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Source: Florida Entomologist, 85(3) : 426-430

Published By: Florida Entomological Society

URL: https://doi.org/10.1653/0015-4040(2002)085[0426:PMTOTW]2.0.CO;2

PHEROMONE MASS TRAPPING OF THE WEST INDIAN SUGARCANE WEEVIL AND THE AMERICAN PALM WEEVIL (COLEOPTERA: CURCULIONIDAE) IN PALMITO PALM

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Abstract

Experiments in Costa Rica and Honduras determined that both *Metamasius hemipterus* L. and *Rhynchophorus palmarum* L. could be captured in the same trap using pheromone lures emitting a mixture of their male-produced aggregation pheromones. Mass trapping of both species was conducted in commercial palmito palm (*Bactris gasipaes*, Kunth) over 16 months using a combination lure and insecticide-laden sugarcane at a density of 4 traps/ha. Capture rates of *M. hemipterus* were initially high and declined significantly while capture rates of *R. palmarum* were initially low and remained relatively constant. Pupae found in and damage to palmito declined significantly in plots with traps compared to pre-trapping levels and to control plots without traps. Yields of palmito palm increased in all plots but increased most in plots with traps.

Key Words: *Metamasius hemipterus*, *Rhynchophorus palmarum*, *Bactris gasipaes*, mass trapping, pheromone-baited trap, damage reduction, yield increase

Resumen

Experimentos realizados en Costa Rica y en Honduras determinaron que ambos insectos *Metamasius hemipterus* L. y *Rhynchophorus palmarum* L. pueden capturarse en la misma trampa utilizando señuelos de feromona emitiendo una mezcla de las feromonas de agregación producidas por los machos de estas especies. El trampeo masivo de ambas especies fué llevado a cabo en palmas de palmito comercial (*Bactris gasipaes*, Kunth) por un período de 16 meses utilizando trampas con el señuelo combinado y caña de azúcar impregnada con insecticida a densidad de 4 trampas/ha. Las razones de captura del *M. hemipterus* fueron altas inicialmente y declinaron significativamente con el paso del tiempo, mientras las razones de captura del *R. palmarum* fueron bajas inicialmente y permanecieron relativamente constantes. El número de pupas encontradas en el palmito dañado declinó significativamente con respecto a los niveles encontrados al inicio como también comparados a los lotes sin trampas. Los rendimientos de palma palmito incrementaron en todos los lotes pero incrementaron más en los lotes con trampas.

Translation provided by author.

The heart of palmito palm (*Bactris gasipaes*, Kunth) is a delicacy in many countries of the world. Increasing demand for dietary fiber continues to fuel demand for palmito heart. Areas dedicated to commercial production in Central and South America in 1996 were about 12,000 Ha of which around 4,000 Ha were in the Atlantic Region of Costa Rica (Anonymous, Min. Agric. & Gran., 1998 Costa Rica). Between 1986 and 1996 the amount of palmito heart exported from Costa Rica increased by an order of magnitude (Anonymous, Min. Agric. & Gran., 1998 Costa Rica).

Palmito palm propagates from offshoots that grow to a harvestable height of one meter in about 3 months. Harvesting discards all parts of the plant except the interior of the stem. In some plantations, competing offshoots are pruned to promote more rapid growth of the remaining offshoots to harvestable size. Harvesting and pruning provide excellent entry points for *Metamasius hemipterus* L. (Vaurie 1966) and *Rhynchophorus palmarum* L. (Couturier et al. 1996; Vásquez et al. 2000) Females of these weevils are attracted to and deposit eggs in cut stem bases. Larvae tunnel the lower stem and rhizome destroying maturing stems.

While *M. hemipterus*, West Indian sugarcane weevil, is a primary pest of sugarcane it is recorded as a pest of several ornamental palms. In sugarcane females lay eggs in replanted stalk. Over 30-60 days larvae feed on the interior stalk before pupating in a fibrous cocoon. Adults live 2-3 months and are good fliers (Vaurie 1966).

R. palmarum, the American palm weevil, is a primary pest of palm in Central and South America. In oil and coconut palm *R. palmarum* vectors *Bursaphelenchus cocophilis*, the red ring nematode that has a major economic impact on commercial oil palm in the New World (Griffith 1968). The weevil life cycle is 70-120 days of which the larval stage is 40-60 days (Giblin-Davis et al. 1989).

