# Field Trapping of the Adult Red Stripe Weevil, *Rhynchophorus vulneratus* (Panzer) with an Aggregation Pheromone in a Coconut Ecosystem+

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*Studies were conducted to evaluate a commercially available male produced aggregation pheromone (Ferrugi-on®; 4-methyl-5-nonanol), as a monitoring tool for the red stripe palm weevil (RSPW),* Rhynchophorus vulneratus *Panzer (Coleoptera: Curculionidae) in the coconut ecosystem. The study on pheromone placement, comparing locating the traps at ground level with aerial trapping showed that the mean weekly weevil capture between the two techniques was not statistically significant (F: 0.4955; P = 0.4930). However, catches were numerically higher in the ground trap (mean ± S.D = 3.25 ± 3.77) compared to the aerial trap (mean ± S.D.= 2.25 ± 1.39). Upon sexing of the weevils, there were more females caught, irrespective of location. The male: female ratio over the trapping period was 8:10 and 7:19 respectively for the aerial and ground traps. Irrespective of sex, trap catches peaked in week 3 in the ground trap whereas the aerial trap peaked a week later. Study on adding sugarcane as a complementary bait showed the combination pheromone + kairomone significantly enhanced trap catches. However sugarcane or water alone, or their combination will not trap any weevil. The field trap data showed weevil catches were obtained almost every week suggesting the perennial presence of weevil. The pheromone traps caught a total of 348 adults. The fluctuation in trap catches was significant, with catches of more than 30 weevils recorded for some traps. The findings suggest aggregation pheromone trapping can be a useful monitoring tool for RSPW in Malaysia.*

**Keywords:** *Red stripe weevil, aggregation pheromone,* Rhynchophorus vulneratus, *coconut.*

The red stripe palm weevil (RSPW), *Rhynchophorus vulneratus* (Panzer) (= *R. schach*) (Coleoptera: Curculionidae) is a major pest of palms in Malaysia, especially the economically important coconut, *Cocos nucifera*, and the sago, *Metroxylon sagu* (Sivapragasam *et al.*, 1990). It is currently a threat to young coconut germplasm in the field. Besides *R. vulneratus*, a congeneric species known as the red palm weevil, *R. ferrugineus*, which is a major pest of the date palm in the Arabian Peninsula and the Indian sub-continent, has also been recently found in Peninsular Malaysia (*Figure 1*). Damage to the palm by RSPW is dué to the grub, usually found in a mass, feeding within the crown region

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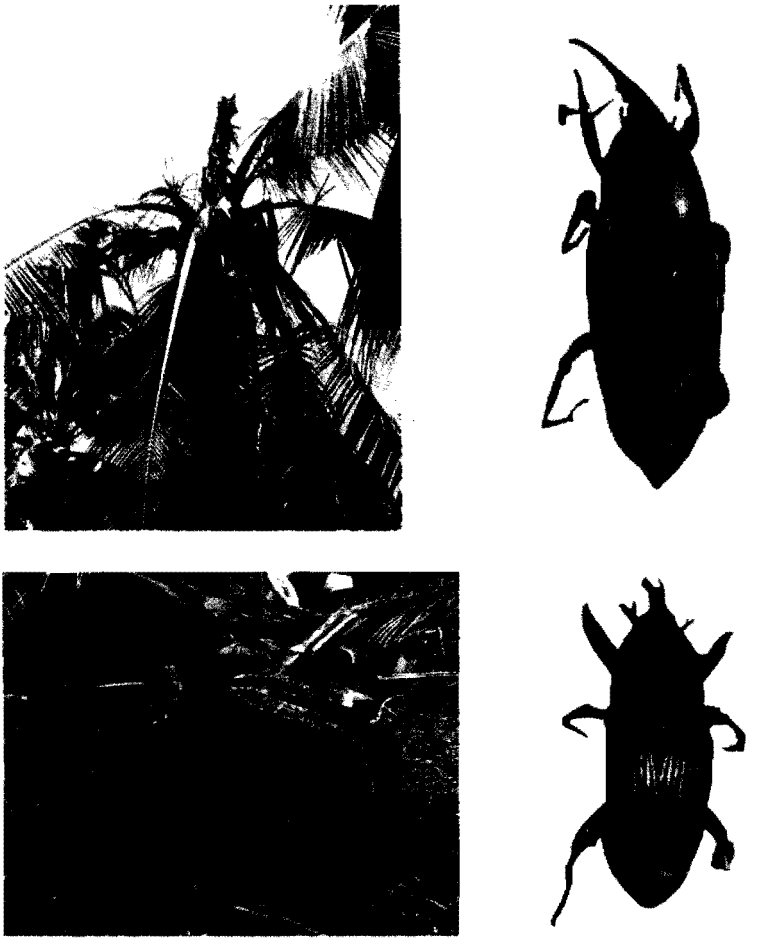

