Pest Management Grants Final Report

Agreement No. 98-0263

Development of an Integrated System for Controlling San Jose Scale, Peach Twig Borer and Oriental Fruit Moth in Clingstone Canning and Fresh Shipping Peaches, Plums and Nectarines

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Contractor Organization: California Tree Fruit Agreement

March 29, 2000

Prepared for California Department of Pesticide Regulation

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ACKNOWLEDGMENTS

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This report was submitted in fulfillment of Agreement No. 98-0263, Development of an Integrated System for Controlling San Jose Scale, Peach Twig Borer and Oriental Fruit Moth in Clingstone Canning and Fresh Shipping Peaches, Plums and Nectarines by California Tree Fruit Agreement under the [partial] sponsorship of the California Department of Pesticide Regulation. Work was completed as of March 21, 2000.

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ABSTRACT

In 1998, California produced over one million tons of peaches, plums, and nectarines. San Jose scale (SJS) has become such a serious pest of stonefruit in the San Joaquin Valley, some growers are removing orchards. Conventional use of organophosphates (OPs) and carbamates to control SJS, peach twig borer (PTB), and oriental fruit moth (OFM) have accounted for approximately 80 percent of pesticide applications to stone fruits annually. This project seeks to mitigate the risks of routine OP use by developing a model IPM system for implementation in peach, plum and nectarine orchards throughout California. During the first year substantial progress was made towards meeting the goals of the project. First, the researchers completed efficacy trials using two commercially available oils as dormant sprays to control SJS. Preliminary data shows good control under moderately infested conditions. Second, a preliminary survey of endemic and commercially reared natural enemies of SJS is complete, and insectary rearing for augmentation and field study is underway. Third, field comparisons of commercially available PTB and OFM pheromone formulations and dispensers has yielded data to refine application rates. The California Tree Fruit Agreement and the California Cling Peach Growers Advisory Board have combined forces to continue this work. The ultimate goal is to demonstrate reduced-risk practices and use the information gathered to develop practical recommendations for stone fruit growers.

EXECUTIVE SUMMARY

The purpose of this project was to evaluate and implement sustainable pest management practices for San Jose Scale (SJS), Peach Twig Borer (PTB) and Oriental Fruit Moth (OFM) in clingstone canning and fresh market peaches, plums and nectarines. Conventional use of organophosphates (OPs) and carbamates to control these pests account for approximately 80% of pesticide applications in stone fruit orchards annually. The project will develop a comprehensive pest management program to reduce or eliminate the need for the use of OPs and carbamates to control these pests. The objectives were to 1) test the efficacy of reduced risk insecticides and oils to abate the application of OPs for dormant SJS control, 2) survey and identify endemic commercial parasite strains and develop a biological control augmentation program for controlling SJS, 3) promote increased use of pheromone mating disruption for PTB and OFM through a comprehensive evaluation of recommended application rates for commercially available products, thus reducing system failure and 4) promote stone fruit grower education and outreach of research results.

During the first year of a projected 3 year project, substantial progress towards meeting the objectives has been made. First, efficacy trials of two commercially available oils as the single component in a dormant spray for controlling SJS have been completed. Data collected suggests both oil formulations may abate overwintering populations of SJS under low to moderately infested conditions. Second, a preliminary survey of endemic and commercially reared natural enemies of SJS has been accomplished. Insectary rearing of potential parasitoids for augmentative release and field testing is underway. Third, field comparisons and aging studies of commercially available PTB and OFM pheromone formulations and dispensers have yielded data to further refine application rates. The information will be used to develop practical recommendations designed to reduce grower uncertainty and potential failure when utilizing this technology. Finally, industry education and information dissemination has been ongoing through industry sponsored newsletters and education days.