Male-produced aggregation pheromones are known for both weevil species. The aggregation pheromone for *M. hemipterus* is a mixture of 4-methyl-5-nonanol and 2-methyl-4-heptanol (Perez et al. 1997) while the aggregation pheromone for *R. palmarum* is 2-methylhept-5-en-4-ol (Oehlschlager et al. 1992).

Trapping *M. hemipterus* at 4-5 traps/ha with pheromone-baited traps effectively lowers damage due to larvae of this insect in newly replanted sugarcane (Oehlschlager et al. 1997). Trapping *R. palmarum* at 1 trap per 5 ha effectively lowers red ring incidence in commercial oil palm by 80% over one year (Chinchilla et al. 1996).

Initial experiments conducted in Costa Rica and Honduras in 1995 led to development of a blend of the two pheromones that allowed trapping of both species in the same trap (Chinchilla et al. 1996). These experiments allowed combination lure trapping of both species in palmito palm.

Pheromone and sugarcane-baited traps have been developed for *M. hemipterus* (Giblin-Davis et al. 1996, Perez et al. 1997).

The purpose of this study was to determine if mass trapping *M. hemipterus* and *R. palmarum* in commercial palmito palm plantations using a combination lure decreased damage due to these weevils and increased yields.

Materials and Methods

Combination Lure Experiments for *Metamasius hemipterus* and *Rhynchophorus palmarum*

Capture of *M. hemipterus* was studied in 5 liter plastic container traps modified for insect entry (Oehlschlager et al. 1993) containing 10 pieces of halved 20 cm long sugarcane stalk (pre-immersed in 1% AI Sevin 80, 1-naphthyl N-methylcarbamate). The ten replicate experiment was conducted a mature oil palm plantation in Coop-California, Quepos, Costa Rica 18-24 February 1995.

Capture of *R. palmarum* was studied in 20 L plastic bucket traps (Oehlschlager et al. 1993) containing 15 pieces of halved 20 cm long sugarcane stalk (pre-immersed in 1% AI Furadan, 2,3-dihydro-2,2-dimethyl-7-benzofuranyl methylcarbamate). The twelve replicate experiment was conducted in a 100 Ha oil palm plantation near La Ceiba, Honduras, 21-27 March 1995.

For both *M. hemipterus* and *R. palmarum* experiments complete randomized block designs were used. Traps were placed at 2 meters above ground at 100 meter intervals with no trap closer than 100 meters from any planting border. Pheromone lures used in both *M. hemipterus* and *R. palmarum* experiments were 2-methylhept-5-en-4-ol (Rhyncolure), 4-methyl-5-nonanol:2-methyl-4-heptanol (8:1, Metalure) and a 1:1 mixture of Rhyncolure and Metalure (Combolure) all released at total rates of 3 mg/day.

Mass Trapping Experiment

Study sites for mass trapping in palmito were in the wet tropical (<500 M above sea level) Atlantic region of Costa Rica. Sites were within the area 82' 45"-83' 46"W and 9' 39"-10' 13"N. Experimental plots (100 M × 100 M) within commercial palmito palm plantations were selected for pruning practices. A 1 Ha plot in a palmito palm plantation in which pruning was practiced was selected as a control plot for evaluation of pheromone trapping under pruning conditions. A second 1 Ha pruned plot in the same area was selected as the trapping plot under pruning conditions. Within the same palmito plantation a 1 Ha plot in which pruning was not conducted was selected as a control plot for evaluation of pheromone trapping under non-pruning conditions. A second non-pruning 1 Ha plot in the same area was selected as a trapping plot under non-pruning conditions. Experimental plots were separated from each other by at least 200 M from and from any plantation borer by at least 100 M.

On September 2, 1996 four traps were established in a 50 meter square centered in each trapping plot.

Traps were 4L yellow plastic containers with 15 cm wide × 10 cm high windows cut in each side for insect entry similar to the square gallon traps reported by Giblin-Davis et al. 1996. Traps were mounted on sticks 0.5 M above ground and contained a Combolure pheromone lure (as described above) suspended by a wire from the below the lids. Traps contained 4-5 pieces of halved 10-12 cm long sugarcane stalk (pre-immersed in 1% AI Sevin 80, 1-naphthyl N-methylcarbamate).

Insects were counted and removed from all traps weekly. Pheromone lures were changed when exhausted as determined by the absence of liquid in the lure (3-4 months). Sugarcane in traps was renewed weekly.

