Pest Management Grants Final Report
Department Of Pesticide Regulation
Agreement No. 98-0266

PESTICIDE RISK REDUCTION IN CALIFORNIA PRUNES

Gary L. Obenauf
California Prune Board
144 W. Peace River Drive
Fresno, CA 93711-6953
Phone: 559 447 2127
FAX: 559 436 0692
E-mail: gobenauf@agrc.cnchost.com

California Prune Board
5990 Stoneridge Drive, #101
Pleasanton, CA 94588-2706

March 31, 2000

Prepared for the California
Department of Pesticide Regulation

Disclaimer

The Statements and conclusions in this report are those of the contractor and not necessarily those of the California Department of Pesticide Regulation. The mention of commercial products, their source, or their use in connection with material reported herein is not to be construed as actual or implied endorsement of such products.

Acknowledgments

Pesticide Risk Reduction in Prunes would not have been possible without help form numerous individuals and organization including:

Rich Peterson, California Prune Board (CPB) and staff

Management Team – Gary Obenauf, Bill Olson, Bill Barnett, Walt Bentley, Janet Broome, Mark Dalrymple, Bob Elliott, John Heier, Themis Michailides, Nick Mills, Carolyn Pickel, Ken Shackel, Steve Sibbett, Fred Thomas, Larry Whitted and Dawit Zeleke

Prune Grower/Cooperators – Onstott Orchards, Brad Johnson, Chico State Farm, Shasta View Farms, Vina Monastary, Red Bluff Farms, Farmland Management, Thiara Ranches, David Crane, John Heier, Monty Johnson, Gary Carlin, Billiou Ranches, Willow Glenn Orchards, Mariana Plant 2, Kulwant Johl, Joe Turkovich, Greenleaf Farms, Thiara Brothers Orchards, Dan Aguair, Campos Brothers and Sherman Thomas Ranch

Additional University of California support – Rick Buchner, Clyde Elmore, Mark Freeman, Brent Holtz, Bill Krueger, Wilbur Reil, Maxwell Norton, Tim Prather, Steve Southwick, Beth Teviotdale, Becky Westerdahl

CPB Research Subcommittee – Jim Edwards, Ron Giovannetti, Eric Heitman, Mike Hurley, Mark Kettmann, Stan Lester, Ken Lindauer, Neil Mitchell, Ken Overly, Ron Sandage, Dennis Serger, Hans Smith, Todd Southam, Walter Stile Jr., Joe Turkovich, Don Vossler, Jeff Chan, Jerry Sneed, Chris Steggall, Pat Fierreira, Miguel Guzman, Steve Danna, Vernon Vereschagin, John Taylor, Larry Pantane, Steve Kollars, Dick Onyett, Ken Kaplan, Michael Billiou, Peter Orlando, Robert Hatch and Gregory Correa

Organizations associated with the project – California Prune Board, CalEPA/Department of Pesticide Regulations, University of California (Cooperative Extension Service, Experiment Station, SAREP), USDA (CSREES, NRCS, ARS), The Nature Conservancy, PCA's, and Private Consultants

This report was submitted in fulfillment of DPR Agreement No. 97-0284, Pesticide Risk Reduction in California Prunes by the California Prune Board under partial sponsorship of the California Department of Pesticide Regulation. Work was completed as of 12-31-99.

Table of Contents

Abstract

Pesticide Risk Reduction in California Prunes, Pest Management Alliance (PMA) Project, is part of the Integrated Prune Farming Practices (IPFP) Program. IPFP serves as an umbrella project for several projects relating to reduced-risk of pesticides in prune production including the PMA Project. Project objectives are: 1) Develop and implement replacement pest management systems impacted by FQPA. 2) Reduce surface water contamination by Diazinon and other organophosphates. 3) Reduce groundwater contamination by herbicides. 4) Evaluate ground covers and cover crops for their ability to increase biological control of pest organisms and reduce groundwater contamination by toxic pesticides. 5) Optimize nitrogen and other nutrient programs. 6) Optimize water use. 7) Reduce human exposure to pesticides . 8) Reduce risks to urban environments. 9) Delay resistance to currently used materials.

During 1999, dormant applications of Diazinon (OP insecticide) were eliminated in all demonstration/research sites, in-season pesticide applications were based on pest monitoring protocols, if pest control was needed softer pesticides were used, cover crops were encouraged where they fit in, plant nutrient applications were based on plant and water analysis and irrigation water was significantly reduced in many of the sites.

Agreement No. 98-0266 in part supported the IPFP Program for the first year full year. A great deal has been accomplished by the prune industry after the first year toward pesticide risk reduction in California Prunes. We are aware that fully reaching the stated objectives will take multiple years. The prune industry is committed to accomplishing the objectives.

Executive Summary

Pesticide Risk Reduction in California Prunes, Pest Management Alliance (PMA) Project, is part of the Integrated Prune Farming Practices (IPFP) Program. IPFP serves as an umbrella project for several projects relating to reduced-risk of pesticides in prune production including the PMA Project. Project objectives are: 1) Develop and implement replacement pest management systems impacted by FQPA. 2) Reduce surface water contamination by Diazinon and other organophosphates. 3) Reduce groundwater contamination by herbicides. 4) Evaluate ground covers and cover crops for their ability to increase biological control of pest organisms and reduce groundwater contamination by toxic pesticides. 5) Optimize nitrogen and other nutrient programs. 6) Optimize water use. 7) Reduce human exposure to pesticides . 8) Reduce risks to urban environments. 9) Delay resistance to currently used materials.

During 1999, dormant applications of Diazinon (OP insecticide) were eliminated in all demonstration/research sites. Asana was applied in the conventional blocks and if a dormant treatment was needed in the reduced risk block, oil was applied. In-season pesticide applications were based on pest monitoring protocols. Ten separate monitoring protocols were developed for monitoring prune pest through the year. If pest control was needed softer pesticides were used, such as Bt. Covercrops have been established in 9 different prune orchards; after getting well established we will monitoring the effect they have on the prune orchards including soil health and biodiversity of beneficial organisms. Plant nutrient applications, fertilizations, were based on plant and water analysis and in most cases less than what the grower would have used. Irrigation water was significantly reduced in most of the IPFP sites. Even though there were different pest management strategies in the conventional and reduced risk plots there was no significant difference in quality or yield between the plots throughout the state in 1999.

Changes have been made for the 2000 season including the addition of 11 sites to be monitored by PCAs using monitoring protocols that have been revised to make them more cost effective and more usable by the prune industry.

Agreement No. 98-0266 in part supported the IPFP Program for the first year full year. A great deal has been accomplished by the prune industry after the first year toward pesticide risk reduction in California Prunes. We are aware that fully reaching the stated objectives will take multiple years. The prune industry is committed to accomplishing the objectives.

Report

Introduction:

The California Prune Board (CPB) is a State Marketing Order that represents the 1,400 growers and 21 packers of California prunes. California produces about 200,000 dried tons annually on 83,000 bearing acres. California prune production represents 99% of the US total and about 70% of the world total. The annual crop value is approximately $200 million.

Although prune growers in the state must contend with a variety of insect, disease, nematode, and weed pests, the number of severe problems are relatively few when compared to other stone and pome fruits such as peaches and pears. In many cases prunes can be grown with a minimum of synthetic fertilizers and pesticides. The California Prune Board has long been committed to reducing high-risk inputs and the adverse environmental effects connected with their use. Because of this support a significant knowledge base has been developed which allows growers to move toward a reduced-risk pest management system.

The focus of the PESTICIDE RISK REDUCTION IN CALIFORNIA PRUNES project is to expand and strengthen current efforts and improve communication and cooperation to implement existing reduced risk management strategies on prunes. This project compliments and adds to the existing and past CalEPA/DPR projects and grants from UC/SAREP, USDA/CSREES and USDA/NRCS to the California Prune Board (CPB) and projects supported by CPB.

Even though the CPB has been supporting IPM research for the past 20 years, the process of getting the industry to implement IPM technology in prunes began 3 years ago with the Biological Prune Production (BPS) and the Environmentally Sound Prune System (ESPS) projects.

Work plan objectives are to:

1. Significantly reduce risk of pesticides in prunes by alternative pest management strategies.
2. Add to the progress already made with past CalEPA/DPR/PMA support including adding demonstration sites and number of field meetings.
3. Validate and implement management of peach twig borer and other lepidopterous pests by using *Bacillus thuringiensis* (Bt) and other less toxic materials.
4. Validate and implement monitoring techniques for prune rust, brown rot, mites, aphids, scale insects and lepidopterous pests in prunes.
5. Demonstrate the use of covercrops for mow and blow weed control technique, and to increase soil health, biodiversity for beneficial organisms, reduce pesticide run-off and provide habitat for wildlife protection.

6. Demonstrate and implement optimum irrigation scheduling techniques to prevent excessive irrigation that increases runoff and ground water contamination.

This project is: 1) Developing and implementing replacement pest management systems impacted by FQPA by minimizing the use of, and finding alternatives for organophosphate insecticides, fungicides, nematicides and herbicides under review by FQPA. 2) Reducing surface water contamination by Diazinon and other organophosphates. 3) Reducing groundwater contamination by herbicides. 4) Evaluating ground covers and cover crops for their ability to increase biological control of pest organisms and reduce groundwater contamination by toxic pesticides. 5) Optimizing nitrogen and other nutrient programs. 6) Optimizing water use. 7) Reducing human exposure to pesticides is a result of the prune program. 8) Reducing risks to urban environments. 9) Delaying resistance to currently used pesticides.

Demonstration and Implementation of this project will demonstrate the feasibility of growing stone fruits while greatly reducing the reliance on toxic pesticides. This could be especially important in almonds, cling peaches and fresh stone fruits where similar pest complexes occur. Grape growers near prune orchards would also benefit because prunes act as a reservoir for grape leafhopper parasites.

Materials and Methods:

A Management Team, (see in acknowledgements Management Team Members), was established in June 1998 to develop the Integrated Prune Farming Practices (IPFP) project. Where possible, BPS and ESPS projects were combined to form the core of the IPFP project. Additional demonstration/research sites were initiated so that all sites in the IPFP project were a replicate and contained conventional farming practices, reduced pesticide use risk and a control or untreated check. The total number of field plots was determined by the total support money from the various sources, see table: IPFP Demonstration/Research Plots. All prune growing areas in California are well represented with the chosen selection of the plots. It should be noted that the Pest Management Alliance (PMA) funding supports site numbers 7, 9, 11, 15, 19 and 22. These 22 prune growers represent approximately 7% of the current bearing prune acreage in California. For the 2000 growing season, 11 additional sites were added as reduced risk plots only and will be monitored by PCAs. The PCAs will use protocols that have been modified to make them more cost effective and more usable by the prune industry, (see attached PCAs Monitoring Protocols). The backbone of the IPFP Project has been built around "Pest Management Evaluation for California Prunes", (this document is not attached but is available for anyone who wishes to see a copy). Grower survey data were taken to establish current pest control methods for each grower during the winter of 1998-99, (IPFP Base Line Grower Information form was attached in previous quarterly reports). The growers pesticide use data will be reviewed periodically during the duration of this project to see if pest control techniques change. CalEPA/DPR/Pesticide Use Data will also be used to evaluate pesticide use by the prune industry during this project.

Field scouts who were supervised and guided by field technicians intensively monitor each plot weekly. Information collected included: insects, diseases, nutritional data, moisture monitoring, and harvest samples. This information was collected at each location and each location consisted of the conventional, reduced risk and untreated control plots. (See IPFP Protocols in previous quarterly report attachments for specific monitoring methods). In addition to pest monitoring, the field scouts took pressure bomb readings in the plots to recommend irrigation scheduling. Leaf samples and irrigation water were sampled in season as a basis for fertilization recommendations. Harvest fruit samples were collected from each plot at each site and are currently being evaluated for quality, and yield comparisons.

During the growing season each grower received the weekly monitoring results. As the season progresses, we were able to help the grower decided when not to treat for specific pests. When treatment was necessary, then the choice of a safer material was recommended when appropriate. We also informed the grower weekly about irrigation status. Nutritional information will be communicated to the grower this coming winter. The protocols are ever changing and will continue to be so until we get the protocol to the point that a PCA would use it in everyday monitoring.

A key component of the project is to follow the BIOS model of field meetings and demonstrations in a timely manner and encourage participation by growers. Field days were held at various PMA demonstration and satellite orchards to view various operations, discuss results, and/or to demonstrate monitoring and other techniques. Farm advisors and the BPS coordinator were primarily responsible for planning and conducting meetings with their growers. Techniques such as the use of degree-days, traps, beating trays, cardboard bands and presence/absence leaf sampling for estimating populations of beneficial insects, leafrollers, PTB, San Jose scale and/or mites were demonstrated as was the use of a pressure bomb as a tool for irrigation scheduling and tissue sampling to determine optimum nutrient levels.