Report

A. Introduction

The foremost proportion of OPs and carbamates used on clingstone canning and fresh market peach, plum and nectarine acreage in California is to control SJS, PTB and OFM. This accounts for the use of these materials on 131,000 acres under stone fruit production from Tehama to San Bernadino counties. In a survey of growers conducted by the California Tree Fruit Agreement (CTFA), 50% of those who responded stated they had had some difficulty controlling SJS in the past. Further, 13% of the respondents stated they had removed orchards due to the inability to control SJS. Based on previous scientific evidence, SJS is now exhibiting resistance to OPs and carbamates, placing growers in a cycle of increasing material usage with declining pest control returns. In addition, technical challenges in using pheromone mating disruption for PTB and OFM have resulted in growers experiencing unacceptable fruit damage and has resulted in the return to the traditional use of OPs and carbamates. Accordingly, future strategies must include reducing SJS to the exposure of OPs and carbamates, and includes the management of other primary (PTB and OFM) pests.

Therefore, the scope and the purpose of the project is to take a statewide approach, through the combined efforts of the California Tree Fruit Agreement (CTFA) and the California Cling Peach Growers Advisory Board (CCPGAB). It is intended to advance the benefits of a coordinated comprehensive SJS, PTB and OFM research effort, with no one area of the research promising complete solutions to the problems currently being experienced by the stone fruit industry. This is being accomplished through the development of a system where the combination of replacing OPs with oil, pheromone mating disruption and developing a system for orchard augmentation with natural enemies will maintain SJS, PTB and OFM populations below an economic injury level.

The attainment of the multiple pest management system, where OP and carbamate use is reduced or eliminated, is designed to curtail the potential for pest outbreaks, conserve endemic and augmented natural enemies, increase grower confidence in the efficacy of alternative materials such as oils and pheromone mating disruption and sustain the economic viability of production costs over time. Moreover, the project was intended to mitigate environmental impacts from the use of OPs and carbamates by reducing the influx of runoff into above and below ground water systems.

The objectives of the project can be broken down into 4 parts:

1. Examine the efficacy of commercially available oils for controlling SJS. Walt Bentley,UC IPM Entomologist, was responsible for this portion of the project. The specific tasks were: a) apply as a dilute dormant spray commercially available oils and compare the treatments to an untreated check; b) trials would be replicated in a RCB design for statistical analysis and fruit samples taken to calculate percent scale infestation and c) crawlers and adult males would be sampled with sticky tape and pheromone traps for comparison to fruit data, and to evaluate efficacy of the treatments over time.

Two commercially available oils, Orchex 692 and Volck Supreme, were applied as dilute dormant spray to evaluate the impact of oil sprays on varying population densities of SJS. Both oils were applied at the rate of 8 gallons of oil in 400 gallons of water per acre in late January 1999 with an Air-O-Fan sprayer. The design was a split plot, randomized complete block with 3 replicates of 3 differing population densities of SJS and the plots were 13 trees long and 4 rows wide. The consistent factor of each treatment was the oil at 8 gallons per acre with the variable factor the scale population density. All work was carried out in a block of plums at the Kearney Agricultural Center in Parlier. This block has a history of SJS populations ranging from moderate to high and has been used for insect growth regulator efficacy trials for controlling SJS. An untreated check treatment was included.

During the spring (April) randomly selected limbs in each of the subplots were equipped with either a double sided sticky tape or pheromone traps to begin monitoring for both crawlers and adult males. Tapes were routinely collected and counted for crawler activity while traps were examined for adult males and parasitoids. At harvest, 500 fruit from each subplot were examined for scale infestation and results were recorded. The results were tested using the sum of squares and Fisher's protected LSD.

2. Describe the natural enemy complex attacking SJS in stone fruit and determine the potential to manipulate one or more of these natural enemy species. Dr. Kent Daane, UC Biological Control Entomologist, was responsible for this portion of the project. The specific tasks were: a) describe the natural enemy complex attacking SJS in stone fruit orchards and determine the field effectiveness of common parasitoid species; b) establish insectary colonies of selected SJS natural enemies for laboratory and field experiments and c) test selected SJS parasitoids for use in augmentative release programs.

Surveys of commercially producing stone fruit orchards, with and without a history of economically damaging SJS population densities and varying pest management strategies from organic to OP/carbamate use, were accomplished to determine the resident natural enemies. Beginning in mid May 1999, orchards were sampled weekly throughout the season. SJS were collected from tree/fruit and SJS infested butternut squash hung in trees as parasitoid traps. Samples were taken to the laboratory where scale life stage and number were recorded. The collected material was then placed into emergence containers where parasitoids were reared and subsequently identified to species (Mike Rose, a taxonomy expert of hard scales, performed this portion of the project). In addition, data collection was completed and the percentage parasitism and density of parasites for each orchard was calculated.