Infestation and Yield Surveys

A survey of damage in palmito was conducted in the week preceding the placement of traps. Damage was determined by examination of all stalks in 60 bunches (mats) of palmito palm within each experimental plot. This was done by cutting all stalks in each bunch at ground level and examination of each stalk for damage. Variables assessed were, total stalks in each bunch, number of stalks in each bunch with larval damage due to *M. hemipterus* and *R. palmarum* and number of *M. hemipterus* or *R. palmarum* pupae in each stalk. We also recorded the number of stalks harvested from each bunch in the week of the survey. This survey was conducted again on March 3, 1997, August 12, 1997 and January 19, 1998.

Data Analysis

Data were tested for heteroscadiscity and if necessary, transformed to achieve homogeneity (Zar 1984). Data was analyzed using Systat 5.2.1, fully factorial ANOVA analysis routine. Means are always presented untransformed.

RESULTS AND DISCUSSION

Combination Lure Experiments for *Metamasius hemipterus* and *Rhynchophorus palmarum*

In agreement with preliminary reports (Chinchilla et al. 1996) we found that in oil palm traps containing lures with a mixture of the aggregation pheromones of *M. hemipterus* and *R. palmarum* were nearly as effective in capturing these weevils as traps containing one lure emitting the pheromone of each species (Figs. 1 and 2). For both weevil species traps containing a combination pheromone lure captured 25-30% less target weevils than traps containing a pheromone lure for the target species. The combination lure (Combolure) was ideal for the mass trapping of *M. hemipterus* and *R. palmarum* in palmito palm. An experiment revealed that this lure functioned more effectively if sugarcane rather than palmito was used in traps (D. Alpizar, unpublished).

Mass Trapping Experiment

At the commencement of trapping capture rates of *M. hemipterus* in both pruning and non-pruning

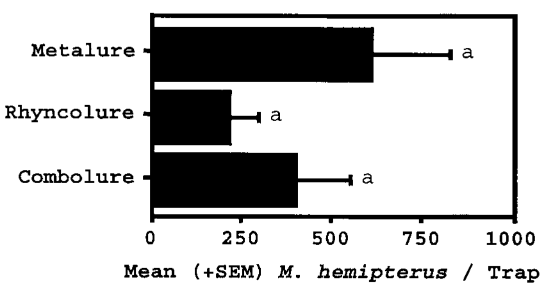

Fig. 1. Mean (+SEM) *M. hemipterus* captured in traps baited with sugarcane and 2-methylhept-5-en-4-ol (Rhyncolure), 4-methyl-5-nonanol:2-methyl-4-heptanol (8:1, Metalure) or a 1:1 mixture of Rhyncolure and Metalure (Combolure). ANOVA (n = 10) gave F = 4.45, p, 0.566 (NS). Means topped by the same letter are equivalent by Bonferonni t-test (P > 0.95).

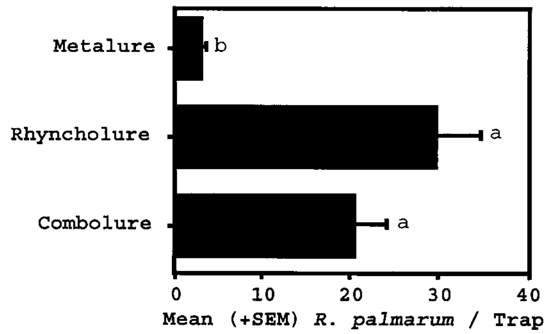

Fig. 2. Mean (+SEM) *R. palmarum* captured in bucket traps baited with sugarcane and 2-methylhept-5-en-4-ol (Rhyncolure), 4-methyl-5-nonanol:2-methyl-4-heptanol (8:1, Metalure) or a 1:1 mixture of Rhyncolure and Metalure (Combolure). ANOVA (n = 12) gave F = 8.50, P < 0.05. Means followed by a different letter are statistically different by Bonferonni t-test (P > 0.95).

plots were similar (Fig. 3). *M. hemipterus* capture rates declined from September through December and increased from January through March 1997. The highest capture rates occurred in March-April whereas a second population build-up occurred in September 1997 (Fig. 3). The first population peak corresponded to the end of the dry season in the Atlantic region of Costa Rica and might be attributed to a higher survival rate of *M. hemipterus* pupae in the dry season due to decreased fungal and bacterial action on pupal cocoons. Mass trapping *M. hemipterus* in banana and plantain in this region previously revealed an increase in capture rates during March-April (Alpizar et al. 1998). The peak in capture rates of *M. hemipterus* observed in September 1997 is attributed to the progeny of weevils that emerged in March-April.

