



RESEARCH ARTICLE

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Attraction Test of the Horned Beetle (*Oryctes rhinoceros* L.) Effect of Natural Attractants on Pineapple Fermentation (*Ananas comosus*) and Palm Oil (*Arenga pinnata*) at PTPN IV Sei Putih Plantation, North Sumatra, Indonesia

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Abstract

Oil palm is a strategic plantation commodity with high economic value, but its productivity can decline due to attacks by *Oryctes rhinoceros*, which damage plants during the immature phase. This study aims to evaluate the response of adult *Oryctes rhinoceros* to several fermented organic material-based attractants. The research was conducted at PTPN IV Sei Putih Plantation, Deli Serdang Regency, North Sumatra, in February-March 2026, using a field experiment with a non-factorial Randomized Block Design (RBD) consisting of 4 treatments and 3 replications. The treatments tested included control (P0), pineapple fermentation (P1), palm sap fermentation (P2), and a combination of pineapple fermentation and palm sap (P3). Observations were made over 7 days, recording the number of *Oryctes rhinoceros* adults caught in each trap. The results showed that the treatments had a significant effect on the number of catches based on analysis of variance (ANOVA). Treatment P1 produced the highest number of catches, totaling 74 individuals with an average of 3.52 individuals per trap per day, while the control treatment showed no catches. Sex identification revealed that males were more dominant than females across all treatments. The use of fermented pineapple-based attractants demonstrated the highest effectiveness compared to other treatments, making it a potentially economical, easy-to-apply, and environmentally friendly control alternative. Therefore, this material is recommended for use as a component of integrated *Oryctes rhinoceros* control in oil palm plantations.

Keywords: Evaluate, Imago, Lure, Organic, Response

1. Introduction

Oil palm (*Elaeis guineensis* Jacq.) is a national strategic commodity that plays a vital role in the Indonesian economy. According to the 2023 Indonesian Palm Oil Statistics, the national oil palm plantation area reached 15.95 million hectares, with crude palm oil (CPO) production reaching 48.29 million tons. The palm oil subsector's contribution to Indonesia's export foreign exchange earnings is substantial, with exports of palm oil and its derivatives reaching 33.66 million tons in 2023, with an export value of approximately USD 26.33 billion

(BPS, 2023).

This performance makes oil palm one of the main pillars of the national economy, as well as a source of income for millions of farmers in various regions. However, national oil palm productivity is still often hampered by various agronomic constraints, especially pests and diseases. One of the main plant pests (OPT) that significantly reduces yields is the rhinoceros beetle (*Oryctes rhinoceros*), which attacks young plants by damaging the growing point. *Oryctes rhinoceros* attacks on oil palm plants not only occur in the immature plant phase

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(TBM), but can also attack mature plants (TM), thus directly impacting production reductions. The intensity of attacks in the mature phase can vary from mild to severe, and in high attack conditions it has been reported to cause the death of mature plants up to around 13%, which ultimately reduces the potential productivity of the plantation significantly (Susanto & Brahmana, 2018).

Oryctes rhinoceros attacks can damage young plant tissue and growing points, which play a crucial role in leaf sheath formation and crown development. This damage disrupts vegetative growth, reduces photosynthetic surface area, reduces flower and fruit bunch formation, and increases the plant's vulnerability to attacks by other pests. If attacks persist and are not properly controlled, this condition can lead to decreased fresh fruit bunch production, reduced harvest yields, and reduced overall productivity of oil palm plantations.

Based on reported research results (Mila Lukmana & Faisal Alamudi, 2018), *Oryctes rhinoceros* attacks on TBM 2 oil palms in Block B24 North showed an attack intensity of 3.86%, categorized as a light attack. A field census of 150 trees revealed that the attacked plants were in criteria 1–3, characterized by boreholes at the base of the frond, broken fronds that were bored, and the appearance of a “V”-shaped cut pattern on young leaves. These data confirm that although attack intensity remains low, the presence of 16 attacked trees per hectare indicates the potential for an increase in the pest population if early control is not implemented, given that the PPKS threshold for action is the discovery of 10 fresh boreholes per hectare. These findings confirm the importance of routine monitoring as a basis for making quick and accurate pest control decisions to prevent an increase in the attack category. (Manda et al., 2024).

