



REVIEW ARTICLE

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Distribution And Pattern Attack *Oryctes rhinoceros* In the Area Coconut Replanting Oil Palm (*Elaeis guineensis* Jacq .) In immature plants at PTPN IV Regional I Sei Putih Plantation

Muhammad Amin Pulungan¹, Henry Budi Hasibuan^{1,*}

Abstract

This study aims to determine the distribution and attack pattern of rhinoceros beetles (*Oryctes rhinoceros*) on immature oil palm plants (TBM) at PTPN IV Sei Putih Plantation, Deli Serdang Regency, North Sumatra. Oil palm is a strategic plantation commodity that contributes significantly to the national economy, but rhinoceros beetle attacks can disrupt its productivity, especially during the young-plant phase. The study was conducted in March-April 2026 using a descriptive method with a field observation approach through censuses at predetermined sample points. The parameters observed included attack frequency, attack intensity, and spatial distribution patterns, analyzed using the Variance to Mean Ratio (VMR) method. The results showed that *Oryctes rhinoceros* attacks on TBM 1 in Afdeling III, covering an area of approximately 21 hectares, were classified as low. Attacks were detected at only a few census points, with an attack intensity of 0.2%, which falls into the light category. Analysis of distribution patterns indicated a VMR value of 0.44, suggesting a uniform distribution pattern. The Shapiro-Wilk normality test results showed that the data were normally distributed, with a significance value greater than 0.05. These findings indicate that proper garden sanitation and effective management of replanting areas can suppress pest population growth during the early stages of plant development. The results provide baseline information that can be used to develop more effective pest monitoring and control strategies. Regular monitoring and ongoing maintenance of area sanitation are recommended to prevent pest population increases and to support healthy plant growth.

Keywords: Damage intensity, Garden Sanitation, Rhinoceros Beetle, Pest Monitoring, Variance-to-Mean Ratio

1. Introduction

Oil palm (*Elaeis guineensis* Jacq.) is one of the world's most important plantation commodities and plays a strategic role in supporting the global economy, particularly in tropical regions. Indonesia and Malaysia are the world's two largest palm oil-producing countries, contributing 44% and 41% of total global production, respectively, and together accounting for about 85% of global palm oil production (Mirwansyah et al., 2025). This substantial contribution demonstrates that successful oil palm cultivation significantly impacts the economic stability of the plantation sector and the availability of global vegetable oils.

Various factors influence oil palm productivity, including attacks by plant-disturbing organisms that can reduce growth and yield. (Daulay, 2022). Some of the main pests frequently found in oil palm plantations include bush rats, fireworms, and rhinoceros beetles. The presence of these pests can cause significant damage if their populations are not controlled (Alhaji et al., 2024). The rhinoceros beetle (*Oryctes rhinoceros*) is one of the primary pests of oil palm pest, especially during the immature phase, because it attacks growing points and young fronds, inhibiting plant growth. Severe attacks can result in up to 25% of young plants dying and reduce fresh fruit bunch production in the first year by up to 69% (Afif

*Correspondence: henrybudialfalah@gmail.com

1) Institut Teknologi Sawit Indonesia - Jl. Willem Iskandar, Kenangan Baru, Kecamatan Percut Sei Tuan, Kabupaten Deli Serdang, Sumatera Utara 20371, Indonesia

et al., 2026). The damage is generally characterized by the formation of holes in the shoots and young leaves, which open in a V-like or scissor-like pattern. Therefore, routine monitoring of pest populations is essential to determine appropriate control measures based on the economic threshold of attack (Nushasnita & Efendi, 2020).

Oryctes rhinoceros, or rhinoceros beetle, is one of the most damaging pests during the immature plant (IMP) phase. This pest attacks plants by boring into and eating soft tissue in the shoots, inhibiting plant growth (Sadewa et al., 2025). Attacks at the growing point can cause characteristic damage symptoms in the form of V-shaped cuts on newly opened leaves. High levels of damage can reduce plant productivity and even hinder garden development during the early growth phase (Arviyanto et al., 2024).

Theoretically, the level of pest attack on a crop area is influenced by population distribution patterns, food source availability, plant age, and environmental conditions. *Oryctes rhinoceros* has a relatively long lifespan: about 9 months in females and 6 months in males. This pest is also able to move from one plant to another every 4–5 days, so that the spread of the attack can occur quickly (Fadila et al., 2024). According to Nabara et al. (2023), a rhinoceros beetle can damage around 6–7 plants in one month and can cause a decrease in the first harvest production of up to 69% and the death of young plants up to 25%.

