TOWARD A LURE-BASED TRAPPING SYSTEM FOR ROOT WEEVILS

Final Report

submitted to

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by

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OBJECTIVE

The objective of this study was to field test 10 antennally-active volatile plant-derived compounds as potential attractants for root weevils, specifically the black vine weevil, *Otiorhynchus sulcatus* (Coleoptera: Curculionidae).

BACKGROUND

Black vine weevils, and other root weevils, are serious pests of nursery crop production throughout the temperate world (Moorehouse et al. 1992), including BC. Adult weevils are commonly controlled by chemical insecticide sprays to the foliage, while larvae are controlled by soil drenches with chemical insecticides or nematodes.

Monitoring of adult weevils to time applications of pesticides is done using passive traps like weevil boards or pieces of burlap under which the weevils seek shelter (Sutherland et al. 1989; Hoover 2000). Two other passive devices, Vernon beetle traps and extruded plastic trenches have been used with some success to trap root weevils (Bomford 1998). An alternative trap, the Exotior™ Black Vine Weevil Trap (AgBio Inc. 2004) relies on electrostatically-charged powder to cause beetles to lose their ability to cling to the inner trap surface and to fall onto a glue board.

We reasoned that baiting traps with attractive chemical lures might improve their efficacy, but no effective lures have ever been developed for root weevils. Two Dutch researchers, van Tol and Visser (1998, 2002) used electrophysiological techniques to identify 14 plant volatiles that were potent elicitors of depolarization of black vine weevil antennae. We selected 10 of these compounds for testing in lures because they represented diverse chemical structures, and are readily available, inexpensive and relatively non-toxic.

Normally one would not conduct field experiments, without first obtaining data from laboratory studies, which disclosed the type of behaviour that one would be searching for in the field. However, such studies require a source of laboratory animals, and demand that a satisfactory olfactometer first be developed and tested. Neither of these criteria could be met, so we judged that bypassing laboratory experiments, and spending a small amount of money going directly to field experiments would be justified.

FORMULATION

We used five different lures, in which compounds were formulated individually or in groups according to their chemical uniqueness or similarity, as well as compatibility with various release devices. Release rates were estimated to range from 5-10 mg per day per compound. The five lures were as follows.

Lure 1: *E*-2-hexen-1-ol, *Z*-3-hexen-1-ol, and 1-hexanol grouped together in one bubble cap,

Lure 2: hexanal and heptanal together in one 400 µL Eppendorf tube,

Lure 3: hexylamine in a separate bubble cap,

Lure 4: 1,2-dimethoxybanzene in one 400 µL Eppendorf tube, and

Lure 5: benzyl alcohol, myrtenol and 3-methylcyclohexanol in one bubble cap.

EXPERIMENTS AND RESULTS

Two experiments were proposed, both using Vernon beetles traps. Four were conducted. One of the additional experiments (not in the original proposal) incorporated five Exotior traps, that were independently purchased at considerable expense by Phero Tech International Inc. All experiments were set up as randomized complete blocks, with 2-5 m between traps.

EXPERIMENT 1: Test of fatty acid derivatives, including three green leaf alcohols, one green leaf aldehyde and heptanal.

Unbaited traps were compared with traps baited with Lure 1, Lure 2 or both lures together. Six replicates were set up on 16-17 May 2006 in the Janzen Farm near Rosedale BC, and six were set up in the deVry Farm, adjoining southern boundary of the Janzen Farm. Damage in 2005 was heavy in both farms, suggesting that they would be a suitable site for experiments in 2006.

The traps were examined for captured insects on 29 May. We were joined by David Woodske of the BC Ministry of Agriculture, Fisheries and Food on that day. No root weevils were captured. Many other types of insects, particularly ground beetles, were found in the traps, indicating that the traps were functioning acceptably. This was also true for the three subsequent experiments.

