Oryctes rhinoceros attraction to pheromone traps placed near the light source at night

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Abstract. The objective of this study was to analyze O. rhinoceros attraction to the pheromone that was placed near and far from the light source. Samples were obtained using pheromone traps placed at a distance of ± 5 m (near) and ± 500 m (far) from the light source. Each village was installed with 10 pheromone traps, 5 traps were placed near the light source, and another 5 traps were far from the light source. Observation on O. rhinoceros imago captured was conducted for 12 weeks. The results showed that O. rhinoceros is more attracted to the pheromone traps placed near the light source. The sex ratio of male and female imago from traps placed both near and far from the light were 1:1.2 and 1:1.3, respectively. This study can provide information regarding O. rhinoceros monitoring using pheromone traps combined with the light to attract more O. rhinoceros imago.

1. Introduction

Oryctes rhinoceros is the major pest of coconut palm in Jepara Regency, Indonesia. This insect undergoes complete metamorphosis through the stages of egg, larva, pupa, and imago (adult). The egg, larva, and pula live under the soil surface with high organic materials, while the imago hides under the coconut leaves [1-2]. The main symptom of the attack of O. rhinoceros imago is the V-shaped cut in the young opened leaves.

People of the Jepara Regency control the larvae mechanically by taking out the larvae from their nest and kill them to reduce their infestation in nature [3]. Biologically, Metarhizium anisopliae can infect O. rhinoceros larva and causes the death of larvae [4]. However, people can not control O. rhinoceros imago because they hide under the leaves of the coconut palm, which is too high to reach. Imago bores the leaves, midribs, and stem, then sucks the liquid from the suction source. If it occurs continuously, it will cause the death of coconut palm [5]. The intensity of damage due to O. rhinoceros infestation in coconut palm plantation of Jerukwangi and Bondo Villages, Jepara Regency in 2015 was 71% and 64%, respectively [6].

One of the methods used to capture the imago is by using Ethyl 4-methyl octanoate synthetic pheromone. Male insect releases an aggregation pheromone to attract the females. Pheromone can be used to know the presence of O. rhinoceros imago. Pheromone is inserted into the pheromone trap to attract the imago, eventually getting trapped and unable to escape.

O. rhinoceros imago is a nocturnal insect that is attracted to light [7]. Light can affect insects’ behaviors, one of which is their interest in the light source (positive phototaxis). This condition makes
the insects tend to approach the light. Imago flies from their place at near dusk until 9 p.m. and is rarely found at midnight [8].

Most of the coconut palm owned by Jepara people is planted in plantations close to the residential area. Resident houses have light sources that can be used to attract the pest due to the insect's nocturnal photoreceptor towards the light. Therefore, it is essential to conduct a study to monitor O. rhinoceros imago by using pheromone traps that are placed near and far from the light source. This method can show O. rhinoceros imago attraction to pheromone and light. The objective of this study was to analyze the O. rhinoceros attraction to pheromone traps placed near and far from the light source.

2. Methods
This study was conducted on April-June 2018 in Jerukwangi, Bondo, and Kaliaman Villages, Jepara Regency, Central Java. Pheromone trap installation was used to capture O. rhinoceros imago. The installation was made using 10 liters plastic bucket with holes (0.2 cm) in the bucket's bottom. The holes were used to drain out the rainwater from the bucket. Five big holes (5 cm) were also made in the bucket's lid, which was placed upside down [4]. Metal roofing sheets 16 cm in height were placed on top of the lid to make the flying insects crashed into it and fell into the hole. Five ml pheromone (Ethyl 4-methyl octanoate) in a perforated plastic bag was hung inside the bucket. A total of 30 pheromone traps were used in this study.

Pheromone traps were placed in three villages, with ten traps for each village. Five traps were placed near the light sources at a distance of ± 5 m from the street light. The other five traps were placed in the coconut plantation (± 500 m from the street light). The light source in this study refers to the street lights that turn on at night. The light chosen was an 18 Watt light bulb with white light. Pheromone traps were tied and hung on the tree or the other high places (4 meters minimum height from the ground). The traps were separated by one another by a minimum distance of 500 m.

Data collection (number of pests trapped) was conducted once a week for 12 weeks from 9 a.m. to 2 p.m. Observation was conducted by counting the number of male and female imago and the other insects trapped. The insects trapped were grouped by observing their morphological characters.

