

Almond Board of California's 2005 Strategy

Strategic Approach

The Almond Board seeks to reduce pesticide risk by researching and developing IPM strategies while educating growers in IPM and other risk reduction strategies. We are pursuing a significant increase in the number and types of IPM-related pollination projects. Thus our research not only impacts almond growers but also beekeepers.

Activity 1

Results from some of the projects funded include:

Production Research Committee

- *Mating Disruption for Navel Orangeworm (NOW)*
While mating disruption using a single pheromone component reduced navel orangeworm damage, it did not provide comparable reduction of NOW damage to the application of an OP at hull-split. However, it was noted that 2-3 applications of methoxyfenozide seemed to provide comparable control to OPs and will be tested further. An additional pheromone component has been isolated and will be added to the current pheromone to determine if it improves control of NOW.
- *Xylella Fastidiosa from Neighboring Vegetation*
A survey of plants growing near almond orchards indicated that some species may be hosts for the two *Xylella fastidiosa* strains that cause the disease in almonds. In addition, the research found that glassy-winged sharpshooter did not carry the almond disease but redheaded and green sharpshooters were positive for the two strains. This data will be useful to determine what hosts and vectors need to be managed to prevent infection. Currently there is no known treatment for infected trees.
- *Insect and Mite IPM Research*
This study, in its 14th year, looks at changes in insect and mite populations and alternative methods of control. The levels and impacts of San Jose Scale were monitored in orchards treated and not treated with a dormant OP application. The potential for alternative mite control pesticides to run off was determined in the lab, and further in-field tests will be undertaken. In essence, the potential environmental impact in addition to efficacy is being analyzed prior to recommendation.
- *Control of Alternaria Leaf Spot*
In the fourth year of the study, a disease severity value model has been developed and tested as a tool for determining when to apply fungicides. The model was not

as effective in predicting and determining when best to apply the first application but was useful for predictions later in the season. Further refinements as well as alternative fungicides will be tested.

- *Epidemiology and Management of Anthracnose and Brown Rot*
Based on both in-field and laboratory measurements, a first draft of a disease predictive model has been developed. It will be tested in the field. In addition, the complexity of the disease means a number of environmental interactions still need to be better understood. The use of alternate row treatments to lessen fungicide applications was found to be too risky to recommend for use.
- *Replant Disease and Lethal Phytophthora Canker*
Continuing efforts to understand all the organisms involved in replant disorder have led to the use of DNA techniques to increase the basic understanding of this disorder. Several tests with chloropicrin, methyl bromide, and no soil fumigant treatment found that soil fumigation significantly increased young tree growth in soils that previously grew *Prunus* sp. Chloropicrin was more effective than methyl bromide in these treatments where nematodes were not a major issue.
- *Chemical and Cultural Control of Band Canker*
The research so far indicates that the Band Canker is caused by different variants of *Botryosphaeria dothidea* than in pistachios. The disease is found in old bark, but so far little is found in orchard debris, though sexual propagules were discovered to be airborne. Wounds to the trunk such as woodpecker holes and pruning or shaker wounds could be an entry way for the disease. Treatment of the trunks with fungicides seems to prevent the disease, but it is difficult to control once started.
- *Utilization of Plant Essential Oils for the Control of the American Foulbrood Pathogen*
American Foulbrood Disease (AFD) is a highly contagious disease of honey bee brood. This research enabled progress in testing the efficacy of essential oils against antibiotic-resistant strains of AFB while also progressing towards an effective delivery system.
- *Essential Oils for Varroa Mite Control*
Varroa mite, a parasitic mite of honey bees, has had a catastrophic effect on honey bee colonies and honey bee vigor thus threatening crops requiring bees for pollination. Mite resistance occurs with both standard treatments, a pyrethroid and an organophosphate (fluvalinate and coumaphos, respectively). A liquid protein honey bee diet proved to be an effective carrier to incorporate essential oils into honey bee colonies for control of *varroa* mite. Results show the essential oils to decrease adult mite infestation and mite reproduction.
- *Developing and Testing a Device to Monitor Fire Ants in Honey Bee Colonies*
There are no pesticides currently registered specifically for treating apiary equipment to eliminate imported fire ants. If fire ants are suspected on a load of bees en route to pollinate the almond crop, they are often held up until thoroughly inspected. This research successfully identified three of the most attractive essential oils to place in bait stations thereby giving beekeepers a tool to better determine the presence or lack of imported fire ants.