One possible hypothesis for the lack of captured weevils is that very few weevils were present in the experimental location, possibly because of prophylactic application of a chemical insecticide. Another hypothesis was that a more complete blend of plant volatiles would be needed to elicit a response. We had deliberately tested only fatty acid derivatives in this experiment, because they are common attractants for other phytophagous insects (Visser and Ave 1978; Dickens 1989). Therefore, we elected to stay at the same location and to proceed with the second experiment, which tested more complex blends, including a blend of all 10 selected compounds.

EXPERIMENT 2. Test of all components to make up more complete blends of potential attractants.

On 29 May, eight replicates were set up as above, four at the Janzen Farm, and four at the deVry Farm. A combination of Lures 1 + 2 was selected as a standard. Unbaited traps were compared with traps baited with the standard composite lure, and with blends of the standard with Lures 3, 4, and 5. Treatments were as follows: unbaited trap, Standard Lure (Lures 1 + 2), Standard + Lure 3, Standard + Lure 4, Standard + Lure 5, and Standard + Lures 3 + 4 + 5. This experiment was evaluated on 27 June 2006.

As in Experiment 1, no root weevils were caught in any trap.

At this point, we had fulfilled our obligation, as stated in our research proposal. However, we had been contacted a couple of days earlier by Dr. Janice Elmhurst, who was conducting similarly unsuccessful trapping experiments on root weevils at NATS Nursery in Langley, with funds provided by the BCLNA. Had we been informed of Dr. Elmhurst's work by the BCLNA, we might have either deferred to her from the outset (with an offer to help), or pooled our resources, with deference to her, because of her superior knowledge and experience. Nonetheless we got together in the end, and set up two supplementary experiments at her invitation at NATS Nursery on 28 June 2006.

EXPERIMENT 3. An uncontrolled test of all five lures combined.

Six Vernon beetle traps were interspersed with Dr. Elmhurst's traps at least 5 m apart along the southern margin of the Nursery. All were baited with all five of the above lures. The traps were checked on 6 July and again on 27 July. No captured root weevils were found on either date. These traps were collected, cleaned and donated to Dr. Elmhurst.

EXPERIMENT 4. Comparison of the Vernon beetle trap with the Exotior trap.

We had purchased five Exotior traps, and elected to bait them with an estimated 3 g of the chopped dried apple lures provided by AgBio Inc., the company that markets the Exotior traps in North America. These were compared in randomized complete blocks with unbaited Vernon beetle traps and with Vernon beetle traps baited with all five of our experimental lures. Five replicates were set out on the north margin of the road running east-west along the northern ends of the row of plant houses. Traps were 2 m apart within a replicate and there was at least 15 m between replicates.

All traps were checked on 6 and 27 July 2006. No captured weevils were found on 6 July, but ONE BLACK VINE WEEVIL was found in an Exotior trap on 27 July. This elevated us into a tie with Dr. Elmhurst!

FURTHER DEVELOPMENTS AND CONCLUSION

By the end of July, we had come to the conclusion that our adventure with black vine weevils had come to an end. However, we were contacted again by Dr. Elmhurst in the second week of September. She informed us that the fall period of adult weevil activity had begun, and that we were welcome to resume our experiments at NATS Nursery. We declined, but she accepted our offer to send her the remainder of our supply of Lures 1-5 for further testing. These were sent to her the following week.

Dr. Elmhurst is obviously knowledgeable about weevil biology, and is a capable field investigator, dedicated to developing a trap-based method of monitoring for root weevils. We hope that she will continue her work on a long-term basis. Should there ever be a need for formulation of attractive lures for root weevils, we have expressed our interest in working with her.

Success in this endeavour may ultimately require an extensive period of laboratory research before returning to the field with a good indication of the potential efficacy of the lures to be tested. Because of the strong antennal responses to plant volatiles found by van Tol and Visser (1998, 2002), and because we lacked the resources to conduct laboratory research, we had elected to skip this phase in proposing our research. In the end, the weevils appear to have shown us that this course of action was unwise.

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