*Figure 1 Adult* Rhynchophorus vulneratus *and its damage (top) and* R. ferrugineus *and damage (bottom)*

of the palm resulting eventually in the collapse of the crown. The control measures currently advocated include a combination of cultural measures such as prompt destruction of infested palms especially for tall palms and curative treatments by drenching insecticides into the crown for shorter palms.

An important aspect of the management program undertaken by plantations to detect the presence of the weevil is based on the census of damaged palms (Arikiah, 1988). However, census based on already damaged palms does not help taking preventive measures since infestations are often not detected until the fronds wilt and the crown collapses suddenly by which time the tree is beyond recovery. In addition, the distribution pattern of infestation tends to be random requiring census of palms in the whole area. Therefore, a method for monitoring the weevil will be useful. Earlier attempts to monitor the adult weevil included using split coconut fronds or trunks baited with fermented alcohol (locally known as toddy) added with a few grains of yeast

(Sivapragasam *et al.*, 1990) and the use of an electronic devise for grubs (Anon, 1971). However, these methods have their limitations.

Male produced aggregation pheromones have recently been identified and tested for *R. vulneratus* and its other con-generic species in other countries (Oehlschalager *et al.*, 1993; Gries *et al.*, 1993; Hallett *et al.*, 1993). Despite the availability, there had been no studies conducted to evaluate the use of the RSPW pheromone under local conditions in Malaysia. The objective of this study was to evaluate a commercially-available aggregation pheromone to monitor the incidence of the weevil in the coconut ecosystem.

## MATERIALS AND METHODS

### Trap components

*Aggregation pheromone*

A commercially available pheromone, 4-methyl-5-nonanol, and known commercially as Ferrugi-on® *(Figure 2)* was obtained from Semiochem, Perth, Australia. The pheromone is reported to be also effective for trapping the red palm weevil, *R. ferrugineus.* The rate of evaporation of the pheromone at 29-31°C is 3 mg/day and an active field lifespan of about 2.5 months depending on wind currents and field temperature.

*Kairomone*

The kairomone, which was also supplied by Semiochem, Australia, as part of the pheromone trap system, is a mixture of low volatile alcohols and acetates with a rate of evaporation of 50 mg/day.

*Trap system (Figure 3a)*

The trap used is a circular 3.0 cm diam. plastic bucket with a cover drilled with six 1.0 cm diam. holes around on the sides about 2.5 cm below its top edge. About 1.5 liters of water with some soap detergent was placed into the bucket to trap and prevent the weevil from flying out and then the bucket cover was put in place. One septum with the aggregation pheromone and two septa containing the kairomone which were held in place using a metal fastener with three slots were hung from inside the bucket *(Figure 3b).*

### Effect of trap placement on trap catches

The catches of the pheromone based on trap placement, *viz.*, aerial (Treatment 1) *versus* ground (Treatment 2), on weevil catches was evaluated. The experiment was conducted in a coconut area which was divided into blocks, each covering 2 - 3 ha. Most of the coconuts