Environmental Committee

- *Environmental Stewardship Campaign*
The Almond Board of California's website now provides information that help growers grow their crops more effectively and with less impact on the environment. It links growers into resources that provide additional information and research results. An electronic newsletter containing links to almond environmental stories and resources is emailed to a subscriber list every two weeks. Each quarter, a newsletter devoted entirely to environmental issues is published and mailed to growers, handlers, government officials and lawmakers.
 - *Almond Pest Management Alliance*
See Activity 2 and 3
 - *Spray Swath Analysis/Drift Management*
Four different types of aircraft were tested for accuracy and drift potential. All 4 types provided results within the acceptable range.
 - *Reducing Impact of Dormant Sprays*
See Activity 4
 - *Linking Almond Board to Central Valley Watershed Coalitions*
See Activity 5
 - *Benefits of Chipping Almond Brush*
Instead of burning, chipping the prunings and incorporating the wood chips into the soil improved water infiltration and increased the basidiomycete activity in the soil. However, it substantially increased the amount of wood debris picked up during the harvesting of nuts.
 - *In-Line Monitor for Evaluating Dust Generation*
First steps to determine the efficacy of using instruments to measure continuously the dust generated by harvesting operations in almonds were taken. The instruments were able to provide data which is more time sensitive than using the dust collection methods. More tests are necessary to ensure the proper calibration.
 - *Emission Factors for Almond Harvesting*
Measurements of PM10 concentrations upwind and downwind of the almond sweeping, conditioning, and pick-up operations were conducted during the 2004 harvest season. Two types of PM samplers were used, and the meteorological parameters (wind speed and direction, air temperature, relative humidity, solar radiation), soil moisture, and implement locations were recorded simultaneously to facilitate the calculation of PM10 emission rates.
 - *Management of Alternatives for Air Quality Mandates*
Efforts are underway to identify the range of soils almonds are grown on and develop a "dustiness" index. The impact of soil amendments will be tested for reduction of particulate matter.
 - *Minimizing Emissions and Chloropicrin Fumigation*
The first year of testing was started where the volatilization of Telone and chloropicrin was monitored for 96 hours after shank injection or drip irrigation applications. More analysis with different soil seal techniques will be tested.
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Activity 2

2004 was the 6th year of the Almond Pest Management Alliance (PMA), where orchards in three locations in California were treated with different IPM strategies to control three major pests in almonds, the navel orange worm (NOW), the peach twig borer (PTB), and San Jose Scale (SJS). The IPM strategies included emphasis on winter orchard sanitation, trials with reduced-risk in-season applications of insecticides, and monitoring of pests and costs. The six-year effort has resulted in learning that less frequent dormant OP applications are sufficient for pest control, that well-timed, in-season applications of reduced risk pesticides can control the two major pests, and that population monitoring and orchard sanitation are required for effective control.

The advantage of a long-term project like the PMA is that changes in pest and beneficial populations can be monitored over time frames realistic to growers. In 2004, San Jose Scale started to be seriously damaging in the orchards not treated with dormant sprays. This has provided an opportunity to develop pest treatment thresholds, as well as an opportunity to determine if an oil treatment alone provides adequate control. In some years the use of beneficials controlled mites well, while in other years a miticide was necessary. Further research to understand when the beneficials work and when they do not is ongoing.

Nine field days were held in Kern, Butte, and Stanislaus Counties attracting nearly 1,000 attendees.

Activity 3

Each of the 3 regions (south, central, northern Central Valley) conducted field meetings and dormant-season workshops, complete with hands-on training and demonstrations. These meetings allowed local growers and PCAs to learn about what had been learned from the demonstration projects. Attendance at the field days has increased with the increased data from the long term study, as well as due to the media reporting of the Annual PESP award to the Almond Board of California.

Most importantly a guide based on what had been learned from five years of the work was compiled in: **Seasonal Guide to Environmentally Responsible Pest Management Practices in Almonds**. It was released in November 2004 and provides how-to guides in reduced risk pest management, as well as techniques for monitoring for pests. The Guide is available through the offices of the Almond Board of California as well as through the UC IPM program.