Capture rates for *R. palmarum* were much lower than those of *M. hemipterus* at the onset of trapping although after one year of trapping capture rates of both species were similar. Initial capture rates of *R. palmarum* were ~3× higher in the pruned plot than in the non-pruning plot and remained higher for the entire trial (Fig. 3). While the capture rates for *M. hemipterus* declined over the trial period capture rates of *R. palmarum* remained rather constant.

Infestation and Yield Surveys

The percentage of weevil damaged stalks was assessed in both trapping and control plots the week before commencement of trapping and 7, 12 and 17 months afterward (Fig. 4). Because palmito palm grows to maturity in three months and the time between assessments was five to seven months, each assessment after the commencement of trapping was conducted on palmito stalks grown after the commencement of trap-

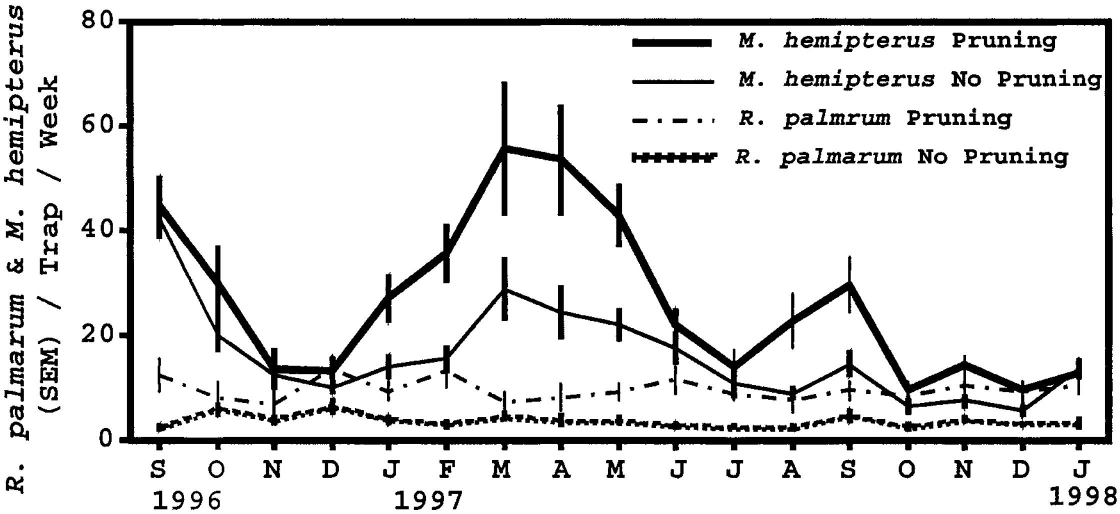

Fig. 3. Mean weekly capture of *M. hemipterus* and *R. palmarum* in palmito palm. Four traps were placed in one hectare of palmito palm in which pruning was practiced and four traps were placed in one hectare in which pruning was not practiced.

ping. The first assessment at month seven revealed weevil damage in trapping plots was reduced by >90% compared to pre-trap levels. This occurred even though considerable numbers of *M. hemipterus* continued to be captured in this time period. We conclude, based upon examination of capture rates and damage data that *M. hemipterus* and probably *R. palmarum* entering trapping plots after September 1996 chose the traps over palmito stems. A similar phenomenon was noted during trapping *Cosmopolites sordidus* and *M. hemipterus* in commercial banana (Alpizar et al. 1998). It is interesting that in control plots, damage also decreased during the period September 1996 to March 1997 but increased again between March and August 1997. The same seasonal fluctuation in damage is present but less pronounced in the trapping plots. This fluctuation can be attributed to the dispersal of low numbers of adults during November-January and higher numbers during February-May. Oviposition and larval development would be expected to be correspondingly low in November-January and high in February-May.

