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Trap Engineering Against The Effectiveness of Caught Imago Rhinoceros Beetle on Palm Oil Plants

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Abstract: This study aims to find out the engineering of traps against the effectiveness of caught by rhinoceros beetles on palm oil plants. This research was carried out on farmers who were planted in Sidadi Village, Batang Angkola Subdistrict, South Tapanuli Regency. From October to December 2020. The method used in this study is a survey with a sampling technique that is purposive sampling. Traps are installed at as many as 2 points on an area of 720 m² with a population of 110 palm oil stalks. Traps were placed at the location of many O. rhinoceros attacks. Ember has a trap size of 20 liters, and at the base of the bucket made 4 holes diameter of 2 mm for water disposal. The zinc plate is cleaved in 2 parts of the faucet 30 x 25 cm arranged in pairs in a 4-room-shaped space placed on top of the bucket and tied with a fastening wire. Pheromones are removed from the packaging and hung on zinc traps given gaps on 4 sides. Trap II, Plastic bucket as a trap. The plastic bucket size of 20 liters, the lid of the bucket is perforated with as many as 5 holes (diameter 55 mm) placed upside down, based on the plastic bucket made 4 holes (diameter 2 mm) for water disposal; Pheromones (Ethyl 4-mathyloctanoate) are removed from the packaging, wrapped around a small 10 cm long wire, and attached to the lid of a plastic bucket that is placed upside down. The results showed that the most effective trap installation is trap 1 which has a higher ability to control rhinoceros beetle pests (Oryctes rhinoceros) which are as many as 46 tails compared to 2 traps with as many as 41 tails on plants that have not produced palm oil.

Keywords : Imago; Palm Oil; Rhinoceros Beetle; Trap

Introduction

Palm oil plant is a plantation crop commodity that is widely grown in Indonesia because it has a high economic value (Aulia et al., 2020; Nurfatriani et al., 2022; Syahza et al., 2020), so it can become one of the country's foreign exchange and create jobs that lead to the welfare of the community. One of the obstacles to palm oil plants is a pest that can cause a decrease in the production of these plants.

Rhinoceros beetles (Coleoptera: Scarabaeidae, Dynastinae) are the main pests in oil palm plantations (Hawkeswood & Sommung, 2019). The problem of rhinoceros beetle pests is getting serious with the use of empty bunches in the area of palm oil plants as mulch and substitutes for non-organic fertilizers (Gomes et al., 2021; Hamzah et al., 2019). The utilization of empty bunches is widely applied to the area of the plant that has not been produced and on the producing plant. The negative impact of the use of empty bunches is as a breeding ground for O. rhinoceros. As a result of this pest attack oil palm plantations can suffer huge financial losses. This pest is a very deadly palm oil plant. Attacks can occur on young to old palm plants. The O. rhinoceros beetle attacks newly planted palm oil plants until it is 2.5 years old. This beetle is rarely found attacking palm oil that has been produced. Beetles scrape the shoots to the point of growing causing leaf malformations. In the attack of heavy areas, almost all

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plants are attacked by this pest, even one plant can be moved several times by these beetles so that it can cause death in plants (Santi et al., 2008; Santi et al., 2022).

O. rhinoceros control efforts can be done technically by cutting down dead plants and then the wood is used for firewood or home furnishings (Oswalt et al., 2019). Pesticides are also used to control these insects, for example spraying Aldrin 40% WP, Toxaphene, and BHC puder level of 0.1% . According to Alouw et al. (2020), pesticide use is considered to have an impact on environmental pollution, the killing of non-targeted living things, and continuous administration causes O. rhinoceros to become resistant (Kumara & Mubarak, 2022; Ong & Sajap, 2022). Therefore, it is necessary to pursue a safe control method.

To support the use of pheromones, it is necessary to choose the appropriate type of trap (Chambers, 1990; Šramel et al., 2021). The selection of the type of trap depends on the type or species of insect (Bedford, 2014) to be caught and the purpose of the capture itself. For monitoring the presence of insects and the types of insects that exist, trap engineering is used which is a 20-liter plastic bucket (Main et al., 2016), a 5-hole perforated bucket cap (55 mm in diameter), and a 20-liter bucket trap with zinc plates. The selection of pheromones is very important. This is due to indications of differences in insect response to pheromones fed in an area or region, concerning the composition of different types of pheromones.

Method

This research was carried out on farmers who were planted in Sidadi Village, BatangAngkolaSubdistrict, SouthTapanuli Regency. From October to December 2020. The tools used in this study are 6 liters of plastic buckets, zinc, plastic mining ropes, poles (pipes/ wood), a ruler, a camera, stationery, and scissors.