Insectary colonies of SJS and parasitoids were established. The SJS scale were reared using a methodology similar to that used by Dr. Dick Rice, UC Entomologist, with the exception smaller sized butternut squash hosts were used to better manipulate SJS in laboratory studies. Crawler stage SJS were sprinkled onto the butternut squash substrate where the crawlers then insert their mouthparts and settle to feed, and complete their life stages. The number of live scale per square inch in a grid for each inoculated squash was documented. The SJS squash is then used to sustain the scale and provide for live host material to test the parsitizing capabilities of commercially available parasitoids. In particular, *Aphytis melinus* was chosen for this portion of the project. Percent parasitism and scale mortality were calculated after exposing the female parasitoids to the scale infested squash for 3 days. Parasitoid fecundity was determined after 3 to 4 weeks by counting the F_1 progeny.

Finally, orchards with low to moderate population densities of SJS were identified and release of commercially available parasitoids begun. Two plots were established in early September 1999. Parasitoids were released at the center point of each plot. Transects moving from the release points were established. The population of SJS and the effectiveness of the released parasitoids were sampled along the transects using the SJS infested butternut squash traps. Samples of SJS were collected and brought to the laboratory to rear out parasitoids and calculate percentage parasitism and scale mortality.

3. Evaluate the efficacy of commercially available pheromone products for mating disruption of OFM and PTB. Janine Hasey, UCCE Farm Advisor for Yuba and Sutter counties, was responsible for this portion of the project. The specific task for this portion of the project was to follow the standard protocol used by universities for evaluating mating disruption.

A 42 acre block of Halfords in Yuba County with a history of low populations of OFM and PTB was divided into six - seven acre blocks. The treatments were as follows:

- Grower Standard - sprayed 3 times with OP
- Unsprayed check
- Check - received a single OP spray
- Isomate M-Rosso (for OFM); Isomate PTwB (for PTB)
- Isomate M-100 (for OFM); Confuse-PTB (paraffin emulsion sprayable)
- Consep Checkmate OFM; Consep checkmate PTB
- Confuse OFM (paraffin emulsion sprayable); Confuse-PTB (paraffin emulsion sprayable)
- Consep OFM-Flowable; Checkmate PTB

The OFM biofix was February 24, 1999. OFM pheromone products were applied on February 26, except Confuse-OFM, which was applied on March 4. The OFM-Flowable product was applied every 28 days throughout the season for a total of 7 spray applications. PTB pheromone products were applied on May 5th and 6th, 1999, preceding PTB biofix. Concurrent with application, all pheromone products were placed in another peach block far away to be collected at certain intervals for release rate testing (aging study).

Traps were monitored weekly. The north and south outside tree and center 10 trees in the middle of each plot were monitored for shoot strikes weekly starting in mid May. Fruit was inspected weekly in the check trees for green fruit strikes starting mid July. Fruit was again inspected for damage at harvest on August 26th and 30th.

4. Enhance communication and implement grower information dissemination. Anneè Ferranti, CTFA, and Heidi Sanders, CCPGAB, were responsible for this portion of the project. Specific tasks included a) provide a quarterly update to clingstone canning and fresh market peach, nectarine and plum growers with quarter updates of project progress through the industry websites and newsletters; b) Coordinate 3 field days with University of California in June, July and August so researchers may communicate directly with growers at the actual research site and c) provide an annual report of research progress both through the CTFA Research Report and at the Tree Fruit day research symposium held in December.

Quarterly newsletters were sent to growers, shippers, packers and other interested parties associated with the clingstone canning and fresh market stone fruit industries discussing project progress. In addition, New Variety and Research Field days were held at Kearney Agriculture Center on June 15, July 13, August 17, and September 21. In addition, a Pest Management Update meeting was held on November 9 and the Tree Fruit day was held on December 1. California Tree Fruit Agreement will publish research reports from these projects, as well as those from other projects it sponsors. That Research Report will be available April 2000.