Oryctes rhinoceros is a major pest in oil palm plantations and significantly reduces productivity. This pest typically attacks young plants by damaging the growing point, inhibiting growth and even causing plant death. This problem is becoming increasingly important because increased *Oryctes rhinoceros* infestations are closely linked to the availability of organic resources in plantations, particularly in areas with accumulations of decaying oil palm trunks or fronds (Wirandanu & Oktari, 2025).

Current control efforts still rely on synthetic pheromone traps, which are relatively expensive and difficult for smallholder farmers to access. Therefore, cheaper, readily available, and environmentally friendly alternatives are needed, such as the use of natural ingredients like pineapple juice and fermented pineapple juice. A mixture of pineapple juice and fermented pineapple juice produces an aroma that attracts horned beetles (Rahmawati & Barokah, 2024).

Several previous studies have shown that natural attractants are capable of attracting *Oryctes* adults because they contain volatile compounds that act as aroma stimuli.

For example, pineapple juice has been reported as a potential pest-control strategy (Jhon Hardin Bangun & Indah Apriliya, 2025). These findings provide a scientific basis for the use of natural ingredients that produce fermented aromas as attractants for target insects. However, previous studies generally focused on the use of a single type of natural attractant. They did not compare the effectiveness of multiple attractants or ingredient combinations in attracting *Oryctes rhinoceros* in the field. The novelty of this study lies in the testing and comparison of pineapple fermentation, palm sap fermentation, and a combination of the two to determine the most effective treatment in attracting *Oryctes rhinoceros* adults in oil palm plantations. This study also provides information on the number of catches and the sex composition of beetles attracted to each treatment. The results obtained are expected to enrich information on the use of fermented ingredients as natural attractants and become a more economical and environmentally friendly control alternative in oil palm plantations.

Based on this background, a study entitled "Attraction Test of *Oryctes rhinoceros* Horned Beetle Pests to Natural Attractants of Pineapple Fermentation (*Ananas comosus*) and Palm Sap (*Arenga pinnata*) at PTPN IV Sei Putih Plantation" was conducted to test the effectiveness of natural attractants in the form of pineapple fermentation, palm sap, and a combination of both on the number of *Oryctes rhinoceros* imago catches in oil palm plantations using simple traps in the field. This study aims to determine the effect of each treatment on the total number and average catches per trap per day, compare the effectiveness of the attractant combination with single treatments or controls, and observe the comparison of male and female beetle catches and the presence of other insects trapped during the observation. The results of the study are expected to provide information on more economical, practical, and environmentally friendly natural attractants as an alternative to control *Oryctes rhinoceros* pests, while supporting sustainable oil palm plantation management.

2. Material and Methods

This research was conducted at PTPN IV Kebun Sei Putih, Galang District, Deli Serdang Regency, North Sumatra from February to March 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 materials used include ripe pineapple and palm sap as natural attractants. At the same time, the research equipment consists of a blender, sieve, plastic bottle, measuring cup, digital scale, bamboo or wooden support, rope, knife, bucket, stationery, documentation camera, and Global Positioning System (GPS) to determine the coordinates of the research location.

The study used a quantitative field experiment with a non-factorial Randomized Block Design (RBD) consisting

of 4 treatments and 3 replications, resulting in 12 experimental units in the form of traps. The treatments tested included P0 as a control without attractant, P1 in the form of fermented pineapple, P2 in the form of fermented palm sap, and P3 in the form of a combination of fermented pineapple and palm sap with a ratio of 1: 1. All attractants were fermented for 24 hours at room temperature and applied as much as 100 mL per trap using a measuring cup as an application tool. The traps were made from plastic bottles mounted on bamboo or wooden poles 2.5 meters high, with a distance of 25 meters between traps. Observations were carried out for 7 consecutive days by recording the number of catches of male and female *Oryctes rhinoceros* imago and the presence of other insects trapped.

