ADVANCES IN TRAPPING & REPELLENCY OF PALM WEEVILS

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ABSTRACT

Rhynchophorus palmarum is a problem in oil & coconut palm in Central & South America due to direct larval damage & vectoring of red ring nematode. Pheromone trapping & removal of red ring nematode infested palms are the only economically viable techniques used in the Americas used to combat palm weevil problems. Trapping is made difficult by the requirement for replacement of water & food bait in the traps. This paper reports discovery of non-repellant additives that extend the effective life of trap food bait from 2 weeks to 7 weeks. The new additives do not evaporate so that in hot weather traps remain attractive up to 7 weeks without addition of water. This paper also describes tests of repellants that reduce captures of *Rhynchophorus palmarum* in pheromone traps by over than 50%. These repellants make possible push-pull strategies to improve management of palm weevils.

Additional Index Words: *Rhynchophorus ferrugineus*, *Rhynchophorus palmarum*, pheromone, kairomone.

INTRODUCTION

Rhynchophorus palmarum is managed in Central and South America without insecticide spray by pheromone trapping and sanitation practices in oil, coconut and palmito palm. It is a strong flyer traps which are normally placed at densities of 3-7 hectare (Chinchilla et al., 1993). This density of traps removes > 80% of weevils during one year (Chinchilla et al., 1993). Traps are plastic containers tied to palms at chest height and are baited with the male-produced aggregation pheromone and insecticide treated sugarcane or palm pieces (Oehlschlager et al., 1993a). Decomposition and desiccation of food bait decreases attraction to traps so food bait is replaced every 2-3 weeks in most trapping programs. Pheromone and kairomone lures are replaced at 3-4 month intervals. The present study was undertaken to improve the attractiveness of the pheromone trap, to decrease decomposition and desiccation of food bait and to determine if repellants could be found for *R. palmarum* that could protect palms from attack.

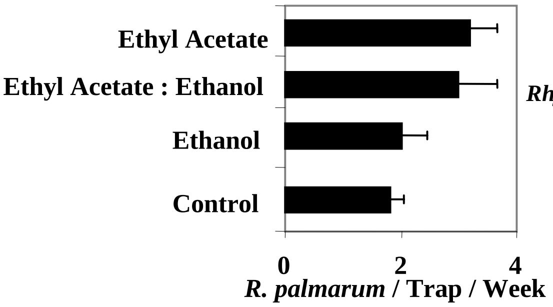
In the early 1990's an initial trial demonstrated that addition of ethyl acetate to pheromone / sugarcane baited traps increased capture of *R. palmarum* (Jaffe et al. 1993). We repeated this work in extensive trials in the 1990's and confirmed that emission of ethyl acetate from pheromone / sugarcane baited traps increased capture of *R. palmarum* by 50-100% (Chinchilla and Oehlschlager, Unpublished). This experiment was repeated for *R. ferrugineus* in the UAE in 1997 with spectacular success. In the UAE emission of ethyl acetate from pheromone / food baited traps increased capture of *R. ferrugineus* by 2.6X (Ferrolure+, Technical Bulletin, ChemTica, Costa Rica). In 1998 an Egyptian test revealed that emission of ethyl acetate increased capture of *R. ferrugineus* in pheromone / sugarcane baited traps by 5X (Oehlschlager, 1998).

MATERIALS AND METHODS

Experiments were conducted in 50 hectares of commercial coconut palm in Costa Rica. Traps were 12 liter white plastic buckets in 50 ha of commercial coconut palm in Costa Rica. Traps were 12 liter white plastic buckets with four 5 cm X 10 cm slots in sides near the top for insect entry. Pheromone and kairomone lures were hung from the bottom side of lids. Traps were strapped to the palms at 1.5 meters above ground 100 meters apart and 50 meters from any border. All traps contained commercial pheromone lures (ChemTica) and 5 pieces of 20 cm long halved sugarcane. Traps were left in place for a minimum of 1 week at which time insects were counted and removed. In the case of trap longevity studies no water or other additives were replaced during the course of any experiment. Analysis of capture data was advised by SYSTAT 9. Means were tested for significant differences by Bonferonni t-test, $P > 0.95$.