The California Prune Board also participated in outreach to all 1400 prune growers in California and strengthened communications/technology transfer with prune industry members via:

a. Quarterly newsletter
b. Annual report
c. Industry meetings
d. Via e-mail by developing:
    - Web page with prune research results
    - Bulletin Board and/or chat room
    - Prune Listserver

Bt was substituted for dormant organophosphate treatments for management of PTB and other lepidopterous pests. In order to replace the prophylactic use of Bt, monitoring techniques were developed by using data collected during the weekly monitoring to develop treatment thresholds.

Field scouts monitored plant moisture status weekly with a pressure bomb while performing their other weekly monitoring tasks. These data were made available to participating growers to be used in irrigation scheduling.

Tissue and irrigation water samples were taken during the growing season at each plot. The results will be used to base fertilizer recommendations during the fall and winter.

Next year the project will continue some of the paired plots and add to the progress already made with past CalEPA/DPR/PMA support by adding demonstration sites and number of field meetings. Some of the plots with paired comparison (conventional vs reduced risk) will be converted to demonstration plots only to reduce the amount of monitoring and to increase the number of growers in the project. PMA plots will go from 6 to approximately 10 sites and total IPFP plots to approximately 30 sites from the current 22 locations. Earlier planning this fall will allow us to add 3-5 additional field meetings.

Results:

Significantly reduced risk of pesticides in prunes by alternative pest management strategies: In the 22 locations, dormant organophosphate (OP) sprays were eliminated in the IPFP and control plots and treatments applied according to in-season monitoring where necessary. When treatments were needed, softer materials were selected if available. Although all the data have not been processed, it is easy to see we have significantly reduced the risk of pesticides in our plots. We will try to validate the reduction with DPR/Pesticide Data when available and resurvey the participating growers.

The "Pest Management Evaluation for California Prunes" was revised this past year. It received further revision to fit the USDA Crop Profiles. The "Crop Profile for California Prunes" can be see at: http://pestdata.ncsu.edu/cropprofiles/Detail.CFM?FactSheets__RecordID=66. Because of the length of the evaluation and the crop profile, neither document is attached but is available for anyone who wishes to see a copy.

Add to the progress already made with past CalEPA/DPR/PMA support including adding demonstration sites and number of field meetings: We were able to more than double earlier efforts by increasing to 22 sites throughout prune productions areas of California. Five Management Team meetings have been held, (minutes of meetings were included in previous quarterly reports). Four IPFP Newsletters have been sent to all prune growers, (IPFP Newsletters were included in previous quarterly reports). A web page for prune research has been put on line at http://fruitsandnuts.ucdavis.edu/prune. Even though we had planned to use the Internet chat room for weekly meetings of everyone involved in the project, it was met with too much resistance. We were able to use the chat room effectively with the 3 head field technicians and the project leader. The chat room on the Internet shows promise as a cost effective method of keeping everyone current on the project thus we will be looking at ways in the future to better

utilize this tool. An e-mail list server has been created to aid communications with all participants of the project. Twenty IPFP meetings were in 1999. It is interesting to note that there have been 7 articles in the newspapers or magazines from parties outside the project.

Validate and implement management of peach twig borer and other lepidopterous pests by using Bacillus thuringiensis and other less toxic materials: The monitoring protocols were evaluated during the season and were modified to help us make pest management decisions. The 22 different locations have provided data to evaluate this winter to see if the protocols need to be modified further. We did have more worm damage than we wanted in one plot so will be closely looking at the data for that prune orchard.

Validate and implement monitoring techniques for prune rust, brown rot, mites, aphids, scale insects and lepidopterous pests in prunes: As stated above the 22 orchards with essentially three monitoring sites at each location (conventional, reduced risk and control) have provided us a lot of data to analyze in the next several months. We had eight locations with significant aphid populations, so will be using this information to see how we can make improvements in the monitoring and thus pest control recommendations.

Demonstrate the use of covercrops for mow and blow weed control technique, and to increase soil health, biodiversity for beneficial organisms, reduce pesticide run-off and provide habitat for wildlife protection: Covercrops have been established in 9 different prune orchards; after getting well established we will monitoring the effect they have on the prune orchards including soil health and biodiversity of beneficial organisms. In cooperation with Frank Zalom, UC Davis, one of the covercrop plots is being used to measure pesticide runoff from dormant OP applications. Additionally, we have established two shrub demonstrations to be used for a filter/hedgerow. Another plot was used to develop baseline data on birds with the idea of using covercrops in the prune orchard and a neighboring bird habitat. Tissue and irrigation water samples have been taken and the results will be communicated to the grower with recommendations on fertilization for the coming year.

Demonstrate and implement optimum irrigation scheduling techniques to prevent excessive irrigation that increases runoff and ground water contamination: Pressure bomb readings were taken throughout the growing season to measure water/tree stress. Irrigation recommendations were made based upon the pressure bomb readings. It was interesting to note that most of the growers wanted to irrigate well ahead of the time we recommended. Results from harvest as to quality and yield have to be analyzed before we know for sure but it looks like we can prevent excessive irrigation and less runoff by utilizing the pressure bomb to schedule irrigations.

Discussion:

The project has progressed well and is doing better than even the project leader felt it would at this point. A brief summary of each of the 22 locations is attached; (see IPFP Demonstration/Research Plots 1999). Again, locations 7, 9, 11, 15, 19, and 22 are the PMA sites. The time is right to make this project the success we hoped it would be from everyone's standpoint. That is not to say that we are anywhere near completion or that we have the problems solved as that is not the case. It will still take several years to resolve issues like aphids, Peach Twig Borer, mites, rust, brown rot and etc. and put them into an economic reduced-risk pest management program. The prune industry has the earnest desire to make this project a reality. The results of this year's project have shown this.

We spent a lot of time evaluating the data generated in the 1999 growing season, see attached Environmentally Sound Prune Systems (E.S.P.S.) and IPFP Sites Progress Report December 1999. There was no significant difference between the reduced risk and conventional plots through out the state relative to quality and yield. Each grower received the summary data from his farm and we discussed what it means to him in his particular situation. Based upon these results we will adjust the IPFP Project, as the Management Team deems necessary. The Management Team is already looking at ideas to help the project add additional grower sites, more field meetings, work with PCAs to see if the protocols can be streamed lined for commercial use. A major addition to the Prune Board IPFP Newsletter is to interview and feature 1 or more participating growers in each newsletter in the future.

Summary and Conclusions:

As noted in the discussion above it is still too early to draw many definitive conclusions. We have developed a very ambitious effort to reduce pesticide use risk in the prune industry and the industry has been very receptive thus far. Our approach of using large numbers of locations in all the major prune production areas has given us the ability to see numerous problems under different circumstances and attest to whether or not our monitoring protocols are adequate, or need to be adjusted. We will be able to see if our recommendations truly demonstrate that prune growers can have a cost effective, reduced-risk pest control program.

During 1999, dormant applications of Diazinon (OP insecticide) were eliminated in all demonstration/research sites, in-season pesticide applications were based on pest monitoring protocols, if pest control was needed softer pesticides were used, cover crops were encouraged where they fit in, plant nutrient applications were based on plant, water analysis and irrigation water was significantly reduced in many of the sites and there was no significant difference between the reduced risk and conventional plots through out the state relative to quality and yield.

IPFP
Demonstration /Research Plots
i.e., ESPS, SAREP/BIFS, DPR/PMA, CSREES, NRCS

	County	Project	Grower/ Ranch	Plot Size Conv./Reduced Risk/Control	Acres of Prunes Farmed	Total Acres Farmed
1.	Butte	BIFS	Onstott Orchards	15/14.5/.5	400	890
2.	Butte	ESPS	Brad Johnson	4.81/5.23/.5	75	100
3.	Butte	CSREES	Chico State Farm	20/5.82/.31	45	650
4.	Tehama	BIFS	Shasta View Farms	45/5/.5	50	50
5.	Tehama	ESPS	Confidential	9.5/12.3/.5	>22	>22
6.	Tehama	CSREES	Confidential	5.9/6.2/.3	>12	>12
7.	Tehama	PMA	Farmland Management	20/19.5/.5	694	2879
8.	Sutter	BIFS	Thiara Ranches	15/10/.3	50	250
9.	Sutter	PMA	David Crane	5.1/5.3/2.9	100	300
10.	Sutter	ESPS	John Heier	5.13/5.13/1.6	65	200
11.	Sutter	PMA	Monty Johnson	9.9/9.6/.35	130	150
12.	Sutter	BIFS	Gary Carlin	9.2/7.4/.83	70	172
13.	Glenn	BIFS	Billiou Ranches	20/20/.3	734	1213
14.	Glenn	ESPS	Willow Glenn Orchards	9/5/4	513	1750
15.	Yuba	PMA	Mariana Plant 2	5.1/5.2/.5	380	380
16.	Yuba	CSREES	Kulwant S. Johl	12.95/5.28/.25	530	600
17.	Yolo	BIFS	Joe Turkovich	9/9/<1	112	160
18.	Merced	ESPS	Confidential	71/5/1	600	2500
19.	Merced	PMA	Thiara Brothers Orchards	35/5/<1	641	800
20.	Tulare	ESPS	Dan Aguair	40/20/20	475	980
21.	Fresno	BIFS	Campos Brothers	20/4.5/.5	500	9000
22.	Madera	PMA	Sherman Thomas Ranch	40/65/1	105	700
			Total	**708**	**>6,303**	**>23,758**

ENVIRONMENTALLY SOUND PRUNE SYSTEMS (E.S.P.S.)

Bill Olson, Walt Bentley, Rick Buchner, Mark Freeman, Brent Holtz, Bill Krueger, Themis Michailides, Nick Mills, Maxwell Norton, Gary Obenauf, Carolyn Pickel, Wilbur Reil, Ken Shackel, Nadeem Shawareb, Steve Sibbett, Steve Southwick, and Fred Thomas

ABSTRACT

Due to the impending loss of many pesticides, stricter regulations on their use and concerns over contaminating natural resources this project was begun to develop, research and implement alternative practices in order to reduce pesticide use and conserve natural resources.

The core of the project revolves around monitoring and developing treatment thresholds for pest, plant nutrition and irrigation needs. Pest being studied include: European and web-spinning mites, San Jose Scale, prune aphids, peach twig borer, leaf-rollers, prune rust, and fruit brown rot.

Results from this year's pest monitoring and applying pesticide treatments only when the pest reaches the treatment threshold indicated that, by using the monitoring/treatment threshold data being developed in this project, nearly three million dollars in pesticides and their application could have been saved in 1999. Most of the savings would have been with the controversial dormant pesticide application and prune rust treatments.

Tree water status monitoring indicated that many of the growers in the program are applying more water than needed for best production. Additional savings appear to be available where tree water needs are monitored and irrigation's applied only as needed.

Some cooperators have well water with nitrate nitrogen in them, which could be utilized by the tree. This available nitrogen source could reduce the cost of applied nitrogen. Over fertilization or poor fertilization timing may be responsible for this well water contamination.

Over ten educational meetings, which discussed progress and implementation of the data being developed, were held in 1999 for an audience of 830 individuals interested in prune production. Many newsletters and a popular article was also published and widely distributed about the progress of the project. Electronic media is being used in at least three counties to advise prune growers of pest status and "reduced risk" treatment options.

PROBLEM AND ITS SIGNIFICANCE

Economics and regulations are creating change in the way prunes are farmed. Cost of farming is going up, the industry is expanding creating concerns of over production and the industry will no longer pay for small poor quality fruit. Federal acts, and California ballot initiatives such as the Federal Clean Air Act, Federal Food Quality Protection Act and California's Proposition 65 and 204 dealing with water quality establish expiration dates and/or threaten the continued use of many pesticides. Some pesticide expiration dates are scheduled for the year 2000. Regulations established by California Department of Pesticide Regulations (DPR) have created new requirements and certification for the application of pesticides. Misuse of natural resources is becoming a common environmental concern.

Alternative practices, to the conventional way prunes have been farmed, need to be researched, demonstrated and implemented to keep pace with current economics and approaching and/or existing regulations. Economic thresholds and monitoring techniques need to be discovered so that pesticide use can be safely reduced or at least used in a timely fashion when needed. Water conservation that does not interfere with prune production needs to be researched and demonstrated.

OBJECTIVES

Environmentally Sound Prune Systems (ESPS) is a research/demonstration project that 8 University of California (U.C.) Prune Farm Advisors, 2 U.C. IPM Advisors, 3 U.C. Faculty Members and 3 U.C. Specialists are participants in to advance economically and environmentally sound approaches to prune production. The project objectives involve the reduced use of biocides, more effective use of fertilizers and natural resources and encourage known useful cultural operations into a more sustainable farming system.

The overall project was begun in 1998 with support from the California Prune Board. The project is being conducted on individual prune farms ranging from Tulare to Tehama County, twenty-two sites total.

