Sampling and Control of the Small Hive Beetle

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Interpretive Summary:

The almond industry relies on honey bees for pollination and utilizes approximately one-third of all managed colonies in the U. S. (Morse and Calderone 2000). The ability to provide healthy colonies for almond pollination is being impacted by parasitic mites, diseases and other pests. One such exotic pest of honey bee colonies is the beetle, *Aethina tumida*, commonly called the small hive beetle (SHB). The USDA-ARS Bee Research Laboratory in Beltsville Maryland determined if sampling techniques for the small hive beetle can accurately predict actual beetle numbers in the colony and compared the current control measures for adult beetles. This information will be valuable to beekeepers, bee inspectors and growers to accurately detect and control this pest. To date, no survey tools are available and the colony level efficacy of current adult beetle control measures is unknown.

The Beltsville Lab conducted two large field experiments using package bees that were artificially infested with adult SHB at different densities and then surveyed and or treated over a four-week period. At the end of four weeks, all colonies were killed in the surveyed colonies and all beetles counted and in the trapped colonies surveys of surviving beetles were made. A simple diagnostic strip left in the colonies for 24 hours was 84% effective in detecting SHB presence in colonies. The use of either a West or CheckMite+ trap for four weeks killed over 90% of all beetles present.

Objectives:

1. Determine the accuracy of a sampling technique for detecting adult small hive beetles in honey bee colonies.

2. Determine the efficacy of current and potential SHB controls

Materials and Methods:

1. Develop and test a survey tool to accurately assess small hive beetle populations within hives.

2. Test chemical and non-chemical small hive beetle control strategies for beehives

General protocol:
Traditional 3-pound "package bees" were used to establish 112 honey bee colonies in Maryland. Ninety of these colonies were inoculated with differing beetle numbers and either surveyed (60 colonies) or treated (30 colonies) with 22 colonies serving as controls. The 112 colonies were located in isolated apiaries at the USDA-ARS facility in Beltsville. This isolation should have eliminated beetles moving into the colonies, other than the between colony migration which should occur. The use of sentinel colonies placed along the compass points at 10 and 50 meters from the hives gave a measure of beetle movement. After beetles were introduced, two to four weeks of either treatment or survey was conducted and then all colonies killed in the surveyed colonies and after four weeks the trap treated colonies were surveyed for remaining beetles.

Survey methods:
A single survey method was employed over each of four one-week periods in beehives with high to low beetle populations. The survey method used a plastic beetle refuge placed in the bottom of beehives (see Photo 1). A plastic cardboard material used to make signs and placards has been used to deliver baits for SHB adults and they readily move into the spaces in these units (This is the same material that is cut in half and used in the one labeled chemical control, Checkmite+, for use in beehives). The survey method used a trap strip (5x50cm) of the material placed on the bottom boards of colonies and then removed after a 24-hour interval and quickly counted. The idea is that beetles will find these refuges attractive to avoid the harassment by worker bees. These diagnostic strips do not require labor intensive opening of colonies as the bottom board strips can be placed and recovered with minimal disturbance to the colony.

Photo 1. Survey diagnostic strips used to test for small hive beetles in honey bee colonies.

A group of 64 colonies were established with three levels of adult SHB introduced. Four sets of 16 colonies each were established in circles with the colony entrances facing outward from the circle center. Four treatments were represented in each circle with four colonies with no introduced beetles (controls) and four hives of each beetle groups of 10, 20 or 100 introduced beetles. Nine colonies with no introduced beetles were maintained in the same apiary and served as sentinel colonies placed at 10 and 50 meters distance on the compass points around the apiary to serve as additional controls for beetle movement with the ninth colony located in the center of the apiary. Surveys were conducted in advance of the beetle introductions. Beetles were introduced and left for one day and then diagnostic strips placed in colonies for 24hours and then read by quickly removing the strip and counting beetles. Each group of 16 colonies were used only once at weekly intervals for four weeks. Following the surveys, colonies were individually bagged, killed and beetles counted by sifting them from adult bees and using visual inspections of combs and hive parts. Weight of adult bees was used to determine adult bee populations. Brood and stores of pollen and honey were made using a 5x5cm grid system. Comparisons were be made on the number of beetles recovered per colony and the number of beetles detected by the survey methods using regression analysis.

Treatment methods:
There are several methods available to try and control adult beetles in colonies (Photo 2). The first one developed involved the use of a CheckMite+ strip (10% coumaphos) attached to a corrugated plastic square placed on the bottom board. The results of testing indicated that a high proportion of the beetles on the bottom board of a hive could be killed. Other methods of trapping beetles on the bottom board (West trap, sold by Dadant and Sons Inc.) or within the hive (Hood trap, being developed with Brushy Mountain Bee Supply Co.) both have the same problem of not being able to relate beetle trap catches to total beetles in the hive. This research should solve this problem and yield a comparison of the current in-hive controls.

Hood trap (HB)

West trap (W)

CheckMite+ trap (CM)

Photo. 2 Three small hive beetle traps tested on ten hives each.