Additional dissemination methods:

The Almond Board of California Website has added a link called "www.enviroag.org" that contains information on environmental issues affecting agriculture, research, IPM projects, etc.:
<http://www.almondboard.com/index.html?page=2&action=links&subaction=www.enviroag.org>

Activity 4

The use of vegetative buffer strips to minimize run-off from diazinon treated orchards was shown to be effective (there had been some concern whether this held true for California conditions). A 10 m vegetative buffer strip reduced run-off by around 50% and 20 or 30 m buffer strips provided some further reduction. In addition, research showed that there was increased run-off from the side of the orchard that was down-wind during the application of diazinon, even though the diazinon was applied to the soil exclusively for experimental consistency reasons. This indicates that growers need to pay attention to the wind direction when applying sprays with regard to minimizing the chances of run-off into sensitive waterways. This information will be incorporated into the CURES advice to grower (see next activity).

Activity 5

The Almond Board of California is working with the Coalition for Urban/Rural Environmental Stewardship (CURES) to help educate almond growers on techniques for minimizing farm run-off including of pesticides. The Almond Board's environmental website links to the CURES website. CURES has published "Best Management Practices - Almonds;" "Orchard Practices for Protecting Surface Waters;" "Diazinon Insecticides"; and "Orchard Air Blast Sprayers."

CURES has also helped link growers to watershed coalitions formed throughout the Central Valley, which help to educate and to monitor waterways. In addition, CURES published their first newsletter in the summer of 2004. Ten thousand copies were circulated through the Almond Board of California, the County Agricultural Commissioner's Offices, the watershed coalitions, and farm groups. An additional 500 copies were sent out through an email list.

Activity 6

The Almond Board of California has increased participation in various activities including: 1) an effort to expand intra industry involvement in environmental issues, 2)

building alliances with grower, academic and government agencies, and 3) participating on committees involved with agricultural production and environmental protection. In addition, research funding for environmental issues has grown to such a level as to become a separate budget and separate committee from production research.

The Environmental Committee met four times during 2004 to deal with air quality, water and crop protection. The web-based database on environmental issues related to the almond industry is up and running at: www.enviroag.org. The website has information on reduced risk practices, research, regulatory issues, and a calendar for upcoming meetings/workshops/presentations for growers on environmental stewardship. Receiving the PESP Environmental Champion Award for the second year in a row provided media coverage of the ABC's activities. Funding for environmental research exceeds \$450,000 with increased emphasis on air quality issues. All of these efforts are increasing growers' awareness of environmental stewardship.

The UC-IPM program conducted a follow-up survey in 2000 to determine the IPM practices being used by almond growers. UC reported in 2004 on the results from the 2000 survey as compared with the results from a 1986 survey. Among the findings were that almond growers sprayed insecticides less frequently at all typical spray timings in 1998-1999 compared to 1985-1986. Thirty percent of the growers had deleted the organophosphate from their dormant spray applications and 40% were using microbial pesticides such as Bt or spinosad. Eighty-eight percent mentioned that they inspect their leaves to determine the need for a post bloom fungicide application to control shot hole, and 56% reported using long range weather forecasts to predict the need for fungicides.

Partnership Activities

The Almond Board is participating in several partnerships with governmental and academic institutions as well as agricultural organizations to improve communication and understanding of environmental issues. These programs include:

- *US-EPA: Pesticide Environmental Stewardship Program*
- *Pest Management Alliance (PMA)*, which is a collaborative program with almond industry leaders, to research and promote reduced risk crop protection tools
- *USDA - ARS, Pest Management Strategic Plans* to describe the steps to decrease dependence on organophosphate and carbamate insecticides by specific pest, compound, and region. EPA relies on this document to assess the status and use of pest control compounds applied to control almond pests. The document also describes the status of reduced risk compounds in development by the pesticide industry
- *USDA - ARS Tucson Bee Lab Liaison Committee* to promote research in IPM-related pollination projects
- *USDA - ARS Parlier, CA Program Review Committee* to highlight key environmental areas in California's Central Valley
- *USDA - ARS Center for Advanced Tree Crop and Viticulture Research* at UC Davis to collectively work with related commodities in key industry issues