The method used in this study is a survey with a sampling technique that is purposive sampling (Johari et al., 2021). Traps are installed at as many as 2 points on an area of 720 m^2 with a population of 110 palm oil stalks. The installation of traps is carried out at 08.00 WIB and the first observation is carried out 1 week after the trap is installed. The taking of insects is carried out at a monitoring interval of 3 days. Observations were made 8 times. O. rhinoceros obtained from each trap is collected.

This study tested traps against O. rhinoceros pests, namely PF = Traps with pheromones (Ethyl 4-methyloctanoate). The survey was conducted on land that is oil palm plantations in land areas in Sidadi Village, BatangAngkola District, SouthTapanuli Regency with a land area of 720 m^2 each then determined the points of installation of traps, to be determined 2 points. Survey the location of the research that aims to find out the state of the location that is used as a place for research implementation. Traps with pheromones (Ethyl 4-methyloctanoate) consist of two types:

Trap 1 (engineered trap)

The bucket has a trap size of 20 liters, at the base of the bucket, made 4 holes diameter of 2 mm for water disposal. The zinc plate is cleaved in 2 parts of the faucet 30 x 25 cm arranged in pairs in a 4-room-shaped space placed on top of the bucket and tied with a fastening wire. Pheromones are removed from the packaging and hung on zinc traps given gaps on 4 sides. Zinc plates are made so that after the beetle smells the scent of pheromones then the beetle will hit the zinc plate and because it is slippery the beetle will fall into the bucket and if the beetle will fly and will be blocked by the zinc plate.

Trap 2 (Plastic buckets as traps)

A plastic bucket size of 20 liters, the lid of the bucket is perforated with as many as 5 holes (diameter 55 mm) placed upside down, based on the plastic bucket made 4 holes (diameter 2 mm) for water disposal; Pheromones (Ethyl 4-methyloctanoate) are removed from the packaging, wrapped around a small 10 cm long wire, and attached to the lid of a plastic bucket that is placed upside down. The advantage of this trap is to only use buckets and not use zinc plates so that the cost used is cheaper and when the pest has entered the bucket, pests can not get out anymore.

O. rhinoceros Population Observation Time

Observation is carried out 7 days after the installation of traps, for 8 observations and made at 09.00-14.00 WIB. Samples are obtained by take beetles caught on each treatment and Imago *O. rhinoceros* comparison caught. Observations were made after the sample was obtained by comparing the physical features of each Caught *O. rhinoceros* imago.

Observation Parameters consist of number of catches of imago *O. rhinoceros* (tail) per treatment. This observation is done by calculating the imago *O. rhinoceros* (tail) caught at each treatment and number of catches of male imago *O. rhinoceros* and female *O. rhinoceros* imago (tail) each treatment.

Result and Discussion

The number of catches of imago O. rhinoceros in palm oil plants can be seen in Table 1. The largest number of Cago O. rhinoceros catches is in trap I which is 46 with an average imago population trapped 5.75 followed by trap II with an average of 5,125 tails. This is

because trap II uses a cover so that the chances of pheromones evaporating are less so that they are caught also less. In addition, the intensity of damage to the observation site falls into the weight category. Type of trap I, trapping imago O. rhinoceros with the largest number (46 tails) compared to trap II as many as 41 tails. This is because the synthetic pheromones (ethyl 4-methyloctanoate) used in traps are a type of aggregation pheromones. Pheromones aggregation are chemicals released by insects to attract male and female insects to gather, find mates, and continue with copulation, defend themselves against predator attacks, and overcome the resistance of host plants by en masse attack (Prasad, 2022; Reddy & Guerrero, 2004).

Table 1. Number of catches of imago *O. rhinoceros* (tail) per treatment

Observation	Trap I	Trap II
1	1	0
2	12	7
3	14	13
4	2	12
5	3	4
6	10	5
7	2	0
8	2	0
Total	46	41
Average	5.75	5.125

The number of catches of male imago *O. rhinoceros* and female *O. rhinoceros* (tail) catches each treatment. The results of the study on the number of palm oil crop pests caught obtained a comparison of the catch of imago *O. rhinoceros*.