Observation data were calculated as total and average daily catches for each treatment. We identified beetle sex based on the morphological characteristics of the horns on their heads. The data were then analyzed using ANOVA to determine the effect of the treatments on the number of *Oryctes rhinoceros* catches. If significant differences were found, Duncan's Multiple Range Test (DMRT) was used at the 5% level to compare treatments. Data processing was performed using IBM SPSS Statistics version 26 and Microsoft Excel 2021, while tables, graphs, and documentation of the research results were prepared using Microsoft Office 2021.

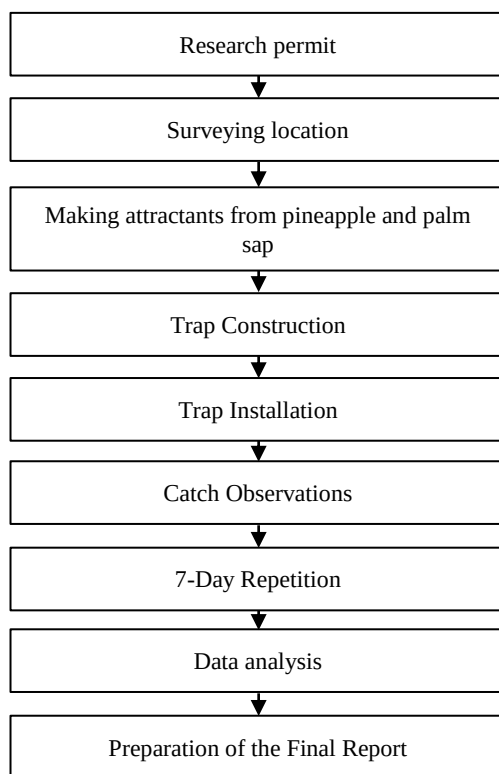


Figure 1. Research Flowchart

3. Results and Discussion

3.1. Overview of Research Location

Sei Putih Plantation is one of the plantation units under the auspices of PT Perkebunan Nusantara IV Regional I. Historically, this plantation originated from a plantation company owned by the Dutch colonial government, which was later nationalized by the Indonesian Government under Law Number 86 of 1958. Along with institutional development, plantation management underwent several changes until finally it became part of the transformation of the PalmCo subholding (PTPN IV) in 2023 to increase the efficiency and competitiveness of the national plantation industry. Geographically, Sei Putih Plantation is located in Galang District, Deli Serdang Regency, North Sumatra, with an altitude ranging from 37.5–112 meters above sea level and borders several surrounding villages, such as Sei Karang Village, West Galang, Tagor Island, and Tanjung Purba.

The research location was in Afdeling III, within a one-year-old area of immature plantations (TBM), with environmental conditions conducive to the development of the *Oryctes rhinoceros* pest. Piles of organic matter, such as oil palm fronds and decaying plant debris, were still found in several locations, potentially serving as breeding grounds for rhinoceros beetles. Furthermore, mild infestation symptoms, such as burrow marks, were still observed on young oil palm fronds and shoots. Plantation humidity, land sanitation, and the presence of organic matter are suspected to influence the activity and attraction of *Oryctes rhinoceros* to the research location.

3.2. Research result

3.2.1. Number of Horned Beetles Caught

The number of *Oryctes rhinoceros* catches was observed daily for 7 days in traps treated with pineapple, palm sap, a combination, and a control attractant to determine the level of pest attraction to each treatment. The observation data are presented in the appendix and then analyzed using analysis of variance (ANOVA) to determine the effect of the treatments on the number of *Oryctes rhinoceros* catches.