B. Results

The results for the objectives are as follows:

1. Examine the efficacy of commercially available oils for controlling SJS. The specific tasks for this portion of the project were met. Data collected from traps and fruit infestation seem to indicate both Orchex 692 and Volck Supreme oils were effective in managing viable populations of SJS when applied in a dilute dormant application. Both treatments show a significant difference in the number of fruit infested with SJS at the time of harvest when compared to the untreated check. To verify the preliminary results, the objective will be repeated in 2000.

2. Describe the natural enemy complex attacking SJS in stone fruit and determine the potential to manipulate one or more of these natural enemy species. As a result of the orchard surveys, two groups of endemic parasitoids have been reared 45% of the time from collected SJS (*Encarsia* and *Aphytis* spp.). Of the two parasitoid groups, a species of *Aphytis* (*A. melinus*) is currently commercially reared as part of an inundative biological control augmentation program for regulating populations of California Red and Yellow Scale in citrus, which are close cousins to SJS. While *A. melinus* was not specifically reared from field collected SJS, it was decided to test this species as a potential biological control agent because the parasitoids are affordable and generally obtainable on demand. The expense of establishing a new species of commercially reared parasitoid is cost prohibitive and not likely to occur. Therefore, this species of *Aphytis* was chosen for laboratory screening to determine if augmentative release for controlling SJS is feasible. Preliminary laboratory results indicate *A. melinus* will both parasitize and cause physical injury to SJS. Subsequently, *A. melinus* produced mortality in butternut squash infested with SJS. Levels of parasitism in closed containers was calculated and ranged from 25-40%. Further, almost all remaining scale were killed by host feeding.

Currently, field tests are being conducted to test the effect of released parasitoids. Using commercial *A. melinus* material, natural enemies have been released at a center point in established plots, and parasitoid activity is being monitored in transects moving from the release points. When the study took place in the orchard the commercial releases were disappointing. Releases of *A. melinus* showed no reduction of SJS densities and little or no *A. melinus* activity on the squash that were placed throughout the release site. Initial conclusions are that *A. melinus* does not attack SJS under field conditions.

Evaluate the efficacy of commercially available pheromone products for mating disruption of OFM and PTB. Throughout the season, both OFM and PTB trap catches were low in the check and grower

standard. Efficacy results showed little worm damage in the checks, which could have been from pheromone influence due to a very windy season or to an inherently low OFM and PTB population that dropped off in the summer. Field aging studies of the various pheromone products confirmed a faster pheromone release rate when temperatures were hotter. The pheromone products may not last as long when applied in the summer as would be expected under a more constant temperature. Generally, the Isomate M-100, Checkmate OFM and Checkmate PTB lasted 90 days as expected. The experimental isomate M-Rosso for OFM lasted 130 days. The OFM pheromone in a paraffin emulsion lasted 86 days for the first application. Isomate PTwB, an experimental product, had residual pheromone after 116 days. The Checkmate OFM flowable appeared to last only 28 days during the cooler weather based on moth trap catches; with pheromone longevity during the summer not being determinable.

4. Enhance communication and implement grower information dissemination. Regular field days were sponsored by the University of California and publicized by CTFA throughout the summer. Newsletters were mailed quarterly to over 1,500 stone fruit industry members and interested parties. Two half day research seminars were held on November 9, 1999 and December 1, 1999, and PCA credits were available.

C. Discussion

Technical challenges, including increasing evidence that SJS is resistant to OPs, growers experiencing unacceptable fruit damage using pheromone mating disruption for PTB and OFM, and grower concerns of economic loss during the transition of instituting reduced risk practices, has been a barrier to developing a comprehensive integrated pest management program for clingstone canning and fresh shipping peaches, plums and nectarines. The testing of commercially available oils, pheromone dispenser systems and reduced risk pesticides in a controlled research environment has provided a representation of best management practices for utilizing a more integrated pest management approach. Furthermore, developing a biological control program of augmentation of natural enemies may increase SJS, PTB and OFM parasitism levels and further reduce the need for OP/carbamate applications.