The objective is to compare cultural practices dealing with pest management, fertilization and irrigation between the conventional and more sustainable or "reduced-risk" approach to growing prunes. Reduced-risk means a reduced risk to the environment without additional risk to the grower. After a few years of establishing these comparisons, an economic comparison will also take place.

"Satellite projects" to evaluate single aspects of ESPS may be established in one or more areas. These satellite projects are "stand alone" projects. Their objectives are designed to address single researchable questions. For example, evaluating aphid control with soft chemicals. ESPS satellite projects will be reported separately by those involved.

PROCEDURE

Research/Demonstration:

In Tulare (1 site), Madera (1 site), Merced (2 sites), Fresno (1 site), Yolo (1 site), Sutter (5 sites), Yuba (2 sites), Butte (3 sites), Glenn (2 sites) and Tehama (4 sites) Counties establish trials which compare two prune farming systems to an untreated check: 1) conventional system and 2) a "reduced-risk" system. Each system will consist of at least 5 acres. The conventional system will consist of the grower's normal practices but must include an Asana and oil dormant spray. Pest control for the reduced-risk system is based on monitoring protocols that are being developed for this project (see protocol 3 at end of report for example). A small-untreated "check" area is also present at each site to help validate the two prune farming systems. The organisms being monitored for include: San Jose Scale, European Red Mite eggs, prune aphids, peach twig borer and the leaf roller complex, beneficial insects, prune rust, fruit brown rot, and spider mites. In addition, the nutrient status and tree water status is being monitored. Tree water status is being used for irrigation scheduling purposes. Field Assistants (Scouts) are doing the

monitoring in each site. There are currently nine scouts hired to do the monitoring. From using these monitoring tools recommendations are made to the grower-cooperators about pest control, fertilization and irrigation scheduling. The cooperator has agreed to apply these recommendations to the reduced-risk segment of the orchard. In some cases separate irrigation schedules can not be applied to the conventional and reduced-risk plots. In these cases our irrigation recommendations are applied in the entire block. As new monitoring techniques and recommendations become available they will be incorporated into the project. These techniques and recommendations will, most likely, come from the satellite projects described earlier and reported on below.

Evaluation of these two farming systems is being carried out using data collected throughout the season and using final plot evaluations that are conducted just prior to harvest. Additionally, these systems will be evaluated based on grade sheets, yield, and dry-away information provided by the grower cooperator.

Education/Outreach:

Each farm advisor is required to have at least one educational meeting each year focusing on the ESPS project. Farm Advisors are also encouraged to write newsletters and other popular articles about the ESPS project. Insect day-degree accumulation equipment was purchased for use in this project. E-mail and web site communication between advisors and clientele, regarding pest monitoring, day-degree accumulation and field observations is also encouraged.

Securing Additional Grant Support:

It is recognized that the California Prune Board can not support this project to the extent needed to attract rapid, wide adoption of reduced risk practices by clientele. To this end, an attempt at securing additional grant support from other agencies is being conducted to expand the project beyond the capabilities of the California Prune Board. However, securing other grant funding is contingent upon prune industry support provided by the California Prune Board.

Satellite Projects:

Projects need to be researched before being demonstrated or adopted on a wide scale. In previous years, under the ESPS project, research was conducted on: 1) Alternate year dormant spray program, 2) A predictive model for forecasting scab off-grade at harvest, 3) Aphid control using soft chemicals, and 4) Mow and throw technique of mowing cover crop, using the residue as a mulch for weed control and the use of rice straw (ag-waste) as mulch for weed control.

This year, under the ESPS project, material efficacy trials were conducted for control of prune aphids using soft materials including a number of novel products not yet registered. These satellite projects will be reported on by those involved.

RESULTS

Research/Demonstration:

Results from this year's project are first discussed by the individual monitoring protocols and

final plot evaluations and then by field evaluation of fruit at harvest. Ultimately, site grade sheets will be used to further evaluate the success of the project. This report precedes the receipt of all grade sheets.

Fall Presence-Absence Monitoring for Prediction of Springtime Aphid Populations and a Dormant Spray Recommendation Guide.

Through dormant spur monitoring we can now assess the population of European Red Mite eggs and San Jose Scale (Protocol 1). The need for a dormant treatment for these two pests can be predicted and an oil application can control these two pests. The pests that are giving us the most problem when we do not put on a dormant insecticide and oil spray, are prune aphids. Both mealy plum aphid and leaf curl plum aphid can be a problem.

To help with the aphid problem the ESPS Project has developed a fall monitoring technique to predict if aphids will be present next spring. By sampling 100 leaves per tree on 20 trees in the fall of 1998 and recording the presence or absence of aphids on a tree in the spring of 1999, we were 70% accurate in predicting the presence of mealy plum aphid populations. (Graph 1). Our accuracy for Leaf Curl Plum Aphid has not been as good. Sampling is done when 75% of the leaves have fallen off (late October- early November). To improve accuracy, we have increased the number of trees monitored for the 1999-2000 season.

If less than 5% of the sampled trees have aphids in the fall we would predict very few aphids next spring and a treatment should not be needed. If 7.5-15% of the trees sampled have aphids in the fall, the model predicts some aphid problem that may justify a treatment. If more than 15% of the trees sampled in the fall have aphids the model predicts a wide spread aphid problem next spring that would definitely require treatment (Table 1).

Using this technique we have found that 64% of the orchards did not have an aphid problem and did not need a dormant insecticide and oil treatment. For the orchards that were predicted to have an aphid problem we are recommending: 1) oil spray during or near bloom or 2) be prepared to control aphids during the growing season with standard insecticides or suppressing aphids with oil.

Coupling this monitoring technique with the dormant spur sampling technique for European Red Mite and San Jose Scale (protocol 1) we have been able to develop the following "Dormant Treatment Recommendation Guide" (Table 2).

Graph 1.

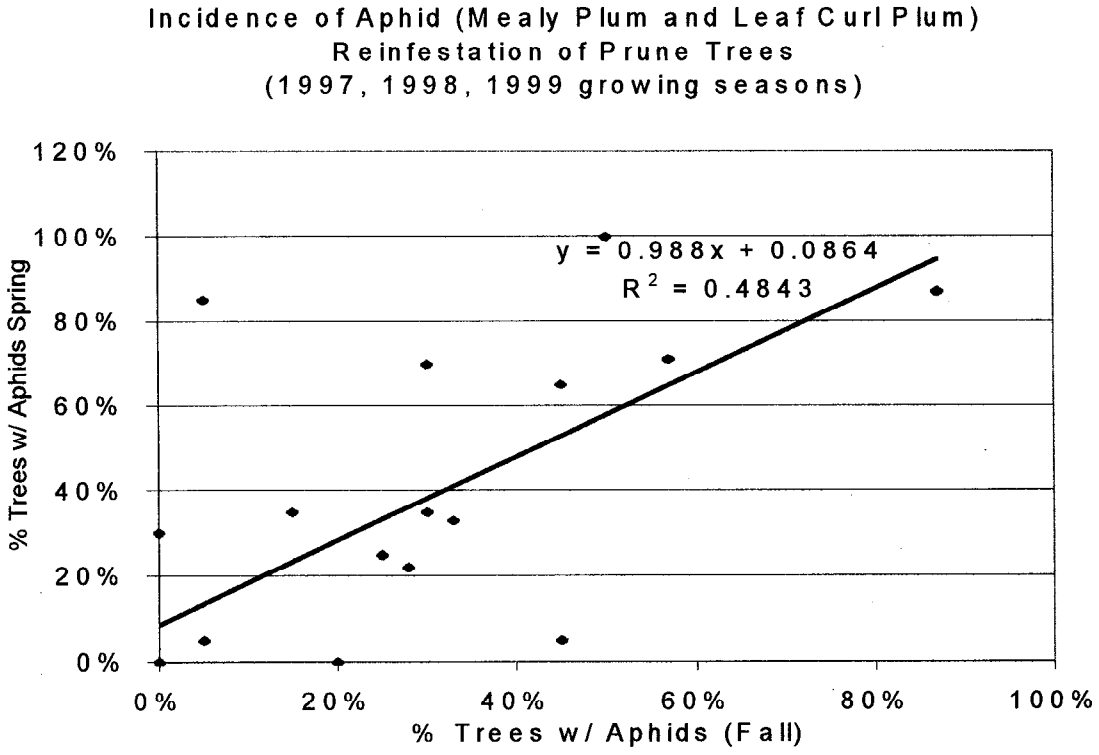


Table 1. Spring aphid prediction model.

Level of Aphid Infestation	# of Trees w/ Aphids Out of 40	% Trees Infested	Expected Spring Aphids
Level 1	0 - 2	0 - 5 %	Very Few
Level 2	3 - 6	7.5 - 15 %	Some
Level 3	7 or more	Over 15%	Wide Spread

Table 2. Dormant Treatment Recommendation Guide

Aphids at Level:			Mites and/or Scale Above Threshold?	Treatment Recommendation
Level 1	Level 2	Level 3		
X			No	Nothing
X			Yes	Dormant oil
	X		No	Oil at bloom
	X		Yes	Delayed dormant oil or oil at bloom
		X	No	Oil at bloom* + in-season
		X	Yes	Delayed dormant oil or oil at bloom* + in-season

* Be concerned with oil applications near Captan or Bravo.

Dormant Spur Sampling for Red Mite Eggs (ERM) and San Jose Scale (SJS)- Protocol # 1:

This monitoring protocol involved the evaluation of prune spurs once during the dormant period. If more than 10 percent of the spurs have ERM eggs or SJS crawlers, a delayed-dormant oil spray is recommended. If less than 10 percent of the spurs have mite eggs or live SJS present, no treatment is recommended. Three sites out of 22 (Madera, Fresno and Tulare) exceeded the threshold for ERM eggs. Only 27 % of the orchards (6 of 22) exceeded the treatment threshold for over wintering San Jose Scale (Butte, Sutter (2 sites), Yuba (2 sites), and Tulare (Table 3). These sites received a dormant or delayed-dormant oil spray for one or both of these pests. None of the reduced-risk sites had an ERM or scale problem during the growing season.

Table 3. % Sites Requiring Dormant Spray for ERM or SJS (22 sites total):

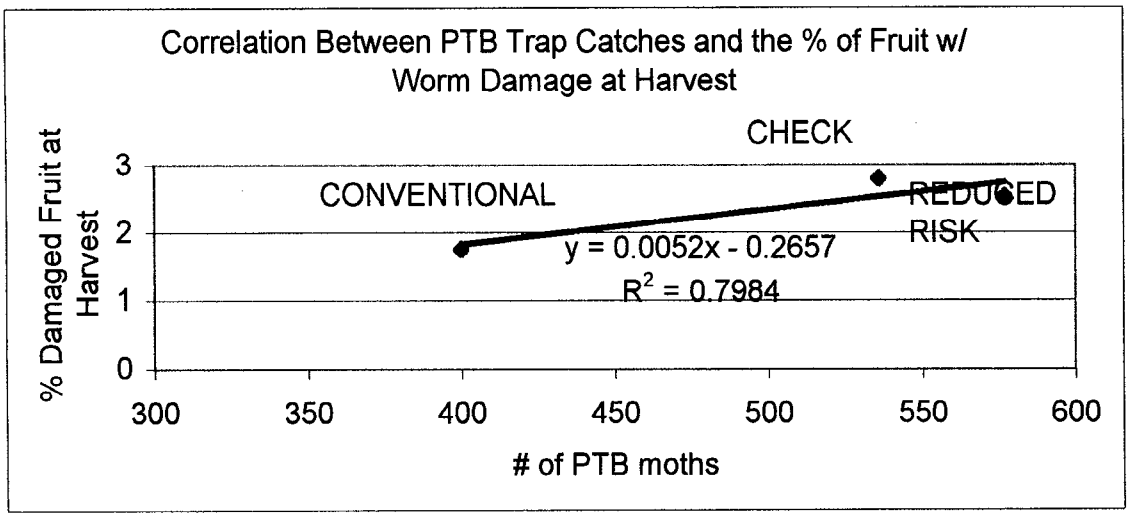
ERM eggs	SJS	Total
14%	27%	36%

Monitoring of Pheromone Traps for PTB, SJS, and Parasitoids of SJS - Protocol # 2

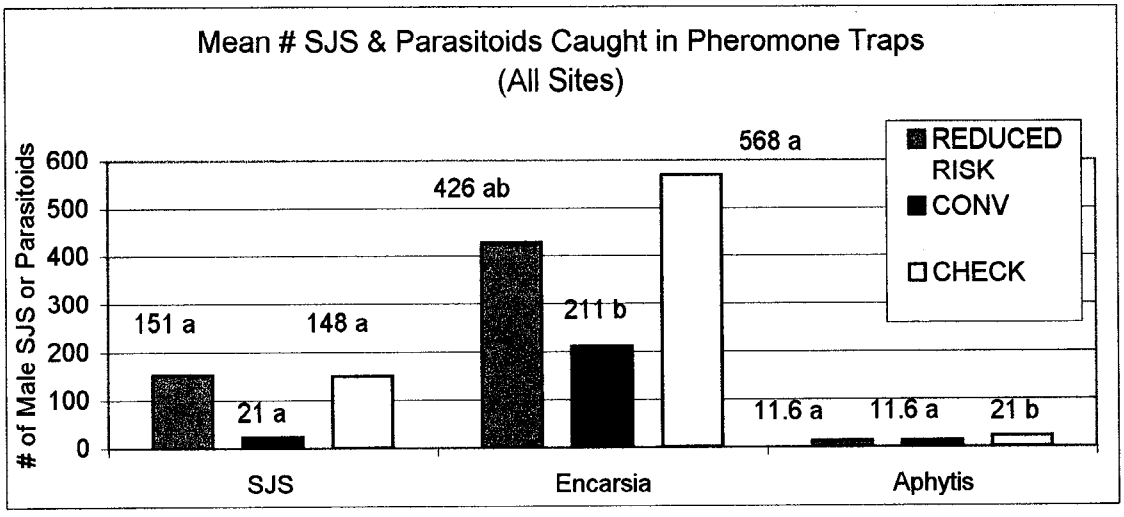
Peach twig borer pheromone trap catches in the reduced risk, conventional, and check plots were not significantly different. Peach twig borer trap catches are correlated (R=.89) to the percentage of fruit with worm damage at harvest (Graph 2).