Several studies have examined *Oryctes rhinoceros* in oil palm plantations with varying focuses. (Santi et al., 2021) studied the effectiveness of using *Oryctes* traps in suppressing the population and intensity of *O. rhinoceros* damage in immature oil palm plantations. (Sinaga & Santi, 2021) studied the effectiveness of placing ferotrap as a method of controlling rhinoceros beetle pests in oil palm plantations. (Wong, 2022) studied the population and attack levels of *O. rhinoceros* in oil palm plantations in Riau Province. (Landes et al., 2025) studied the population dynamics and attack levels of *O. rhinoceros* in oil palm plantations bordering replanting areas. These studies generally focused on control techniques, the effectiveness of control agents, pest populations, and attack levels at specific locations. Studies that specifically analyzed and compared the distribution and attack patterns of *O. rhinoceros* based on immature plant age groups, namely TBM 1, TBM 2, and TBM 3, remain relatively limited (Mulyono, 2022). Therefore, the novelty of this study lies in the analysis of spatial distribution patterns and levels of *O. rhinoceros* attacks on various age groups of immature plants in the replanting area, so that it can provide more specific information regarding the level of plant vulnerability at each growth phase as a basis for developing more effective monitoring and control strategies (Rahmawati, 2023).

Research on the distribution and patterns of *Oryctes rhinoceros* attacks is important because it can inform more

effective and efficient control strategies. Data on the distribution of attacks across various plant age groups can help companies prioritize monitoring, determine control timing, and allocate resources more accurately. This information can also support efforts to prevent economic losses due to rhinoceros beetle attacks on young plants.

Based on these conditions, this study focuses on the distribution and attack patterns of *Oryctes rhinoceros* on immature plants and how these patterns differ between TBM 1, TBM 2, and TBM 3. This study aims to determine the distribution and attack patterns of *Oryctes rhinoceros* on immature plants and to analyze differences in distribution and attack patterns across TBM 1, TBM 2, and TBM 3 to support the development of more appropriate pest control strategies.

2. Material and Methods

This research was conducted at PTPN IV Regional I Kebun Sei Putih, Galang District, Deli Serdang Regency, North Sumatra Province in March–April 2026. Geographically, the research location is at coordinates around 3°24'34" N and 98°52'57" E, with an altitude ranging from 37.5–112 meters above sea level (masl). The research objects were oil palm plants in the Immature Plant (TBM) 1, TBM 2, and TBM 3 phases that were attacked by rhinoceros beetles (*Oryctes rhinoceros*). The research materials included TBM oil palm plants, *Oryctes rhinoceros* pests, and rapia ropes as sample markers. The equipment used consisted of notebooks, stationery, block maps, cameras or mobile phones for documentation, and supporting equipment for field observations.

The study employed a descriptive method with a field observation approach through a census at predetermined sample points. The research stages included preparation of tools and materials, a site survey to purposively determine observation points based on the presence of attack symptoms, interviews with plantation staff to obtain supporting information, and field data collection using a diagonal observation pattern. Data collected included the number of infested plants, the level of plant damage, and environmental conditions in the observation area.

Observed parameters included the frequency of attacks, the intensity of attacks, and the spatial distribution pattern of *Oryctes rhinoceros* attacks. Attack frequency was calculated as the percentage of attacked plants relative to the total number of plants observed. Attack intensity was analyzed using a damage scale of 0–5 and calculated using the attack intensity formula (Santi et al., 2021). The spatial distribution pattern was determined using the Variance to Mean Ratio (VMR) method to determine whether the attack pattern was clustered, random, or uniform. The observation data were tabulated and calculated using Microsoft Excel 2021, then analyzed statistically using IBM SPSS Statistics version 26. The analysis included a normality test using the Shapiro–Wilk method at a 5% significance level to assess

data distribution and support interpretation of the research results.