RESULTS AND DISCUSSION

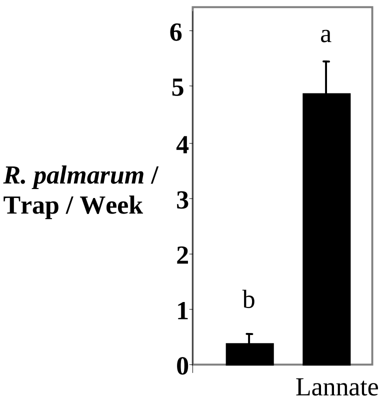
In the current study we examined a report that combination of ethyl acetate and ethanol improve the attraction of *R. palmarum* to pheromone / sugarcane traps more than ethyl acetate (Rochat et al. 2000). In several experiments (eg., Figure 1) ethyl acetate was as effective as any combination of ethanol and ethyl acetate and more effective than ethanol. These experiments further confirmed a 50% increase in capture of *R. palmarum* in pheromone / food baited traps that additionally emit ethyl acetate.



***Rhynchophorus palmarum* Attraction to Pheromone / Sugarcane Baited Traps with Ethyl Acetate & Ethanol**

Figure 1 Test conducted May 17-30, 2000 using traps made from 20 liter white plastic buckets with four 5 X 8 cm slots near the top for insect entry. One liter 1% lannate was added to each trap at start of test and 500 mL after the first week. Treatments were fresh sugarcane and ethyl acetate:ethanol lure; fresh sugarcane and ethyl acetate lure; fresh sugarcane and ethanol lure or fresh sugarcane (control). Weevils were counted and removed after first week at which time trap positions rerandomized. ANOVA (n = 20) revealed no significant differences between treatments.

Some palm weevil trapping programs have recommended the use of traps without insecticide. We examined the efficiency of pheromone / food baited traps containing insecticide vs those without insecticide. In Figure 2 it is obvious that addition of as little as 0.25% Lannate to pheromone / food baited traps acts to retain arriving *R. palmarum*. In this experiment we found 10 *R. palmarum* in traps without insecticide. Out of these, 7 were alive suggesting that without using the insecticide, *R. palmarum* still enter the traps but leave. This result is in agreement with weevil retention studies in which we demonstrated that without insecticide > 90% *R. palmarum* escaped from a 20 liter plastic bucket after 24 hrs (Oehlschlager et al., 1993b).



Capture of *R. palmarum* in Pheromone / Sugarcane Baited Traps With and Without Insecticide

No
Lannate

Figure 2 Experiment conducted July 29-August 12, 2000. Traps contained fresh sugarcane, ethyl acetate:ethanol (1:1) lures and 1 liter of 0.25% Lannate (Lannate) or 1 liter of water (No Lannate). ANOVA (n = 12-13) gave df = 1, 23 F = 15.07. Means topped by different letter are significantly different by Bonferonni t-test, P>0.95.

Replacement of food bait due to decomposition and desiccation is a major effort in trapping *R. palmarum*. In the dry season food bait becomes dry and unattractive after 2 weeks while in the wet season, decomposition renders food bait unattractive due to decomposition after 3-4 weeks. Attempts to construct artifical food bait from chemical odors (Rochat et al., 2000) have not been successful (Oehlschlager et al., in preparation). Water is an essential ingredient of traps since a primary method of retaining weevils in traps is for them to feed on insecticide-laden wet food. In the Middle East where trapping is targeted against *R. ferrugineus* food bait in traps often dries out within a few days and traps lose their ability to retain attracted weevils.

We conducted several experiments to extend the useful life of trap food bait by addition of inexpensive materials that retard the evaporation of water, are not repellant to the weevils and are not toxic to humans. Figures 3 and 4 show typical results with one such Trap Extender currently under test. The Extender does not evaporate so traps containing it do not get dry. The Extender is not toxic to humans and is relatively inexpensive. The Extender prolongs the useful life of sugarcane baited traps until at least 7 weeks. In Figure 3 after 4 weeks traps with the Trap Extender are still more attractive than 2 week old traps with water. Traps with Trap Extender were still attractive and contained liquid after 10 weeks.