San Jose Scale pheromone traps were used to monitor SJS and two parasitoids that attack SJS. No significant differences in pheromone trap catches were found for male SJS between the conventional, reduced-risk, and check plots. Significant differences in parasitoid populations between the test plots did occur. *Encarsia* (*Prospatella*) wasps were caught in significantly larger numbers in the check plots that the conventional. *Encarsia* trap catches in the reduced-risk plots were intermediate, but not significantly different from the check or conventional. Trap catches of *Aphytis melinus* in the check plots were significantly higher than the conventional and reduced risk plots (Graph 3).

Graph 2.



Graph 3.



Treatment means that are not followed by a common letter are significantly different from each other at the 5% level according to Duncan's Multiple Range Test for Mean Separation.

Evaluation of Green Fruit for SJS and Parasitized SJS – Final Evaluation

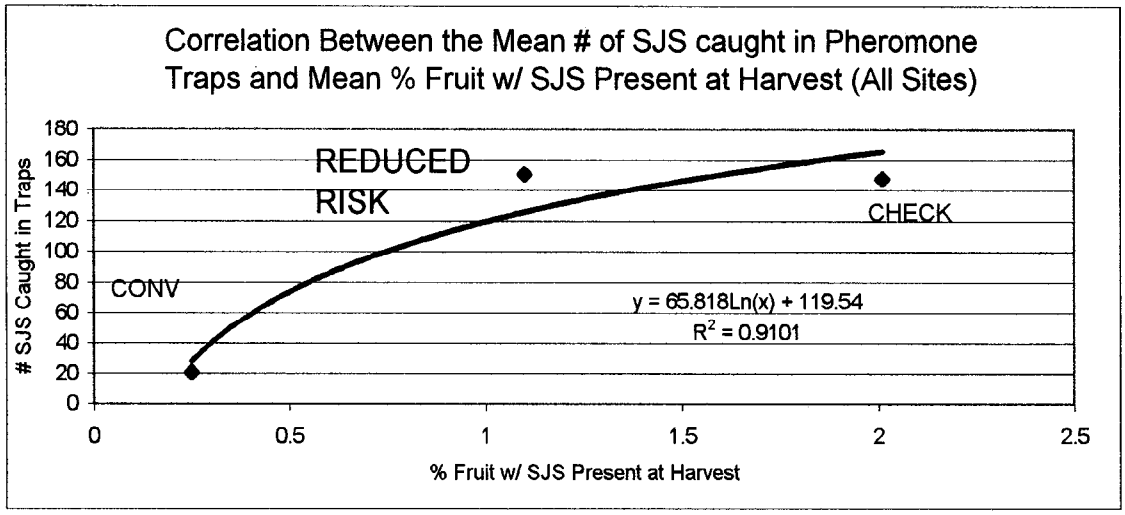
For each of the 22 sites, five hundred fruit per treatment were examined for the presence of SJS or parasitized SJS during the final evaluation. The untreated check plots had significantly more fruit with SJS present compared to the conventional plots. The reduced risk plots were intermediate and
not significantly different from the check or the conventional. No significant differences occurred in terms of parasitized SJS (Table 4). There was a strong correlation (R=.95) between the number of male SJS caught in pheromone traps and the percentage of fruit with SJS present at harvest (Graph 4).

Table 4. Mean % Fruit w/ SJS or Parasitized SJS Present at Harvest (All Sites)

TREATMENT	% Fruit w/ SJS	% Fruit w/ Parasitized Scale
REDUCED RISK	1.1 ab	.01 a
CONVENTIONAL	.25 b	0 a
CHECK	2.01 a	0 a

Treatment means not followed by a common letter are significantly different from each other at the 5% level according to Duncan's Multiple Range Test for Mean Separation.

Graph 4.



Blossom/Shoot Tip Sampling for PTB, Leaf Roller Complex, and Other Larvae (Protocol # 3)

Sampling of blossoms and shoot tips is used to determine the need for "bloom time" or "in-season" applications of *Bacillus thuringiensis* (*Bt*) to control lepidopterous larvae. Two techniques were evaluated this season. One technique (old protocol) involved random sampling of 20 blossoms and 20 shoot tips on 20 trees for the presence of damage or larvae. The mean percentage of blossoms/shoot tips with larvae or larval damage present was not significantly different for the three systems (Table 5).

The other method (new protocol) involved visual inspection of entire trees (80 per plot) to determine the presence or absence of larvae or larval damage. The conventional plots had significantly fewer trees with larvae or larval damage present compared to the reduced risk and check plots (Table 6).

For each of the 22 sites, five hundred fruit per treatment were examined for the presence of larvae or damage during the final evaluation. There were no significant differences between the three treatments (Table 7).

Table 5. Old Protocol. Mean % of Blossoms/Shoots w/ Larvae or Damage Present

TREATMENT	% Blossoms/Shoots w/ Worms or Damage
REDUCED RISK	0.56 a
CONVENTIONAL	0.39 a
CHECK	0.41 a

Treatment means not followed by a common letter are significantly different at the 5 % level according to Duncan's Multiple Range Test for Mean Separation.

Table 6. New Protocol. Mean % of Trees with Larvae or Damage Present

TREATMENT	% Trees w/ Worm Damage
REDUCED RISK	8.6 a
CONVENTIONAL	6.0 b
CHECK	9.7 a

Treatment means not followed by a common letter are significantly different at the 5 % level according to Duncan's Multiple Range Test for Mean Separation.

Table 7. Mean % Fruit w/ Larvae or Damage Present (Final Evaluation)

TREATMENT	% Worm Damage
REDUCED RISK	2.54 a
CONVENTIONAL	1.76 a
CHECK	2.80 a

Treatment means not followed by a common letter are significantly different at the 5 % level according to Duncan's Multiple Range Test for Mean Separation.

Spring Prune Aphid Monitoring – Protocol # 4:

Beginning in April, a random sample of 75-80 trees per plot is examined for the presence of leaf curl plum aphids (LCPA) and mealy plum aphids (MPA). If more than 10 % of the trees examined are infested with aphids, then a treatment is justified. The conventional plots had significantly fewer trees infested by mealy plum aphid and leaf curl plum aphid compared to the reduced risk plots and the check plots, which were statistically similar to each other (Table 8). Thirty-two percent of the reduced risk plots (7 of 22) exceeded the treatment threshold for leaf curl plum aphid. These orchards were located in Sutter (2 sites), Tehama (2 sites), Glenn (1 site), Yolo (1 site) and Butte (1 site) Counties. Twenty seven percent of the reduced risk plots (7 of 22) exceeded the treatment threshold for mealy plum aphid. These orchards were located in Sutter (2 sites), Glenn (2 sites), Merced (1 site), Madera (1 site) and Butte (1 site) Counties.

Table 8. Mean % of Trees w/ Prune Aphids Present – All Sites

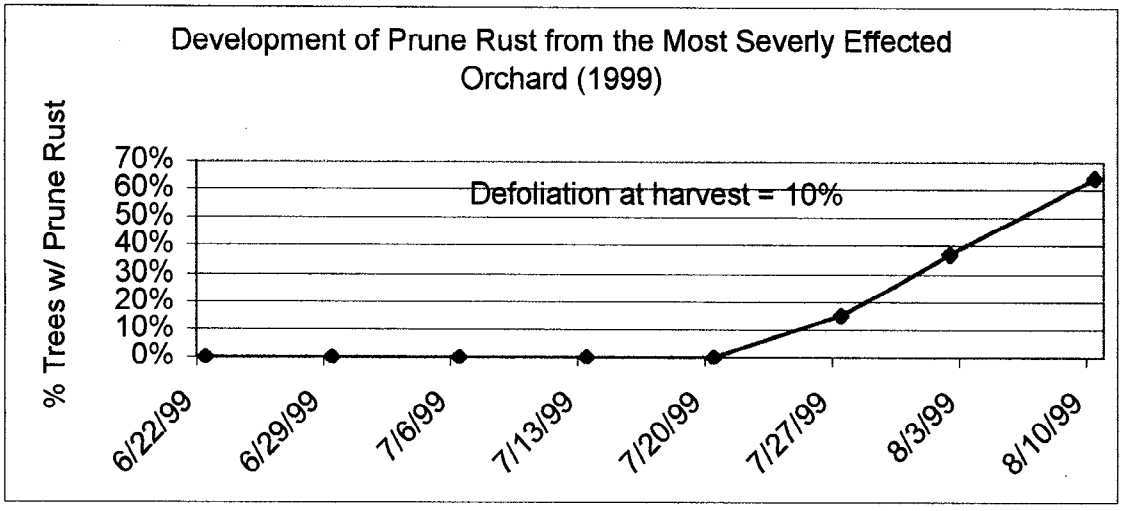
TREATMENT	% Trees w/ LCPA	% Trees w/ MPA
REDUCED RISK	12.78 a	14.6 a
CONVENTIONAL	2.05 b	2.0 b
CHECK	12.99 a	20.8 a

Treatment means not followed by a common letter are significantly different at the 5 % level according to Duncan's Multiple Range Test for Mean Separation.

Prune Rust Monitoring and Treatment Timing Recommendations:

Previous research has shown that rust treatments applied close to the onset of rust infection are most beneficial. This monitoring technique involves watching trees for the first signs of rust. Once rust is first detected, a treatment is recommended. After a rust treatment is applied, and continued monitoring indicates an increase in rust, additional treatments are recommended. Only three of the sites (14%) had rust, all in the Sacramento Valley. However, the rust did not show up till August and consequently no rust treatments were needed. Only one of the three orchards had any defoliation prior to harvest. The percent of trees with some defoliation in this orchard was 10 percent (Graph 5). Most defoliation was on young replants. The time to monitor a plot for rust took 30 minutes for one person. Monitoring took place over an 8-week period.

Graph 5.



Presence–Absence Sequential Sampling for Webspinning Mites:

Only four of the twenty-two sites were over the treatment threshold (over 53 percent of the leaves having webspinning mites with predacious mites present). Only one site was treated. This site had some defoliation, which was stopped once a treatment was applied. There was no statistical difference between webspinning mite populations or mite predator populations in the ESPS, conventional, and check plots for the 22 sites (data not shown). Monitoring for mites took 1.5 hours per week per person. Monitoring took place over a 10-week period.

Fertilization:

Plant tissue and water samples for each site were collected in July. The tissue and water nutrient data are shown in Tables 9 and 10. Highlighted tissue analysis sites indicate a deficiency in one or more nutrients. Highlighted water analysis sites indicate either high N or high salt. Five sites were considered to have low leaf nitrogen levels. Four of them were new sites to the program. Two sites were considered to have low zinc levels in the tissue samples. No sites were considered deficient in potassium or boron. In the water samples, nine sites had high nitrate nitrogen levels, and one site had high Ec levels.