This type of trap with pheromones traps the female O. rhinoceros (tail) with a greater number than the male O. rhinoceros (tail), by comparison (12:34, and 5:36 or 26:74 and 12:88)%. This type of trap with pheromones is a type of trap that uses synthetic aggregation pheromones with the chemical compound ethyl 4-methylactonoate. Ethyl 4-methyloctanoate is an aggregation pheromone compound produced by the male imago O. rhinoceros. Then the use of pheromones will attract more female insects (Levi-Zada & Byers, 2021; Regnier & Law, 1968). This was reinforced by (Hasni et al., 2017), which stated synthetic aggregation pheromones (Ethyl 4-methyloctanoate) attracted 69-79% of female imago while male imago attracted only 21-31%.

The use of traps using pheromones can result in a decrease in the population of O. rhinoceros in the field in the next generation, this is due to changes in the rate of birth. One of the main factors determining the rate of birth is the ratio of sex. The sex ratio in most insect populations is 1:1, male to female (Hadi et al., 2009). But with the use of pheromones, there is a change in the ratio of sex in the field to 2:1 or 3:1 males to females, because pheromones attract 69-79% of female imago while male imago is only 21-31%. The reduction of female imago individuals in the field can result in a decrease in the birth of new individuals, due to disruptions in the mating process (mating of insects). Strengthened by Hadi et al. (2009) who stated that the change in the proposed imago of females in the field caused a change in the rate of birth.

Table 2. Number of catches of male imago *O. rhinoceros* and female *O. rhinoceros* (tail) catches each treatment

Observation	Trap I		Trap II	
	Male	Female	Male	female
1	0	0	0	0
2	1	11	2	5
3	4	10	1	12
4	1	1	0	12
5	0	4	1	3
6	5	5	1	4
7	0	2	0	0
8	1	1	0	0
Total	12	34	5	36
Average	1.5	4.25	0.625	4.5

From the results obtained by the goddess that the spread of beetles can be influenced by several factors including environmental factors such as temperature, rainfall, humidity, and wind. This is following Fauzi et al. (2012) who state that the spread of animals and plants in nature is not a coincidence but a result of the interaction of the influence of environmental factors on it.

Factors that can affect population density are food availability, temperature, temperature range, humidity/rain, light/color/smell, wind, and topography. Physical factors are one of the factors that affect insects more than other factors (Jumar, 2000). The large density of rhinoceros beetles on the dark moon compared to the light moon is thought to be caused by light factors. Where the behavior of larvae is dominated by light factors, moving larvae are influenced by a light that appears suddenly (Maldonado & Young, 1996; Xu et al., 2022). Features of the Rhinoceros Beetle The results of observations of the characteristics of male rhinoceros beetles and trapped female rhinoceros beetles can be seen in the Table 3.

Table 3. Features of the Rhinoceros Beetle

Male	Female
Horns are longer, curved backward and pointed	Shorter horns, in the form of protrusions and not pointed
Smaller, longer body size	Body size is bigger, shorter
The hair of the end of the abdomen is not there.	The feathers of the abdomen end are thicker
More shiny colors	Color is not shiny

Pigidium (tail) does not protrude. Pigidium stands out more.

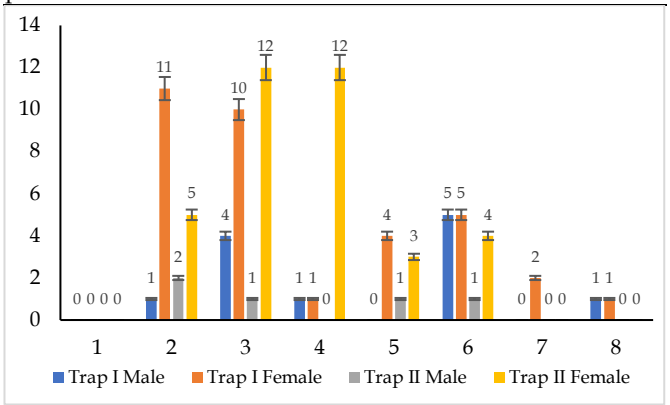

Figure 1. Number of caught by male and female imago O. rhinoceros (tail)

Prominent difference is in the head because the horns of male beetles are longer and pointed while female horned beetles are shorter and not pointed. Beetletanduk (*O. rhinoceros* L.) with the characteristics of an egg round or elongated body shape, blackish brown color, shiny, the length can reach approximately 5-6 cm, has one horn on the head, is quite large, has sharp thorny legs, has two pairs of wings, male beetles have longer horns than female beetles, female beetles have hair at the ends of the abdomen while male beetles do not have hair at the ends of the abdomen (Borror et al., 1992).