The number of O. rhinoceros attracted to pheromone was tested using a one-sample Kolmogorov-Smirnov normality test followed by a homogeneity test to determine the data variance. Data analysis was then followed by a t-test (Independent sample t-test) with a 95% confidence level. The sex ratio was analyzed by using quantitative descriptive analysis.

Figure 1. Pheromone trap installation and Oryctes rhinoceros.

3. Results and Discussion
The results of 12 weeks study in Jerukwangi, Bondo, and Kaliaman Villages showed that O. rhinoceros imago in both types of the trap was attracted to pheromone (Figure 2). The number of O. rhinoceros imago obtained from the traps near and far from the light source were 314 and 176, respectively.
Results of the Independent t-test showed that results obtained from both types of the trap were significantly different. *O. rhinoceros* is more attracted to the pheromone trap placed near the light source.

Figure 2 shows that the number of *O. rhinoceros* imago obtained from traps near the light source is more than those from traps placed far from the light. Insects are attracted to light and lights at night, so there are two factors: the smell of pheromones and the light from the lamp, which adds to the attraction.

This condition is because the imago smells the pheromone and tends to be attracted to the light. According to Chapman [9], insects can recognize pheromone because they have antennae as receptors for impulse in the form of pheromone odor that will be passed on to the neuron and then transferred to the insect's brain so that the insects go to the source of the smell.

The number of imagos captured decreased over the time course of the study. This condition is due to the reduced amount of pheromone. A number of *O. rhinoceros* captured experienced fluctuation and decreased over time [10]. An aggregation pheromone used contained Ethyl 4-methyl octanoate that can quickly evaporate, especially when packed in a perforated plastic bag. Ethyl 4-methyl octanoate can only last for three months in the study field because it will run out due to evaporation [11]. Data obtained showed that the study site's temperature ranged from 32-33 °C in the afternoon and 28-30 °C at night, with humidity of 73.9%. This high temperature increased the evaporation rate of the pheromone. The smell of pheromones will evaporate a lot.

The use of white light in this study was able to attract more *O. rhinoceros* imago. White light is a visible spectrum for humans (400–700 nm). In addition, Coleoptera insects can see the light from wavelengths of 348–620 nm. It can be assumed that *O. rhinoceros* imago could see the white light because it is still within their visible spectrum [12]. Nocturnal beetles have compound eyes with specific (sensitive to certain colors) color-sensitive photoreceptor cells. These compound eyes allow the beetles to capture more lights at night [13–14].

White LED light used was the street light. People stated that they often saw *O. rhinoceros* flying around the street light or inside the houses. It indicates that the population is very high. The imago is interested in light at night. *O. rhinoceros* is active at night and is interested in a light turned on at night to be attracted to the light in the pheromone trap and get trapped [3].

Aggregation pheromone Ethyl 4-methyl octanoate also attracted the other insects from the Coleoptera order. The traps near the light captured 21 *Xylotrupes Gideon*, and those placed far from the light captured five insects from the same species. This result is supported by a study by Indriyanti et al. [3] which stated that aggregation pheromone could also attract *X. gideon* and *R. ferrugineus*.
The sex ratio of the male and female imago from traps placed both near and far from the light were 1:1.2 and 1:1.3, respectively. The higher number of female imago in both types of trap is caused by the Ethyl 4-methyl octanoate content that is more specific to the female. Indriyanti et al. [3] stated that aggregation pheromone could attract more female imago than the males with the percentage of 61% and 39%, respectively [3].

This statement is supported by a statement by Said et al. [15] that Ethyl 4-methyl octanoate is more effective to attract female imago, while male imago is more attracted to 4-methyloctanyl acetate [15]. The synthetic aggregation pheromone attracts more female imago because they better recognize the Ethyl 4-methyl octanoate molecule using their antennae. Antennal sensilla of female O. rhinoceros are denser and covering a wider area than the males', so it is possible for female imago to respond to the pheromone better [16].

The use of aggregation pheromone can decrease the population of O. rhinoceros imago in the study field in the next three to four months. It is because the imago captured were taken and killed, which resulted in a decreasing population. Indriyanti et al. [3] stated that pheromone is for monitoring and controlling purposes by killing all the O. rhinoceros captured in the pheromone trap.

4. Conclusion

The number of O. rhinoceros imago got trapped in the pheromone traps near the light (314) was more than that of traps far from the light (176). The sex ratio of male and female imago from traps placed both near and far from the light were 1:1.2 and 1:1.3, respectively.

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