Table 9. 1999 Tissue Analysis for Various Nutrients

County & ID	Treatment	N-Total (%)	K-Total (%)	B (ppm)	Zn (ppm)
Butte-BJ	Conv.	2.268	2.27	44	178
Butte-BJ	ESPS	**2.153**	2.22	44	160
Butte-CSUC	Overall	2.632	3.15	66	27
Butte-OO	Overall	**2.029**	3.64	60	22
Glenn-B	Overall	2.546	3.44	71	165
Glenn-WG	Conv.	2.614	3.55	58	93
Glenn-WG	ESPS	2.306	2.73	54	36
Merced-GL	Conv.	2.923	2.18	66	21
Merced-GL	ESPS	2.467	3.23	80	17
Merced-TB	Conv.	2.367	2.74	47	17
Merced-TB	ESPS	2.67	2.07	55	182
Sutter-DC	Overall	2.284	2.25	48	18
Sutter-GC	Overall	**2.213**	2.48	52	19
Sutter-JH	Overall	2.389	2.25	45	**16**
Sutter-MJ	Overall	**2.202**	3.93	61	**14**
Sutter-TR	Overall	2.407	2.14	58	88
Tehama-F	Overall	2.245	4.05	46	20
Tehama-M	Conv.	2.38	2.89	73	263
Tehama-M	ESPS	2.59	2.49	73	26
Tehama-RB	Conv.	2.518	3.29	102	194
Tehama-RB	ESPS	2.684	3.42	106	231
Tehama-SV	Overall	2.746	3.73	71	231
Tulare-A	Conv.	2.579	3.23	59	70
Tulare-A	ESPS	2.54	2.33	51	33
Tulare-A	Check	2.482	195	57	30
Yolo-T	Conv.	3.353	1.82	46	51
Yolo-T	ESPS	2.467	2.2	51	50
Yolo-T	Check	2.464	2.08	52	47
Yuba- KJ	Overall	2.333	2.92	57	36
Yuba-M	Overall	**2.199**	3.39	47	18

Table 10. 1999 Water Analysis

County & ID	pH	EC mmhos/cm	Ca meq/L	Mg meq/L	Na meq/L	SAR	Cl meq/L	B ppm	NO3-N ppm	Lbs.N/Acre Ft
Butte-BJ	7.2	0.67	2.5	4.5	0.9	<1	0.2	<0.1	**10.5**	**28.6**
Butte-CSU	7.4	0.34	1.6	1.7	0.4	<1	<0.1	0.1	**5.71**	**15.5**
Butte-OO	7.6	0.08	0.4	0.2	0.1	<1	<0.1	<0.1	<0.05	0.0
Glenn-B	7.7	0.63	3.1	2.5	1.3	1	1	0.3	**5.18**	**14.1**
Merced-TB	NA	0.04	0.2	0.1	0.1	<1	<0.1	<0.05	<0.05	0.0
Sutter-DC	7.2	0.24	0.8	1.4	0.5	<1	0.1	<0.1	1.3	3.5
Sutter-GC	7.4	0.08	0.4	0.2	0.1	<1	0.1	<0.1	<.05	0.0
Sutter-JH	7.2	0.34	1.1	1.5	0.8	1	0.3	0.1	**5.9**	**16.0**
Sutter-MJ	7	0.73	2.7	4.8	1	1	0.7	<0.1	**8.17**	**22.2**
Sutter-TR	7.6	0.65	2.4	3.9	1.1	1	0.3	0.1	**11.1**	**30.2**
Tehama-F	6.9	0.28	0.9	1.2	0.7	1	0.1	<0.1	**6.05**	**16.5**
Tehama-M	7	0.15	0.5	0.5	0.5	1	0.1	0.1	0.09	0.2
Tehama-RB	6.8	0.6	1.1	1.5	3.2	3	2.5	1.4	2.11	5.7
Tulare-A-1	7.8	0.26	1.2	0.1	1.4	2	0.2	0.1	2.36	6.4
Tulare-A-2	7.2	0.62	4	1	1.8	1	0.4	0.1	**10.1**	**27.5**
Yolo-T	7.3	**0.88**	2.9	5.7	2.1	1	1.6	0.43	**6.28**	**17.1**
Yuba- KJ	7	0.66	2.7	3.9	1.3	1	0.5	0.1	1.71	4.7
Yuba-M	7.1	0.55	<0.1	<0.1	1	<1	0.3	<0.1	1.76	4.8

Irrigation Management *(Objective, procedure, results):*

The reduced-risk recommended management of irrigation is based on research findings in prune, that: 1) stress can be accurately and reliably measured using the midday bagged leaf method (midday stem water potential), and 2) prune tree economic production appears to benefit from mild to moderate water stress later in the season, when dry yield is not affected but fruit hydration ratio is improved. Additional beneficial effects may also occur in prune (reduction in excess vegetative growth, increased return bloom), but these have been more difficult to clearly identify. Reduced water input is also one of the goals of ESPS, and so the objective of our irrigation management strategy are to minimize the applied water without causing detrimental effects on economic yield.

Midday stem water potential is measured by selecting an interior canopy leaf, attached near the trunk or main scaffold, and enclosing this leaf in a foil-covered black polyethylene envelope to stop leaf transpiration. After about 2 hours, at midday, the water potential of this non-transpiring leaf is measured with a pressure chamber. The relationship of this measurement to the midday conditions of temperature and humidity have been determined for fully irrigated prune trees (Table 7), and this value is used as a reference value for any particular date and site.

Table 11. Values of midday stem water potential (in Bars) to expect for fully irrigated prune and almond trees, under different conditions of air temperature and relative humidity.

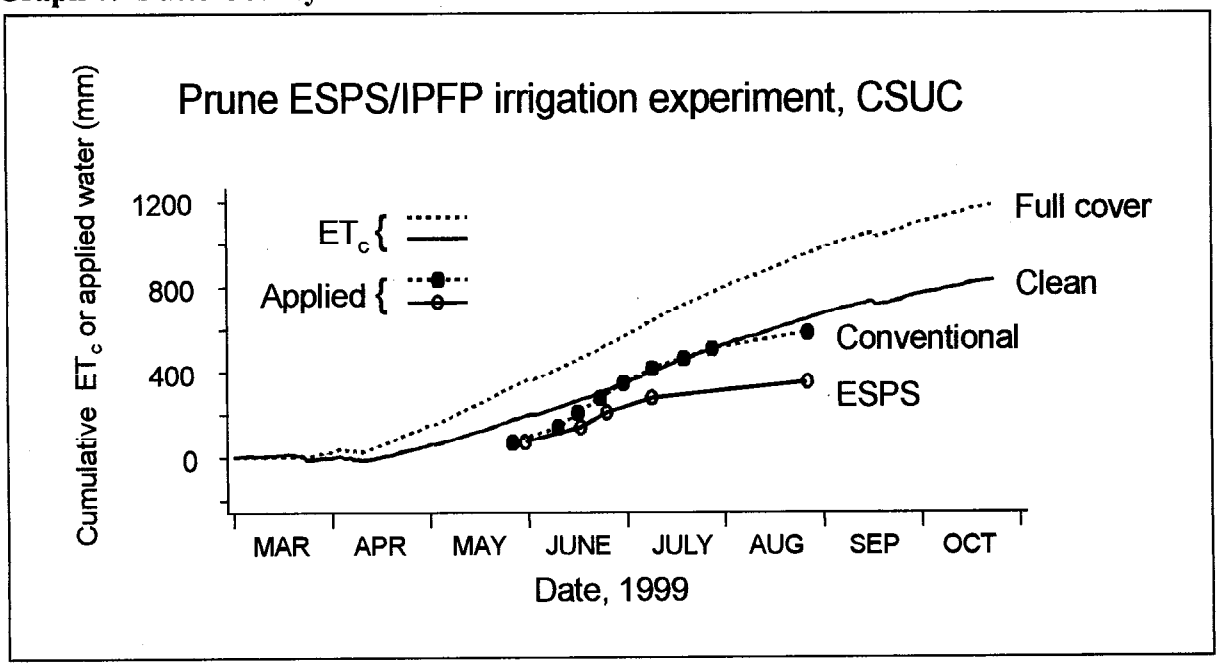
Temperature (EF)	Air Relative Humidity (RH, %)						
	10	20	30	40	50	60	70
70	**-6.8**	**-6.5**	**-6.2**	**-5.9**	**-5.6**	**-5.3**	**-5.0**
75	**-7.3**	**-7.0**	**-6.6**	**-6.2**	**-5.9**	**-5.5**	**-5.2**
80	**-7.9**	**-7.5**	**-7.0**	**-6.6**	**-6.2**	**-5.8**	**-5.4**
85	**-8.5**	**-8.1**	**-7.6**	**-7.1**	**-6.6**	**-6.1**	**-5.6**
90	**-9.3**	**-8.7**	**-8.2**	**-7.6**	**-7.0**	**-6.4**	**-5.8**
95	**-10.2**	**-9.5**	**-8.8**	**-8.2**	**-7.5**	**-6.8**	**-6.1**
100	**-11.2**	**-10.4**	**-9.6**	**-8.8**	**-8.0**	**-7.2**	**-6.5**
105	**-12.3**	**-11.4**	**-10.5**	**-9.6**	**-8.7**	**-7.8**	**-6.8**
110	**-13.6**	**-12.6**	**-11.5**	**-10.4**	**-9.4**	**-8.3**	**-7.3**
115	**-15.1**	**-13.9**	**-12.6**	**-11.4**	**-10.2**	**-9.0**	**-7.8**

Based on: McCutchan and Shackel, 1992. Stem-water potential as a sensitive indicator of water stress in prune trees (*Prunus domestica* L. cv. French). Journal of the American Society for Horticultural Science 117(4):607-611 and Shackel et al. 1997. Plant water status as an index of irrigation need in deciduous fruit trees. HortTechnology 7(1):23-29.

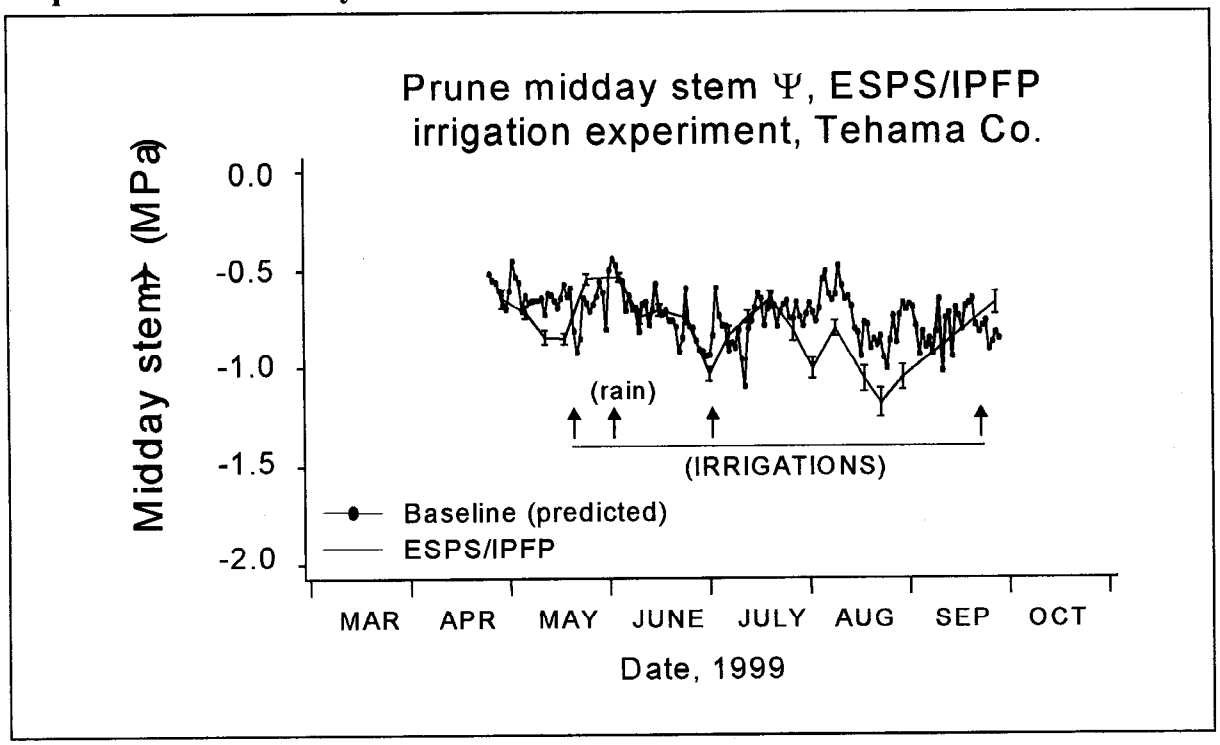
Mature prune trees can be allowed to progressively decline through the growing season towards mild levels of stress (-15 bars on average) by harvest, with no effect on yield, and some improvement in fruit quality (lower fresh fruit moisture content). Rapid recovery from a stress of -15 bars or more should be avoided during the crack sensitive period (late June/early July), and substantial recoveries should probably also be avoided near harvest, since we have associated this with increased pre-harvest fruit drop.

