Almond Pest Management Alliance II

Final Report to the California Department of Pesticide Regulation

Almond
Community Alliance
with Family Farmers
Department of Pesticide Regulation
Almond Board of California
UC Cooperative Extension
Farm Advisors
UC Statewide IPM
Program
Pest Management Alliance

Prepared by the Community Alliance with Family Farmers
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Executive Summary

The Almond Pest Management Alliance II project was a two-year, collaborative demonstration and outreach program that successfully extended reduced risk pest control practices to thousands of almond growers and pest control advisors throughout the Central Valley of California. Building on the success of the first Almond PMA project, PMA II implemented pest control demonstrations in eight grower orchards; held 16 grower and PCA field days, workshops and meetings attended by over 680 participants; mailed informative newsletters to over 5,000 growers and PCAs; and built strong working relationships between partner organizations. Through this project growers and PCAs have learned more about essential pest and beneficial organism monitoring, cultural controls, and reduced risk pest control materials.These educational and organizational successes bring with them excellent progress toward cleaner air and water for the people of California, and safer work environment for farmers and farm workers.

Introduction

From 1998 through 2005 the California Department of Pesticide Regulation funded the first Almond Pest Management Alliance project. This collaborative project used demonstration sites and intensive outreach to promote environmentally responsible practices to manage economic pests in almonds. One major accomplishment of this project was the publication of the *Seasonal Guide to Environmentally Responsible Pest Management Practices in Almonds*, an eight-page booklet that shows growers and pest control advisors (PCAs) how to successfully manage the most critical almond pests while minimizing pesticide risks to the environment and human health.

Analysis of Pesticide Use Report (PUR) data and a subsequent report by DPR stated that almond growers reduced dormant spray applications by 77% from 1991 to 2000, primarily attributed to the efforts of Almond PMA I. Almond PMA I promoted the adoption of intensive monitoring protocols and tracked pest populations, damage levels, and economic data over successive years. This consistency demonstrated the long-term economic success of reduced-risk practices.

The almond industry, California's top horticultural export with an annual farm gate value of more than $2 billion, currently encompasses over 755,000 acres in California's Central Valley and has grown steadily for the past 15 years. Defying most basic economic principles, increased crop size has been accompanied by increased prices, prompting farmers to abandon lower value crops and plant new almond acreage.

The project was re-formed as PMA II in 2008 to build on the success of the first PMA project, and to help the many new California almond growers adopt good pest management practices that minimize pesticide risks. The PMA II project partners are the Almond Board of California, the UC Cooperative Extension, UC Statewide IPM program, US EPA Region 9, the California Department of Pesticide Regulation (DPR) and the Community Alliance with family farmers. A list of project team members is included as Appendix A of this report.

The Almond PMA II project operated through April 2010, extending the reduced risk and IPM messages to new almond growers and PCAs and to counties not part of the first PMA project.

Project description

The Almond PMA II consisted of four parts: collaboration; demonstration; outreach to growers and PCAs; and outreach to crop protection companies. The collaborative nature of this project has been essential to successful outcomes. Though CAFF coordinated the overall project, each of the partners participated fully and contributed to project success. Demonstrations of good monitoring and reduced risk pest control took place in growers' orchards in the five project counties as described below. Outreach also was concentrated in those counties, with some of the demonstration orchards serving as field day locations, allowing growers to experience first hand the challenges and successes of other farmers. Newsletters that reinforced the themes brought forward at field days were distributed across the almond growing regions. In the planning stages of the project the partners identified the need to keep up communications with crop protection companies to be sure that they were aware of the need to expand the reduced risk pesticide choices available to farmers. The Almond Board has a special interest in promoting pesticides that pose the least possible risk to bees.

Demonstration grower Gary Martin talks shop with UCCE Farm Advisor David Doll.

The project focused on reducing the pesticide risks associated with the use of organophosphates (OPs), carbamates, and pyrethroids because these compounds affect growers, workers, communities and the natural environment. As the project evolved, the issue of volatile organic compounds (VOCs) was recognized as an important area where the project could make a positive impact. An increasingly common practice is the prophylactic application of abamectin to prevent mite outbreaks. However this product contributes to the VOC and air quality problems and there are many miticides available for remedial applications that do not pose that same air quality risks. Most formulations of chlorpyrifos also have high VOC emissions potential. All these risk can be minimized by growers with robust IPM programs through pesticide applications at established pest thresholds, monitoring beneficial organisms as well as pests, and by choosing pest control materials with lower risks. These concepts formed the core of the demonstration site practices and the outreach messages brought out by the project.

Almond PMA II examined the latest PUR data, surveys, and current research to select critical practices and geographic areas in which to concentrate the renewed PMA project. An important tool for this discussion was *Pesticide Use Comparison Between Major Almond Producing Regions*, a report by Sarah Gatzke, a graduate student at UC Davis. This report is included as Appendix B.

