Improving Integrated Pest Management of Spider Mites on Almond

Project No.: **13-RESEARCH1C-Tollerup**

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Objectives:

1. Short-term
    a. Establish base-line LD_{50} for susceptible strain of Pacific mite to abamectin and bifenazate.
        i. Evaluate Pacific mite populations collected from various locations in the southern and central San Joaquin Valley against the susceptible strain.
        ii. Evaluate additional compounds as necessary.
    b. Determine the within-season relationship between overwintering and tree canopy densities of spider mites.
2. Long-term
    a. Evaluate effect of spider mite damage on yield.
    b. Investigate targeting overwintering spider mite populations using soil-applied miticides as a tactic to manage populations prior to entering the tree canopy.

Interpretive Summary:

At this early stage in the project, we have not yet collected sufficient data to provide an interpretive summary. We anticipate, although that bioassay data collected during July – September 2014, will indicate that populations of Pacific mite in the southern, and perhaps the central region of the San Joaquin Valley have developed low-level resistance to abamectin. Growers rely less heavily on the miticide Acramite (bifenazate) and likely no resistance has developed. Because Pacific mite pressure is generally less in the northern parts of the San Joaquin Valley, it is highly probable that populations have no resistance to abamectin nor bifenazate. If resistance has developed, the data will afford growers and PCAs information needed to make the most effective Pacific mite management decision.

Materials and Methods:

Objective 1a

Colony
To establish a base line for *T. Pacificus* we will establish a laboratory colony using individuals obtained from susceptible populations maintained on bean, *Phaseolus vulgarus* (L.), in the Frank Zalom laboratory at the University of California, Davis.

Bioassays
For each compound, we will conduct bioassays using five concentrations replicated five times including a de-ionized water spray control. Each replicate will consist of a single bean leaf placed on moist cotton contained in a 150 x 15 mm plastic Petri dish. Twenty-five females, all approximately the same age, will be placed on the bean leaf using a small camel hair paint brush. We will prepare miticides sprays and apply 2 ml of spray on each assay arena using a Potter spray tower. Arenas then will be placed in temperature-controlled chamber set at 72 °F and 30% RH. Mite mortality will be scored at 24 h after treatment; mites will be considered dead if unable to ambulate.

Statistical Analysis
Mortality will be corrected using Abbott's formula (Abbott 1925) and analyzed using probit analysis in SAS (SAS Institute 2010). This analysis determines the lethal concentration, LC_{50}, with a respective 95% confidence limit. Resistant ratios will be calculated for each test compound by dividing the LC_{50} value for field populations by the LC_{50} value of the susceptible population.

Objective 1b

Soil Samples
Beginning in mid to late-February, we will collect samples of approximately 200 ml of soil, collected within a 20 x 20 cm^2 area, beneath randomly selected almond trees. Soil samples will be placed into 250 ml Pyrex beakers, taken to the laboratory and held at room temperature until spider mites emerge. We will count the emerged mites by placing each beaker onto a sticky trap card; then counting the number of mites trapped. Sampling will take place at the Kearney Agricultural Research and Extension Center (KARE) in a ~ 0.8 ha, 15-year-old almond orchard planted with Carmel, Butte, and Mission cultivars.

Canopy Sampling
At approximately 2 to 4-week intervals beginning in May, 20 leaves from each of the 40 trees will be sampled. We will count the number of mites per leaf by brushing mites onto chilled glass plates. Chilling causes a fine layer of condensation to form prior to brushing the leaves thus allowing for the mites to be trapped to the glass plate while facilitating the easy removal of individuals for identification.

Statistical Analysis
Regression analysis (SAS Institute 2010) will be used to determine any relationship between spider mite density in the soil and tree canopy.

Objective 2a

Spider Mite Damage Effect on Yield
In the spring of 2014, we will select six three-tree plots within the same orchard used in objective 1b. Treatments will consist of defoliation: 1) prior to bud differentiation, 2) at bud differentiation, 3) post bud differentiation, 4) prior to and post differentiation, and 5) a non-defoliated control. Trees will be defoliated by applying zinc sulfate at 10 lbs/100 gal water (Gerdts, et al. 19877) using a pressurized handgun sprayer.

At harvest, we will harvest each tree, weigh the nuts, and take a 100-nut subsample. Subsampled nuts will be evaluated for weight and size. In addition, ~100 fruiting spurs distributed on four, third-year wood branches will be randomly selected and labeled. In November, an additional 50 spurs from third-year wood will be removed at the base and analyzed for carbohydrate content. We will send spur samples to the UC Davis Analytical Laboratory for carbohydrate analysis.

Objective 2b

In the same orchard as used in objectives 1b, we will select 20 plots within tree-rows consisting of three contiguous trees. In late winter, soil samples will be taken using the method described in objective 1b. Treatments will consist of 1) untreated control, 2) Grandevo @ 2 lbs/A, 3) PFR-97 @ 2 lbs/A, and 4) mite exclusion by banding trunks. We will randomly assign a single treatment to each plot and apply treatments directly to the soil surface at the time spider mites begin emerging from the soil. Data will be collected from the center tree of each plot. Mites will be sampled in the canopy as described in objective 1b.

Statistical Analysis
We will analyze data using a 2-factorial and single-factor analysis of variance (SAS Institute 2010) for objectives 2a and 2b respectively. To determine differences among means, we will use the LSD method.

Results and Discussion:

A Pacific mite colony was established in May, initiated from an unsprayed population maintained at UC Davis; this colony, although become infested with predatory thrips and had to be discarded. We have since established a new colony.

In late February, I collected a single soil sample of approximately 200 ml within a 20 x 20 cm^2 area, beneath 10 randomly selected almond trees. Soil samples were placed into 250 ml Pyrex beakers, taken to the laboratory, and placed on sticky cards to collect emerging mites. Samples were held at ~72 °F for 21 days. Canopy assessments of Pacific mite densities were conducted on 1 and 30 June; and 28 July 2014.

At the end of 21 days, no mites emerged from any of the soil samples; and mite density in the canopy did not exceed 1 mite per leaf on any of the sample dates. Bentley and Zalom (unpublished data) reported collecting soil from beneath almond trees and observing mites

emerge. The infestation history, however, of where the samples were collected is not known. Pacific mite infestations do occur within the KARE orchard, although do not generally reach high levels and the absence of mites in the soil samples is likely a result of too low overwintering populations. The low spider mite density observed in the canopy also suggests that very low populations of overwintering mites were present. In February and March of 2015, we will select an orchard/orchards with a history of heavy Pacific mite populations to assess the relationship between overwintering and canopy population densities.

On 16 July we applied $ZnSO_4$ to plots, however no leaf-drop occurred; and upon close visual inspection, it appeared that leaves did not sustain a sufficient amount of damage to initiate leaf-drop. The compound was reapplied on 30 July at 25 lbs/A (35% Zn, 17.5% SO_4).

Research Effort Recent Publications:

No recent publications.

References Cited:

Abbott, W. S. 1925. The method of computing the effectiveness of an insecticide. Journal of Economic Entomology 18: 265-267.

Gerdts, M. H., et al. 19877. Chemical defoliation of fruit trees. California Agriculture April: p. 19.

SAS Institute. 2010. SAS/STAT users guide. SAS Institute, Cary, North Carolina.