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Aggregation pheromones for monitoring the coconut rhinoceros beetle (*Oryctes rhinoceros*) in Jerukwangi Village, Jepara, Indonesia

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Abstract. *Oryctes rhinoceros* (Coleoptera: Scarabaeidae) is the most serious pest of coconut plantations in Indonesia. Jerukwangi Village is *O. rhinoceros* attacked one of the coconuts producing villages with more than 75% of the coconut plant population *O. rhinoceros*. The study aimed to monitor the population and analyze the sex ratio of *O. rhinoceros* that were attracted to aggregation pheromones in the field. Aggregation pheromones is a chemical compound containing Ethyl 4-methyl octanoate. The pheromone compounds were placed in traps (buckets), hung 2 meters above the ground. The traps were observed, and the beetles trapped were counted every week. In 12 weeks of monitoring, the traps captured 101 insects consist of 90.1% *O. rhinoceros* and 9.9% other insect species (*Rhynchophorus ferrugineus* and *Xylotrupes gideon*). This result indicates the high population of *O. rhinoceros* in the field. Aggregation pheromone is useful for attracting females. *Rhinoceros* by 61% and the males by 39%. The advantage of research is it can be used in integrated pest management (IPM) packages for monitoring of beetle population, and removal of beetles.

1. Introduction

Oryctes rhinoceros (Coleoptera: Scarabaeidae) is the most serious pest in coconut plantations in Jepara, Indonesia [1-4]. It has reportedly attacked the coconut plants in Africa, especially in Ivory Coast [5] and was also found in Malaysia [6]. Jepara is located on the Shore of Java Sea. It has the coastal climate which drives the coconuts to thrive. However, this area is one of the areas with the highest intensity of *O. rhinoceros* attacks. *O. rhinoceros* is very damaging to plants, causing the young leaves to break down [7]. The symptoms of coconut plants infected by *O. rhinoceros* are the presence of holes in the midrib and the young leaves which form the letter V [7,8]. *O. rhinoceros* undergoes a perfect metamorphosis (egg, larva, pupa, and imago). Eggs, larvae, and pupae are in the soil, while the imago bore at the top of the coconut plant. *O. rhinoceros* larvae are difficult to control because the larval habitats are in the soil with a depth of more than 20 cm [9, 10].

Control of *O. rhinoceros* larvae in Jerukwangi was performed by the physical/mechanical way. People were searching the larvae in the nest and then killed them. Also, biological control was also conducted by the application of entomopathogenic fungus *Metarhizium anisopliae* on the nest or on the larvae that were caught [2]. The high population of *O. rhinoceros* in a region is due to supporting factors such as the diversity of coconut vegetation found around the area [19]. Piles of decaying



organic waste, rotten coconut trunks, animal waste such as cattle and wood saws are suitable places for larvae to live and eat the organic matter [1].

O. rhinoceros beetle control in Jerukwangi has not been done yet due to the difficulties in catching the image that hides in the top of tall trees. The application of aggregation pheromones as the trap of *O. rhinoceros* can be performed to find out their population. Aggregation pheromones is a chemical compound containing specific compounds, one of them is Ethyl 4-methyl octanoate which has been proven to attract male and female insects [11]. Such compound includes a synthetic aggregation pheromone. Installation of traps containing pheromones is expected to determine the population of beetles in the affected area. In addition to pheromones, according to Santi and Sumaryo [12] *O. Rhinoceros* also interested in the light of lamp at night because they include the nocturnal animals. The number of both female and male *O. rhinoceros* and even the other insects that are interested in light was not yet known. Therefore, it is necessary to conduct research that aims to find out the sex ratio of beetles coming and whether or not the other species are caught. The advantage of research is it can be used in integrated pest management (IPM) packages for monitoring of beetle population, removal of beetles, and biological control [13].

2. Methods

This study was conducted in Jerukwangi Village, Jepara, from April to July 2017. In this village, the coconut plants that were attacked by *O. rhinoceros* was more than 75 percent.

The aggregation pheromone used is made by the Medan Palm Oil Research Center/Pusat Penelitian Kelapa Sawit (PPKS) Medan. It contains Ethyl 4 methyl octanoate compounds. This compound is an aggregation pheromone that attracts both male and female *O. rhinoceros*. Liquid pheromones were packaged in porous plastic packaging which can efficiently be used for approximately three months. Pheromones were placed in 10 L bucket traps with 35 cm in diameter and 40 cm high (Figure 1). Pheromones are hung inside the bucket. In the bottom of the bucket, there was sawdust and a hole for water discharge when it rains. The top of the bucket was covered with a hole with 5 cm in diameter for the entry of the beetle into the bucket. Rectangular zinc was placed at the top of the bucket to direct the beetles that come in to get into the bucket through the hole.



Figure 1. *O. rhinoceros* beetle trap device contains the aggregation pheromone

The trap was hung about 2 m high. It was placed close to the coconut plant owned by the people, close to the people's housing, and also close to the light of the lamp because the pests are very fond of the bright lights [14]. Traps were placed at ten different locations, 500 meters apart. Observations the calculation of *O. rhinoceros* and other insects in the traps were conducted for 12 weeks with weekly intervals. The data were analyzed descriptively, and the number of *O. rhinoceros* trapped was made a graph.

3. Result and discussion

In 12 weeks of treatment, there were 101 insects captured by the traps. It consisted of 90.1% *O. rhinoceros* and 9.9% other species (*Rhynchophorus ferrugineus* and *Xylotrupes Gideon*) (Figures 2 and Figure 3). The number of catches indicates the existence of *O. rhinoceros* population around the coconut plantation. The number of the female caught was more than the males. According to Morin et al., [15] Ethyl 4-methyl octanoate, a major component of male pheromone in *O. rhinoceros*, but in this study, not only male but also a lot of females were captured. This needs to be cautioned because a large number of females may produce the more offspring in the future. Many female *O. rhinoceros* beetles were caught possibly because of traps installed near the lights. The beetle active at night, people turn on the lights at night. Insects have attracted lights. The possibility of the female beetles being attracted due to by the lights and entering the trap with the males.

