plants. Infestation intensity across all blocks decreased from 2.60–3.55% prior to control measures to 0.43–1.82% after implementation.

Keywords: Effectiveness, Fero Trap, *O. rhinoceros*, Orynet Trap

1. Introduction

Oil palm (*Elaeis guineensis* Jacq.) is a major global commodity for vegetable oil production, is highly productive, and plays an important role in the food and energy industries (osephine et al., 2025). However, oil palm plant productivity often declines due to pest attacks (OPT), especially the rhinoceros beetle Oryctes rhinoceros, a primary pest from the juvenile stage through the beginning of the productive phase. Infestation reached an average of 77.33% in immature plants (TBM) and 98.67% in mature, productive plants (TM), with average infestation intensities of 35% (TBM) and 37.07% (TM). Control efforts against *O. rhinoceros* use mechanical, biological, and chemical methods.

O. rhinoceros attacks by boring into the plant's growing points, damaging meristematic tissues, hindering vegetative growth, and reducing production potential. At high attack levels, this pest can cause severe damage or even kill young plants (Sihotang et al., 2023; Hardiansyah et al., 2022). Additionally, the presence of organic materials, such as stumps and decayed fronds, on plantation land can increase pest populations by serving as breeding sites for larvae(Fauzana et al., 2023)

O. rhinoceros is generally controlled through an Integrated Pest Management (IPM) approach that combines various environmentally friendly methods. One widely

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used method is pheromone-based traps (Fero Trap), which use attractant compounds to lure adult beetles (Lestari et al., 2020). Net traps (Orynet Trap) are also mechanical methods that directly prevent and captureests in the field (Santi et al., 2021).

Citing Fauzana et al. (2024), previous research on the biological control of *Oryctes* pests examined the effectiveness of compost containing the fungus *Metarhizium anisopliae* against *O. rhinoceros* larval mortality. A dosage of 0.4 kg/plant yielded the highest mortality rate; although it did not reach optimal control, the results show that *O. rhinoceros* can be managed through various methods, biological or chemical.

This high larval suppression is corroborated by several recent studies validating the optimization of *M. anisopliae* delivery. For example, Nurfiana et al. (2026) confirmed that modifying localized organic carriers directly influences fungal pathogenicity, highlighting that sufficient concentration limits are necessary to trigger absolute mortality in beetle larvae.

Furthermore, research by Umar et al. (2024) explained the underlying histopathological progression of this bio-pesticide; they found that localized application of *M. anisopliae* leads to successful spore attachment and cuticle penetration, followed by internal mycelium growth and toxin production that causes up to 91% larval mortality within a 20-day window.

Several studies indicate that the effectiveness of these two methods varies depending on environmental conditions and installation techniques. *Fero Trap* has been reported to be more effective in increasing the number of adult beetle captures, while *Orynet* Traps tend to be more stable in protecting the plant's growing points. (Junaidi et al., 2025; Santi et al., 2021).Therefore, further evaluation under specific site conditions is necessary to determine the most effective control method.

This study aims to evaluate and compare the effectiveness of *Fero Traps and Orynet Traps in suppressing Oryctes rhinoceros populations* and reducing attacks on oil palm plants.

2. Research Methods

This research was conducted at Brahma Bina Bakti Plantation, Muaro Jambi Regency, Jambi Province, at an elevation of approximately 51 meters above sea level, from December 2025 to February 2026.

The research lasted for 3 (three) months, from December to February 2026. The study used a quantitative, descriptive, comparative approach to evaluate the effectiveness of two pest control methods for *Oryctes rhinoceros*, namely *Fero Trap* and *Orynet Trap*, on immature oil palm plants (Young Palm Stage, YPS). The research location was purposively selected in areas with high pest infestation, and sampling points were evenly distributed at each trap installation to minimize environmental influence. The procedures included installing *F*ero Traps that use aggregation pheromones (ethyl 4-methyloctanoate) as attractants to lure adult beetles, and Orynet Traps consisting of nets as physical barriers at specific boundaries or areas to capture pests.

The identification of the sex of the *Oryctes rhinoceros* adult is based on observable external morphological features. Male adults generally have longer, larger, backwards-curving horns than females. Additionally, at the end of the abdomen, male adults do not have prominent hairs or bristles. In contrast, female adults have relatively shorter and smaller horns, and there is a cluster of fine hairs at the end of the abdomen, which serves as one of the distinguishing features of the sex.