- *UC Davis Pomology Program Review* to insure UCD programs are meeting the almond industry environmental challenges
- *California Commodity Committee* to meet periodically with other California agricultural representatives and collaborate on key concerns
- *University of California Statewide IPM Program* to improve utilization of reduced risk compounds
- *Almond Hullers and Processors (AH&P)* to provide the key contact for reporting comments to EPA in the FQPA reregistration process. AH&P provides leadership in the Environmental Committee and the Pest Management Alliance.
- *The California Association of Pest Control Advisors (CAPCA)* to allow the Board to target outreach activities to professionals who help growers make pest management decisions in the orchard.
- *Commodity Groups* - to involve other commodity groups in research, FQPA, environmental and water issues that are common to a number of different commodity groups. The Nut Consortium, in particular, is seeking to address common issues jointly.
- *Pesticide Registrants* - to meet on a regular basis with representatives from the pesticide registrant community to keep abreast of pipeline products consistent with the Almond Pest Management Strategic Plan.
- *The Methyl Bromide Alternatives Workgroup* to review current research in methyl bromide alternatives and a discussion of directions for new research activities. This workgroup is the key California conference on methyl bromide alternatives activities.
- *The Glassy-Winged Sharpshooter/Pierce's Disease Task Force* to address the immediate threat to agriculture and spread of Glassy-winged Sharpshooter and the vectoring of Pierce's Disease and Almond Leaf Scorch. Board staff is involved in this task force to insure Board research adequately addresses the factors that relate directly to the almond industry. Research will determine the relative susceptibility of the disease to almonds and varieties of almonds. Appointed by the Secretary of the California Department of Food and Agriculture.
- *The Coalition for Urban/Rural Environmental Stewardship* to identify farm practices that can protect California rivers from pesticide runoff from farming operations, including almond orchards.

Activities for the Coming Year

Activity 1

More than \$900,000 will be spent in 2004-2005 on new and continuing research and development of IPM techniques that will enable growers to reduce their reliance on higher risk pesticides. More than 50% of this funding is for projects directly related to

our extensive IPM program and making progress toward developing and implementing IPM strategies. With the increase in concerns about the role of agriculture in poor air quality in California, a number of projects focus on gaining a better understanding of those relationships.

The projects funded for 2004-2005 include:

Production Research Committee

- Mating Disruption for Navel Orangeworm
- Attractants for Navel Orangeworm
- Ant Management in Almonds
- Insect and Mite IPM Research
- Biology and Management of Striped Mealybug
- Attractants for Ten-Lined June Beetle
- Control of *Alternaria* Leaf Spot
- *Xylella fastidiosa* - Almond Host Interactions
- Occurrence/Movement *Xylella fastidiosa*
- Epidemiology and Management of *Anthracnose* and Brown Rot
- Chemical and Cultural Control of Band Canker
- Replant Disease and Lethal *Phytophthora* Canker
- Field Evaluation of Almond Rootstocks
- Utilization of Plant Essential Oils for the Control of the American Foulbrood Pathogen
- Essential Oils for *Varroa* Mite Control
- Developing and Testing a Device to Monitor Fire Ants in Honey Bee Colonies

Environmental Committee

- Environmental Stewardship Campaign
- Almond Pest Management Alliance
- Spray Swath Analysis/Drift Management
- Linking Almond Board to Central Valley Watershed Coalitions
- Benefits of Chipping Almond Brush
- In-Line Monitor for Evaluating Dust Generation
- Emission Factors for Almond Harvesting
- Site-Specific Application of Fumigants
- Minimizing Emissions and Chloropicrin Fumigation

How does this activity reduce pesticide risk?

Research into these insect and disease problems of almonds provides the foundation for practices that will facilitate use of reduced risk pesticides where appropriate. These studies increase knowledge for growers and consultants of pest biology, pest monitoring, and potential pest control techniques in the almond production system. Understanding

the basic biology allows the development of predictive models for determination of need and timing of pest control measures. The addition of alternative methods for application or mitigation of pesticide applications should assist in development of methods to reduce the impact of pesticides on the environment. Results of solid, reliable research give growers more confidence in adopting new practices for controlling pests, including IPM and reduced risk pesticides.

How will you measure the risk reduction gained from this activity?