Each of the 22 sites were monitored using a gas or pump up pressure chamber. All sites showed the expected increases in stem water potential following irrigation and declines as soil water was depleted (Graph 6, Butte Co. and Graph 7, Tehama Co). The Butte site compared the grower's conventional practice against irrigation recommendations based on monitoring. At this location, the number of micro sprinkler irrigation's totaled nine for the conventional and five for the reduced risk plot. At the Tehama site, the entire orchard was irrigated based on pressure chamber monitoring. At this site, one timely rain and three flood irrigations were applied. The number of irrigations applied in 1999 was far less than the grower's previous practice.

Graph 6. Butte County



Graph 7. Tehama County



ONFIT Procedure – Fruit Brown Rot Predictive Model:

A predictive model for estimating fruit brown rot infection has been developed by Themis Michailides, plant pathologist at the Kearney Agricultural Center. The "Overnight Freezing Technique" (ONFIT) involves freezing green fruit to reveal latent infections by *Monilinia fruticola* or *Monilinia laxa*. Levels of latent infection revealed using the ONFIT model are correlated to levels of fruit brown rot infection that will become visible in the field later in the season as well as post harvest infection. This information is used to determine the need to protect fruit from brown rot infection with a fungicide application. Results of the ONFIT procedure predicted that 8 of the 22 sites had low levels of latent brown rot present. No fungicide treatments for fruit brown rot were recommended for any of the 22 sites based on the ONFIT fruit brown rot predictive model. At harvest, 2000 fruit per plot were examined for the presence of brown rot infection. Results of the final field evaluations at harvest indicted that fruit brown rot was present at 4 of the 22 sites. Brown rot levels at harvest did not exceed 1% infected fruit at any of the 22 sites (Table 12).

Table 12.

	% Infected Fruit or Clusters of Fruit			
County and Site	ONFIT Prediction	Brown Rot Present at Harvest		
	ESPS	ESPS	CONV	CHECK
Butte - CS	0%	0.2	0	0
Yuba - KJ	0%	0	0	0
Yuba - MP	1%	0	0	0
Butte - BJ	1%	0	0	0
Sutter - MJ	0%	0	0	0
Sutter - DC	0%	0	0	0
Sutter - GC	1%	0	0	0
Sutter - JH	0%	0	0	0
Tehama - VM	0%	0	0	0
Tehama - RB	0%	0	0	0
Glenn - WG	0%	0.1	0	0
Yolo - JT	0%	0	0	0
Merced - GL	0%	0	0	0
Merced - TB	0%	0	0	0
Fresno - CB	0%	0	0	0
Tulare - DA	0%	0.45	0	0
Madera - ST	0%	0	0	0
Glenn - B	1%	0	0	0
Butte - OO	4%	0	0	0
Tehama - FM	2%	0	0	0
Tehama - SV	5%	0	0	0
Sutter - TR	6%	0.05	0.35	0.85

Yield and Quality Evaluation from P-1 Gradesheets:

Yield and quality grade sheets ("P-1") were not received in time to be included in this report.

Education/Outreach:

Each participant advisor held one or more educational meeting which discussed the ESPS project. Over 830 people received information on the ESPS project at meetings. Following is a list of meetings held, dates, and subjects covered:

County	Date(s)	Subjects Covered
Butte/ Sutter	1/20, 3/4, 10/8, 10/10/99	Sprayer calibration, ESPS case history, ESPS overview, Aphid monitoring
Glenn	5/5/, 11/17/99	Vegetation to reduce dormant spray runoff, ESPS overview
Merced	Twice monthly during Spring and summer	Pest updates
Tehama	5/6/, 10/6/99	Cover crop planting, ESPS overview
Tulare	2/26/99	ESPS overview
Yolo	5/13/99	ESPS overview, prune aphids

In addition, Tehama, Glenn, and Butte County advisors provided insect day degree accumulation to clientele via e-mail or web site on a regular basis. Advisors wrote several newsletters and one popular article was published.

Securing Additional Grant Support:

Additional grant support was solicited and secured from several sources. Listed below are the sources of each additional grant that is being used to support this project:

DPR-Pest Management Alliance
BIFS/SAREP
USDA/CSREES
USDA/NRCS

CONCLUSIONS

Research/Demonstration:

Fall Presence-Absence Monitoring for Prediction of Springtime Aphid Populations and a Dormant Spray Recommendation Guide.

The fall aphid sampling was only 70 percent accurate in predicting mealy plum and leaf curl plum aphid populations in the spring. The technique was more accurate in predicting mealy plum aphid than in predicting leaf curl plum aphid. This monitoring protocol has been modified to improve the ability to predict aphid populations and will be tested in the fall of 1999 and spring of 2000.

The "Dormant Spray Recommendation Guide" was very useful. This guide accurately predicted a dormant insecticide and oil treatment would be useful in controlling aphids and/or SJS and /or ERM in 64 percent of the orchards and that 36 percent of the orchards would not benefit from a dormant treatment. Not treating 36 percent of California's bearing prune orchards with a dormant insecticide and oil spray would save the industry approximately $1,102,000 and go a long way in demonstrating a reduction in pesticide use and a conscious effort to reduce pollution of our natural resources.

Dormant Spur Sampling for European Red Mite (ERM) Eggs and San Jose Scale (SJS) Crawlers:

This sampling technique has the potential of helping to decide if a dormant insecticide spray is justified. Only 8 of the 22 orchards needed a dormant treatment for SJS or ERM. Since grade sheets report several defect categories together, we have found it necessary to use harvest time fruit evaluations in the field to accurately validate our thresholds for SJS on the dormant spur samples.

Pheromone Trap Monitoring for PTB, SJS, and for Parasitoids of SJS – Protocol # 2:

Peach twig borer pheromone trap catches in the reduced risk, conventional, and check plots were not significantly different. Peach twig borer trap catches are correlated (R=.89) to the percentage of fruit with worm damage at harvest.

No significant differences in pheromone trap catches were found for male SJS between the conventional, reduced-risk, and check plots. Significant differences in parasitoid populations between the test plots did occur. *Encarsia* (*Prospatella*) wasps were caught in significantly larger numbers in the check plots that the conventional. *Encarsia* trap catches in the reduced-risk plots were intermediate, but not significantly different from the check or conventional. Trap catches of *Aphytis melinus* in the check plots were significantly higher than the conventional and reduced risk plots.

Based on fruit evaluations at harvest, the untreated check plots had significantly more fruit with SJS present compared to the conventional plots. The reduced risk plots were intermediate and were not significantly different from the check or the conventional. No significant differences occurred in terms of parasitized SJS. There was a strong correlation (R=.95) between the number of male SJS caught in pheromone traps and the percentage of fruit with SJS present at harvest suggesting high trap catches would indicate a significant number of SJS on fruit.

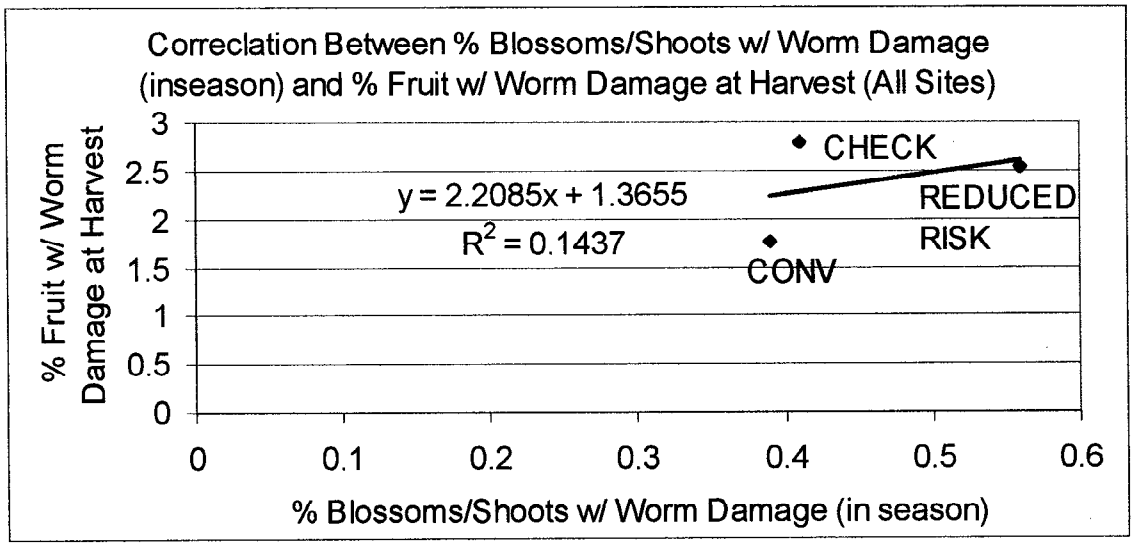
We are finding that both the dormant spur sampling and use of pheromone trapping provide the grower with useful information.

Shoot Tip and Blossom Sampling for Evaluating the Presence of Peach Twig Borer and the Leafroller Complex:

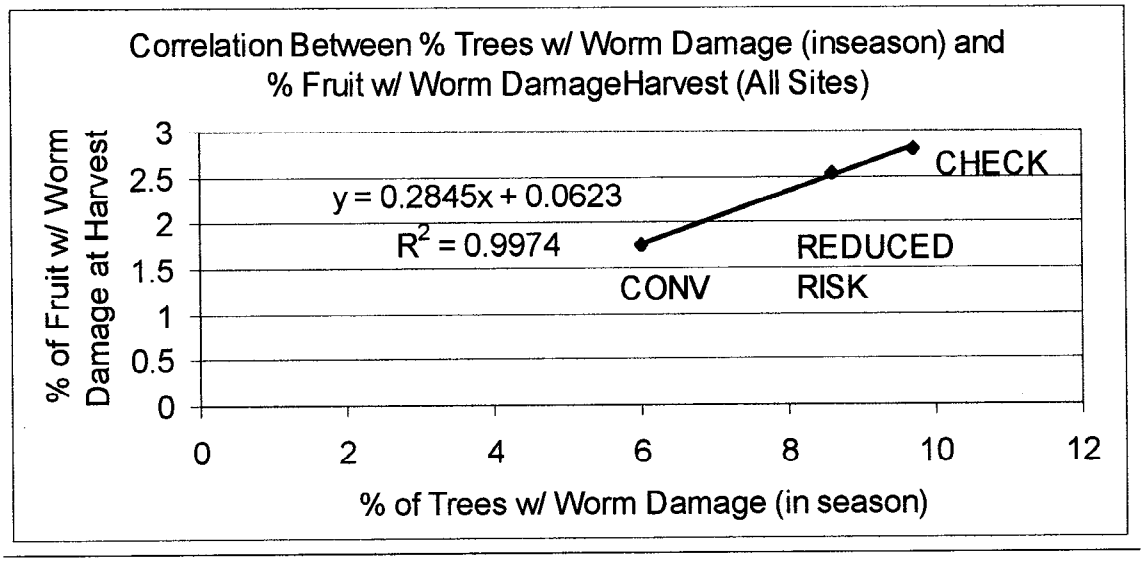
The new protocol, which involves evaluating entire trees for the presence of absence of larvae or damage and looking at more trees, has greatly improved the accuracy of this monitoring technique. Using the old protocol, there was not a strong correlation (R=.37) between the percentage of blossoms/shoot tips damaged and the % of fruit with worm damage at harvest

(Graph 8). Using the new protocol, there is a strong correlation (R=.99) between the percentage of trees with larvae/damage present and the percentage of damaged fruit at harvest (Graph 9). Shoot and blossom monitoring for PTB and leafrollers can help determine the need for a *B.t.* spray as well as the optimum treatment timing.

Graph 8



Graph 9



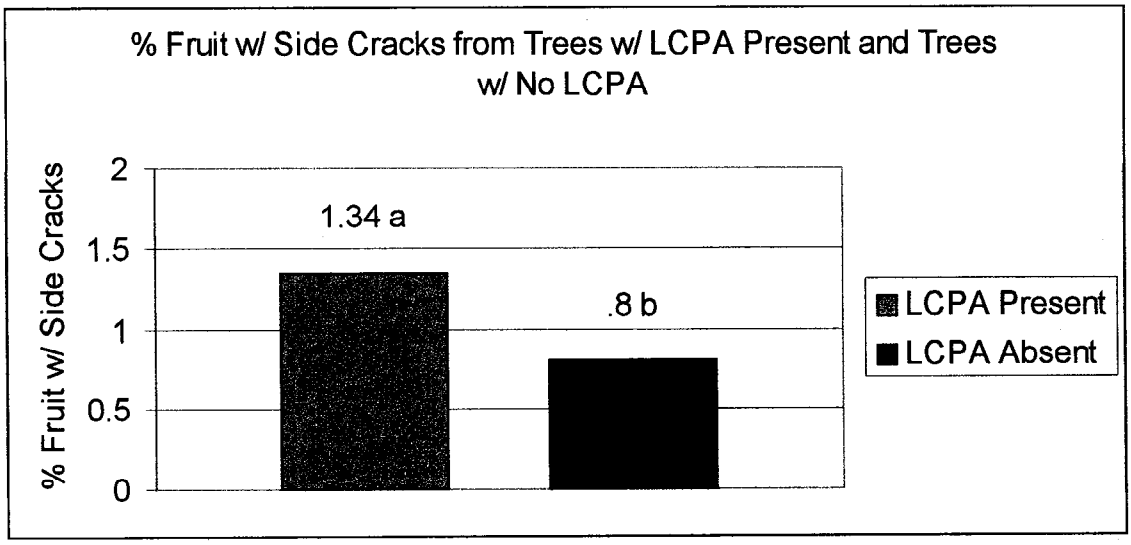
Spring Aphid and Monitoring:

The new monitoring technique, which involved looking at more trees and noting the presence or absence of aphids, was more reliable than the previous protocol. The 10 percent treatment threshold appears to be fairly accurate.