Table 1. Number of Daily Catches of *Oryctes rhinoceros* in Each Treatment

Day	P0	P1	P2	P3
1	0.00 ± 0.00	8 ± 0.67	3 ± 0.58	3 ± 1.00
2	0.00 ± 0.00	15 ± 1.53	1 ± 0.33	2 ± 0.00
3	0.00 ± 0.00	12 ± 1.15	1 ± 0.33	4 ± 0.33
4	0.00 ± 0.00	4 ± 0.67	2 ± 0.33	4 ± 0.33
5	0.00 ± 0.00	12 ± 2.08	5 ± 0.67	0.00 ± 0.00
6	0.00 ± 0.00	10 ± 0.88	1 ± 0.33	4 ± 0.33
7	0.00 ± 0.00	13 ± 2.03	0.00 ± 0.00	7 ± 1.45

Based on the results of the analysis of variance using SPSS, the following results were obtained in Table 3. Based on the results of the analysis of variance (ANOVA), the value of $F_{(3,80)} = 26.108$ was obtained with a significance value of $p < 0.001$. The results of the

normality and homogeneity of variance tests showed that the data met the ANOVA assumptions so that the analysis could be continued. This value indicates that the treatment had a significant effect on the number of *Oryctes rhinoceros* catches, so a further Duncan Multiple Range Test (DMRT) was carried out at the 5% level.

Table 1 of *Oryctes rhinoceros* Catches

Treatment	Total	Average
P1	74	3.52 ± 0.50
P2	13	0.62 ± 0.17
P3	24	1.14 ± 0.28
P0	0	0.00 ± 0.00

Table 3. Results of Variance Analysis Using SPSS

Sources of Diversity	Degrees of Freedom (df)	Sum of Squares (SQ)	Central Square (CT)	F Count	Sig.
Treatment	3	149,560	49,853	26,108	0,000
Error	80	152,762	1,910		
Total	83	302,321			

Table 4. Duncan's Advanced Test (DMRT) Results

Treatment	n	Average Total Catch	DMRT 5% Notation	Treatment
P1	21	3.52 ± 0.50	a	P1
P3	21	1.14 ± 0.17	b	P3
P2	21	0.62 ± 0.26	bc	P2

Mean values followed by the same letter indicate no significant difference based on Duncan's test at the 5% level ($\alpha = 0.05$). The mean used is the observed mean from SPSS output with 21 replications for each treatment, while the notation is based on the results of Duncan's Homogeneous Subsets test.

Duncan's test showed that treatment P1 produced the highest average total catch and differed significantly from the other treatments. Treatment P2 was not significantly different from P0 or P3 because it was in the same homogeneous subset, while P3 was significantly different from P0. Thus, treatment P1 was the most effective treatment for the total catch of *Oryctes rhinoceros*.

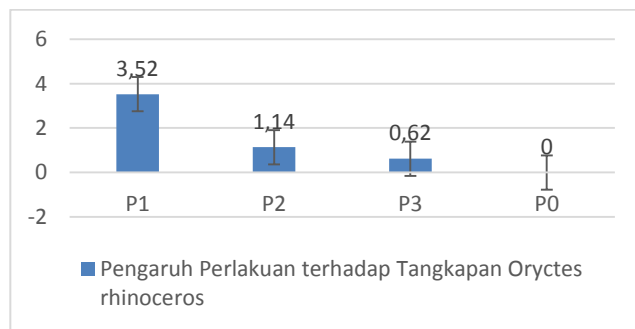


Figure 2. Diagram of the Effect of Treatment on Catches of *Oryctes rhinoceros*

The graph shows that treatment P1 yielded the highest average catch and was significantly different from the other treatments based on Duncan's test at the 5% level. Treatments P2 and P3 did not differ significantly, while treatment P0 yielded the lowest catch.