These projects form the basis for developing or implementing reduced risk pest control strategies. Within the context of our partnerships with academic and regulatory communities, we continually strive to better measure risk reduction. Currently the real measure of risk reduction is gained from the significant decrease in the use of organophosphate pesticides in the almond industry, as evidenced by the California Department of Pesticide Regulation's Pesticide Use Reports (PURs).

Activity 2

The Almond Board is providing funding to continue the Almond Pest Management Alliance (PMA) project into its eighth year. Being able to observe changes in pests and beneficials over more than a year or two provides credibility to growers in research results and confidence to try successful reduced-risk alternatives. With the loss of funding from CDPR due to budget limitations, the project will continue at two of the three sites in 2005 (northern and southern regions). The objective is to focus on pest management solutions that reduce pesticide risk to human health and the environment.

To meet this objective, demonstration and research projects were set up in three commercial orchards, representing different regions of almond production in 1998. The initial focus on the project was to assess the effectiveness of alternatives to dormant organophosphate applications. However, with time, the project has expanded to include research on other issues as well, such as the impact of different cover crops in relation to insect pests.

The goals for the eighth year of the demonstration projects include the monitoring of the long-term effects of different reduced-risk pest management strategies. After five years of reduced risk treatments, there were high levels of rejects in 2003 raising questions about how best to employ the reduced risk techniques in the long run. For example, after five years of no dormant organophosphate treatment, San Jose Scale (SJS) started to reach damaging levels in those sections of the commercial orchards. This provides an opportunity to study whether an oil dormant spray alone is effective for control, or whether the occasional OP treatment should be used when SJS reaches threshold levels.

The continued monitoring of changes in pest and beneficial populations will allow the researchers to determine how best to use reduced risk techniques to keep crop damage at a low level in the long term. While the initial focus has been on control of three major

insect pests, Navel Orangeworm, Peach Twig Borer, and San Jose Scale, the project has expanded to include determination of water contamination, cover crops on soil texture, etc.

The results from the continued research will be used to update the recently released "Seasonal Guide to Environmentally Responsible Pest Management Practices in Almonds."

How does this activity reduce pesticide risk?

Having different commercial orchards test varied reduced risk techniques alongside traditional pest control methods for several years, combined with intensive monitoring by researchers of all aspects of the orchard, results in quality, scientifically valid data. The more researchers, PCAs, and growers become familiar with new techniques, the greater the chance that reduced-risk pest management strategies will be used.

How will you measure the risk reduction gained from this activity?

Risk reduction from adopting IPM and other practices can be measured by analyzing pesticide use reports from the Department of Pesticide Regulation and comparing current and past use of traditional control product usage with alternative practices.

Activity 3

An important part of the Pest Management Alliance project is to provide outreach and education to Pest Control Advisors (PCAs) and growers on what has been learned from the comparisons of different pest-management strategies. PCAs act as an important channel for disseminating information to growers, since a large percentage of growers use the services of PCAs when making decisions on pest control practices.

Outreach to growers and PCAs includes several field days held in each of the demonstration orchard locations. In addition, the Almond Board website now links to the PMA information. To encourage PCAs to participate, the Almond Board is also ensuring that attendance at the annual research meeting and their field days can be counted toward the necessary continuing education hours PCAs must achieve each year.

In 2005, the PMA project will focus on training growers and PCAs in the monitoring of various pests, as the data developed so far indicate that good monitoring of pest populations is critical for the successful use of reduced risk materials. The field demonstration days allow growers and PCAs to compare the effectiveness themselves in orchards treated in different ways, as well as see the data collected. Seeing that a new technique works and how to make it work increases the chance that growers and PCAs will be willing to try new pest management techniques.

Another goal of the PMA for 2005 is to update the guidelines released in 2004 with any pertinent new information. These guidelines will make it easier for others to copy any effective pest control strategies in their own orchards.

How does this activity reduce pesticide risk?

The outreach effort with PCAs and growers will help disseminate information on reduced risk pest control practices to these key influencers in the industry. In many cases, farmers will not try a new practice unless their PCA is knowledgeable and endorses the new practice or they are convinced it is worth trying. Educational outreach continues by giving PCA, OA, or CCA education credits for attending meetings.

How will you measure the risk reduction gained from this activity?

PCA and grower participation in field days will measure risk reduction, and research meetings will be monitored.