During the final evaluations, 1000 fruit were examined from trees which had been infested by prune aphids and 1000 fruit were examined from trees which had no prune aphid infestation (100 fruit from 10 different trees were examined for cracked fruit.) Trees with leaf curl plum aphids

present had significantly higher levels of side cracks present on fruit than trees without leaf curl plum aphids present (Graph 10). There was no significant difference in fruit cracking between trees with or without mealy plum aphids.

Graph 10.



Prune Rust Monitoring and Treatment Timing Recommendations:

Previous research (Teviotdale and Sibbett) has shown that post harvest defoliation from rust has no influence on fruit quality or productivity. In 1997 Olson, Krueger, and Teviotdale reported the appearance of rust infection on leaves has no influence on fruit soluble solids, dry away, size, etc.

Pre-harvest defoliation from rust has been reported to result in reduced fruit dry away and other fruit damage. The rust monitoring protocol appears to be a very good tool in timing and predicting needed treatments. None of the orchards monitored needed to be treated for rust and only one had any defoliation prior to harvest. In the Sacramento Valley, where rust is more prevalent, monitoring should be done weekly.

This monitoring technique is easy, accurate and takes little time. It accurately predicted that rust sprays were not needed this year. Many growers were aware of this through our e-mail and web site "Pest Updates". Had all Sacramento Valley prune orchards (where most of the prune rust is found) followed this predictive model, it would have saved the industry $1,920,000 in 1999 in unneeded preventative prune rust applications.

Presence-Absence Sequential Sampling for Webspinning Mites:

The presence- absence mite monitoring technique takes too long. To shorten the time required, monitoring will only take place every other week until mites are near the threshold and monitoring only 6 trees instead of 20 trees per site will be required. Only one of the four orchards that exceeded the threshold had any defoliation. This suggests that the treatment threshold may be adequate for prunes. Further evaluation of the treatment threshold will take place as more orchards with mites have defoliation.

Fertilization:

Based on critical mid summer leaf tissue levels a few sites had nitrogen and zinc levels below U.C. recommendations. The advisors involved at these sites will be working with their cooperators with fertilizer recommendations. Water samples did indicate several wells with significant levels of nitrate nitrogen in the water. This will be considered when making fertilizer recommendations. Some of these high nitrate- N levels may be the result of contamination due to fertigation. Advisors will be investigating if fertigation is involved and the extent that this practice could account for the nitrate nitrogen in the water.

Irrigation Scheduling:

Many grower cooperators were quite impressed with the irrigation-scheduling component of this project. Several growers found that they could apply fewer irrigation's than they had been used to applying. This will be reflected in lower electric bills and labor cost. One drawback to the monitoring technique is that it takes "decoding" and interpretation of the field data before an irrigation recommendation can be made. Next season we will attempt to use the following table which lists the suggested irrigation threshold values for midday stem water potential (bars) during the growing season for prunes. These values should be considered preliminary, but are based on research showing that levels of –15 bars by harvest will improve fruit drying ratio with no detrimental effects on yield or quality.

Suggested Threshold Values for Midday Stem Water Potential (bars) During the Growing Season for Prunes.

	Month						
Period	March	April	May	June	July	August	Sept.
Early-	-6	-8	-9	-10	-12	-13	-14
Mid-	-7	-8	-9	-11	-12	-13	-15
Late-	-7	-9	-10	-11	-12	-14	-15

ONFIT Procedure – Fruit Brown Rot Predictive Model:

The ONFIT procedure is a valuable tool to help determine the levels of fruit brown rot infection. Accurate prediction of brown rot levels at harvest can help determine the likelihood of economic loss and the necessity of preventative treatments.

Some latent infection levels indicated there would be higher fruit brown rot levels at the end of the season than was actually experienced. The discrepancy is probably due to difficulty in identifying brown rot in the laboratory. Training on identifying laboratory colonies will be important to correctly predict populations of brown rot on fruit at harvest.

Yield and Quality Evaluation:

The removal of the dormant insecticide and oil treatment, treatments for mites, rust, and aphids based on monitoring and treatment thresholds and irrigation scheduling based on leaf stem water potential had no visible adverse effects on productivity or fruit quality. Final grade sheets will

be used to verify these observations. Adjustments to the monitoring techniques and treatment thresholds are ongoing. Long term production and fruit quality impacts that occur as a result of these reduced-risk techniques will be measured over the next few seasons.

Education/Outreach:

Meetings to share information were numerous and well attended. In total over 830 people attended meetings that discussed the ESPS project in 1999. A wide spread popular article on the ESPS project was also published. The word is starting to get out about this project. Educational meetings are a vital part of this project and will continue. In 2000, all advisors are encouraged to use the insect day-degree equipment and report findings to interested clientele by electronic communication.

Securing Additional Grant Support:

The new grants secured will allow this project to expand to new sites and utilize new tools. We tentatively plan on reducing the number of comparison sites but increasing the number of demonstration sites. In total there will be more sites involved in the project in 2000. With the support of the California Prune Board and other sources of grant support, this work can continue to produce "reduced risk" pesticide and cultural options for prune producers.

New Directions in the ESPS Project:

- For next year the ESPS project will become more self reliant on advising growers on irrigation scheduling by using the irrigation scheduling table found in the conclusions.
- There will be fewer sites, which have a conventional. "reduced risk", and a check plot. But more sites demonstrating the "reduced risk" techniques researched.
- Pest Control Advisors (PCA's) will become more involved in the project by using the monitoring techniques in some demonstration plots.
- Some of the monitoring techniques will be modified to be more "PCA friendly."
- Possible inundative releases of *Harmonia axyridis* (multicolored Asiatic lady for aphid control.
- Begin trapping for leaf rollers to help improve monitoring protocol.

ESPS Protocol No. 3

Monitoring for P.T.B., Leafroller Complex, and Other Larvae using Blossom and Shoot Tip Sampling

(Under Evaluation)

Revised 7/28/99

Bill Olson, Carolyn Pickel, and Nadeem Shawareb

Purpose: Determine the need for "bloom time" and "in-season" applications of *Bacillus thuringiensis* (Bt) to control over wintering Peach Twig Borer Larvae and Leafroller Larvae. Several species of leaf roller are difficult to identify in the field such as fruit tree leafroller and oblique-banded leafroller. Other larvae that should be counted in this category are canker worm, green fruit worm, and rarely omnivorous leafroller.

Monitoring Timing: Bloom Time- Monitoring for blossom feeding should start when flowers are nearly at "popcorn stage" and continued weekly until the end of April.

In-season- Start monitoring for leaf rollers in mid June. Monitor each orchard weekly until August.

Method: Bloom time- Randomly sample 50 trees minimum for each plot (Conventional, ESPS, and Check plot). DO NOT sample the same trees each week. Inspect 10 shoots per tree by reaching up from ground. Shoots and blossoms do not need to be picked from the tree. If you suspect there is larvae or damage present then pick the blossom/shoot tip for a closer examination. Sample around the tree. Record the number of damage sites from larval feeding or, if present, larvae for each tree.

In-season- Visually inspect 80 trees per plot by walking around trees and looking for larvae or larval damage. (These can be the same trees as used in the aphid protocol). Be sure to look in areas where fruit are touching and where fruit are touching leaves. Record the number of larvae found or larval damage sites for each tree. Also record the type of damage: (rolled leaves and webbing; hole in shoot; scar on fruit or hole in fruit).

Treatment Threshold: Bloom time-If a total of more than 25 shoots (5%) have larvae present or are damaged and have some larvae (PTB or leafroller) present, a treatment is recommended. For fresh prunes, 1 % is the treatment threshold.

In-season- If more than 4 trees of the 80 (5%) have evidence of larvae or larval damage and have some larvae present a treatment is recommended. For fresh prunes, 1 % is the treatment threshold.

Orchard History: If last years crop had significant P.T.B. or leafroller damage, bloom time B.t. treatments are recommended regardless of monitoring levels. However, monitoring is still encouraged to further refine technique and treatment thresholds.

Treatment Timing and Rates: If populations exceed the treatment threshold, treatment should be made during bloom with *B.t.*and as soon as possible in-season. See Pest Management Guidelines for recommendations.

Note: Record the amount of time it took to sample for cost analysis.

University of California Cooperative Extension
ESPS Protocol No. 1 for PCAs
Dormant Spur Sampling
(Under Evaluation)
Revised 1/20/2000

Bill Olson, Carolyn Pickel, and Nadeem Shawareb

Purpose: To determine the need for a dormant oil treatment for European red mite (ERM) eggs and or San Jose Scale (SJS).

Monitoring Timing: Dormancy, Mid November to end of January.

Method: Collect a sample of 50 spurs from each orchard to be monitored using the following procedure:

Clip off at their base and collect 2 spurs from each of 25 trees (50 spur sample). Spurs should be selected randomly around tree. Trees should be selected randomly throughout orchard. Examine each spur using a hand lens or binocular microscope for the presence of mite eggs, live San Jose scale, European fruit lecanium (EFL), and aphid eggs. Note: The presence of any prune aphid eggs on dormant spurs generally indicates a very large over wintering population of aphid eggs. This should confer with the data collected using the fall aphid sampling technique.

*Record the following information:
1) NUMBER OF SPURS with red mite eggs
2) NUMBER OF SPURS with live San Jose scale
3) NUMBER OF SPURS with prune aphid eggs
4) NUMBER OF SPURS with European fruit lecanium

*Do not record the number of eggs or scale present on each spur. Record the number of spurs with mite eggs, live SJS, European fruit lecanium and/or aphid eggs.

Treatment Threshold: If more than 10 percent of the spurs have mite eggs or if more than 10 percent of the spurs have live San Jose scale or European fruit lecanium, a treatment is recommended. With the presence of any aphid eggs, a treatment is recommended.

Treatment Timing: Delayed dormancy: Late January through February.

Treatment Material and Rate: Oil, refer to UC IPM Pest Management Guidelines for Prunes.
Note: Record the time required to collect and evaluate spurs.

University of California Cooperative Extension
Dormant Spur Sampling for Determining Treatment Threshold for San Jose Scale (SJS). Also Treatment Thresholds for European Fruit Lecanuim (EFL), Brown Almond Mite (BAM), European Red Mite (ERM) and Prune Aphids.

ESPS Protocol No. 1 for PCAs

Revised 1/20/2000

Sampling:

During winter, collect 100 spurs per orchard collecting 2-3 spurs from 35-50 trees randomly throughout orchard.

Evaluating:

Initially, examine 20 spurs using a hand lens or microscope for the presence of SJS, EFL, mite eggs, and aphid eggs as well as parasitized scale. Using the attached sampling form, record your results. Do Not count the various pests, just mark the spur number having live SJS, EFL, mite or aphid eggs in the appropriate column. Add together the total number of spurs marked in each pest column and record in the total box. Follow instructions on record sheet which is based on the SJS population in the sample.

University of California Cooperative Extension
ESPS Protocol No. 2 for PCAs
Pheromone Trap Monitoring for P.T.B. and S.J.S.
Revised 1/20/00

Peach Twig Borer (PTB):

Purpose: Trap catches may be used as an indicator of PTB populations. Trap catch and day degree information will be used to time an in-season treatment for PTB if it is needed. Traps are used to determine the biofix of PTB.

Timing: Start monitoring traps around March 15 and continue at least until harvest.

Method: Place one PTB pheromone trap in each orchard. Place each trap at least five trees in from the edge of the orchard. If orchards are larger than 10 acres, then more than one trap per orchard may be necessary. A minimum of one trap for every 10 acres being monitored is a good rule of thumb.

Observe traps weekly and record the beginning of the biofix (first consistent trap catch).

Change the pheromone lure regularly as needed. (Ex. Change Trece lures every two weeks.)
Always remove the old lures from the orchard.

Change the trap bottom as needed.

San Jose Scale (SJS):

Purpose: Trap catches act as an indicator of in-season SJS populations and as well as parasitoids attacking SJS (Aphytis and Encarsia). Trap catch and day degree information will be used to time an in-season SJS treatment if it is needed.