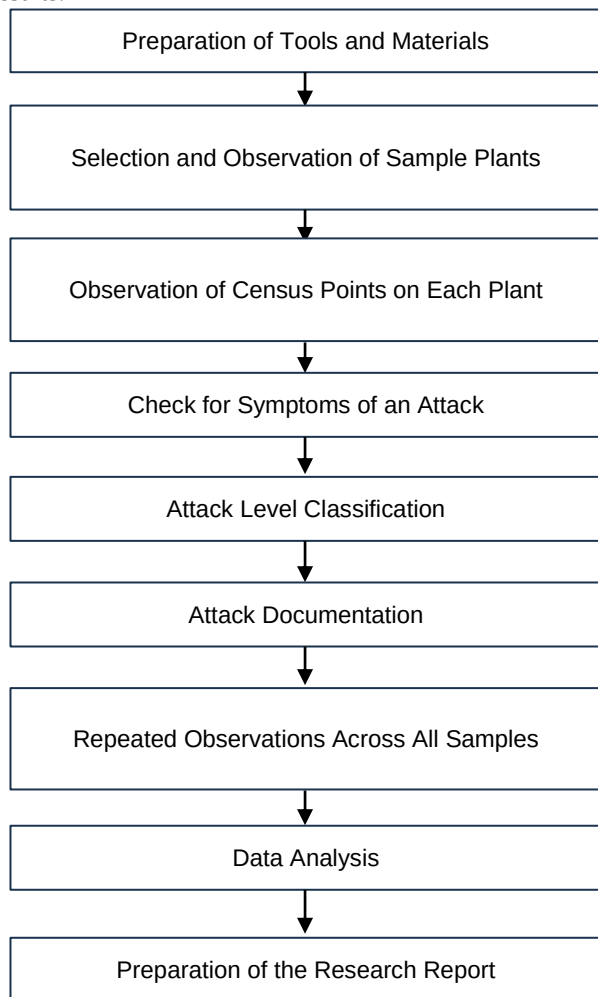


Figure 1. Research Flow Diagram

3. Results and Discussion

3.1. Description of Research Location

Sei Putih Plantation is one of the business units of PT Perkebunan Nusantara IV (PalmCo) Regional I located in Galang District, Deli Serdang Regency, North Sumatra. This plantation has a long history, beginning as a Dutch-owned plantation that the Indonesian government later nationalized under Law No. 86 of 1958. Its management has undergone several institutional changes, from PPN Aneka Tanaman, PNP IV, PT Perkebunan IV (Persero), and PT Perkebunan Nusantara III (Persero) to PalmCo (PTPN IV) after the merger of several state-owned plantation companies in 2023.

Based on the area statement data, Sei Putih Plantation has a total Cultivation Rights (HGU) area of 3,039.63 ha consisting of 776.98 ha of mature oil palm plants (TM), 1,066.40 ha of immature oil palm plants (TBM), 577.05 ha of mature rubber plants, 4.79 ha of conservation area, 9.85 ha of nursery area, and 604.56 ha for roads, buildings, and other facilities. Geographically, this plantation borders Sei

Karang Village to the north, Galang Barat Village to the south, Pulau Tagor Village to the east, and Tanjung Purba Village to the west, with an altitude ranging from 37.5–112 meters above sea level.

PT Perkebunan Nusantara IV's vision is to become a global company based on integrated and sustainable agribusiness. In conducting its business, the company applies the cultural values of AKHLAK, which include Trustworthiness, Competence, Harmony, Loyalty, Adaptability, and Collaboration. The company's mission focuses on providing high-quality products, increasing innovation and digital-based operational efficiency, developing competent human resources, preserving the environment, developing downstream businesses, supporting national food and energy security, and implementing good corporate governance.

3.2. Rainfall Data

Continuous rainfall observations have been conducted at various locations using a variety of methods, resulting in historical data that can be used for various research purposes. This rainfall data plays a crucial role in supporting the development of accurate prediction models, particularly in the planning and management of drainage systems in mining operations.

Previous research shows that rainfall prediction in the mining sector still largely relies on conventional methods such as the Gumbel and Thomas-Fisher methods. Technological developments are driving the use of artificial intelligence (AI)-based approaches, particularly Artificial Neural Networks (ANNs), which are considered capable of producing predictive models with greater speed and accuracy than conventional methods (Jayadianti *et al.*, 2020).

3.3. *Oryctes rhinoceros* L. pest attack data.

To date, rhinoceros beetle (*Oryctes rhinoceros*) attacks remain a major obstacle in oil palm cultivation, particularly during the immature plant (IMT) phase. This infestation causes indirect losses by damaging leaf sheaths, disrupting photosynthesis, and reducing plant growth and productivity. Another impact is the increase in the IMT period from approximately 4 years to 5–7 years. Under certain conditions, plants cannot recover and fail to produce.

Direct losses from *Oryctes rhinoceros* attacks include damage to plant growing points or shoots of plants, which can lead to plant death. The most frequently affected parts are leaf or spear leaves, which stunt plant growth. High levels of damage to young plants can reduce the productive plant population and increase garden maintenance costs (Fauzana, 2020).