According to Himawan et al. (2026), the main morphological difference between male and female imagos is the longer horn length in males, which functions in mate competition. Other parts, such as the pronotum and the segments of the hind legs, are also larger in males.

We collected data periodically through direct field observations, focusing on parameters such as the number of adult beetles caught, gender composition, and the extent of plant damage, indicated by visual symptoms such as V-shaped leaf damage and damage at the growing point. The data were analyzed descriptively and quantitatively, followed by an Independent-Samples t-test at a 95% confidence level ($\alpha = 0.05$) to test differences in effectiveness between the two control methods.

2.1. Tools and materials

This study used *Oryctes rhinoceros*, pheromone, rope, bamboo poles, and TBM 3 palm oil. The tools used in this study include a camera, a book, a pen, a beetle trap monitoring checklist, a Fero Trap, netting, sticks, buckets, and brushes.

2.1.1. Preparation survey location

In this study, the location used was TBM 3, a palm oil plantation affected by *Oryctes rhinoceros, characterized by symptoms such as inverted* V-shaped leaves. The location was determined based on the control type used, which was the same: Fero Traps and Orynet/net traps.

2.1.2. Census pests

The Early Warning System (EWS) for *Oryctes rhinoceros* attacks is conducted through regular primary census activities in the plantation area. The census is carried out by observing the symptoms of adult insect attacks on the plants, such as V-shaped young leaves, broken leaf stalks, and damage to the growing points. The census results are used to calculate the percentage of affected plants, which indicates the attack level. If the attack percentage shows an upward trend or exceeds the control threshold, it serves as an early warning signal to implement control measures immediately, in accordance

with applicable procedures.

2.1.3. Trap installation Technique

a. *Fero Trap*

Fero Trap is an *Oryctes rhinoceros* trap based on aggregation pheromones, assembled from a bucket and zinc as the impact surface, where each trap uses a single type of pheromone to attract the adult beetle. The trap is installed at a density adjusted to the level of infestation: 1 unit per 2.5 hectares for heavy infestation, 1 unit per 5 hectares for moderate infestation, and 1 unit per 10 hectares for light infestation.

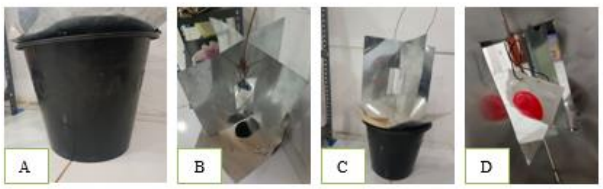


Figure 1. Fero Trap

Observation or collection of the catches is conducted weekly, while the pheromone is replaced every two months to maintain its effectiveness because the attractant concentration decreases over time and with environmental conditions. The Fero Trap works by using pheromone attraction to lure beetles closer, causing them to hit the zinc and fall into the trap.

b. *Orynet Trap*

Control using net traps aims to restrict the movement of *Oryctes rhinoceros* entering and exiting the block and to prevent attacks from outside the plantation, especially at the HGU boundary. Nets with hole sizes of 15–20 mm are installed around the block using bamboo poles approximately 4 meters high, with a net length of 50 meters per roll and a height of about 3 meters supported by three poles per unit. The catch results were observed from the imago's trapped on the net, with identification performed on unmarked individuals. The captured image is left to die on the net, while the net is replaced if it becomes damaged or decayed.



Figure 2. Orynet Trap

2.2. Observation parameters

The parameters observed include:

2.2.1. Number of captured Imago Oryctes

The number of catches is calculated per observation and tabulated monthly for the control methods, *Fero Trap* and *Orynet.*

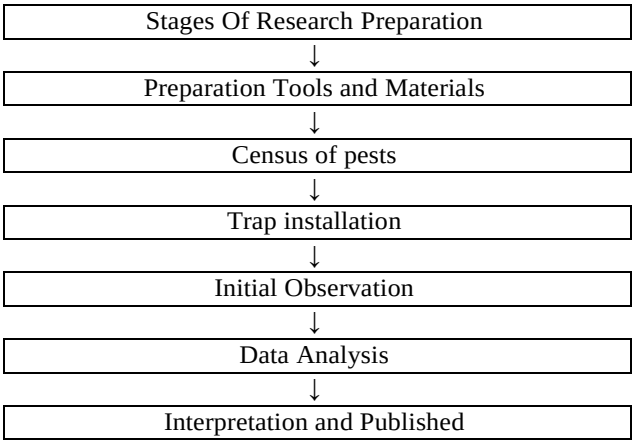


Figure 3. Track Research

2.2.2. Attack intensity

The Early Warning System (EWS) for *Oryctes rhinoceros* attacks is conducted through periodic main census activities in the plantation area. The census is carried out by observing the symptoms of adult insect attacks on the plants, such as young leaves shaped like the letter V, broken leaf stalks, and damage at the growing points. The census results are used to calculate the percentage of affected plants, which indicates the attack level. If the attack percentage increases or exceeds the control threshold, this condition serves as an early warning signal to take control measures immediately, in accordance with applicable procedures (Singh et al., 2022).