Thirty hives were treated with either the Checkmite+, West, or Hood traps (n=10/treatment, see Photo 2) and checked twice a week for a one-week period prior to beetle introduction. After pre-treatment assessments 100 beetles were introduced into each of the 30 colonies and traps checked weekly for 4 weeks. For all traps, dead

beetles were counted and removed weekly. Following four weeks of treatment, all colonies were systematically inspected frame by frame and adult beetles counted.

Results and Discussion:

The use of a diagnostic strip in honey bee colonies was 84% effective in detecting SHB presence in colonies after a 24-hour period. The regression analysis revealed a positive relationship between the actual number of beetles in the colony and beetles caught in the trap(r-square = 0.44, see Fig. 1). The correlation was not as high as one would want, to be able to use the trap catch in making management decision on beetle levels within the hives. However, because there was a positive correlation then you can gain some information on the number of beetles actually present in the hives by using the strips. That is to say, the use of the diagnostic strip does in deed give some indication of the actual number of beetles present in the hive.

The number of beetles caught or killed by the traps is given in figures 2&3 and show that the West and CheckMite+ traps were clearly better at catching beetles than the Hood trap. The Hood trap was baited with apple cider vinegar and could be improved by using a better bait material. The HB and HT notations on the Hood trap refer to the placement of the Hood trap in the wooden frame, HB is the normal placement pictured while HT was a placement (not pictured) where the trap was placed higher in the frame in alignment with the top bar of the frame. The idea being that beetles might find the trap more easily along the top bar than in the middle of the frame. The West trap did collect the largest number of beetles but is cumbersome to use in a large migratory operation, the CheckMite+ traps were efficacious and are easy to use. The Hood trap would benefit by an improved bait (yeast attractant developed by USDA-ARS is being tested) and perhaps by altering the location in the hive. All three traps reduced the level of adult beetles in the colonies.

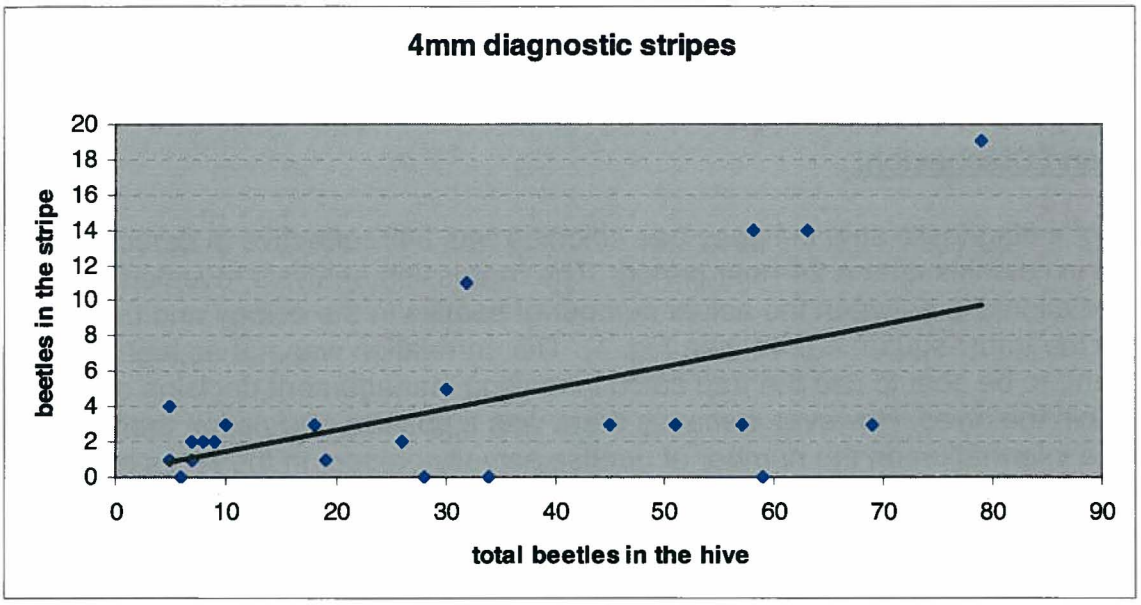

Fig. 1 Regression of beetle number in the hive vs the number caught in a diagnostic strip placed in the colony for 24 hours. (r-square = 0.44).
While the predictive value of SHB adults was not very high (Fig. 1) the diagnostic strips did detect beetles in all but 4 cases where beetles were present or 83% of the time it accurately detected beetles when they were present.