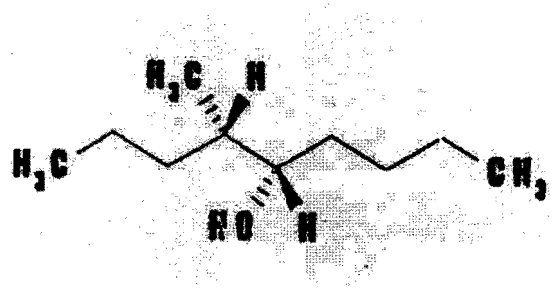


*Figure 2 Chemical structure of aggregation pheromone, Ferrugi-on® (4-methyl-5-nonanol)*

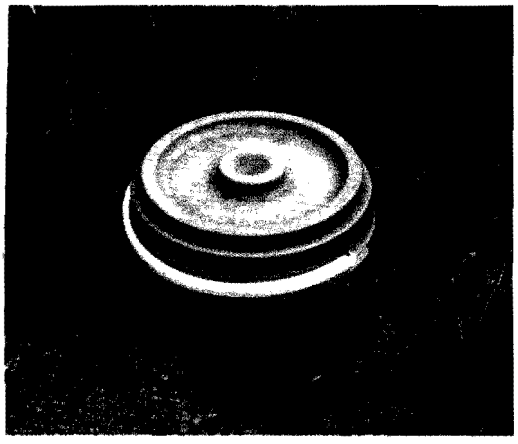

*Figure 3a Installed (ground trap) pheromone trap for red stripe palm weevil*

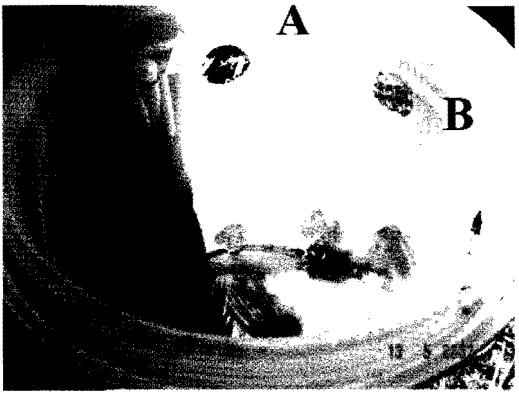


*Figure 3b Close up inside of the trap: A - septa with pheromone + attractants; B – Trapped adult weevil floating in the water*

in the area were 10-year old and belonged to a mixture of varieties dominated mainly by the Malayan Talls. In each block, weevil catches in the trap located on the ground (*Figure 3a*) and in aerial trap (*Figures 4a&b*), were compared. For placement of aerial traps, palms in open area with good air-flow were selected. The trap was hung on the trunk of palm at a height of about 120 cm above the ground. For comparison, the ground trap was also placed in the same block but at a distance of about 30 m away from the aerial trap. The ground trap was partially embedded in the soil with the holes exposed above the soil surface. Trapping was done for a period of 8 weeks for the thirteen blocks (= replicates) and weekly trap catches, and number of males and females recorded. Sexing was based on the morphological features of the snout (Sivapragasam *et al.*, 1991). Adult weevils caught in the bucket were removed only after 4 weeks. The water in the trap bucket was replenished when necessary. The data were analyzed using pooled data of trap catches for

*Figures 4a - b Aerial trapping system*

all the blocks and mean trap catches for each treatment was separated using the Duncan Multiple range test at $P< 0.05$.

**Effect of sugarcane as bait on trap catches**

To improve the relative attractiveness of the trap, the use of sugarcane as additional bait, besides the kairomone, was examined. The following six treatments were evaluated using the ground trap. Each treatment was replicated 10x in different coconut cultivated areas at the MARDI Hilir Perak station. In each replicate, each of the treatment was placed in the same block but at a distance of about 30 m away from each other.

