Cool-Weather Acoustic Monitoring of *Diaprepes abbreviatus* Infestations in an Experimental Orange Grove at Ft. Pierce

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Summary

Diaprepes abbreviatus (L) has become an important pest of Florida citrus. Promising treatments to control *D. abbreviatus* include the use of entomopathogenic nematodes (Bullock et al. 1999), kaolin particle films (Lapointe 2000) and landscape fabric (McKenzie et al. 2001). It is difficult to assess the efficacy of treatments for reducing larval feeding damage or to compare among different treatments without destructive excavation of the trees involved in the tests. Indirect procedures used to assess treatments have included the trapping of adults (e.g., Bullock et al. 1999), or in the laboratory (e.g., Lapointe 2000), the measurement of leaf consumption or numbers of eggs found on leaves. Direct assessment of larval damage in field tests typically involves a time-consuming, laborious process--pulling up groups of treated trees, counting the larvae recovered, and assessing differences in tree growth. A second, potentially nondestructive method is to evaluate larval presence by acoustic techniques (Brandhorst et al. 2001, Mankin et al. 2001).

Acoustic technology has not yet been extensively tested under severe conditions. This report describes results from a recent study where trees were sampled acoustically under unusually cold conditions and then were excavated and inspected to verify the presence or absence of larvae in the root systems. It was anticipated that temperatures near freezing would reduce larval activity and degrade the predictive capability of acoustic monitoring. Indeed, although insect sounds were detected at several trees and the % infestation levels followed the trends found by inspection of excavated root systems, the error rate exceeded the levels required for statistical significance. Unexpected sounds were heard near freezing temperatures that we have not yet differentiated from *D. abbreviatus* sounds. Consequently, we recommend that the use of currently available acoustic monitoring technology be avoided at temperatures near freezing.

Methods

The monitoring device was an accelerometer system with an amplifier, recorder, and headphones, described in Mankin et al. (2001). (Fig. 1A). A 30-cm-long nail was inserted into the soil near the crown of the root system and recordings were made for 3-minute periods. After acoustic monitoring, each tree was pulled up with a tractor-lift (Fig. 1B) and the roots were searched for 3 minutes (Fig. 1C). The insects recovered were counted and weighed. Four treatments in 4 blocks of 3 trees each were acoustically monitored and excavated: a control, Nematodes, 3% Kaolin at 3-week intervals, and 3% Kaolin at 2-week intervals (12 trees per treatment). In each block, 7 other trees were excavated and examined for use in a broader study (40-trees/treatment). Tests were conducted in an experimental field at the Ft. Pierce IFAS Experimental Station in January 2002.

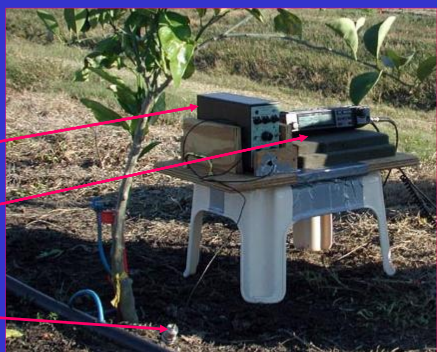

Fig. 1A Apparatus for acoustic monitoring of *D. abbreviatus* larval activity:

a. Amplifier

b. Recorder with headphones

c. Accelerometer attached to nail inserted into soil near tree

Fig. 1B. Excavation of orange tree

Fig. 1C. Inspection of root system to find *D. abbreviatus* larvae

Results

Both the acoustic and the excavation method identified the Kaolin@3 wks treatment (3% Surround applied at 3-week intervals) as the most heavily infested, in agreement with the results of the larger 40-tree sample (see Table 1). The excavation but not the acoustic method identified the nematode treatment as least infested. The acoustic method correctly identified 70% (34 of 48) of the tested trees as uninfested or infested.

Table 1. Comparison of Predicted % Infestation in Treatment Based on Acoustic Monitoring and Excavation of 12-Tree Samples vs. % Infestation in 40-Tree Sample

Treatment	% Infested Estimated by Sounds	Excavation	% Infested in 40-tree Sample
Control	17	17	15
Nematode	17	8	6
Kaolin@3 wks	41	33	21
Kaolin@2 wks	17	17	19

Nevertheless, the results of the acoustic tests failed to establish statistical significance in direct comparisons with the excavation method. As expected, part of the failure was due undetected insects (6 in Table 2). Unexpectedly, there were also 8 false positive identifications.

Subsequent acoustic analysis in the laboratory revealed multiple sounds that listeners and the computer classified as *D. abbreviatus* sounds in all of the false-positive recordings. We are conducting further analyses to determine the source of the sounds. Five of the 8 false positives occurred in the coldest period of testing (during the first morning). We are considering the possibility that the plant root systems generated sounds at near-freezing temperatures that are not encountered frequently at warmer temperatures.

Table 2. Comparison of acoustically predicted and actual numbers of infested and uninfested trees in field test

Predicted No.	Actual No. Uninfested	Infested
Uninfested	31	6
Infested	8	3

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