Morphologically, *Oryctes rhinoceros* has a blackish-brown body with a length of approximately 3–5 cm and a width of approximately 2 cm. Male and female beetles differ in antennal characteristics: females have relatively

longer antennae with a higher density of sensilla than males. harvest season. (Rivera *et al.* , 2025) . This pest attack on TBM plants can cause a very significant decrease in yield, ranging from 40% to 92% in the first

Table 1. Rainfall Data

Year	Parameter	Jan	Feb	Mar	Apr	May	June	Jul	August	Sep	Oct	Nov	Des	Amount
2017	MM	70.00	191.00	247.00	130.00	441.00	208.00	174.00	235.00	416.00	149.00	265.00	220.00	2,746
	HH	13	14	18	10	14	14	6	14	21	12	15	12	163
2018	MM	98.00	40.00	104.00	169.00	180.00	186.00	147.00	81.00	306.00	262.00	386.00	165.00	2,124
	HH	13	5	11	16	16	10	10	6	21	27	17	12	164
2019	MM	123.00	66.00	37.00	150.00	313.00	255.00	181.00	254.00	254.00	313.00	49.00	141.00	2,136
	HH	10	7	5	8	13	12	12	12	10	17	7	12	125
2020	MM	228.00	38.00	72.00	137.00	213.00	462.00	353.00	298.00	315.00	271.00	434.00	417.00	3,238
	HH	7	4	5	12	14	11	18	15	13	13	17	12	141
2021	MM	237.00	16.00	141.00	149.00	204.00	145.00	200.00	355.00	325.00	298.00	546.00	276.00	2,892
	HH	13	2	14	10	10	10	9	22	15	13	21	15	154
2022	MM	181.00	240.00	195.00	158.00	311.00	274.00	98.00	278.00	186.00	452.00	424.00	532.00	3,329
	HH	11	16	10	12	12	12	9	15	14	26	22	22	181
2023	MM	99.00	61.00	172.00	24.00	210.00	142.00	89.00	103.00	115.00	165.00	124.00	126.00	1,43
	HH	9	7	11	6	8	8	9	14	17	15	12	12	128
2024	MM	62.00	50.00	16.00	65.00	123.00	50.00	39.00	134.00	241.00	233.00	258.00	80.00	1,351
	HH	11	5	4	8	10	7	5	14	12	17	15	9	117
2025	MM	162.00	66.00	103.00	104.00	139.00	90.00	117.00	284.00	134.00	241.00	383.00	222.00	2,045
	HH	12	7	9	6	9	5	4	16	14	18	13	11	124
2026	MM	43.00	77.00	122.00	-	-	-	-	-	-	-	-	-	242
	HH	4	6	6	-	-	-	-	-	-	-	-	-	16

Source: PTPN IV Regional I Sei Putih Plantation (2026)

Table 2. Research Data on *O. rhinoceros* Attacks

TS	PS	TS	PS	TS	PS	TS	PS	TS	PS	TS	PS	TS	PS	TS	PS	TS	PS
1	1	2	1	3	1	4	1	5	1	6	1	7	1	8	1	9	1
	2		2		2		2		2		2		2		2		2
	3		3		3		3		3		3		3		3		3
	4		4		4		4		4		4		4		4		4
	5		5		5		5		5		5		5		5		5
	6		6		6		6		6		6		6		6		6
	7		7		7		7		7		7		7		7		7
	8		8		8		8		8		8		8		8		8
	9		9		9		9		9		9		9		9		9
	10		10		10		10		10		10		10		10		10
	11		11		11		11		11		11		11		11		11
	12		12		12		12		12		12		12		12		12
	13		13		13		13		13		13		13		13		13
	14		14		14		14		14		14		14		14		14
	15		15		15		15		15		15		15		15		15
	16		16		16		16		16		16		16		16		16
	17		17		17		17		17		17		17		17		17
	18		18		18		18		18		18		18		18		18
M1											1						
M2																	
M3									1								
M4	1		1														
PTS	16		14						12		6						
SK	1		3						2		2						

Information:

Ts = Sensu Point

Ps = Census Item

M1 = Week 1

M2 = Week 2

M3 = 3rd week

M4 = Week 4

Pts = Trees Attacked

Sk = Damage Scale

Red Mark = Tree Attacked

Based on observational data, the level of *Oryctes rhinoceros* infestation in TBM 1 in Afdeling III, covering a 21-ha block, is relatively low, as only a few infested plants were found at each census point. This indicates that the pest population remains under control, resulting in a relatively low risk of crop damage. This low infestation rate also improves control cost efficiency, as fewer control measures

are required and can be implemented more precisely.

