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Research Article

Integrated Pest Management of *Rhynchophorus phoenicis* in Okomu Oil Palm Plantation, Uhiere, Nigeria

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Abstract

Background and Objective: The use of pheromones has been instrumental in increasing the effectiveness of both monitoring insect populations and in providing adequate information to enable implementation of cost effective control. Field trials were conducted at Okomu oil palm field, Uhiere, Edo state, to test the efficacy of pheromone traps against *Rhynchophorus phoenicis*. **Materials and Methods:** About 3 L bucket traps containing 9 mg/day *Rhynchophorus phoenicis* pheromone enhanced with pineapple, impregnated with 20 mL insecticide (Cypermethrin) and a control bucket (with only 300 mL water) were set up. In the pre-pheromone assessment survey, fields K, I and H were observed to have been attacked by *Rynchophorus phoenicis*. Observations were made once a week for 6 weeks after pheromone application. During the pheromone treatment period under review, adult *Rynchophorus phoenicis* trapped were a total of 169. **Results:** Mean total distribution per trap of adult *R. phoenicis* during the study period was 5.63. Week 2 had the highest number (42) of trapped insects, while week 1 had the lowest tapped insects (17). The control trap without pheromone caught nothing. The p-value of the analysis of variance (0.70) indicates that there is a significant difference (p>0.05) among the fields in the number of adult *R. phoenicis* collected due to the pheromone treatment. It was observed that fields H and I had the highest distribution of *R. phoenicis*. This implies that more attention should be paid to these fields. Other insects trapped include butterflies, beetles, grasshoppers and wasps. **Conclusion:** This study confirms the effectiveness of pheromones for control of the adult *Rynchophorus phoenicis*. This is with minimal insecticidal use and maximum benefit to the palms and environment.

Key words: Oil palm, *Rhynchophorus phoenicis*, pheromone, trap, integrated pest management, environment

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The African black palm weevil, *Rynchophorous phoenicis* (Coleoptera: Curculionidae) is a major insect pest of oil palm in Nigeria. The life cycle of *R. phoenicis* takes place within the host tree (oil palm) and other similar hosts[1]. During these developmental stages, the larvae of *R. phoenicis* can excavate cavities of more than 1 m in length which may lead to the death of the tree after 3-4 months of infestation[2]. Often, palm weevil infestations are not detected before damage caused by larval mining in the trunk is extensive and it is not possible for the tree to recover[3].

However, several control methods are currently in use to control palm weevils. Biological control[4], chemical control[5], cultural and sanitary[6], pheromones and other behavioral chemical[2], methods have been used in the western and some African countries.

The basic life cycles of *Rhynchophorus* species are similar. Adult female weevils are attracted to damaged, stressed or healthy palms and oviposit 30-400 eggs on plants. Larvae bore into the palms and after several instars develop into adults in about 2 months[7]. *Rhynchophorus* species seek harborage in leaf axils of healthy palms[8]. Moist fermenting tissues from various palm species, fruits, sugarcane and pineapple are similarly attractive to palm weevils[9,10]. Early research provided evidence that general fermentation volatiles, such as ethanol, appeared attractive to *Rhynchophorus* weevils[11]. Kairomones include ethyl acetate, ethyl propionate, ethyl butyrate and ethyl isobutyrate for different weevil species[12].

Current methods recommended for the management of *Rhynchophorus* species have focused on Integrated Pest Management (IPM) involving surveillance, pheromone lures, cultural control and chemical treatments[13].

Pheromones are behavior-modifying chemicals, also called semio-chemicals that act as signals to other insects of the same species. Pheromone released by one sex (i.e., female) of insect species which influences the behavior of the opposite sex (i.e., male) of the same species. In this capacity, the pheromone is capable of disrupting mating or otherwise controlling the insect population. Pheromones are reported to be useful for assessing seasonal activity of pests by Patil *et al.*[14]. Trap catches may provide meaningful index for estimating population densities. Trap catches in relation to field infestation and environmental factors are crucially important for decision making process. If a consistent relationship does exist, the pheromone traps could be used to indicate when the field should be scored more intensively to determine the need to initiate pest management operations[15].

