ATTRACTANTS FOR FEMALE ORIENTAL FRUIT MOTH FROM SHOOT AND FRUIT ODORS

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Abstract
We requested an extension of this grant through 2006 to allow us to finish bioassays of reconstructed odor blends from peach shoots and fruits. All bioassays conducted in both California and Australia were negative, and provided no leads for the development of attractants for oriental fruit moth based on host plant compounds.

Introduction
The oriental fruit moth (OFM) is a primary pest of stone fruits in many parts of the world, including California. Damage is caused by shoot strikes, and later in the season, infestation of the ripening fruits. OFM is usually managed either by pheromone-based mating disruption, or by insecticide sprays (UCIPM 2003). When used properly, pheromone-based mating disruption can be highly effective, but careful monitoring of the crop is required to ensure that the pheromone treatment is holding up. However, once orchards are treated with mating disruptants, monitoring of OFM populations with pheromone-based traps is not very effective. Thus, an alternative method of monitoring OFM based on some other type of attractant would be an extremely useful tool for sampling OFM in orchards treated with mating disruption. The goal of our project was to investigate whether such an attractant could be developed from a blend of volatile chemicals from the host plant. Specifically, in the first two years of the project, we collected volatile chemicals emitted from peach shoots and fruits, both in situ on trees, and using cut shoots and fruits in the laboratory. Furthermore, volatiles were sampled at intervals throughout the growing season, to track how the blends of volatiles changed with the physiological state of the host plant. We then analyzed the collected volatiles with coupled gas chromatography-electroantennogram detection (GC-EAD), using the antennae of live OFM to tell us which compounds in the blends were most likely to be host attractants, i.e., the compounds that elicited the largest responses from the moth antennae. Using this method, we identified a series of different odor blends, corresponding to shoot and fruit odors from early March through to September. However, due to logistical problems, we were not able to finish field trials of these various blends within the original timeframe of the grant, and requested an extension to finish up the work. We report here the results of the final sets of screening trials,

which were carried out in both California and Australia, to take advantage of the different field seasons.

Materials and Methods

The chemicals tested in blends included dimethoxytoluene, benzaldehyde, ß-caryophyllene, (E)-ß-farnesene, pentadecane, methyl salicylate, cis-jasmone, γ-decalactone, ethyl (Z4)-decenoate, δ-decalactone, γ-dodecalactone, ethyl octanoate, haptadecane, nonadecane, and heneicosane, all of which were commercially available. α-Farnesene, (3E,7E)-4,8,12-trimethyl-1,3,7,11-tridecatetraene, and (Z3)-hexenyl octanoate were not commercially available, and thus were synthesized in our laboratories. Test compounds were formulated in hexane and ethanol in different trials, using dispensers consisting of rubber septa, low-density polyethylene vials, or glass vials with wicks. Formulations with stabilized with an antioxidant (BHT) and a UV stabilizer (Sumisorb). In total, five different blends were tested, mimicking the volatiles profiles in early March, late March, late May, July, and August. Lures were deployed in sticky traps in multiply replicated randomized blocks in experimental peach plots at Kearney, and in commercial peach orchards in Victoria, Australia. Traps were checked approximately twice per week.

Results to December, 2006

Multiply replicated field trials of five different blends of volatiles reconstructed from odors collected from peach shoots and fruits, and deployed for periods of several weeks per trial, were a complete failure. Although the GC-EAD analyses carried out in the first two years of this project clearly showed that the antennae of OFM of both sexes are highly sensitive to subsets of the compounds that comprise shoot and fruit odors, there was no sign of attraction of moths of either sex to the reconstructed blends of those odors. There are several possible explanations for this apparent dichotomy, as follows:

1. The reconstructed blends, consisting of nine or fewer components that elicited the strongest responses from OFM antennae, were only an approximation of the actual odor of peach shoots and fruits. Furthermore, it was beyond the scope of this project to reproduce the enantiomeric composition of the blends; for those compounds that were chiral, we were only able to use racemic materials instead of the enantiomers that are produced by peach shoots and fruits.
2. The release rates may have been wrong. However, because the lures were deployed for a number of days for each treatment, with the release rate decreasing approximately exponentially with time, moths in the field would have been exposed to a continuum of release rates from high to low.
3. The competition from natural sources may have overwhelmed any effect from our synthetic lures. That is, when deployed in the middle of peach orchards, synthetic lures would have to be considerably more attractive to moths than the peach trees themselves in order to attract significant or even noticeable numbers of moths.

It is also worth mentioning that parallel efforts from the group of Silvia Dorn in Switzerland also appear to yielding very limited success. At the most recent annual conference of the Entomological Society of America in December 2006, a representative of that laboratory described the results of their laboratory bioassays of reconstructed odor blends with OFM (Jaime

Pinero and Silvia Dorn, Abstract 0873). In those bioassays, testing odor blends versus clean air (i.e., no stimulus at all), their best blends only attracted about three times as many moths as clean air controls, indicating only weak attraction at best. Thus, at the present time, the chance of developing an effective attractant for OFM, that can compete with the background odor in peach orchards, seems remote.

Summary

We identified a number of compounds from peach shoots and fruits that could be potential attractants for gravid OFM females, using the coupled GC-electroantennogram method to determine which compounds in complex odor blends elicited the strongest responses from antennae from OFM of both sexes. However, field trials of reconstructed blends of these compounds, in both California and Australia, were uniformly negative. In the absence of any sign of a lead that could be followed to develop an effective OFM attractant based on host plant volatiles, the project is being terminated.

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