3.2.2. Number of Other Insects Caught

Based on field observations, the non-target insects caught are suspected to be *Anomala* sp. from the Scarabaeidae family, known as the puthul beetle or night beetle. The number of non-target insects caught varied across treatments, while documentation and a summary of the catch figures are presented in the following table:

Table 2 Number of Other Insects Trapped

Treatment	Amount	Average
P0	0	0.00 ± 0.00
P1	63	3.00 ± 0.52
P2	35	1.67 ± 0.51
P3	45	2.05 ± 0.62

Based on the table, the highest number of other insects trapped was in treatment P1, namely 63 individuals, followed by treatment P3 with 45 individuals and P2 with 35 individuals. In contrast, treatment P0 showed no captures. The high number of non-target insects caught in certain treatments indicates that the attractant used was not fully selective for *Oryctes rhinoceros*. This is in line with previous research which shows that insect attraction to attractants is influenced by volatile compounds that are present in the environment, thus functioning as chemical signals that can attract insects from a certain distance (Candra et al., 2019).

3.2.3. Identification of the Sex of the Horned Beetle

Based on the results of gender identification of the captured beetles, data were obtained as in the Table 6. Based on the table, the number of male beetles caught was more dominant than females in all treatments. Treatment P1 showed the highest number of catches for both males and females, namely 67 males and 7 females. The dominance of male beetle catches is suspected to be related to a higher response to the fermentation aroma produced by pineapple and palm sap attractants. This fermentation aroma produces volatile compounds that can attract *Oryctes rhinoceros imago*.

Based on the percentages, male beetles dominated catches across all treatments. The highest percentage of male beetles was in treatment P3 (95.83%), while the lowest was in treatment P2 (76.92%). This indicates that males predominantly responded to the attractant. This finding aligns with previous research showing that male rhinoceros beetles were predominantly captured (Hardiansyah et al., 2022).

Table 3 Number of Male and Female *Oryctes rhinoceros*

Treatment	Male	Mean $\pm$ SE Male	Female	Mean $\pm$ SE Female	Total	Mean $\pm$ SE Total
P1	67	3.19 $\pm$ 0.53	7	0.33 $\pm$ 0.11	74	3.52 $\pm$ 0.50
P2	10	0.48 $\pm$ 0.17	3	0.14 $\pm$ 0.08	13	0.62 $\pm$ 0.17
P3	23	1.10 $\pm$ 0.31	2	0.10 $\pm$ 0.07	24	1.14 $\pm$ 0.28
P0	0	0.00 $\pm$ 0.00	0	0.00 $\pm$ 0.00	0	0.00 $\pm$ 0.00

Table 4 Percentage of Gender

Treatment	Male (%)	Female (%)
P1	90.54%	9.46%
P2	76.92%	23.08%
P3	95.83%	4.17%
P0	0%	0%

3.2.4. Total and Average Catch Between Treatments

Based on the results of the observations that have been carried out, the total and average number of *Oryctes rhinoceros* catches in each treatment were obtained as presented in the table below:

Table 5 Total and Average Catch

Treatment	Total Catch (tail)	Average Catch (tail/trap/day)
P1	74	3.52 $\pm$ 0.56
P2	13	0.62 $\pm$ 0.17
P3	24	1.14 $\pm$ 0.28
P0	0	0.00 $\pm$ 0.00

The average catch was obtained by dividing the total number of catches by 21 observation units in each treatment. Based on the results, treatment P1 produced the highest total and average catch, with 74 individuals and an average of 3.52 individuals/trap/day. At the same time, P2 and P3 showed lower catches, and P0 produced no catch. These results indicate that the pineapple fermentation attractant is more effective in attracting *Oryctes rhinoceros* adults than the other treatments, as supported by the results of the analysis of variance and further DMRT tests.

3.3. Discussion of Research Results

3.3.1. Number of *Oryctes rhinoceros* catches

Based on the research results, the use of natural attractants of pineapple fermentation and palm sap water affects the number of *Oryctes rhinoceros* catches. The results of the analysis of variance (ANOVA) showed that the treatments given had a significant effect on the number of adults caught. The pineapple fermentation treatment (P1) produced the highest number of catches, namely 74 individuals, followed by the combination of pineapple fermentation and palm sap water (P3) with 24 individuals, and palm sap water fermentation (P2) with 13 individuals. In contrast, the control treatment (P0) produced no catches during the study.