Timing: Start monitoring traps around March 1 continuing at least until the end of the first flight.

Method: Place a minimum of one SJS pheromone trap in each orchard. Place each trap at least five trees in from the edge of the orchard. If orchards are larger than 10 acres, then more than one trap may be necessary. A minimum of one trap for every 10 acres being monitored is a good rule of thumb.

Collect and replace the "sticky card" and lure each month. Wrap each "sticky card" in plastic wrap for laboratory identification of SJS males and parasitoids. Use the sampling template for estimating the total number of SJS and parasites present on the card (Ex. Count the number of SJS or parasitoids in the highlighted boxes only, and multiply by five to get an estimated total).

Count the Aphytis, Encarsia, and male SJS and record the information on the data sheet provided.

Record the amount of time required to monitor the pheromone traps.

University of California Cooperative Extension

ESPS Protocol No. 3 for PCAs

Monitoring for P.T.B., Leafroller Complex, and Other Larvae using Blossom and Shoot Tip Sampling

(Under Evaluation)

Revised 1/20/00

Bill Olson, Carolyn Pickel, and Nadeem Shawareb

Purpose: Determine the need for "bloom time" and "in-season" applications of *Bacillus thuringiensis* (*Bt*) to control over wintering Peach Twig Borer Larvae and Leafroller Larvae. Several species of leaf roller are difficult to identify in the field such as fruit tree leafroller and oblique-banded leafroller. Other larvae that should be counted in this category are canker worm, green fruit worm, and rarely omnivorous leafroller.

Monitoring Timing: Monitoring for larvae should begin 200 degree days after biofix. Visually inspect 80 trees per orchard by walking around trees and looking for larvae or larval damage. (These can be the same trees as used in the aphid protocol). Be sure to look in areas where fruit are touching and where fruit are touching leaves. Record the number of larvae found or larval damage sites for each tree. Also record the type of damage: (rolled leaves and webbing; hole in shoot; scar on fruit or hole in fruit). In early May, inspect 20 fruit per tree from 50 trees (1000 fruit sample) for any evidence of larval damage. Sample every other week until near harvest.

Treatment Threshold: If more than 4 trees of the 80 (5%) have evidence of larvae or larval damage and have some larvae present a treatment is recommended. For fresh prunes, 1 % is the treatment threshold. (1 tree out of 80). **Fruit Sampling:** If more than 2 % of the fruit has damage, a treatment is recommended. For fresh prunes, any damage justifies a treatment.

Orchard History: If last years crop had significant P.T.B. or leafroller damage, bloom time *B.t.* treatments are recommended regardless of monitoring levels. However, monitoring is still encouraged to further refine technique and treatment thresholds.

Treatment Timing and Rates: If populations exceed the treatment threshold, treatment should be made as soon as possible with *B.t.*. See Pest Management Guidelines for recommendations.

Note: Record the amount of time it took to sample for cost analysis.

University of California Cooperative Extension

ESPS Protocol No. 4 for PCAs
Spring Prune Aphid Monitoring
(Under Evaluation)
Revised 1/20/99

Carolyn Pickel and Bill Olson

Purpose: There are 2 species of aphids that can cause economic damage to prunes in the spring. Mealy plum aphid (MPA) is a waxy light green aphid and leaf curl plum aphid (LCPA) is yellow green aphid with no wax. Winged aphids should not be counted in the spring, usually they are aphids migrating from recently mowed or disked land near the orchard. The damaging aphids are not winged but are young aphids hatched from overwintering eggs that become stem mothers producing live young.

Monitoring Timing: April to July. Monitoring can stop when a treatment decision is made and control measures have brought the aphid population below the threshold for three weeks. If no aphids are found after four bi-weekly inspections, then monitoring can cease.

Method: Monitor each orchard concentrating the sampling on trees at the edges of the orchard. If the orchard has 4 exposed sides monitor 25 trees/side. If the plot has 3 exposed sides monitor 33 trees/side. If the plot has 2 exposed sides, monitor 50 trees/side.

Select trees at the outside edge of the orchard or close to known or potential "aphid hot spots". Potential hotspots for aphid infestation are areas of the orchard: where aphids have occurred previously, or where windbreaks and/or natural vegetation exist. Trees should be sampled randomly therefore you may end up sampling trees more than once during the season.

Examine each tree for the presence of live prune aphids. Look for telltale signs of aphid presence then examine branches and leaves more carefully (look for "honey dew" on leaves, severely curled leaves, and look for the presence of bees or ants and for beneficial insects that prey on aphids). Do not neglect looking at the tips of the trees and in the crotch of trees.

If the tree has aphids present:

1) Record the type of aphid present (MPA or LCPA) and if they are alive. If LCPA damage is present, then uncurl and examine up to 5 leaves per tree to verify the presence of live LCPA. Record "Live LCPA " or "LCPA damage" if no live leaf curl plum aphid is found.

2) Move on to the next tree.

If the tree does <u>not have</u> aphids present:

1) Move on to the next tree.

Treatment Threshold and Treatment Timing:
If more than 10% of the trees have aphids present (mealy plum and/or leaf curl plum aphid) **then a treatment is justified**. Treat immediately after a decision is made.

If aphid population never reaches more than 10% of the trees infested, **then a treatment is <u>not</u> justified.**
However " SPOT " treatment may be advisable if LCPA populations are high on individual trees.

What to Use: Use 4 gallons of oil (minimum) per 100 gallons water (minimum) in a full coverage spray or other pesticide used to control aphids in prunes.

<u>*Record the amount of time it takes to do monitoring for each plot.</u>

University of California Cooperative Extension

ESPS Protocol No. 5 for PCA's
Prune Rust Monitoring
(Under Evaluation)
Revised 1/20/00

Bill Olson and Nadeem Shawareb

Purpose: Determine treatment timing for the control of prune rust.

Monitoring Timing: Begin monitoring orchards by May 1. Monitoring should be done at least on a twice-monthly basis (every other week) in the San Joaquin Valley and every week in the Sacramento Valley and continue until near harvest (early August).

Method: Mark and number 40 trees in each orchard using flagging . Examine the same 40 trees each time. If there are young replants in the orchard, make sure to monitor those trees first and mature trees second. Look each tree over for the presence of leaves with prune rust symptoms being sure to look at low hanging branches and branches on replants. Closely examine any suspect leaves to verify if there is rust present. Count and record the number of trees with rust present.

Treatment Threshold and Timing: If there are no trees with rust present, continue to monitor twice-monthly or weekly. At the first sign of rust in the orchard, a treatment should be applied immediately. No additional treatments are necessary within two weeks of harvest.

Treatment Material and Rate: Refer to the U.C. I.P.M. Pest Management Guidelines for prunes.

Additional Monitoring and Treatments: Additional treatments may be necessary particularly if a treatment is required early in the season. Continue monitoring after a treatment is applied. If the number of trees with rust increases, a second treatment is recommended if there is significant time remaining between the rust increase and harvest.

Note: Record the amount of time to monitor.

University of California Cooperative Extension

Aphids at Level:			Mites, aphid eggs and/or Scale	Treatment
Level 1	Level 2	Level 3	Above Threshold?	Recommendation
X			No	Nothing
X			Yes	Dormant oil
	X		No	Oil at bloom
	X		Yes	Delayed dormant oil or oil at bloom
		X	No	Oil at bloom + in-season*
		X	Yes	Delayed dormant oil or oil at bloom + in-season*

* Do not apply Captan or Bravo in combination with, immediately following, or closely following oil sprays.

Example:

Step 1: Using Protocol 6 (Fall Aphid Sampling), 16 out of 40 trees had aphids present. This means the aphid population is at **Level 3**.

Step 2: Using Protocol 1 (Dormant Spur Sampling), 8 % of the spurs examined had mite eggs present and 2 % of the spurs had scale crawlers present. **No**, the dormant spur thresholds were not exceeded.

Step 3: **Level 3** aphid population, and **No**, the spur sampling threshold was not exceeded.
Recommended Treatment = oil at bloom + in-season

University of California Cooperative Extension

ESPS Protocol No. 6 for PCAs

Fall Presence-Absence Monitoring of Prune Trees for Prediction of Springtime Aphid Populations

(Under Evaluation)

Revised 1/20/2000

Purpose: Prediction of springtime aphid infestation by estimating the over wintering population of Mealy Plum Aphid and Leaf Curl Plum Aphid. Currently there is no monitoring protocol that enables prune growers to determine the risk of wide spread aphid infestation before it occurs in the spring. This technique will provide information to growers to help determine if their orchard runs a high risk of severe aphid infestation if a preventative (dormant) treatment is not applied.

Fall Monitoring Timing: Monitor in late October or early November preferably when trees begin to defoliate but still have enough leaves to sample 50 leaves per tree.

Fall Monitoring: Examine up to 50 leaves per tree from 40 trees per orchard. Monitor trees that are known aphid hotspots or sections of the orchard which have windbreaks and areas with natural vegetation adjacent. Examine each leaf for the presence of aphids until a prune aphid is found or until 50 leaves per tree have been examined. If possible, distinguish between winged forms of MPA and LCPA. Even if the full 50 leaves have not been examined, if one leaf per tree has any MPA or LCPA present, record the tree as having "Prune Aphids Present" and move on to the next tree. Be sure to sample as high in the tree that can be reached.

Treatment Threshold: There is a positive correlation, with 80 % reliability, between the percentage of trees with aphids present in the fall and the percentage of trees that have aphids in the spring. For example: If no aphids are found in the fall, there is an 80 % likelihood that no aphids will be present in the spring. Or if 20 % of the trees have aphids in the fall, there is an 80 % likelihood that there will be aphid infestation on approximately 20 % of the trees the following spring etc.

Note: Record the amount of time required to do monitoring.

Our experience is as follows:

Level of Aphid Infestation	# of Trees w/ Aphids Out of 40	% Trees Infested	Expected Spring Aphids
Level 1	0 - 2	0 - 5 %	Very Few
Level 2	3 - 6	7.5 - 15 %	Some
Level 3	7 or more	Over 15%	Wide Spread

Based on Protocol #6 (Fall Aphid Monitoring) and Protocol #1 (Dormant Spur Sampling), follow steps 1-3 below to determine which treatment options to use.

Step 1: Follow Protocol #6 to determine if the aphid population in that block is at Level 1, Level 2, or Level 3.

Step 2: Follow Protocol #1 to determine if mite eggs or scale are above the threshold (Yes or No).

Step 3: Apply the information from Steps 1 and 2 to the following table to determine which treatment(s) are recommended.

University of California Cooperative Extension

ESPS Protocol No. 7 for PCAs
Presence Absence Sequential Sampling For Webspinning Mites
Revised 1/20/00

Purpose: Determine if webspinning mite populations are high enough to justify a treatment.

Monitoring Timing: Sample every other week beginning in June until the mite population is near the threshold (ie. 20% of leaves with webspinning mites present) then start sampling weekly until harvest.

Method: Sample a minimum of 6 trees per orchard. Sample trees at random, examining 15 leaves per tree. With the exception to the number of trees to be sampled, use the method described in the University of California guidelines "Presence Absence Sequential Sampling For Webspinning Mites" and the accompanying data sheet (attached).

Other Useful Monitoring Suggestions:
1. Observe orchard for leaf bronzing and defoliation.
2. Observe mite webbing; if delicate, mites are on the rise, if coarse, mites are on the decline.
3. Some observers can smell the presence of mites.

Treatment Threshold: Use the treatment thresholds outlined within the data sheet to determine the need for a treatment.

Treatment Timing and Material: If the treatment threshold is exceeded, use Vendex or oil.

Note: Record the amount of time required to do the monitoring.

University of California Cooperative Extension

ESPS Protocol No. 10 for PCAs
ESPS Final Plot Evaluations 2000
Revised 1/20/00

Purpose: **Data collected will be used to evaluate the effectiveness of monitoring techniques and treatment thresholds established in the ESPS monitoring protocols.**

Timing: Final evaluations should be done just prior to harvest.

ESPS Protocol No. 3: Monitoring for PTB, Leafroller Complex, and Other Larvae using Blossom and Shoot Tip Sampling. Randomly sample and examine 500 fresh fruit (10 fruit on 50 trees) for the presence of larvae or larval feeding, San Jose Scale, or parasitized San Jose Scale. Indicate the type of larvae present or if there is no larvae present, whether the damage is surface feeding only or if the larvae "bored" into the fruit.

ESPS Protocol No. 5: Prune Rust Monitoring. Prior to harvest examine the same 40 trees in each block that were monitored for prune rust during the growing season. Estimate the percent defoliation due to rust infection.

ESPS Protocol No. 7: Presence-Absence Sequential Sampling for Web-Spinning Mites. Examine 40 trees and estimate the percent defoliation due to webspinning mites.