Treatment 1: Pheromone + kairomone + sugarcane + water
Treatment 2: Pheromone + kairomone + sugarcane - water
Treatment 3: Pheromone + kairomone + water
Treatment 4: Sugarcane + water
Treatment 5: Pheromone + kairomone only - water
Treatment 6: Water only

The trap system used with the pheromone and kairomone is the same as the one described above. Fresh sugarcane stems each about 15 cm in length were used in some of the treatments. Before use, the stem was split into half and hung from the lower surface of the bucket cover by means of a wire. Trapping record was based on the catches for the duration of eight weeks. The data were analyzed as in the experiment on trap placement.

**Evaluating trap performance in the field**

A preliminary study on the performance of the trap was conducted in a 58 ha coconut area (cv. MATAG; planted in 1995) at the Bagan Pasir Estate, Hilir Perak. The area was infested with *R. vulneratus* and in dire need for pest management measures which inevitably require detection of the weevil populations. The trapping was conducted from 4th May 2004 to 7th October 2004 with an interval between the 13th and 14th weeks based on the ground pheromone trap described above. Lures and the kairomone bait were replaced at every 8th week. The traps were placed at 1 trap per ha with a total of 32 traps used for the whole area. Trap catches were recorded weekly by the estate staff but the weevils are not sexed. Adult weevils in the trap were removed only after 4 weeks and water level in the trap was replenished as needed.

## RESULTS AND DISCUSSION

**Effect of position of trap**

The mean weekly weevils captured between aerial and ground trap were not statistically significant ($F: 0.4955$; $P = 0.4930$), although catches were numerically higher in the ground trap (mean ± S.D = 3.25 ± 3.77) compared to the aerial trap (mean ± S.D.= 2.25 ± 1.39). Irrespective of location there were more females caught than males. The males: females ratio based on total numbers caught over the trapping period was respectively 8:10 and 7:19 for aerial and ground traps. Irrespective of insect gender, trap catches peaked in the 3rd week for ground trap and 4th week in aerial trap (*Figure 5*).

Studies conducted by Hanounik *et al.* (1999) on date palm also showed more weevil *R. ferrugineus* (Oliver) caught in ground traps compared to those hung (aerial) on the palm. The probable reason could be due to the fact

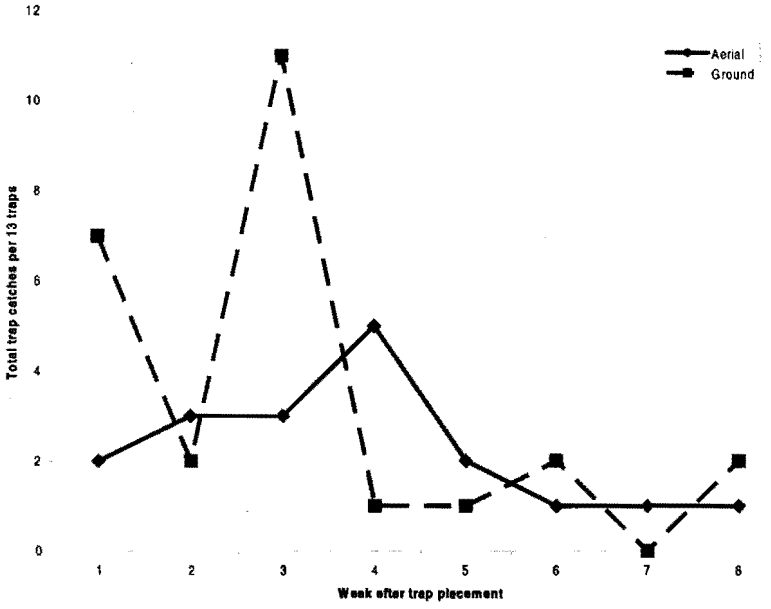


*Figure 5 Mean* R. vulneratus *catches in aerial and ground trap*

that the weevil usually land near the trap area before crawling in. Furthermore, there are wide landing area around the ground trap, in proximity to the entry holes. Another reason for this could be the moist environment provided by the ground as other studies had also showed that traps with water are more attractive to weevils than dry traps. Oehlschlager *et al.* (1993) also reported higher *R. palmarum* (L.) in ground traps.

