# Detoxification of Insecticides Individually and in Combination in Navel Orangeworm Populations Resistant to Pyrethroid Insecticides

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## PROJECT SUMMARY

### Objectives:

- **Objective 1:** Using our bifenthrin-resistant and susceptible navel orangeworm colonies, conduct neonate feeding assays to calculate median-lethal concentrations of pesticides (chlorantraniliprole, methoxyfenozide, flubendiamide) and phytochemicals (furanocoumarins, chlorogenic acid).
- **Objective 2:** Apply synergists piperonyl butoxide (PBO), diethyl maleate (DEM), and S,S,S-tributyl phosphorotrithioate with an $LC_{50}$ dose of each insecticide to determine if cytochrome P450s, GSTs, and/or esterases, respectively, are involved in detoxification
- **Objective 3:** Use the Parlier USDA-ARS spray tower to test effects of adjuvants on pesticide toxicity to eggs and sublethal effects on survivors from pyrethroid resistant R347 and susceptible CPQ colonies.
- **Objective 4:** Using the newly available NOW genome, compare our susceptible CPQ strain with the R347 resistant strain by deep-sequencing transcriptomes, mapping the cDNA reads to the reference genome, and identifying differences in detoxification loci that distinguish the strains

### Background, Results and Discussion:

**Objectives 1-2**: PBO synergized the toxicity of acetamiprid, λ-cyhalothrin, and spinosad, suggesting P450-mediated detoxification. In contrast, PBO interacted antagonistically with the organophosphate chlorpyrifos to reduce toxicity, consistent with inhibition of P450-mediated bioactivation. Toxicity of the anthranilic diamide chlorantraniliprole was not altered by PBO, suggesting no P450-mediated metabolism. Methoxyfenozide and flubendiamide assays remain to be done. The resistant R347 strain is toxicologically similar to a strain from fig, indicating elevated P450-metabolism associated with resistance facilitates metabolism of host chemistry.

**Objective 3**: We tested the impact of adjuvants Cohere™, Dyne-Amic™, FastStrike™, Induce™, and Latron B-1956™ on toxicity of chlorantraniliprole and flubendiamide. Each adjuvant was individually applied with each insecticide and sprayed on eggs and adults with a spray tower at ca. field application rates (125 ppm). Adjuvant application rates scaled down to 10 ml sprays were Cohere 8 oz/100 gal; Dyne-Amic 8 oz/100 gal; FastStrike 64 oz/100 gal; Induce 8 oz/100 gal; Latron B-1956 3.5 oz/100 gal. Individual insecticides and insecticide-adjuvant combinations were applied in 60% MeOH to sets of 250 eggs and 40 adult moths. Proportion unhatched eggs and larval mortality 2 weeks after spray as well as adult mortality of survivors were recorded. Early results indicate all five adjuvants are themselves toxic to adults. FastStrike increased larval and egg mortality with both diamides. Dyne-Amic increased larval and egg mortality with flubendiamide but not chlorantraniliprole. All assays are being replicated (for a total of 3 replicates). In this study the methylated seed oil penetrants FastStrike and Dyne-Amic increased diamide efficacy relative to the spreader-sticker adjuvants Cohere/Latron B-1956 and the wetter-spreader Induce.

**Objective 4:** The NOW genome is complete and being uploaded to the i5K workspace (https://i5k.nal.usda.gov/). Once the genome and NCBI annotation models are incorporated into the i5k WebApollo, manual annotation by the community can begin. A new cost-effective method, Pool-Seq, will allow us to examine genome-wide polymorphisms between resistant R347 and susceptible CPQ strains. We are collecting adults from these two strains for the analysis.

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**Project Cooperators and Personnel:** Joel Siegel, Spencer Walse, USDA/ARS, Parlier

**For More Details, Visit**

- Poster location 19, Exhibit Hall A + B during the Almond Conference; or on the web (after January 2016) at Almonds.com/ResearchDatabase
- 2014 - 2015 Annual Reports CD (14-ENTO1-Berenbaum); or on the web (after January 2016) at Almonds.com/ResearchDatabase
- Related Project: 14-ENTO11-Siegel/Walse (2014-15 Annual Report CD)