Overall, the objectives and tasks for the first year of the project were met. The analysis of the data indicates SJS, PTB and OFM populations may be maintained below an economic injury level in stone fruit without or with minimal use of OPs and carbamates. Thus, several grower demonstration plots were established in December 1999, which will incorporate the reduced risk practices outlined in this project. The implementation of the demonstration blocks is aimed at addressing the dynamic pest management pressures in a commercial setting from dormant sprays beyond harvest. The successful performance of the combination of replacing OPs with oil, pheromone mating disruption and augmenting with natural enemies under conditions and acreages growers face every day, may increase grower confidence in the efficacy of alternative materials and reduced risk practices. In addition, growers now have more awareness of the need to adopt more IPM practices as the Food Quality Protection Act (FQPA) has started taking away some of the chemical tools that have traditionally been used in the past. This awareness has been demonstrated by the large number of growers that have attended several of the research days that have been held this past year. The November 9 seminar attracted a crowd in excess of 200 and the December 1 seminar attracted approximately 300.

D. Summary and Conclusions

This was the first year of a comprehensive pest management project where a systems approach was taken to examine reduced risk alternatives for controlling SJS, PTB and OFM in clingstone and fresh market peaches, plums and nectarines. The objectives of the project distinctly seek to substantially reduce reliance on OPs/carbamates and provide a model sustainable pest management system for stone fruit growers throughout the state of California.

The project tested the efficacy of two commercially available oils as the single component in a dormant spray for controlling SJS and found moderate populations of scale could be reduced under dilute application conditions. Work was also started to develop a biologically and economically viable inundative release program for natural enemies of SJS. Commercial orchards were surveyed and endemic natural enemies of SJS were identified. As a result, two potential groups of parasitoids, *Encarsia* and *Aphytis spp.*, were targeted as potential SJS augmentative biological control agents. To date, testing has begun with an easily attainable commercially produced parasitoid, *Aphytis melinus*.

Moreover, work was completed to evaluate the efficacy of experimental and commercially available pheromone mating disruption dispensers and formulations for controlling larvae damage from OFM and PTB. The efficacy results were inconclusive due to low populations of both OFM and PTB in the research block. Consequently, a comparison between % fruit damage in the untreated check and between the treatments could not be made. However, information was obtained during the aging studies of the pheromone dispensers which will be used to develop a refined application rate. Finally, the CTFA and CCPGAB utilized their communications infrastructures to support the UC grower education days, published quarterly newsletters and maintained active websites.

Appendices

Tree Fruit Pest Management Meeting
Sponsored by the University of California

November 9, 1999
9:00 am to 1:00 pm

Kearney Ag Center
9240 S. Riverbend
Parlier, Ca
PCA Credits Applied For

Agenda

8:30 – 9:00 Registration

Moderator – Kevin Day – UCCE Farm Advisor

9:00 am	Welcome	Kevin Day, UCCE Tulare County
9:05 am	Dormant Spray Best Management Practices	Parry Klassen, C.U.R.E.S.
9:30 am	Degree Day Models	Walt Bentley, UC IPM Program
9:55 am	Keys for Successful Mating Disruption	Dick Rice, UC Kearney Ag Center
10:10 am	Break	

Moderator – Harry Andris – UCCE Farm Advisor

10:30 am	Identifying Major Pests	Rich Coviello, UCCE Fresno County
10:50 am	Systems Approach Protocols Mexico and B.C.	Carol Hafner, Fresno Co. Ag Commissioners Office
11:30 am	Owl Boxes for Controlling Rodents	Steve Simmons, Merced High "The Raptor Works"

Lunch will be provided by the California Tree Fruit Agreement at 12:00 pm
Lunch will be provided only to those who register prior to October 29, 1999. Space is limited to the first 200 registrants. Please send or fax the form below to:

California Tree Fruit Agreement
Anneè Ferranti
PO Box 968
Reedley, CA 93654
ph. 559-638-8260
fax: 559-638-8842

Names: _____ _____

_____ _____

Company Name and Address: _____

Phone/Fax/E-mail: _____

University of California
Kearney Tree Fruit Review

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