**Effect of sugarcane as bait**

Effect on catches in trap treatments with or without sugarcane as bait are shown in *Table 1*. Trap catches were obtained only in traps with pheromone + kairomone as lure. The result suggests only pheromone + kairomone are crucial in insect monitoring. The addition of sugarcane as additional bait would significantly enhance the effectiveness (T1 in *Table 1*). However, sugarcane or water alone or their combination did not trap any weevil. Essentially, pheromone, food and moisture are all key ingredients in attracting weevils to the traps.

The presence of water is not critical in insect trapping. This is evident where inclusion have little or no effect at all on *R. vulneratus* catches (*Table 1*), as exemplified when comparing T1 with T2, and T3 with T5. This is contrary to the finding by Oehlschlager *et al.* (1993) on *R. ferrugineus* that showed preference to sites with high relative humidity.

In all the treatments, more females were caught than male weevils. This is typical for an aggregation pheromone, and the finding is in accord with preceeding study on trap placement.

**Evaluating trap performance in the field**

The in-field trapping data is shown in *Figure 6*. With the exception of the interval

TABLE 1
*RHYNCHOPHORUS VULNERATUS* CATCHES IN TRAP USING SUGARCANE AS BAIT

| *Treatments* | *Total catches (mean ± S.D)** | *Female (mean ± S.D)** | *Male (mean ± S.D)** |
|---|---|---|---|
| Pheromone + kairomone + sugarcane + water (T1) | 7.55 ± 10.19 **a** | 5.55 ± 7.47 **a** | 2.00 ± 2.83 **a** |
| Pheromone + kairomone + sugarcane (without water) (T2) | 3.33 ± 4.77 **ab** | 2.89 ± 4.04 **ab** | 0.44 ± 0.88 **b** |
| Pheromone + kairomone + water (T3) | 1.33 ± 2.00 **b** | 1.33 ± 2.00 **b** | 0.00 ± 0.00 **b** |
| Sugarcane + water (T4) | 0.00 ± 0.00 **b** | 0.00 ± 0.00 **b** | 0.00 ± 0.00 **b** |
| Pheromone + kairomone only (without water) (T5) | 1.55 ± 2.24 **b** | 1.56 ± 2.24 **b** | 0.00 ± 0.00 **b** |
| Water only (T6) | 0.00 ± 0.00 **b** | 0.00 ± 0.00 **b** | 0.00 ± 0.00 **b** |

* Means within column with the same letter are not significantly different at $P < 0.05$, Duncan Multiple Range Test.

