Project Concluded: Final Report

Development of Pheromone Traps for Monitoring Citrus Leafminer

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The citrus leafminer (CLM), *Phyllocnistis citrella* Stainton (Lepidoptera: Gracillariidae) is a problem for growers in most of regions of the world where citrus is grown (Heppner 1998). Grapefruit, tangerine, and pummelo are among the most susceptible hosts, but the leafminer can attack all varieties of citrus and some related plant species (Legaspi and French 2003).

In California, it was first reported from southern Imperial County in 2000, and its range has rapidly expanded since then (Anonymous 2003). Until recently, there were no good methods for early detection of this insect, so that it could be tracked as it continues to spread through California. Although a pheromone attractant for this insect was reported from screening trials almost 20 years ago (Ando et al. 1985), the putative pheromone was not effective as a trap bait in China, Spain, Florida, and Italy (Jacas and Peña 2002).

We report here the identification, synthesis, and testing of a powerful sex pheromone blend for California populations of citrus leafminer, which will greatly increase the speed, simplicity, and effectiveness of detection and monitoring of this pest. Our specific project objectives were: (1) To identify and synthesize all the components of the sex pheromone of the citrus leafminer *Phyllocnistis citrella*; (2) To conduct all field tests required to develop robust and reliable pheromone traps for grower use; and (3) To transfer the technology for monitoring citrus leafminer to end users and pheromone supply companies.

All project objectives have been met. First, we determined that the pheromone blend of California populations of the citrus leafminer consists of two compounds, including the previously reported (7Z,11Z)-hexadecadienal that was active in Japan (Ando et al. 1985), and the closely related (7Z,11Z,13E)-hexadecatrienal. Stereoselective syntheses have been developed for both compounds.

The two-component lures are extremely attractive, attracting hundreds of moths per trap per night. However, both components must be present for any attraction to occur. Furthermore, our two-component lure is highly attractive to Florida populations of citrus leafminer. We have also corresponded with Professor Ando in Japan, and he has confirmed in recent trials that the Japanese populations of citrus leafminer are indeed attracted to the single component (7Z,11Z)-hexadecadienal lure, suggesting that the California populations are a different strain and possibly even a different species than the one in Japan.

In 2005, we also synthesized and field tested a third possible component of the pheromone, (7Z,11Z,13E)-hexadecatrienal. However, field tests showed that this compound had no effect at low concentrations, and became inhibitory at high concentrations. Thus, it is clearly not a component of the active blend.

Second, we have now finished working out all the operational details for use of the pheromone, such as optimal dose (100 µg), blend ratio (trienal:dienal, 3:1), release device (grey rubber septum), and formulations with useful field lifetimes. We found that grey rubber septum lures with 100 µg doses, and with a stabilizer and an antioxidant added, maintained their attractiveness for at least 4 weeks in the field

(Figure 1). Thus, we have accomplished our goals of fully identifying and developing the pheromone blend of citrus peelminer for use in monitoring this important pest.

Third, we have submitted this work for publication (Moreira et al., in press). Furthermore, copies of the manuscript were sent directly to the Citrus Research Board and to several of the major pheromone supply and distribution companies (e.g., Trécé, Suterra, ISCA Tech, Chemtica) to transfer the technology as rapidly as possible. We have also supplied a number of batches of our pheromone lures to colleagues for ongoing studies of the seasonal phenology and distribution of this pest.

This project will benefit the citrus industry by providing a simple, highly sensitive, and very selective method of detecting and tracking leafminer populations throughout California. Furthermore, it will provide a valuable tool for following the population cycles and estimating the population sizes of citrus leafminer infestations. We anticipate that pheromone traps should be commercially available for use by the citrus industry by early 2006.

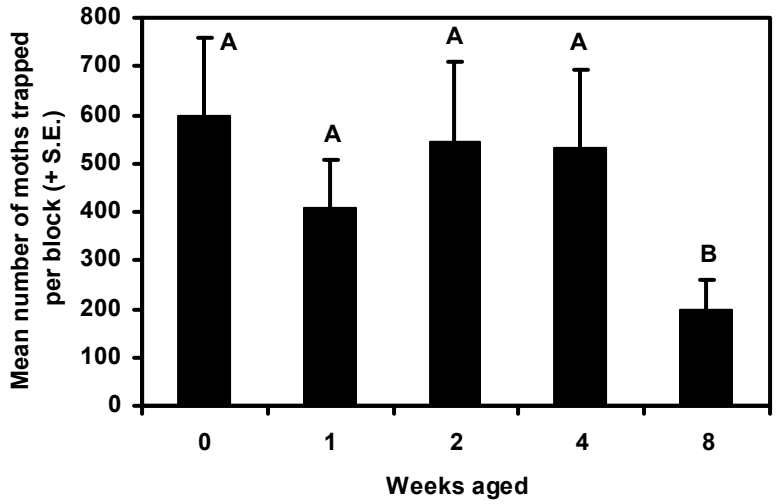

Figure 1. Attractiveness of citrus leafminer lures aged for increasing amounts of time under field conditions. There was no difference in attractiveness of lures aged from zero to 4 weeks. Furthermore, the lures were highly attractive; during the field trial, >13,000 moths were caught in one night.