The characteristics of horn beetles obtained are the shape of the egg round or elongated body, black brown, shiny, has one horn on the head. The body size of the male is longer than the female with a body length ranging from 45-47 mm, a width of 21-23 mm and a horn length of 6-10 mm, the male beetle has longer horns than the female while the female beetle has hair at the end of the abdomen and the male does not, has 2 wings. While Wood (2000) stated the characteristics of horn beetles are dark brown black, shiny, 35-50 mm long and 20-23 mm wide with one horn protruding on the head. Male beetles have longer horns than females while females have a lot of hair at the end of the last section of the abdomen and males do not.

Conclusion

The most effective trap installation is trap 1 which has a higher ability to control rhinoceros beetle pests (Oryctes rhinoceros) which is as many as 46 tails compared to 2 traps as many as 41 tails in plants have not produced palm oil. Researchers are next to be able to research the difference in the height of traps on oil palm land. For insect control, it is necessary to determine the optimal number of traps to obtain maximum control results.

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References

Alouw, J. C., Hosang, M. L. A., & Nguyen, Q. (2020). Biotechnology contributing to integrated pest management: The example of two major coconut pests, Oryctes rhinoceros and Brontispa longissima. *Coconut Biotechnology: Towards the Sustainability of the 'Tree of Life,'* 151–168. https://doi.org/10.1007/978-3-030-44988-9_8

Aulia, A. F., Sandhu, H., & Millington, A. C. (2020). Quantifying the economic value of ecosystem services in oil palm dominated landscapes in Riau Province in Sumatra, Indonesia. *Land*, *9*(6), 194. https://doi.org/10.3390/land9060194

Bedford, G. O. (2014). Advances in the control of rhinoceros beetle, Oryctes rhinoceros in oil palm. *Journal of Oil Palm Research*, *26*(3), 183–194. Retrieved from http://jopr.mpob.gov.my/wp-content/uploads/2014/10/joprv26sep2014-geoffrey.pdf

Borror, D. J., Johnson, N. F., & Triplehorn, C. A. (1992). *Pengenalan Pelajaran Serangga, edisi ke enam. Terjemahan Soetiyono*. Gadjah Mada University Press.

Chambers, J. (1990). Overview on stored-product insect pheromones and food attractants. *Journal of the Kansas Entomological Society*, 490–499. Retrieved from https://www.jstor.org/stable/25085215

Fauzi, Y., Erna, Y. W., Satyawibawa, I., & Paeru, R. H. (2012). *Cultivation of Utilization of Results and Waste Of Business Analysis and Marketing*. Self-Help Spreader.

Gomes, M. F., Vasconcelos, S. S., Viana-Junior, A. B., Costa, A. N. M., Barros, P. C., Ryohei Kato, O., & Castellani, D. C. (2021). Oil palm agroforestry shows higher soil permanganate oxidizable carbon than monoculture plantations in Eastern Amazonia. *Land Degradation & Development*, *32*(15), 4313–4326. https://doi.org/10.1002/ldr.4038

Hadi, M. H., Tarwotjo, U., & RRahadian. (2009). *Biology Insekta Entolomogi*. Graha Science.

Hamzah, N., Tokimatsu, K., & Yoshikawa, K. (2019). Solid fuel from oil palm biomass residues and municipal solid waste by hydrothermal treatment for electrical power generation in Malaysia: A review. *Sustainability*, *11*(4), 1060.

https://doi.org/10.3390/su11041060

Hasni, N., Pinier, C., Imed, C., Ouhichi, M., Couzi, P., Chermiti, B., Frérot, B., Sa\"\id, I., & Rochat, D. (2017). Synthetic co-attractants of the aggregation pheromone of the date palm root borer Oryctes agamemnon. *Journal of Chemical Ecology*, *43*, 631–643. https://doi.org/10.1007/s10886-017-0862-8

Hawkeswood, T. J., & Sommung, B. (2019). *A new record of the Coconut Rhinoceros Beetle, Oryctes rhinoceros (L., 1758)(Coleoptera: Scarabaeidae: Dynastinae) from near Kantharalak, Sisaket Province, Thailand*. Calodema. Retrieved from https://www.researchgate.net/publication/333531181_A_new_record_of_the_Coconut_Rhinoceros_Beetle_Oryctes_rhinoceros_L_1758_Coleoptera_Scarabaeidae_Dynastinae_from_near_Kantharalak_Sisaket_Province_Thailand