R. palmarum Capture in Pheromone / Food Traps with CTI Trap Extender

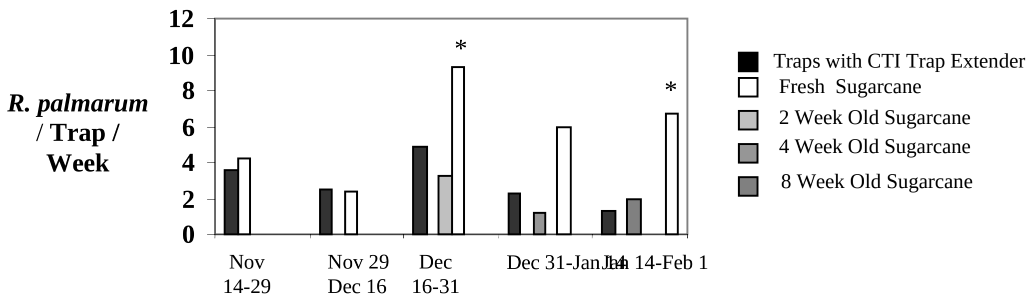


Figure 3 Experiment set up November 14, 2000. All traps contained commercial pheromone lures (ChemTica). Treatments were traps baited additionally with fresh sugarcane in 750 mL of water containing 0.13% Lannate (New Sugarcane); 2 week old sugarcane in 750 mL of water containing 0.13% Lannate (2 Week Old Sugarcane); 6 week old sugarcane in 750 mL of water containing 0.13% Lannate (6 Week Old Sugarcane) and fresh sugarcane, ethyl acetate lures in 750 ml of water with 20% CTI Trap Extender and 0.13% Lannate placed November 14, 2000 (Traps with CTI Trap Extender). Ten traps of each treatment were placed. Means of capture are presented. ANOVA on data collected November 29 (n = 9-11), December 16 (n = 9-10) and January 14 (n = 9-10) indicated no significant differences between treatments. ANOVA (n = 8-10) on December 31 and Feb 1 (n = 9-10) indicated traps containing new sugarcane were significantly more attractive than other treatments.

In Figure 4 traps prepared with Trap Extender January 14, 2001 remained attractive 7 weeks until March 8, 2001. At this time point traps containing Trap Extender were still almost as attractive as freshly prepared traps.

Capture of _R. palmarum_ in Pheromone / Food Traps containing CTI Trap Extender or Not

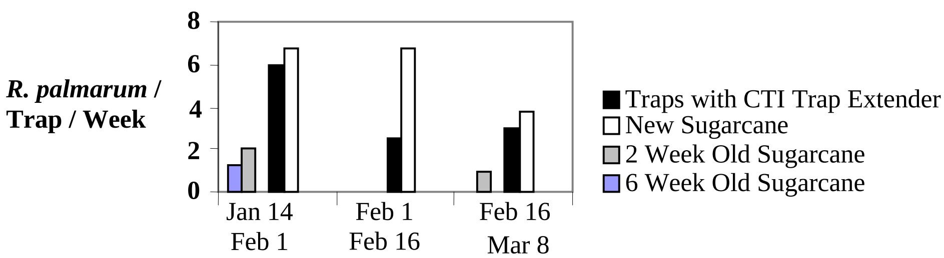


Figure 4 Experiment set up January 14, 2001 all traps contained commercial pheromone lures (ChemTica). Treatments were traps baited

additionally with fresh sugarcane in 500 mL of water containing 0.13% Lannate (New Sugarcane), 2 week old sugarcane in 500 mL of water containing 0.13% Lannate (2 Week Old Sugarcane), 6 week old sugarcane in in 500 mL of water containing 0.13% Lannate (6 Week Old Sugarcane) and fresh sugarcane, ethyl acetate lures in 750 ml of water with 50% CTI Trap Extender and 0.13% Lannate placed January 14, 2001 (Traps with CTI Trap Extender). Ten traps of each treatment were placed. Means of capture are presented.

A final aspect of our recent work has been to search for repellants that could be used to decrease attack of *R. palmarum* on oil, coconut or palmito palm. The strategy adopted was to compare capture efficiency of pheromone / food baited traps with pheromone / food baited traps additionally releasing candidate repellants. This approach allows a rapid screening. Repellants are an important strategy for the management of several species of bark beetles. Thus, for management of Mountain Pine Beetle (*Dendroctonus ponderosae*) trees are baited with pheromone lures to induce beetles to attack trees in timber stands selected for cutting. Simultaneous baiting of surrounding stands with repellants increases the efficiency of the bait-tree beetle concentration strategy. Similar strategies of push – pull are used for management of the Southern Pine Beetle (*Dendroctonus frontalis*) and the Douglas Fir Beetle (*Dendroctonus pseudotsugae*). In trials conducted to date two potent repellants for *R. palmarum* have been discovered. In Figure 5 release of one of these, Repellant A, from highly attractive pheromone / sugarcane / ethyl acetate baited traps decreases capture rates by over 50%. In Figure 6 a similar test of known repellants of other insects is shown. While it could be argued that alpha-pinene would mask the odor of palm trees with that of a non-host pine tree this candidate is not repellant. Likewise, leaf alcohol has been reported to be repellant to many species of insects but is not repellant to *R. palmarum*.

