Developmental and Environmental Impacts on Pesticide Detoxification in Navel Orangeworm (NOW) (*Amyelois transitella*)

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PROJECT SUMMARY

Objectives:

- **Objective 1:** Determine the degree to which NOW larval detoxification capacity changes developmentally
- **Objective 2:** Measure the degree to which co-occurring phytochemicals in different parts of almonds influence toxicity and detoxification capacity
- **Objective 3:** Ascertain the extent to which *Aspergillus* fungi contribute to pesticide detoxification
- **Objective 4:** Assess the impact of the adjuvants Dyne-Amic, FastStrike, Induce, Cohere, and Latron B-1956 on the toxicity of insecticides sprayed for NOW control in almond orchards

Background, Results and Discussion:

Objectives 1: To investigate developmental changes in detoxification capacity in NOW, we continued feeding assays with larvae to identify median-lethal concentrations (LC_{50}). The LC_{50} for bifenthrin increased ~7-fold from first to second instar. Initial efforts to estimate fifth instar LC_{50} revealed that low concentrations of bifenthrin may stop larvae from feeding on artificial diet short of causing mortality. For susceptible populations of NOW, a 2 ppm concentration of bifenthrin caused half of the larvae to stop eating artificial diet; in the pyrethroid-resistant R347, this concentration was 8 ppm.

Objective 2: We are currently conducting feeding assays with first instar NOW to examine the effects of quercetin and chlorogenic acid, which are naturally occurring phytochemicals in almonds. Previous assays demonstrated that quercetin and chlorogenic acid are detoxified by cytochrome P450 monooxygenase genes (P450s) in NOW. We will identify the effects of quercetin and chlorogenic acid on toxicity of lambda-cyhalothrin, chlorantraniliprole, and chlorpyrifos, which are representatives of pyrethroids, diamides, and organophosphates, respectively. Our goal is to induce P450s with quercetin and chlorogenic acid and quantify changes in toxicity of these three insecticides toward navel orangeworm.

Objective 3: We investigated the toxicity of the pyrethroid bifenthrin and the spinosyn spinetoram, on laboratory strain NOW performance in the presence and absence of the fungus *Aspergillus flavus*. Larval mortality rates on diets containing the insecticides rose significantly (approximately two-fold) in the presence of *A. flavus*, indicating that fungal presence exacerbated the negative effects of insecticides. However, development time was shortened significantly (by 19%) in the spinetoram assays when *A. flavus* was present. We noticed that larvae refused to eat diets containing insecticide for the first few days of the experiment, and we suggest that this period allows the fungus to outcompete and infect the weakened caterpillars.

Objective 4: We are planning on using the spray tower located at the USDA-ARS facility in Parlier to continue investigating the effects of adjuvants on pyrethroids. Previous research showed that methylated seed oil adjuvants, including FastStrike and Dyne-Amic, had the most toxic effect with diamide insecticides against navel orangeworm. We will identify the adjuvant classes that most effectively potentiate pyrethroids and evaluate their utility in circumventing resistance.

Genome Update: A high-quality NOW genome assembly is complete and available online; annotation of the CYPome (genes encoding cytochrome P450s) revealed 83 genes, including 41 in Clan 3, associated with detoxification. A new cost-effective method, Pool-Seq, will allow us to examine genome-wide polymorphism in three NOW populations: a pyrethroid-resistant population, a susceptible population collected from almonds, and a population collected from figs. Genome sequencing for these three populations was recently completed. We are in the process of assembling the sequences and aligning them to the reference genome in order to identify differences.

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

For More Details, Visit

- Poster location 93, Exhibit Hall A + B during the Almond Conference; or on the web (after January 2017) at Almonds.com/ResearchDatabase
- 2015 - 2016 Annual Reports CD (15-ENTO1-Berenbaum); or on the web (after January 2017) at Almonds.com/ResearchDatabase