Johari, A., Zuhrah, N. E., & Wulandari, T. (2021). The diversity of Macrofauna in peatlands that planted by palm oil and without palm oil in Jambi region, Indonesia. *Journal of Entomological Research*, *45*(2), 311–315. http://dx.doi.org/10.5958/0974-4576.2021.00050.5

Kumara, A., & Mubarak, A. N. M. (2022). Advances, Prospects and Limitations of Genetic Tools for Pest Management Strategies in Sri Lanka. In *Genetic Methods and Tools for Managing Crop Pests*, 285–302. Springer. https://doi.org/10.1007/978-981-19-0264-2_9

Levi-Zada, A., & Byers, J. A. (2021). Circadian rhythms of insect pheromone titer, calling, emission, and response: a review. *The Science of Nature*, *108*(5), 35. https://doi.org/10.1007/s00114-021-01746-w

Main, B. J., Lee, Y., Ferguson, H. M., Kreppel, K. S., Kihonda, A., Govella, N. J., Collier, T. C., Cornel, A. J., Eskin, E., Kang, E. Y., & others. (2016). The genetic basis of host preference and resting behavior in the major African malaria vector, Anopheles arabiensis. *PLoS Genetics*, *12*(9), e1006303. https://doi.org/10.1371/journal.pgen.1006303

Maldonado, M., & Young, C. M. (1996). Effects of physical factors on larval behavior, settlement and recruitment of four tropical demosponges. *Marine Ecology Progress Series*, *138*, 169–180. https://doi.org/10.3354/meps138169

Nurfatriani, F., Sari, G. K., Saputra, W., & Komarudin, H. (2022). Oil Palm Economic Benefit Distribution to Regions for Environmental Sustainability: Indonesia's Revenue-Sharing Scheme. *Land*, *11*(9), 1452. https://doi.org/10.3390/land11091452

Ong, S. P., & Sajap, A. S. (2022). Insect Pests of Tropical Malaysian Urban Trees. In *Urban Forestry and Arboriculture in Malaysia: An Interdisciplinary Research Perspective*, 135–150. https://doi.org/10.1007/978-981-19-5418-4_7

Oswalt, S. N., Smith, W. B., Miles, P. D., & Pugh, S. A. (2019). Forest resources of the United States, 2017. *General Technical Report-US Department of Agriculture, Forest Service. Forest Service*. Retrieved from https://naldc.nal.usda.gov/download/7510303/PDF

Prasad, K. V. H. (2022). Insect Chemical Ecology. In *Insect Ecology: Concepts to Management*, 61–76. https://doi.org/10.1007/978-981-19-1782-0

Reddy, G. V. P., & Guerrero, A. (2004). Interactions of insect pheromones and plant semiochemicals. *Trends in Plant Science*, *9*(5), 253–261. https://doi.org/10.1016/j.tplants.2004.03.009

Regnier, F. E., & Law, J. H. (1968). Insect pheromones. *Journal of Lipid Research*, *9*(5), 541–551. https://doi.org/10.1016/S0022-2275(20)42699-9

Santi, I. S., Prayoga, A., Setyawan, H., & AtmakaAji, W. (2022). Implementation of integrated pest control to reduce rhino beetle (Oryctes rhinoceros) attacks in oil palm plantations. *Tropical Plantation Journal*, *1*(2), 68–74. https://doi.org/10.56125/tpj.v1i2.10

Santi, I. S., Sumaryo, B., & Wagiman, F. X. (2008). Pengaruh warna perangkap feromon terhadap hasil tangkapan imago Oryctes rhinoceros di perkebunan kelapa sawit. *Jurnal Perlindungan Tanaman Indonesia*, *14*(2), 76–79. https://doi.org/10.22146/jpti.11890

Šramel, N., Kavčič, A., Kolšek, M., & De Groot, M. (2021). Estimating the most effective and economical pheromone for monitoring the European spruce bark beetle. *Journal of Applied Entomology*, *145*(4), 312–325. https://doi.org/10.1111/jen.12853

Syahza, A., Irianti, M., Nasrul, B., & others. (2020). What's Wrong with Palm Oil, Why is it Accused of Damaging the Environment? *Journal of Physics: Conference Series*, *1655*(1), 12134. https://doi.org/10.1088/1742-6596/1655/1/012134

Xu, L., Xue, F., Zheng, H., Ji, Q., Qiu, C., Chen, Z., Zhao, X., Li, P., Hu, Y., Peng, Q., & others. (2022). An insect larvae inspired MXene-based jumping actuator with controllable motion powered by light. *Nano Energy*, *103*, 107848. https://doi.org/10.1016/j.nanoen.2022.107848