Evaluating a Female Attractant for the Indianmeal Moth (Lepidoptera; Pyralidae): A Controlled Laboratory Study and Field Trial

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Abstract

Previous studies demonstrated the ability of female Indianmeal moths, Plodia interpunctella (Hübner) (IMM), to locate oviposition sites by following airborne volatiles. An attractant was isolated and is a mixture of naturally occurring product is being sold under the name Moth Suppression®. The effectiveness of the female attractant at luring female IMM to sticky traps was tested in a controlled laboratory study over a 7-day period in a large room in which approximately 600 adults were released. There were 10 diamond sticky traps baited with the female attractant and ten were blank controls. There were 14 ± 5 (mean ± SEM) female IMM captured in baited traps compared to 0.6 ± 0.3 moths in the control traps. A separate field experiment was conducted in a warehouse in Winnipeg, Canada. Ten Moth Suppression traps were baited with male and female IMM lures and placed in a small area of the warehouse that contained packaged pet treats. Monitoring of IMM with 10 Discrete® traps baited with just male IMM lures continued during the trapping with Moth Suppression traps, as well as several months before and after the test. During the 17-week study a total of 67 females and 175 males were caught in the Moth Suppression traps. Both studies demonstrated that the female attractant can be an effective new tool for monitoring female IMM.

Introduction

Larvae of Plodia interpunctella and related species in the family Pyralidae infest stored products throughout the world. Monitoring and control of these pests through Integrated Pest Management (IPM) has taken on greater prominence as the need for pesticide-free organic foods increases and also as insects develop resistance to conventional fumigants and insecticides. The primary tool for monitoring IMM populations has been through the use of traps baited with the synthetic female-produced sex pheromone, 5,6,9,12-tetradecadienyl acetate, referred to as ZETA (Brady and Tumlinson, 1971; Zhu and Ryne, 1999). The major drawback to using pheromone-based methods as mass trapping and mating disruption is that they target only males. Untrapped males or males unaffected by mating disruption can mate multiple times, thus maintaining a substantial moth population (Luen, 1990). Female IMM can lay 250-300 eggs in a lifetime. Trapping females could make a greater impact on the population and make the development of a female moth attractant useful in the management of these pests. Several studies have demonstrated the ability of gravid female Indianmeal moths to locate grain-based food material upward for oviposition (e.g., Phillips and Strand, 1994). Other studies involving wind-tunnel and controlled laboratory tests showed that various food sources and oils could be used to stimulate oviposition at close range (Nansen and Phillips, 2003). Recent work in our laboratory showed that gravid female Indianmeal moths responded positively to an extract of food materials. We now have an attractive extract that is a mixture of naturally occurring food volatiles for which a patent application has been filed and a commercial product is being sold under the name Moth Suppression®.

Materials and Methods

Insects. The Indianmeal moth (IMM), Plodia interpunctella (Hübner) used in the laboratory study, were reared on a diet of corn meal in a growth chamber with a photoperiod of 18.6:6.0 (L:D) at 60-70°F and RH and temperature at 25±3°C.

Laboratory Experiment. A large basement on the campus of OSU was used in this experiment (Figs. 1 and 2). Temperature and humidity varied slightly from one location to the next in the basement (e.g., the northeast corner of the room averaged 32.2°C while the northwest corner averaged 28.7°C). The experiment consisted of 20 standard diamond shaped sticky flight traps regularly spaced throughout the experimental facility. 15 of which were randomly selected and baited with the lure of the female attractant, Moth Suppression® (Figs. 3 and 4) and the remaining 10 were assigned as blank controls. Four repeating groups of 100-150 adult moths of mixed sexes were released equal distances from each other at the beginning of the experiment. The traps were removed after seven days and the moths caught were sexed to accurately determine numbers of females present in each trap.

Field Experiment. This study was conducted in a large commercial food warehouse in Winnipeg. Monitoring with a total area of 30,500m² (Fig. 5). Ten Moth Suppression® trap kits, in which traps were baited with both the sex pheromone for trapping males and with the female IMM lures, were deployed in an area with an area of 4.5 m between traps and hung 2.5 m off the ground in a small area of the warehouse that contained packaged pet treats (Fig. 6). Separate monitoring of the male IMM population was also conducted using 10 Discrete® (Traps Inc.) traps baited with sex pheromone lures only, which continued during the trapping with Moth Suppression traps, as well as for two years before and several months after the female lure.

Results and Discussion

The laboratory study of P. interpunctella had a mean number of females caught in response to the female attractant of 14.0 (±1.6) compared to 0.8 (±0.5) caught in unbaited traps (F=12.63, P<.002). This study clearly demonstrated the ability of Female IMM to locate food odors distributed in traps around the test facility.

In the field trial, Moth Suppression traps caught a total of 67 females and 175 males over the 17 week study (Fig. 7). The high number of males captured relative to females is due to the synthetic sex pheromone ZETA, which is well known as a strong attractant for male IMM. There was a significant correlation between male captures and female captures in Moth Suppression traps (r=0.5, p=.005). This trial showed that the Moth Suppression® female attractant could definitely attract female IMM in a commercial setting that contained other competing odor sources. Monitoring of male IMM populations was done with Discrete® traps for three years in various locations throughout the facility and showed typical cyclic activity of IMM males with season (Fig. 8).

Conclusions

- Both field and laboratory studies showed that the female attractant was able to attract female IMM to traps
- Both studies also demonstrate the usefulness of the female attractant as a new monitoring tool for IMM populations
- Further research on female behavior may improve our understanding of moth infestations.
- Using the attractant in traps or in poison bait stations as part of a monitoring or control program will be evaluated.
- We are using electro-antennograms (EAG) and a coupled GC-EAD (gas chromatograph linked with the electroantennographic detector) to identify various volatiles that are responsible for the attraction to Moth Suppression lures; e.g., preliminary dose responses (Fig. 9).

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