Capture of *R. palmarum* in Pheromone / Food / Ethyl Acetate Traps Containing Repellant A

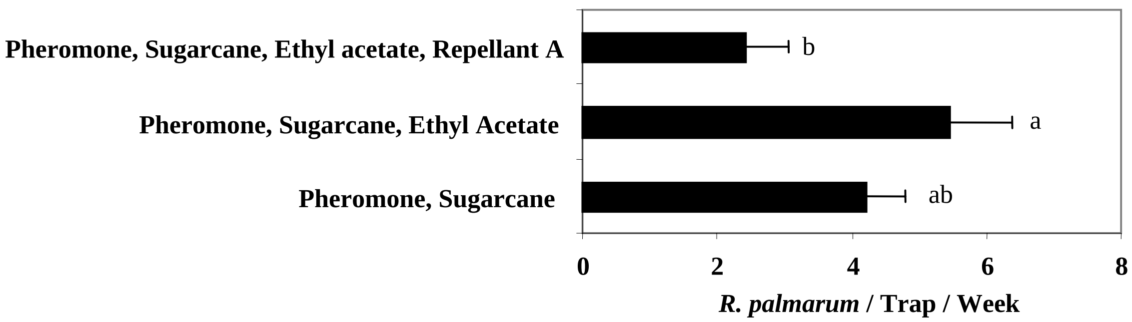


Figure 5 Experiment conducted November 14-29, 2000 in 50 ha of commercial coconut palm in Costa Rica. Treatments were pheromone and sugarcane in 750 mL 0.13% Lannate; pheromone, sugarcane, ethyl acetate with 750 mL water containing 0.13% Lannate and pheromone, sugarcane, ethyl acetate, and Repellant A with 750 mL water containing 0.13% Lannate. ANOVA (n = 8-10) gave $p < 0.05$. Means followed by different letter are significantly different by Bonferonni t-test, $P > 0.95$.

Capture of *R. palmarum* in Pheromone / Food / Ethyl Acetate: Ethanol Baited Traps

Containing Candidate Repellants

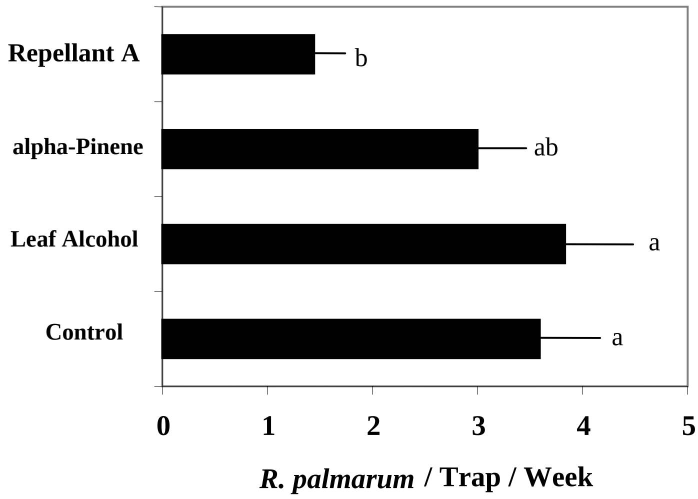


Figure 6 Experiment conducted May 31-June 13, 2000. All traps contained pheromone lures, ethyl acetate:ethanol (1:1) lures and fresh sugarcane immersed in fresh sugarcane 1 liter of 0.25% Lannate. Repellant candidate traps additionally contained slow release devices containing the indicated candidate repellants. Weevils were counted and removed June 6 at which time trap positions were re-randomized. Analysis determined no differences in capture rates on June 6 and June 13 allowing combination of captures for June 6 and 13. ANOVA (n = 17-20), df = 3, 72, F = 4.62. Means followed by different letter are significantly different by Bonferonni t-test, $P > 0.95$.

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