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The Use of Aggregation Pheromone for Monitoring *Oryctes rhinoceros* Population

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Abstract. *Oryctes rhinoceros* is the main pest that damages the coconut palm by punching holes in its shoot area. The purposes of this study were to monitor the population of *O. rhinoceros* imago using aggregation pheromones, analyze the comparison of sex ratio, and analyze the other insects captured by pheromones traps. This research was an exploratory study using purposive sampling method. Monitoring *O. rhinoceros* was carried out by installing pheromone traps using aggregation pheromones in 2 areas (10 samples each). The observations were carried out once a week for three months. The captures of *O. rhinoceros* imago in the Bondo and Kaliaman Villages were 131 and 83 individuals respectively. Comparisons of sex ratio (male: female) obtained in Bondo and Kaliaman Villages were 1: 1.3 and 1: 0.9 respectively. The other insect species that were attracted by pheromones were *Xlotrupes gideon*, *Rhyncophorus ferruginneus*, and *Rhyncophorus schach*.

Keywords: aggregation pheromone, Jepara Regency, *Oryctes rhinoceros*

1. Introduction

Coconut palms (*Cocos nucifera*) are plants that thrive in coastal areas and some can grow in the mountains [1]. The trade-in coconut meat makes this plant become one of the sources of economic support. Jepara Regency is one of the areas with coconut plantation. However, the coconut palms in that area were damaged by *Oryctes rhinoceros* attack [2]. The characteristics of coconut palms that are attacked by *O. rhinoceros* are the form of gaps cut out of the edges of the leaflets. The leaves in the coconut palm become like letter V. The mechanism of *O. rhinoceros* in damaging the coconut palms is by punching holes in the leaf area of the very young leaves, so that when the leaves have opened there will be damages that will make the leaves become dry and die [3].

Since *O. rhinoceros* live in the shoots of the coconut palm, it is very difficult to catch them. Therefore, pheromone can be used to attract them to come out. Pheromones are divided into two groups, primer, and releaser [4]. Primer pheromones are pheromones that affect insect physiology while releaser pheromones affect insect behavior of the same species [5]. The types of pheromones used were aggregation pheromones which are included in the releaser pheromone group. Aggregation pheromone is a type of pheromone that is released to attract male and female insects in groups, this type of pheromone is generally produced by insects from the Coleoptera order to defend themselves against predatory attacks ([3]; [6]).

Based on the survey conducted, 75% of the coconut palms damaged by *O. rhinoceros* attack. Therefore, the monitoring of *O. rhinoceros* population in Bondo and Kaliaman villages were needed for integrated pest control (IPM) management.

2. Methods

The study was conducted in Bondo and Kaliaman villages, Jepara Regency area. The population used in this study was *O. rhinoceros* in Bangsri District, Jepara Regency and the samples used were *O. rhinoceros* captured by pheromone traps in Bondo and Kaliaman villages. The method used was purposive sampling with 10 repetitions in each village. Data retrieval was done once a week by observing the number of *O. rhinoceros*, sex ratio and other insects captured in pheromone traps. Abiotic factors measured were temperature and humidity. Pheromones used were containing ethyl 4-methyloctanoate compounds and obtained commercially. Pheromones were installed in the pheromone trap and hung at a height of 5 meters in a location adjacent to the coconut plantation.

3. Results and discussion

O. rhinoceros imago lives in holes in high coconut midrib, so that the pheromones were needed for monitoring. This monitoring used pheromone which were placed inside the traps. Aggregate pheromones are attractant that attract male and female *O. rhinoceros* imago to come and gather. The results of *O. rhinoceros* monitoring for 12 weeks of observation is presented in Table 1.

Table 1. Number of *O. rhinoceros* captured in pheromone traps in 2 villages of Jepara Regency

Week	Bondo Village		Kaliaman Village	
	Male	Female	Male	Female
1	3	3	2	0
2	14	22	5	5
3	16	28	10	11
4	23	33	17	17
5	38	47	22	19
6	44	51	27	24
7	53	60	30	27
8	54	61	35	29
9	55	62	38	35
10	56	67	41	36
11	56	71	43	37
12	57	74	43	40

Based on Table 1, *O. rhinoceros* captures in the Bondo Village is more than the captures in the Kaliaman Village. The location of Bondo village in a coastal area causes a sea breeze to spread pheromones. Aggregated pheromones can spread as far as 800 meters if placed at a

height of 4-5 meters above ground level. Sea breeze assistance in Bondo Village is likely to help spread the pheromones so that the number of captures in Bondo Village was also greater compared to Kaliaman Village. The number of coconut palm and farmers also affects the number of *O. rhinoceros* captures in Bondo Village. The number of farmers in Bondo Village is 55% and there are no livestock waste management activities resulted in the high *O. rhinoceros* population. This is in accordance with a study by [7] that showed that abundant food availability can increase the population of *O. rhinoceros*.

