SUMMARY OF ALMOND RESEARCH 2001

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Project Title: Part I: Evaluation of "soft" insecticides on moth pests and their natural enemies

Part II: Population dynamics of San Jose scale and its natural enemies: investigating the potential for natural or augmented control

Almond growers lose millions of dollars to insect pests each season. In the first project, least-toxic chemical controls for the peach twig borer (PTB) and navel orangeworm (NOW) were investigated. Dimilin® and Confirm® are insect growth regulators (IGRs), which are larvicides that interfere with the insects' chitin deposition (the outside shell) and this prevents the insect from molting. Currently, Dimilin® and Confirm® are not registered for use in almonds, but both have been pursuing registration. Success® is a bacterial by product and is currently registered for use in almonds. Our goal was to provide information that might better usher these "softer" products into widespread use. In a second project, a control program for the San Jose scale (SJS) was investigated under a cooperative project sponsored by Almond Board of California research combined with funding from CDFA's Department of Pesticide Regulation and commodity boards of the California Tree Fruit Agreement and California Cling Peach Advisory Board. The goal of these projects was to determine the negative or positive effects of the replacement of dormant oil and organophosphate treatments with least-toxic spring and summer treatments.

Part I: Evaluation of "soft" insecticides on moth pests and their natural enemies

From 1998 to 2000, we used "diet-incorporated" bioassays to develop LD50s and LD90s for Dimilin®, Confirm®, and Success® for control of peach twig borer. In 1999 and 2000, we completed field studies on the efficacy of these products against PTB and NOW. All three products were shown to be found effective against PTB; less control against NOW was evident. In 2000, we initiated tests for potential negative effects of Dimilin®, Confirm®, and Success® on natural enemies of navel orangeworm and San Jose scale. We used a high application rate (4 X the label rate). We detected some affect on beneficial insects, particularly parasitoids.

In 2001, we completed field tests of these products on commonly found beneficial insects. Almond trees were treated, using commercial methodologies, with the label rate for each product and compared with a no-spray control (randomized block design; 3 replicates). Nuts from those trees were collected at 1, 7, and 14 days after spray application and placed, individually, in plastic rearing cells. To each cell, a green lacewing larva (common orchard predators), *Goniozus legneri* adult (common navel orangeworm parasitoids), or *Aphytis vandenboschi* (a common San

Jose scale parasitoid) was added. The insects were checked daily and their condition (alive or dead) recorded.
Results from this study are still being processed. Data suggest that both Dimilin® and Success® cause mortality of *Goniozus legneri* and *Aphytis vandenboschi*. There was less mortality of tested beneficial insects in the Success® treatment. This winter, we will complete theses studies with a twig-dip bioassay.

Part II: Population dynamics of San Jose scale and its natural enemies: investigating the potential for natural or augmented control

In the second project, we investigated population outbreaks of San Jose scale, looking specifically at the impact of natural enemies and methods to manipulate natural enemy numbers. San Jose scale (SJS) has recently moved from a secondary pest problem to a primary concern in stone fruits; economic damage in almonds and cling peaches, while less common, has also occurred. The importance of SJS may increase in the near future because possible legislative restrictions, guided by FQPA and directed against organophosphates and dormant-season applications, may remove some of the more effective chemical controls. In response to grower concerns, a SJS research team was organized to investigate possible reasons for increased SJS pest status and to determine control alternatives. Research areas have been prioritized and include alternate chemical controls (to provide immediate solutions), SJS insecticide resistance (to determine reasons for failure of current insecticides and to predict appropriate resistant management programs to maintain effectiveness of registered insecticides), SJS field biology studies (to determine if recent SJS outbreaks were induced by changes in management practices), and biological controls (this study).

Results from 1999 and 2000 show three parasitoid species dominate the natural enemy complex: *Encarsia perniciosus*, *Aphytis aonidiae*, and *Aphytis vandenboschi.* Highlights of this work are: (1) *E. pernicious* was found in every orchard sampled, (2) *Aphytis* species were less common, (2) *Aphytis* species were less common on SJS pheromone traps, as compared with *Encarsia*, than the recovery of parasitoids from "live" SJS traps (this result indicates that *Aphytis* species densities are not well-represented by collections on SJS pheromone traps, (3) in most orchards, SJS was not an economic problem, in large part due to the action of natural enemies. An initial objective is to determine the efficacy of resident natural enemies and whether their species composition (what kinds of natural enemies) or abundance (how many) vary between different crops (e.g., almonds, stone fruit) or grower cultural practices (e.g., insecticide use).

In 2001, we continued to monitor population levels of SJS in almond and stone fruit orchards using SJS pheromone traps and harvest samples. These data are just now being entered into the computer for analysis. We tested the augmentative release *Aphytis vandenboschi* for SJS control. There has been a great deal of success with the augmentation of parasitoids against "diaspid scale" (e.g., releases of *Aphytis melinus* for control of red scale on citrus trees). In 2000, we successfully established laboratory colonies of *A. vandenboschi* and *E. perniciosus*; although numbers of parasitoids produced remained disappointingly low. In June and July, we began field trials of an inoculative release (June) and inundative of caged SJS. To begin, branches were infested with SJS crawlers (tested material was from insectary stock) in spring. After SJS had settled the number of scale per branch was counted and the branches were caged.

After the SJS had matured to the second instar, *A. vandenboschi* were added at a ratio of 1 parasitoid : 50 SJS (inoculative release) or 1 : 10 (inundative release). After 12 weeks (inoculative) and 4 weeks (inundative) the branches were removed and taken to the laboratory to count and dissect each SJS to determine abundance and condition. We have processed about 60% of these samples. Initial data analysis indicates <25% parasitism even with the 1:10 release ratio. Data analysis will be complete this winter.