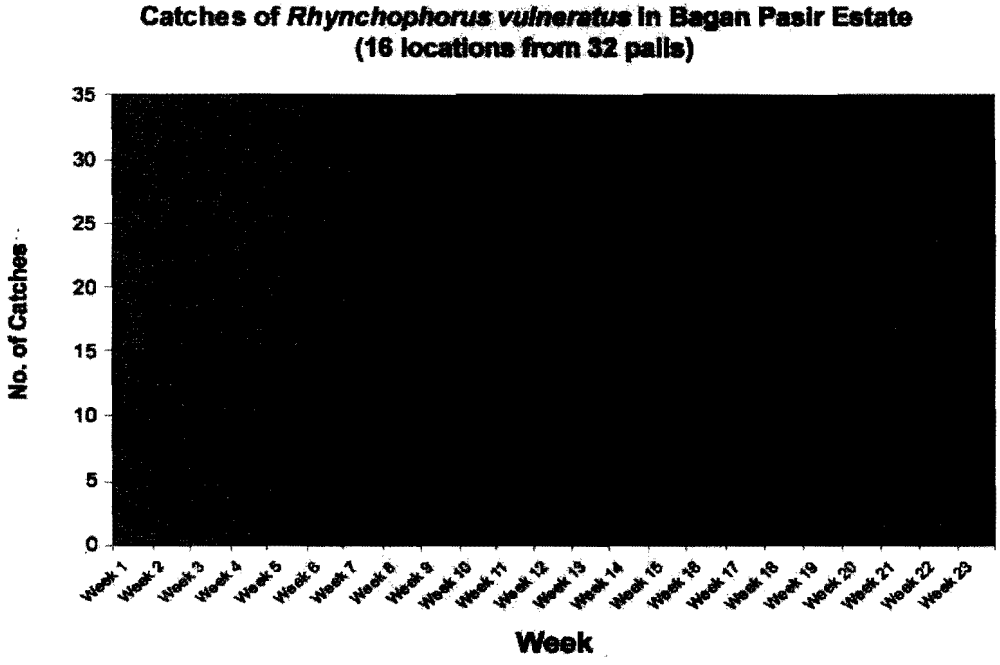


*Figure 6 Weekly trap catches of* Rhynchophorus vulneratus *in a field in Bagan Pasir using pheromone and ground trap*

between the 13th and 14th week, there were catches every week. The catches fluctuate drastically with the range varying from 3 to >30 per week. The numbers caught were decreasing over the 6 months monitoring period, which could either be due to the reduction in the attractiveness of the pheromones or due to decreasing numbers of weevils in the field due to the trapping. In total, the pheromone system caught 348 adults - adults which otherwise could have multiplied and damaged the palms. Thus, another potential advantage from the trapping is the removal of female weevils from the ecosystem. Although the sexes of the adults were not recorded, however, based on a general sex ratio of 1:1 for *R. vulneratus* (Sivapragasam *et al.*, 1990), we could expect the number of females to be about 174 adults - which is a sizeable damaging population. This translates to a high potential population when it is known that a female can lay about 204 eggs during its life span of 2-3 months (Sivapragasam *et al.*, 1990). Future trials are needed to measure the specific impact of the trapping system on the damage to the coconut palms.

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## REFERENCES

ANON. 1971. An electronic devise for the detection of red weevil infestation. Coconut Research Institute. Leaflet No. 49.

ARIKIAH, A. 1988. Identification, sensoring and treatment of *Rhynchophorus schach* Oliver (red stripe weevil). Paper presented at the Planting Practices Committee Meeting at United Plantations Berhad on 27 July 1988 (mimeograph).

GRIES, G, GRIES, R, PEREZ, A L, OEHLSCHLAGER, A C, GONZALEZ, L M, PIERCE JR, H D, KOUDA, M, ZEBEYOU, M and NANOU, N. 1993. Aggregation pheromone of the African palm weevil, *Rhynchophorus phoenicis* F. *Naturwissenschaften*, 80: 328 - 331.

HANOUNIK, S B, M SALEM, G M HAGAZY, O AL-MOHANA, AL- HAGI and H AL-DHAGER. 1999. Development of a new food-baited aggregation pheromone/kairomone trapping system for the red palm weevil *Rhynchophorus ferrugineus* (Oliver). Report on *Project on Biocontrol of Red Palm Weevil,* Arab Organization for Agricultural Development, Minsitry of Agriculture and Waters, El Qateef, Saudi Arabia (mimeograph).

HALLETT, R H, OEHLSCHLAGER, A C, GRIES, G, ANGERRILLI, N P D, AL SHAREQI, R K, GASSOUMA, M S and BORDEN, J H. 1993. Field testing of aggregation pheromones of two Asian palm weevils. In: *Proceedings PORIM Intl. Palm Oil Congress -Update and Vision (Agriculture)*, pp: 661 - 68.

OEHLSCHLAGER, A C, CHINCHILLA, C M, GONZALEZ, L M, JIRON, L F, MEXZON, R and MORGAN, B. 1993. Development of a pheromone-based trapping system for *Rhynchophorus palmarum* (Coleoptera: Curculionidae). *J. Econ. Entomol.*, 86: 1381 - 1392.

SIVAPRAGASAM, A, ARIKIAH, A and RANJIT, C A. 1990. The red stripe weevil, *Rhynchophorus schach* Olivier (Coleoptera: Curculionidae): an increasing menace to coconut palms in Hilir Perak. *The Planter*, 66: 113-123