$$IS(\%) = \Sigma\ (nxv) \times 100$$

$$N \times V$$

Where:
IS: % of plants affected
n: Certain score count
v: Score value
N: Total number of samples
V: Highest score value

2.2.3. Level of Plant Damage

The level of damage to oil palm plants caused by *Oryctes rhinoceros* attacks is determined using a scoring system based on a census of the trees and observations of attack symptoms on young leaves and growing points. A score of 0 indicates the plant is not damaged. A score of 1 indicates a recent attack with less than 5% damage or 2–3 spear leaves chewed. A score of 2 indicates a recent attack with 5–10% damage or 3–5 spear leaves chewed. A score of 3 indicates a recent attack with 10–25% damage or most spear leaves chewed, and the plant begins to dwarf. A score of 4 indicates a recent attack with 25–50% damage or spear leaves forming a fan pattern. A score of 5 indicates a severe attack with more than 50% damage or a withered, twisted, non-developing, or dead plant. These scoring results are

used to determine the level of plant damage, as well as to serve as a basis for calculating attack intensity and making control decisions in the field.

$$\%\ O.r\ ♂ = \frac{Or.♂}{total\ Or\ tertangkap}\ x\ 100\%$$

$$\%\ O.r\ ♀ = \frac{Or.♀}{total\ Or\ tertangkap}\ x\ 100\%$$

Where:
Or. ♂: O. Male *rhinoceros* beetle
Or. ♀: *O. rhinoceros* female

2.2.4. Composition of the sex of the captured adult

The gender composition of captured adult Oryctes rhinoceros was determined based on morphological identification of adults obtained from the Fero Trap and Orynet Trap. Identification was carried out by distinguishing male and female adults based on visible external features. morphological features. The proportion of male and female imagos captured was used to describe the population structure of *O. rhinoceros* in the field. Differences in gender composition can inform population dynamics and the pest's reproductive potential in the study area. The gender composition data for imagos were further analysed to support evaluations of control effectiveness and to plan control strategies for *O. rhinoceros* in the plantation.

The empirical data in the table indicate that attack intensity of Oryctes rhinoceros across the observed blocks (L19 to L24) is relatively low, with a calculated mean attack intensity of 2.96%. The lowest infestation levels were documented in blocks L19 and L22 (both at 2.60%), while the highest peaked in block L21 at 3.55%. These relatively suppressed population dynamics and low damage rate can be attributed to continuous monitoring, early detection protocols, and integrated mitigation strategies—such as pheromone or light trapping coupled with good plantation management—as highlighted in the accompanying text.

When evaluated against established agricultural thresholds, an attack intensity below 3% falls safely beneath the economic injury level (EIL) typically set for young oil palm plantations. According to Nabilah et al. (2023), an infestation rate under 5% is classified as a light attack category, meaning it does not cause severe physical disruption to the plant's growing point (meristem) or require drastic chemical intervention. The decreasing population trend toward February further validates that localized ecological variables or proactive trapping mechanisms effectively disrupted the breeding cycles of the beetles within the research site.

3. Results and Discussion

3.1. Number of Insect Captures

a. Results of *Fero Trap* Captures

Observations of *Fero Trap*s from December to February showed fluctuations in the number of *Oryctes rhinoceros* captures. The highest was in December (947 individuals), decreasing in January to 686 and further in February to 504, indicating a population decline during this period.

Block L24 had the highest capture count, with 259 individuals in December, 143 in January, and 136 in February. Conversely, the lowest capture count was recorded in block L21, with 90 in December, 83 in January, and 51 in February.

The number of pherotraps in each block ranged from 10 to 15 units, for a total of 78 units. Despite these differences, the capture pattern was similar, peaking in December and declining thereafter. The decline is likely due to reduced adult populations and environmental influences.