The high catch rate in the pineapple fermentation treatment is thought to be due to the fermentation aroma produced by the sugars, esters, alcohols, and organic acids

in pineapples. These volatile compounds act as chemical signals that attract *Oryctes rhinoceros* adults. The resulting aroma resembles the odor of decomposing organic matter, which naturally serves as a food source and breeding ground for rhinoceros beetles. This makes adults more attracted to traps containing pineapple fermentation than to other treatments.

The results of this study align with those of García et al. (2021), who stated that pineapple produces various volatile aromatic compounds, such as esters and alcohols, that can produce a strong aroma. This finding is also supported by Munawaroh et al. (2023), who reported that pineapple-based materials have the potential to be used as natural attractants in controlling *Oryctes rhinoceros* in oil palm plantations.

The combination of pineapple fermentation and palm sap water resulted in lower catch rates than pineapple fermentation alone. This indicates that mixing the two ingredients did not optimally increase the attractant's attractiveness. Palm sap water fermentation was still able to attract *Oryctes rhinoceros*, but its effectiveness was lower than that of pineapple fermentation. The difference in catch rates between treatments is thought to relate to the type and concentration of volatile compounds produced during fermentation.

3.3.2. Non-Target Insect Catch

Observations showed that non-target insects were found in all treatments using natural attractants and were caught. The highest number of non-target insects caught was found in the pineapple fermentation treatment, followed by the combination of pineapple fermentation and palm sap water, and palm sap water fermentation. Meanwhile, the control treatment caught the fewest non-target insects.

The presence of non-target insects in the traps indicates that the volatile compounds produced during the fermentation process not only attract *Oryctes rhinoceros* but also attract a variety of other insects that respond to the aroma of fermented organic matter. The aroma produced by fermentation contains alcohols, organic acids, and esters that various insect groups can detect.

The high number of non-target insects in the pineapple fermentation treatment indicates that the attractant strongly attracts various insect species. However, the pineapple fermentation's ability to attract *Oryctes rhinoceros* was still higher than that of non-target insects, suggesting that the

material still has potential as a natural attractant for rhinoceros beetle control.

3.3.3. Sex of Caught *Oryctes rhinoceros*

Sex identification results showed that male adults were captured more frequently than female adults in all treatments. Of the total catches, males accounted for 100, while females accounted for only 12. Male dominance was observed in all treatments using natural attractants.



Figure 2. Results of the *Oryctes rhinoceros* catch

Male dominance is thought to relate to their higher food-seeking behavior and stronger response to volatile compounds than females. Male imagoes tend to be more active and explore larger areas, increasing their chances of

finding sources of fermentation aromas. This activity results in a higher number of males being caught in traps than females.

The results of this study align with those of Hardiansyah et al. (2022), who reported that *Oryctes rhinoceros* catches in attractant traps were generally dominated by males. The male dominance in traps indicates that the volatile compounds produced by natural attractants can attract a greater number of males than females.

4. Conclusion

Based on the research results, pineapple fermentation attractant (P1) was the most effective treatment in attracting *Oryctes rhinoceros* adults, with the highest number of catches, namely 74 individuals or an average of 3.52 individuals/trap/day. These results indicate that pineapple fermentation has the potential to be used as a more economical, readily available, and environmentally friendly natural attractant in controlling rhinoceros beetles in oil palm plantations. Male individuals also dominated imago captures in all treatments.

Users, particularly oil palm plantation managers, are recommended to utilize fermented pineapple as an alternative attractant in *Oryctes rhinoceros* control programs. This attractant can be used as part of integrated pest management to help suppress rhinoceros beetle populations more sustainably.

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