Activity 4

The Almond Board of California, through its Environmental Committee, is participating in a grower coalition to determine how best to reduce the contribution of pesticide use to the development of volatile organic compounds (VOCs). While pesticides are a minor contributor to the production of VOCs, they do contribute, and air quality in the San Joaquin Valley has been steadily worsening with the increased population growth. In less than ten years more stringent air quality standards will take effect.

How does this activity reduce pesticide risk?

Based on these discussions, the ABC will decide whether additional research should be funded. Also any available tools will be communicated to growers to start the process of increasing awareness of VOCs and pesticides.

How will you measure the risk reduction gained from this activity?

Because this is a long-term project that is just starting, the main gain will be a better understanding within the industry of the issue as well as possible direction to move to reduce the VOC contribution from pesticide use.

Activity 5

Agriculture in the Central Valley of California is under intense pressure to contribute to better water quality by minimizing pesticide, nutrient, and sediment run-off from fields and orchards. In California, local water quality coalitions have been formed in response to the need for better data as well as better management of local watersheds. These coalitions are required to perform water monitoring of agricultural drains as well as promote adoption of Best Management Practices to solve problems.

The Almond Board of California is supporting the Coalition for Urban/Rural Environmental Stewardship's (CURES) efforts to develop and compile information on Best Management Practices for protecting surface waters in the Central Valley. The Coalition has developed guides that have been disseminated. CURES plans to release two more newsletters in 2005 to provide growers with additional information on run-off minimization tools using mail, email and links in the Almond Board website.

How does this activity reduce pesticide risk?

Educating and making information on techniques to minimize the run-off of pesticides into surface waters easily available to growers will reduce the impact of pesticides on aquatic species.

How will you measure the risk reduction gained from this activity?

Initially, the focus will be on disseminating the information. In the long run, the monitoring done by the local water quality coalitions should show changes in the water quality from agricultural drainages.

Activity 6

The Almond Board of California is continuing its active participation in various partnerships and educational efforts. This includes expanding intra-industry involvement in environmental issues, building alliances with grower, academic and government agencies, and participating on committees involved with agricultural production and environmental protection. In addition, research funding for environmental issues continues to grow as air quality issues are added to the environmental issues almond growers face.

Environmental Committee (EC) Current Activities

- To pursue the Almond Board's strategic priority: "Proactively seek solutions to environmental challenges"

- To build programs based on the EC's Mission: "Develop and promote almond production practices that are based on sound scientific research, common sense and a respect for the environment"
- To fund research and activities based upon the EC's goals:
 - Proactively seek solutions to emerging environmental challenges
 - Provide a clearinghouse of information for industry data and research results
 - Inform consumers about almond growing practices that support good land stewardship
 - Pursue partnerships to seek ways to improve the impact of agriculture production on water, air and soil resources
- To launch the Environmental Stewardship Campaign
- Maintain and expand a web-based database on environmental issues related to the almond industry, www.enviroag.org
- Develop key messages for a public relations project educating target audiences about the stewardship efforts of almond growers
- Create press releases on stewardship efforts of almond growers
- Conduct grower outreach activities announcing new and pending regulations, upcoming workshops, meetings and field days as well as highlighting "model" grower activities concerning stewardship
- To meet quarterly as members of a broad-based grower and handler group to direct and advise the Board on issues such as: the Food Quality Protection Act; re-registration of pesticides; and air and water quality

Partnership Activities

The Almond Board of California will continue in 2005 to partner with the governmental and academic institutions as well as agricultural organizations listed under Progress on 2004 Activity 6: Environmental Committee; Related Industry Groups and Partnerships to improve communication and understanding of environmental issues.

How does this activity reduce pesticide risk?

The Environmental Committee and other activities, in themselves, do not reduce risk but can assist in directing information on reduced risk practices to growers. Furthermore, the involvement with the different groups allows the industry to identify issues that need to be addressed and communicated to almond growers, while allowing others to understand current practices and efforts in the industry. One responsibility of the Committee is to identify opportunities where innovative, low risk and cost-effective pest control practices or environmental issues of concern (food quality, water quality, etc.) can be communicated to growers and handlers.

How will you measure the risk reduction gained from this activity?

Risk reduction from adopting IPM and other practices can be measured by analyzing pesticide use reports from the Department of Pesticide Regulation and comparing current and past use of pest control products.