Table 1. Number of Insect Captures

Block	Amount *Fero Trap*	Des	Jan	Feb
L19	13	121	69	83
L20	14	156	124	76
L21	15	90	83	51
L22	12	147	145	82
L23	10	174	122	76
L24	14	259	143	136
Amount	**78**	**947**	**686**	**504**

b. Results of *Orynet Trap* Captures

Observations of *Oryx trap*s showed the highest number in blocks 121/122, with 4,289 individuals during the observation period: 1,763 in December, 1,414 in January, and 1,112 in February.

Blocks 124/123 captured 2,927 individuals: 1,354 in December, 889 in January, and 684 in February. Blocks 119/120 captured 722 individuals, with 362 in December, 193 in January, and 167 in February.

Total captures were highest across all blocks, with February lowest. This suggests that the *O. rhinoceros* population at the research site tends to decrease over the observation period.

The sharp contrast in total captures between Blocks 121/122 (4,289 beetles) and Blocks 119/120 (722 beetles) underlines the critical impact of spatial micro-habitats on pest clustering. According to a geographical distribution analysis by Nabilah et al. (2023), *O. rhinoceros* populations exhibit a strong clumped spatial pattern, aggregating densely in sectors adjacent to active replanting borders or uncomposted palm trunk chipping heaps. The low capture numbers in February across all blocks also align with the longitudinal field observations by Umar et al. (2024), which showed that adult beetle flight activities and trapping frequencies are heavily suppressed during periods of changing rainfall patterns, which directly disrupt their nocturnal navigation. Ultimately, the progressive quantitative drop in caught beetles across December,

January, and February validates that the long-term installation of *Orynet* Traps acts as a highly effective barrier, suppressing the local *O. rhinoceros* population before they can cause irreversible mechanical damage to the sensitive meristem tissue of young oil palms.

Table 2. Observation of Orynet Traps

No	Block	Period Catch *Orynet Trap*			Total
		Des	Jan	Feb	
1	124/123	1354	889	684	2927
2	121/122	1763	1414	1112	4289
3	119/120	362	193	167	722

3.2. Attack Intensity

The attack intensity value of *Oryctes rhinoceros* was 2.96%, indicating a low pest attack level. Most plants fall into the light score category, with no severe damage. The results remain within the Triputra SOP tolerance limits, so *O. rhinoceros* attack at the research site can be categorized as low.

The high attack intensity is suspected to be related to the effectiveness of control methods using *Fero Trap* and *Orynet Trap* to manage the adult population of *O. rhinoceros*. Routine monitoring allows early detection and quick control. Using traps and good plantation management helps keep attack levels low.

Table 3. Attack Intensity (%)

Block	Attack Intensity (%)
L19	2.60
L20	2.77
L21	3.55
L22	2.60
L23	3.20
L24	3.03
Average	2.96

This uniform control efficiency mirrors the findings of Pradana et al. (2022), who noted that strategic trap placement limits localized pest aggregation, resulting in balanced attack intensities below a 4.0% margin.

Suppressing these attack levels during the initial growth stages is critical; as Santi et al. (2024) showed, young palms exposed to even mild *O. rhinoceros* boring (exceeding 6%) experience delayed maturity and greater susceptibility to lethal secondary bud-rot infections. Therefore, the low average attack rate of 2.96% confirms that the current plantation protocol meets the Triputra SOP's strict operational criteria, offering a highly dependable template for integrated pest management in immature oil palm estates.

3.3. Plant Damage Level (Scoring)

Based on the census, most plants scored 1 and 2, while scores 4 and 5 were not found, indicating light to moderate damage. In block L19, 14 plants scored 1, 9 scored 2, and 3 scored 3. In L20, 13 plants scored 1, 6 scored 2, and 2 scored 3. In L21, 9 scored 1, 7 scored 2, and 3 scored 3. L22 had 11 with scores 1 and 2, with no score 3. L23 had 11 with score 1, 8 with score 2, and 3 with score 3. L24 had 12 with score 1 and 7 with score 2, with no score 3.