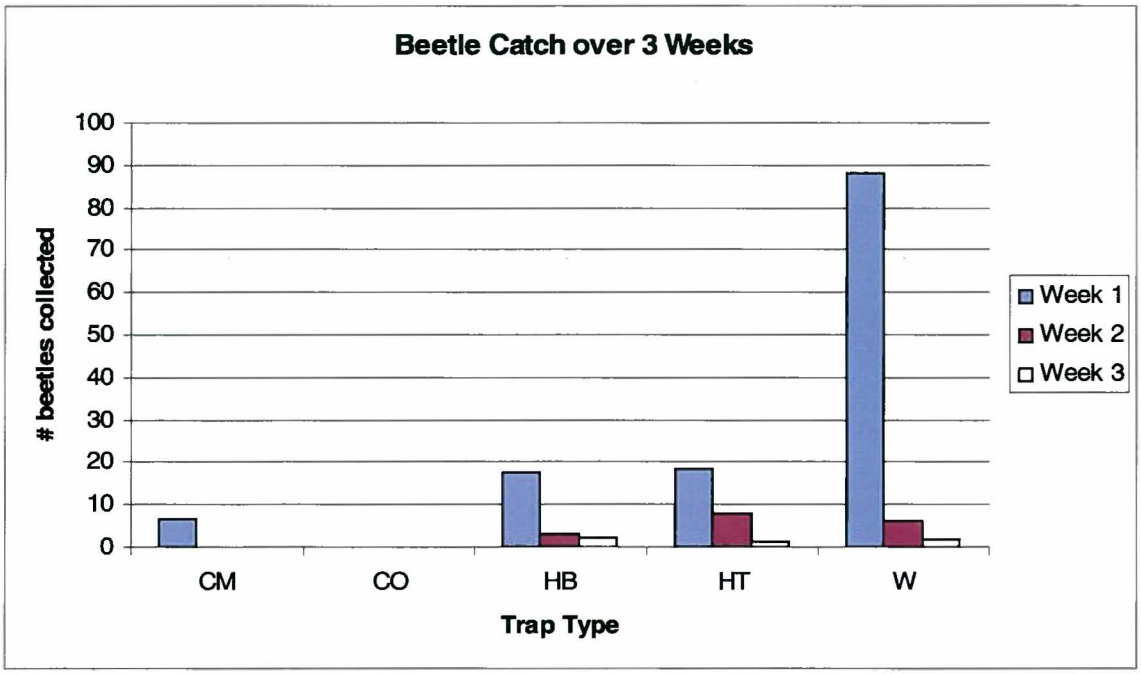

Fig. 2 Small hive beetle catch over three weeks using three traps, CM = Checkmite+ trap, CO = Control hives, HB and HT = Hood traps, and W = West trap (100 beetles per hive introduced).

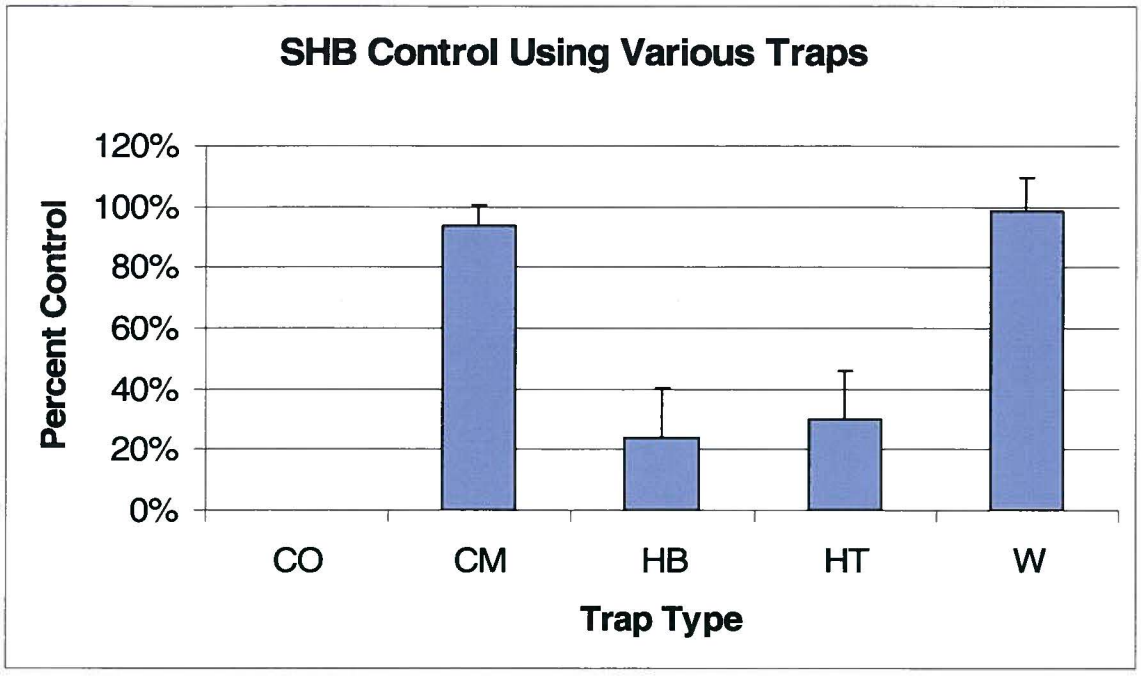

Fig.3 Average (SE) percent control of small hive beetles after four weeks of treatment using four trap types.

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