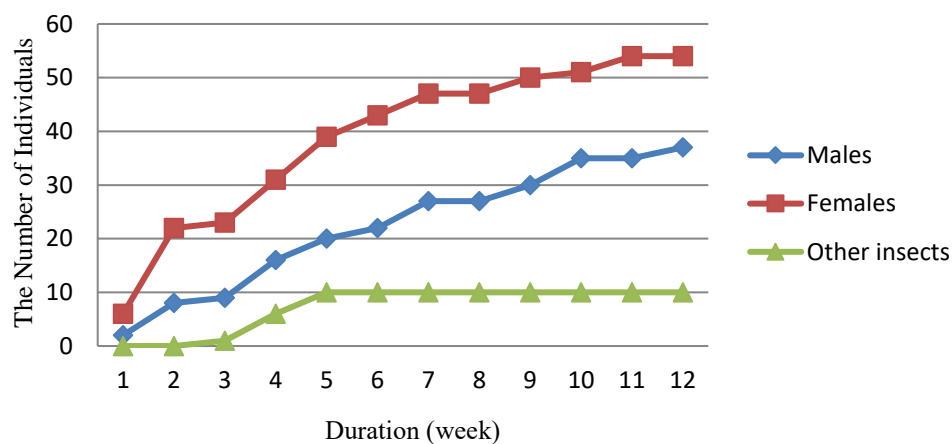


Figure 2. The number of *O. rhinoceros* attracted to aggregation pheromones for 12 weeks in Jerukwangi village

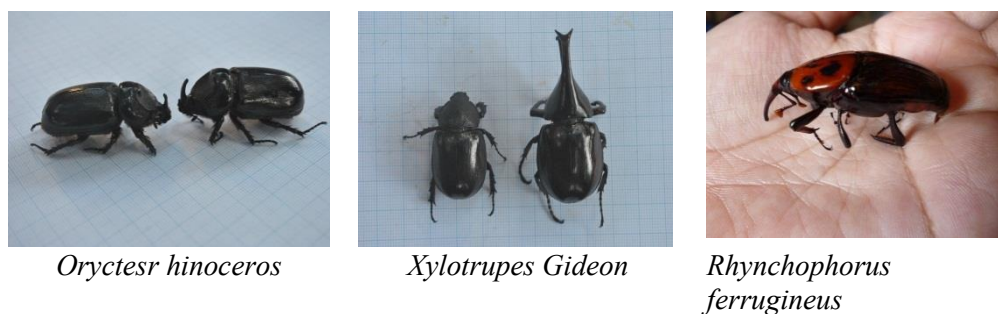


Figure 3. The picture of insects that have been captured by the traps (*O. rhinoceros*, *X.gideon* and *R. ferrugineus*)

This aggregation pheromone is quite effective because it can capture more female insects (61%) than males (39%) with the ratio of 1.56: 1. Therefore, the use pheromones are not only for the monitoring purpose but also for controlling the beetles. After being caught the *O. rhinoceros* beetles were being killed with alcohol.

Aggregation pheromone is also able to invite *X. gideon* (Coleoptera: Scarabaeidae) and *R. ferrugineus* (Coleoptera: Curculionidae). *X. gideon* is insects are found in Southeast Asia, including in Indonesia [16], it also attacks coconut plant. *R.ferrugineus* known as Red Palm Weevil (RPW). *R.ferrugineus* is known as one of the most destructive pests of coconut palm (*Cocos nucifera*)

[17], date palm (*Phoenix dactylifera*) and oil palm (*Elaeis guineensis*) [18]. This coconut beetle attacks the growing point so it can cause the death of coconut plants. This pest continues the infection of *O. rhinoceros*. Their larvae live in the former hole of *O. rhinoceros*, so that. The damage of the coconut plant is getting worse. According to Rebecca et al. [19], *R. ferrugineus* is interested in ferrugineol aggregation (4-methyl-5-nonanol) pheromone. Therefore, the reason why these insects are also interested in Ethyl 4 methyl octanoate aggregation pheromone is that they both contain the methyl compounds.

The high population of *O. rhinoceros* in Jerukwangi village is due to the existence of their food sources. According to the study by [1], there are 26 larval nest sites in Jerukwangi village. The favored locations are the old pile of cow dung, the rotted haystack, and the rotted coconut trunk. These places are suitable for *O. rhinoceros* to live and breed. The collection of cow dung emits a distinctive aroma favored by the *O. rhinoceros* imago so that the pile of cow dung attracts the imago to come and lay their eggs down. Besides, these animal dung stacks also have the nutrients needed by the *O. rhinoceros* larvae for food intake before it develops into an adult imago.

Another factor drives the beetle *O. rhinoceros* to grow well in Jerukwangi is the varieties of coconut plants produced by the farmers. In general, the amount of Genjah varieties was 65%, and Dalam varieties were 35%. Genjah varieties are known to be more susceptible to *O. rhinoceros* attacks than Dalam varieties [1].

4. Conclusion

The aggregation pheromone (Ethyl 4-methyl octanoate) can attract the *O. rhinoceros* by 90.1% and other insects (*R. ferrugineus* and *X.gideon*) by 9.9% in 12 weeks of treatment in Jerukwangi village, Jepara. The catches indicate that the population of *O. rhinoceros* is still high in the field. Aggregation pheromone is useful for attracting the females. *O. rhinoceros* by 61% and the males by 39%.

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