The effectiveness of pheromone based mass traps and a variety of fruit attractants for control of *Oryctes monoceros* and *Rhynchophorus phoenicis* and to identify major entomopathogens identified as control agents of the *Latoia viridissima* on oil palms at Okomu oil palm plantation was determined[16]. In this study, pheromone based mass traps and pineapple fruit attractant was utilized for control of *Rhynchophorus phoenicis* on oil palms and confirms the previous study.

The project objective was to use pheromone based mass traps for control of *Rhynchophorus phoenicis* on oil palms at Okomu oil palm plantation, Uhiere, Edo state, Nigeria.

MATERIALS AND METHODS

Pre-application assessment

Study site: Pre-application assessment of *Rhynchophorus phoenicis* were conducted in fields J, K, H, I and G. The study area was selected based on initial phytosanitary observations that indicated *Rhynchophorus phoenicis* attack on the palms. The survey assessment of the study site was conducted with walk through observations taken at every 10th row at 27 palms per row. Observations were made once a week for 6 weeks after pheromone application. Figure 1 shows an infested palm.

Post-application assessment

Study site: The study sites were fields K14.4-18.2, J15.2-17.3, I13.1-17.4, H13.2-18.1 and H13.2-18.1 which were 24.79 ha plots planted in 2016. Each treatment was laid at every 10th row and hung on a metal suspension. About 20 mL of insecticide (Cypermethrin) was poured into 300 mL water in each treatment apart from the control.

Treatments:

- Pheromone (P)+20 mL Insecticide+Pineapple cuttings
- 300 mL of water without pheromone (Control)

Rhynchophorus phoenicis pheromone bucket trap hung on a metal pole stand is presented (Fig. 2).

Statistical analysis: Data was analyzed by one-way analysis of variance and testing for significant difference in the effect of pheromone activity on *Rhynchophorus phoenicis*.

Fig. 1: Infested palm with *Rhynchophorus phoenicis*

Fig. 2: Pheromone bucket trap

RESULTS

In the pre-pheromone assessment survey, fields K, I and H were observed to have been attacked by *Rynchophorus phoenicis* with fields I (2197 palms) and H (496 palms) being the most attacked (Table 1).

Post-pheromone application *Rynchophorus phoenicis* recoveries: During the pheromone treatment period under review, adult *Rynchophorus phoenicis* trapped were a total of 169 (Table 2). Week 2 had the highest number (42) of trapped insects (Table 3), while week 1 had the lowest tapped insects (17). This indicated that the pheromone attractants