The *O. rhinoceros* captures in Kaliaman Village is less than the captures in the Bondo Village. This condition can occur because the livestock waste in Kaliaman Village has been processed into organic fertilizer by residents so that the female beetles will look for other locations to lay their eggs. Based on the results of interviews with the head of the farmer group, the number of coconut palm was only 221 stems and the number of farmers was 40% of the total population. Farmers in Kaliaman Village have also processed livestock manure into organic fertilizer so that they can slightly reduce the *O. rhinoceros* pre-imago living habitat. Moreover, the location of the village is 3 km from the coastal area of Bondo, resulted in no significant contribution of the sea breeze in spreading the pheromones.

Varieties of coconut palm can also affect the number of *O. rhinoceros* imago. The population of *O. rhinoceros* was high in two villages because there were many varieties of coconut palm, especially early-maturing variety which is susceptible to *O. rhinoceros*. The other cause of *O. rhinoceros* high population is the abundance of coconut palms and piles of livestock that fulfill the needs of *O. rhinoceros*. Moreover, the absence of pest control by the community keeps the population increasing.

Sex ratio of *O. Rhinoceros* imago. Result of *O. rhinoceros* sex ratio calculation is presented in Table 2

Table 2. Sex ratio of *O. rhinoceros* captures

Location	Population of <i>O. rhinoceros</i>		Sex Ratio	
	Male	Female	Male	Female
Bondo	57	74	1	1.3
Kaliaman	43	40	1	0.9

Based on Table 2, it can be seen that number of female *O. rhinoceros* captures in Bondo village is higher than the male. While, in Kalimanan village, the number of male is higher than female. According to [5], aggregation pheromones are capable of capturing 69-79% of female and 21-31% of male. The more female captures will help to reduce the possibility of *O. rhinoceros* population explosion in the next 3-4 months. Based on the study by [8] ,for 274 days of life, the female imago is able to lay eggs up to 3-4 times. According to [9], one female *O. rhinoceros* is able to lay eggs about 35-70 eggs in each laying eggs. The use of this aggregation pheromone can help to reduce the population of *O. rhinoceros* in the field if followed by the act of killing the pests.

The other insects captured by pheromone trap. In addition to *O. Rhinoceros*, aggregation pheromones can also trap the other insects as shown in Table 3.

Table 3. Insects captured by pheromones other than *O. rhinoceros*

Location	<i>X. gideon</i>		<i>R. ferruginneus</i>		<i>R. schach</i>	
	Male	Female	Male	Female	Male	Female
Bondo	3	5	1	5	0	3
Kaliaman	1	2	0	1	0	0

Table 3 shows that the insect captures other than *O. rhinoceros* are *X. gideon*, *R. ferruginneus*, and *R. schach*. *X. gideon*. These three types of insects have the same sensitivity to pheromones containing ethyl 4-methyl octanoate. Pheromone aggregation with ethyl 4-methyl octanoate content is able to attract *X. gideon*, *R. ferruginneus*, and *R. schach* even in small amounts. This is in accordance with the opinion of [6] that aggregation pheromones are able to attract *X. gideon* and *R. ferruginneus*, *R. schach* and *O. rhinoceros*. However, according to [10], [11] and [12], *R. ferruginneus*, and *R. schach* only have an interest in pheromones with ethyl 4-methyl nonanol while *O. rhinoceros* is only interested in ethyl 4-methyl octanoate.

The role of *X. gideon*, *R. ferrugineus* and *R. schach* in damaging the coconut palm is very significant. *R. ferrugineus* and *R. schach* attack is very dangerous because their larvae and pupae that live in coconut stems can kill coconut palm and are very difficult to detect. According to [13], *X. gideon* and *O. rhinoceros* serve as primary destroyers which obtain food by punching holes in young leaves of coconut palm. The existing hole will then be utilized by *R. ferrugineus* and *R. schach* as a shelter and food source. *R. ferrugineus* and *R. schach* eat tissues in the shoots and stems of coconut palms, so that, the coconut palms will wither and die. Identification of coconut palm attacked by *R. ferrugineus* and *R. schach* cannot be done directly because they attack the transporting tissue of coconut palm stems. The characteristic of coconut palms attacked by *R. ferrugineus* and *R. schach* is the presence of a 21-35 cm diameter hole from the base to the tip of the coconut stem.

4. Conclusion

Results of *O. rhinoceros* monitoring carried out for 12 weeks in the Bondo and Kaliaman Villages obtained 131 and 83 *O. rhinoceros* respectively and there was still an increase in the number of *O. rhinoceros* captured until the end of the study. The sex ratio of male : female in Bondo and Kaliaman villages were 1 : 1.3 and 1 : 0.9 respectively. Other insects that were caught by pheromone trap were *Xlotrupes gideon*, *Rhyncophorus ferruginneus*, and *Rhyncophorus schach*.

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