Determining the Route of Detoxification of Insecticides Used to Control Navel Orangeworm (NOW)

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PROJECT SUMMARY

Objectives:

- Determine whether navel orangeworm resistance to pyrethroids is metabolic or due to target site insensitivity
- Establish a resistant colony in order to determine if resistance is maintained across multiple generations in the absence of selection pressure
- Examine resistant navel orangeworm responses toward additional insecticides used and often tank mixed with pyrethroids
- Continue work on the manual gene annotation of detoxification and chemosensory genes of the navel orangeworm

Background and Discussion:

This research effort used our established methods for conducting bioassays from the 2011 project (11-ENTO1-Berenbaum) and allowed us to identify the mechanism for resistance to pyrethroids in a recently wild-caught strain of navel orangeworm, *Amyelois transitella*.

The applications of synergists piperonyl butoxide (PBO) and S,S,S-tributyl phosphorotrithioate (DEF) in bioassays with pyrethroids bifenthrin and beta-cyfluthrin have allowed us to determine if cytochrome P450 monooxygenases (P450s) or esterases are contributing toward resistance in this navel orangeworm population. Synergism with PBO or DEF indicates that both P450 monooxygenases and esterase contribute toward resistance.

Results from median-lethal concentration (LC_{50}) assays have shown that resistance has been consistent across generations. Assays with PBO and DEF revealed that resistant navel orangeworms detoxify pyrethroids using both P450s and esterases, which indicates resistance is metabolic and not due to target site insensitivity.

We are now investigating the effects of insecticides with different modes of action that are currently applied and often tax mixed with pyrethriods. Our efforts will focus on the ryanodine receptor antagonist chlorantraniliprole (Altacor) and the insect growth regulator methoxyfenozide (Intrepid). We will assay for synergistic interactions between the pyrethroids and these insecticides to determine if any of the mixes overcome metabolic resistance.

Ultimately, this research may generate insights that lead to the establishment of novel management practices that reduce reliance upon insecticides. We hope that this research will be of use to the almond growers and to researchers associated with the almond industry.

As well, work continues from our 2012 project (12-ENTO1-Berenbaum) in manual gene annotation of detoxification and chemosensory genes of the navel orangeworm. A set of 61 P450s generally considered to be in involved in detoxification have been transcribed in the NOW midgut comprises the four insect CYP clans (CYP2, CYP3, CYP4, and mitochondrial) (Noble 2013).

Project Cooperators and Personnel: Joel Siegel, USDA/ARS, Parlier; Brad Higbee, Paramount Farming Co.

For More Details, Visit

- Poster location 10, Exhibit Hall A and B during conference; or on the web (after January 2014) at www.almondboard.com/researchresports
- 2012.2013 Annual Report CD (12-ENTO1-Berenbaum); or on the web (after January 2014) at www.almondboard.com/researchreports
- Related Project: 13-ENTO11-Siegel/Walse