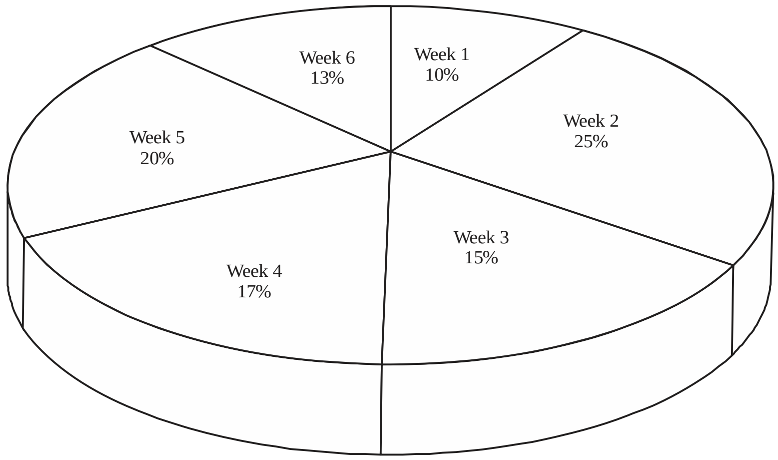

Fig. 3: Weekly percentage population of *R. phoenicis* distribution

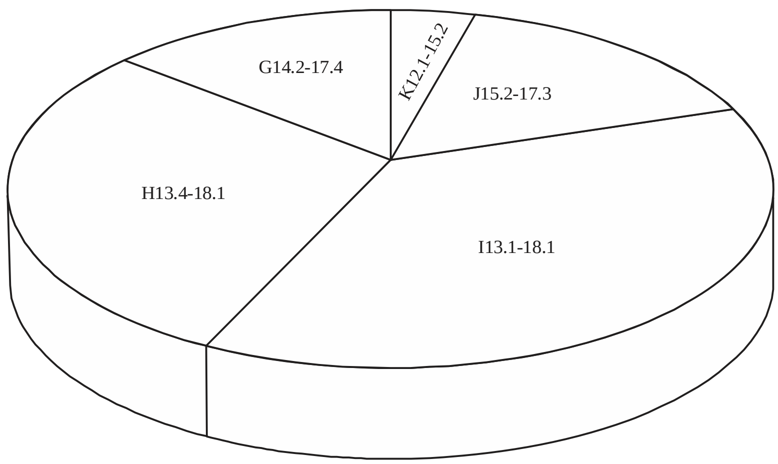

Fig. 4: Percentage population of *R. phoenicis* distribution in fields

Table 1: Pre-pheromone application survey in fields attacked by *R. phoenicis*

Fields	No. of *R. phoenicis* attacked palms
K14.4-18.2	66
J15.2-17.3	0
I13.1-17.4	2197
H13.2-18.1	496
G14.2-17.4	0
Total	2759

Table 2: Total number of *R. phoenicis* trapped in the various fields

Fields	No. of *R. phoenicis* trapped
K12.1-15.2	7
J15.2-17.3	27
I13.1-18.1	62
H13.4-18.1	49
G14.2-17.4	24
Control	0
Total	169

were most potent at week 2. Mean total distribution per trap of adult *R. phoenicis* during the study period was 5.63 (Table 4). Insect populations of non-*Rynchophorus phoenicis*

Table 3: Total weekly number of *R. phoenicis* trapped

	Weeks						
	1	2	3	4	5	6	Total
No. of *R. phoenicis* trapped	17	42	26	29	33	22	169

Table 4: Analysis of variance of treatments application

Treatments application	Mean	p-value (ANOVA)	Significance
Pheromone trap	5.63	0.70	0.05

Table 5: Numbers of non-*R. phoenicis* trapped after pheromone application

	Weeks					
Insects	1	2	3	4	5	6
Butterfly	271	246	157	127	52	6
Others - grasshoppers, beetles and wasps	52	13	19	16	18	13

trapped after pheromone application is presented in Table 5. Week 2 had the highest percentage (25%) of trapped insects (Fig. 3). Field H had the highest percentage (37%) distribution (Fig. 4).

DISCUSSION

Since the discovery of pheromones[17], a multiplicity of uses has been found for them involving monitoring and control although no significant applied use was achieved for monitoring[18] until the mid 1970's. In the pioneering years, it was never considered that a sex pheromone might consist of more than one compound. Later, it became obvious that multiple component pheromones were more a rule than an exception. In 1978, it was discovered that sex pheromone gland extracts of *Bombyx mori* contained, in addition, the corresponding aldehyde of Bombykol, namely Bombykal, which was part of the sex pheromone[19]. This explained the collection of other insects in the experimental traps. Pheromone based strategies have been used to manage a number of insect pests[20-22]. Pheromones have also been described for *R. phoenicis*[23] and various other species. The control had no adult *R. phoenicis* beetle trapped (Table 2) which is attributed to the absence of the pheromone attractant. The butterfly population trapped was observed to be high which could be attributed to the use of pineapple in the trapping buckets to enhance the pheromone attractants.

The p-value of the analysis of variance (0.70) indicated that there is a significant difference ($p>0.05$) among the fields in the number of adult *R. phoenicis* collected due to the pheromone treatment (Table 4). It was observed that fields H and I has the highest distribution of *R. phoenicis*. This implies that more attention should be paid to these fields for site specific control. As insect pests have become increasingly resistant to conventional insecticides and farmers have been unable to control the insects that threaten crop yield, pheromone-based alternatives for pest management has given effective new options in the control of insect pests.

CONCLUSION

This study confirms the effectiveness of pheromones for control of the adult *Rynchophorus phoenicis*. This is with minimal insecticidal use and maximum benefit to the palms and environment.

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