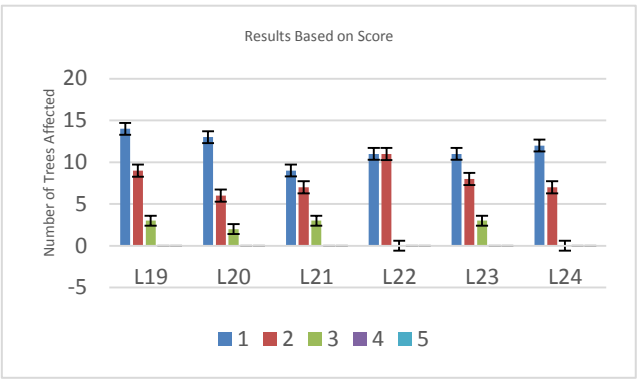


Figure 4. Plant Damage Level

Overall, plants with a score of 1 were most common across all observation blocks, indicating light attack by *O. rhinoceros* on young leaves or fronds that does not cause serious growth disturbances. Score 3 was rarely found, only in blocks L19, L20, L21, and L23; none were found in L22 and L24. No plants scored 4 or 5, indicating *O. rhinoceros* caused no severe damage during the observation. These results align with the low attack intensity of 2.96%, suggesting that the palm oil condition remains good and pest attacks are still manageable. This low damage level indicates effective control, including *Fero Trap* and *Orynet Trap, which suppress pest populations and* prevent serious attacks.

3.4. Imago Sex Ratio Composition

In *Fero Trap* s, the sex ratio for December 2025, January 2026, and February 2026 was 1.38:1; 1.38:1; and 1.36:1, respectively, with a total sex ratio of 1.38:1. Meanwhile, in *Orynet Trap* s, the sex ratio was 1.47:1 in December 2025, 1.15:1 in January 2026, and 1.20:1 in February 2026, with a total sex ratio of 1.29:1. These values indicate that the population of imago captured during the study period was dominated by males. Research results show that the number of male *Oryctes rhinoceros* imagos captured in both trap types was higher than the number of females.

The variance in monthly stability between the two trapping mechanisms highlights differences in operational trap design. The *Fero Trap* maintained a highly uniform male attraction rate (varying only from 1.38:1 to 1.36:1). At the same time, the *Orynet* Trap displayed a sharper drop in January (1.15:1) before rebounding in February (1.20:1). This fluctuation mirrors the observations of Pradana et al. (2022), who explained that net-based barriers (*Orynet*) rely heavily on physical flight interception combined with olfactory cues; hence, changes in wind direction or sudden rainfall heavily impact the flight trajectories of heavier

female beetles more than the agile male imagos.

Table 4. Imago Sex Ratio

Observation Month	Trap	Male (Tail)	Female (Tail)	Sex ratio (J:B)
December 2025	*Ferotrap*	525	380	1.34 :1
January 2026		399	289	1.38 : 1
February 2026		291	214	1.36 : 1
December 2025	*Orynet*	2074	1408	1.47 : 1
January 2026		1427	1243	1.15 : 1
February 2026		1068	889	1.20 : 1



Figure 5. Research documentation

3.5. Analysis of Test Results

Based on the Shapiro-Wilk normality test, the *Orynet Trap* data were normally distributed (Sig. = 0.585 > 0.05). In contrast, the *Fero Trap* data had a significance value of 0.049, slightly below the 5% significance level. Therefore, the *Fero Trap* data does not fully meet the normality assumption.

Table 5. Analysis Test

		Kolmogorov-Smirnov			Shapiro-Wilk		
	Month	Statistics	df	Sig	Statistics	df	Sig
Orynet	December	0.273	3	0.05	0.945	3	0.05
	January	0.204	3	0.05	0.994	3	0.05
	February	0.192	3	0.05	0.997	3	0.05
Fero Trap	December	0.371	3	0.05	0.786	3	0.05
	January	0.342	3	0.05	0.845	3	0.05
	February	0.271	3	0.05	0.988	3	0.05

4. Conclusion

The results showed differences in the effectiveness of the *Fero Trap* and *Orynet Trap* in controlling Oryctes *rhinoceros* in immature oil palm plantations at Brahma Bina Bakti Plantation, Muaro Jambi Regency.

The *Orynet* Trap captured more adult Oryctes rhinoceros than the Ferotrap. During the study period, the *Orynet* Trap captured 7,938 individuals, whereas the Ferotrap captured 2,137. Deploying both the Ferotrap and Orynet Trap successfully suppressed *O. rhinoceros* infestation levels in oil palm plants. Infestation intensity across all blocks decreased from 2.60–3.55% pre-control to 0.43–1.82% post-control. Scoring results also showed an increase in plants with a score of 0 and a decrease in those with scores of 1-3, with no plants scoring 4 or higher.

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