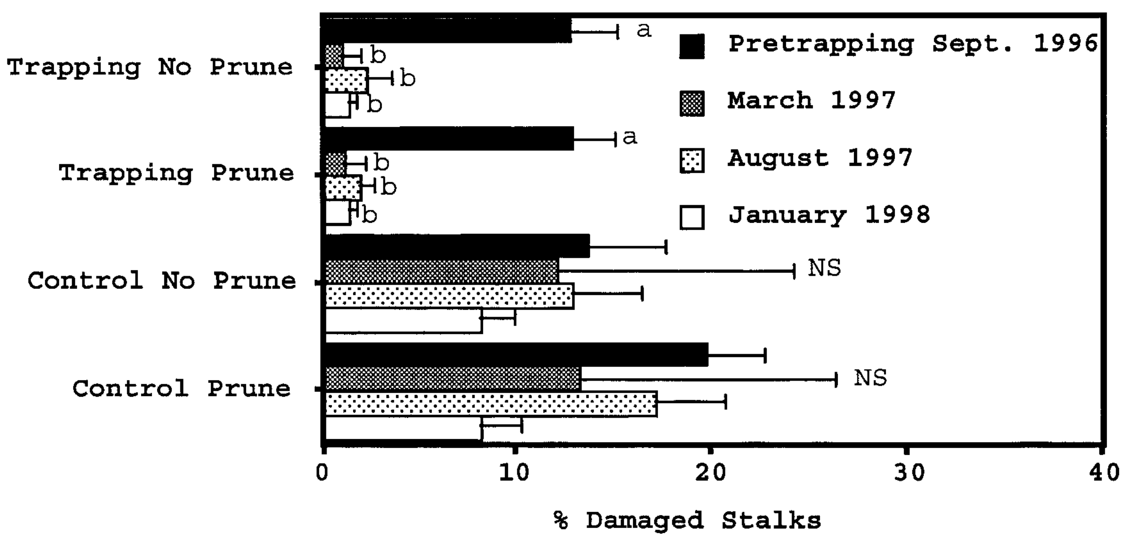

Fig. 4. Percent of damaged stalks in palmito palm stalk prior to and after commencement of trapping for *M. hemipterus* and *R. palmarum*. Statistical analysis compares each treatment at different dates and does not compare between treatments. Means followed by a different letter are statistically different by Bonferonni t-test (P > 0.95).

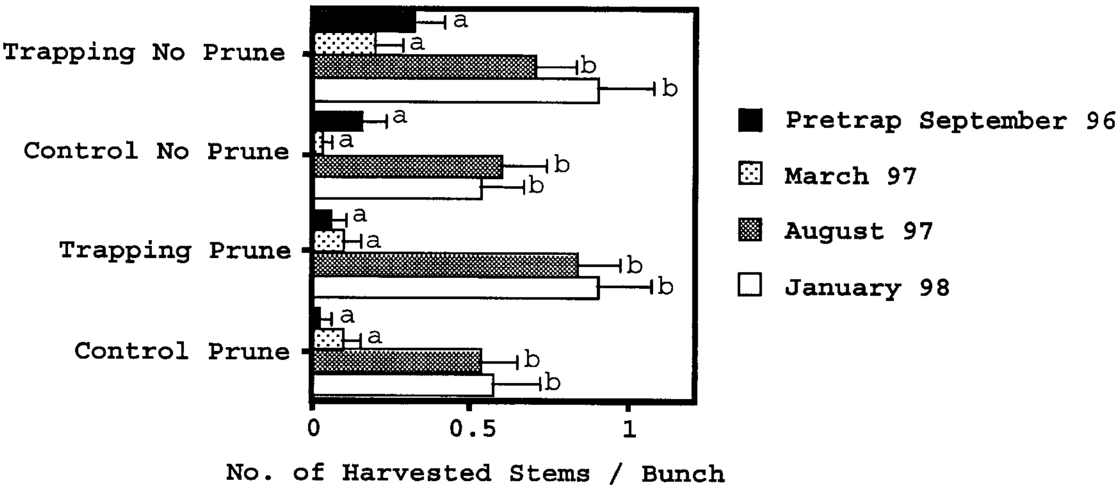

Fig. 5. Harvested stems per bunch prior to and after commencement of trapping for *M. hemipterus* and *R. palmarum*. Statistical analysis compares each treatment at different dates and does not compare between treatments. Means followed by a different letter are statistically different by Bonferonni t-test (P > 0.95).

Yield was assessed on the same dates that damage was assessed (Fig. 5). Yields increased dramatically in both trapping and control plots during the trial. After commencement of trapping those plots receiving traps consistently yielded higher numbers of harvestable stems per bunch than control plots without traps. Percentage yield increase attributable to trapping was 58% in plots in which pruning was conducted and 70% in plots in which pruning was not conducted.

ACKNOWLEDGMENTS

The authors thank the technical staff of DEMASA of Costa Rica for their help in execution of this study.

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