3.3.1. *O.rhinoceros* attacks

Based on calculations, the intensity of *Oryctes rhinoceros* attacks on oil palm plants was 0.2%. This value indicates that the rhinoceros beetle infestation remains in the light category, as most plants experienced only minor

damage.

$$\begin{aligned}
 &= (5 \times 0) + (1 \times 1) + (2 \times 2) + (1 \times 3) + (0 \times 4) + (0 \times 5) \\
 &= 8 \times 5 \\
 &= 8 \\
 &\frac{40}{8} \times 100\% \\
 &= 0.2\%
 \end{aligned}$$

Although the infestation rate is relatively low and has not significantly impacted overall plant growth, the presence of this pest still requires attention. Routine monitoring and control are necessary to prevent an increase in the *Oryctes rhinoceros* population, which could cause more severe damage to oil palm plantations. **A37**

3.3.2. Special attack pattern results

So the average attack = 0.44, the Variance to Mean Ratio (VMR) calculation, a value of 0.44 was obtained. This value indicates that the distribution pattern of *Oryctes rhinoceros* attacks at the research location is uniform or even, because the VMR value is <1.

Table 3. Attack data from each sigma (TS)

Table 4. Normality Test Results

Tests of Normality						
	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistics	df	Sig.	Statistics	df	Sig.
PTS	.250	4	.	.927	4	.577
SK	.250	4	.	.945	4	.683

a. Lilliefors Significance Correction

Based on the results of the normality test using the *Shapiro-Wilk method*, it is known that the PTS variable has a significance value of 0.577 and the SK variable has a significance value of 0.683. Because both significance values are greater than 0.05 (Sig. > 0.05), it can be concluded that the PTS and SK data are normally distributed.

3.3.4. Attack Data Graphic Data

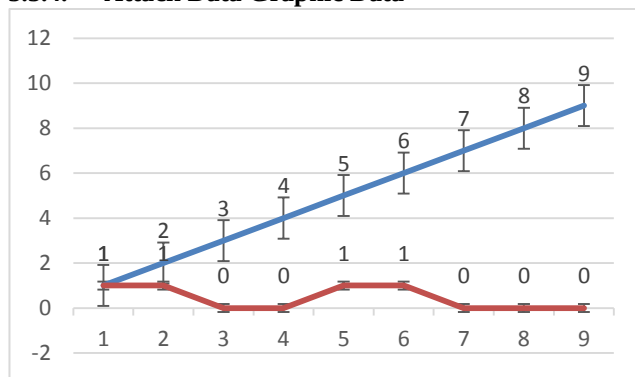


Figure 2. *Oryctes rhinoceros* pest attack graph

Oryctes rhinoceros infestation is relatively low, with only 0–1 infestations during the observation period.

TS	Number of Attacks
1	1
2	1
3	0
4	0
5	1
6	1
7	0
8	0
9	0

Number of sigma observations = 9

Results of attack sigma calculation

VMR = 4

9

VMR = 0.44

3.3.3. Normality Test Statistical Data

The stages of this research showed very significant results in both the first and fourth weeks. The results are shown in the table below.

Infestations were detected at some observation points, while none were found at other times, indicating that the pest population is still under control and has not caused significant damage. Although the plantation is relatively well maintained, regular monitoring and control are still necessary to prevent future pest population increases (Kurniasari, 2020).

3.4. Discussion of Research Results

Based on the results of research on oil palm plantations TBM 1 in Afdeling III with an observation area of ± 21 ha, it is known that the rhinoceros beetle (*Oryctes rhinoceros*) pest attack is still relatively low. Of the nine census points observed, attacks were only found in TS 1, TS 2, TS 5, and TS 6, while the other points did not show any symptoms of attack. This indicates that the pest population remains controlled and has not caused serious damage. The attack intensity obtained in this study was 0.2%, much lower than the results of research (Wong, 2022) on oil palm plantations at PT Cakra Alam Sejati, Riau Province, which reported a higher percentage of attacked plants and attack levels. Similarly, research by Landes *et al.* (2025) on oil palm plantations bordering replanting areas showed that the presence of replanting areas can increase the population and attack levels of *O. rhinoceros*. These

differences are thought to relate to garden sanitation conditions of the gardens, the availability of organic materials as breeding grounds for pests, plant age, and the effectiveness of control measures applied at each research location (Pramuhadi et al., 2020).

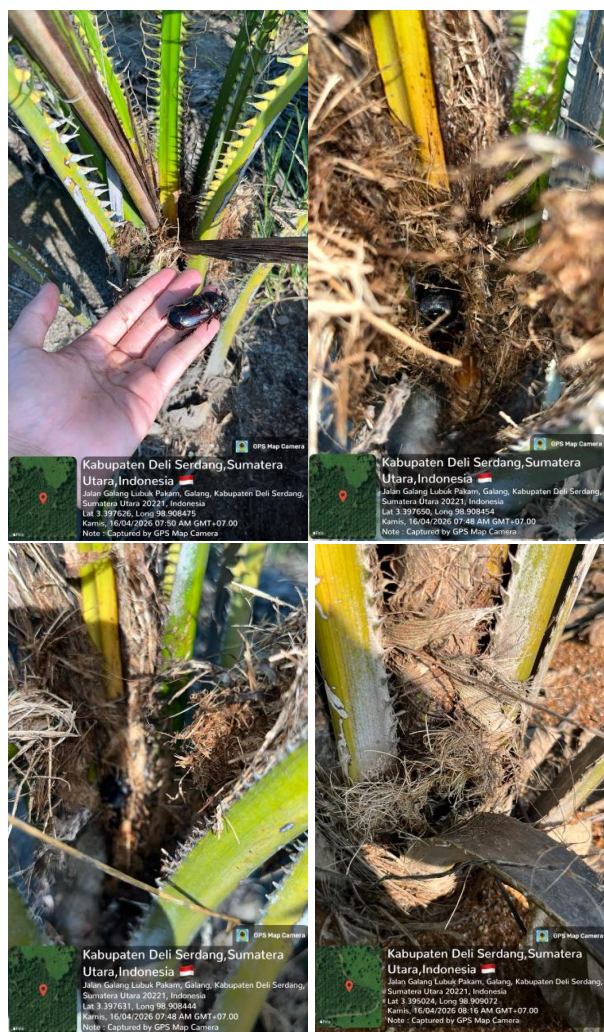


Figure 3. Distribution and Pattern of *Oryctes rhinoceros*

The low infestation rate is thought to be due to well-maintained gardens and routine sanitation and plant maintenance. Garden sanitation plays a crucial role in reducing breeding sites for *Oryctes rhinoceros*, such as rotting stems, accumulated fronds, and decaying organic matter (Pujiswanto, 2024).

The results showed that most attacks remained in the light category. This is reflected in the attack intensity value, which reached only 0.2%, indicating that the damage had not significantly affected the overall growth of the oil palm

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plantations.

Despite low infestation rates, *Oryctes rhinoceros* remains a major pest in the immature phase of plants. Attacks on the growing point can cause abnormal growth, damage young leaves, delay production, and even kill the plant if not properly managed (Idris et al., 2020).

Distribution pattern analysis showed that the pest infestation was uniform, with a Variance to Mean Ratio (VMR) of 0.44. This value indicates that the infestation was not clustered, but rather evenly distributed across the observation area. This pattern generally occurs when pest populations are low, and the plantation environment is relatively homogeneous.

The results of the normality test using the Shapiro-Wilk method indicated that the research data were normally distributed. The PTS variable had a significance value of 0.577 and the SK variable a significance value of 0.683, both of which were greater than 0.05. The four-week observation graph also showed a relatively stable attack rate, with the number of attacks only ranging from 0 to 1 in each observation period.

Research results show that *Oryctes rhinoceros* attacks on oil palm plantations in TBM 1 in Afdeling III are classified as mild, with low attack intensity and an even distribution pattern. This indicates that plantation management has been quite effective in suppressing the pest population. However, routine monitoring and control through plantation sanitation, ferotrap installation, biological control, and mechanical control are still necessary to prevent population increases and greater losses.

4. Conclusion

The results of the study showed that the attack of *Oryctes rhinoceros* on oil palm plants (TBM 1) in Afdeling III was relatively low, with an attack intensity of 0.2% and a uniform distribution pattern indicated by a Variance to Mean Ratio (VMR) of 0.44. These findings suggest that the condition of the replanting area at the research site is still capable of suppressing pest development. This study provides information on the level of attack and the distribution pattern of *O. rhinoceros*, which can serve as a basis for developing more effective pest monitoring and control strategies. To maintain these conditions, regular population monitoring and the implementation of sustainable plantation sanitation are recommended to prevent an increase in attacks in the future.

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