The project partners looked for counties with increasing numbers of almond acres and stable or increasing quantities of conventional pesticides being applied. Another criterion was the interest and willingness of the local UCCE farm advisor to get involved with this project. The team initially chose three counties for demonstration sites and to focus outreach efforts: Fresno, San Joaquin and Sutter. In 2008, a new UCCE Farm Advisor, David Doll, started working in Merced County. Both David and the other partners recognized an opportunity to expand the project while helping to establish the almond farm advisor program in Merced County. In the 2009 growing season, the project partners added Yolo County, since UCCE Farm Advisor Carolyn DeBuse was also an new advisor and eager to coordinate a demonstration site and as well as learn more about almond pest management issues.

Pest Issues

The pest problems directly addressed by this project are the major entomological pests in almonds. At this time diseases and weeds are not considered a high priority for change because toxic levels of pest control materials for weeds and diseases of almonds are not currently identified as environmental problems, and there are few, if any cost effective alternatives. Listed below are the major pests, their treatment and alternatives.

Navel Orangeworm is a primary pest of almonds in California. The first instar larvae bore into the nutmeat and later instars can consume most of the nut. Navel orangeworm larval damage can also lead to infections of the fungus *Aspergillis flavus*, the source of aflatoxin, a potent carcinogen. The larvae over-winter in mummy nuts either in trees or on the ground. Conventional treatments include OP or pyrethroid sprays at hullsplit–when the almond hulls begin to open, revealing the susceptible in-shell nut. The most important alternative is winter sanitation: knocking unharvested nuts off the trees and destroying them on the ground with a flail mower. Growers can also use low-risk pesticides in May and at hullsplit. These include Intrepid™, Altacor™, Belt™, Bt products, and Delegate™.

Mummy nut in an almond tree at bloom.

Peach Twig Borer is a major pest in several tree crops. Larvae damage both growing shoots and nuts, causing shallow channels and surface grooves on the nutmeat. Preferred treatment timing is at bloom, but treatments during the dormant season with environmentally sound insecticides are also acceptable. Standard treatments include a dormant spray of OPs or pyrethroids, or reliance on NOW treatments later in the season. Low-risk alternatives include Dimlin™ in a delayed dormant spray, Bts or other low-toxicity pesticide at bloom (avoiding harm to bees.)

San Jose Scales suck plant juices from twigs and limbs and inject a toxin resulting in loss of tree vigor, growth and productivity and death of limbs. Untreated infestations can kill fruit spurs and scaffold wood within 1 to 3 years. A dormant spray of oil and/or a pyrethroid or OP typically controls San Jose scale. With careful winter monitoring, most dormant spray applications for SJS can be avoided. Oils alone can be effective as can new insect growth regulators such as Sieze™ or Centaur™.

Pacific spider mite, two spotted spider mite and strawberry spider mite are difficult to distinguish as adults, have similar life histories, and are controlled in the same manner. However, Pacific mite is often the most difficult to control with miticides. During favorable conditions, mites develop within 7 days with 8 to 10 generations per season. Mites damage foliage by sucking cell contents from leaves. The damage begins with leaf stripping. Leaves can turn yellow and drop off. High populations cover tree terminals with webbing. Crop reduction and reduced vegetative tree growth shows up the year after damage occurs. Conventional treatments include prophylactic treatments with abamectin, or any of several remedial spray materials. Alternatives include presence/absence monitoring of pest and beneficial mites, cultural controls such as dust control on roads and remedial sprays of low-toxicity, non-disruptive materials such as narrow-range oil or Acramite™.

The **leaffooted bug** was formerly considered a minor pest in almonds, but has now become a pest of serious concern. Feeding on young nuts before the shell hardens can cause the nut embryo to wither and abort, or may cause the nut to gum internally, resulting in a bump or gumming on the shell. It can also cause nut drop. After the shell hardens, leaffooted bug feeding can still cause black spots or wrinkled, misshapen nutmeats. The only treatments available are carbaryl and chlorpyrifos. No treatment thresholds have been established, so treatment is recommended when populations are high.

The **pavement ant** and the **southern fire ant** are common in almond orchards. These ants infest nuts that have been shaken to the ground for drying at harvest and hollow out the nuts. Conventional treatments include sprays of chlorpyrifos or abamectin, though these are only marginally effective. Alternatives include baits with low vertebrate toxicity, and the shortest possible drying time on the orchard floor.

Demonstration

The Almond PMA II project, like its predecessor focused on demonstration and outreach. The project partners worked with individual growers and their PCAs to implement reduced risk practices. Almost all those practices are described in the *Seasonal Guide to Environmentally Responsible Pest Management Practices in Almonds*. The eight demonstration orchards, covering 450 acres were identified by project partners working in each of the counties. Each of the demonstration blocks were monitored for the targeted pests and the growers were encouraged to use the reduced risk practices with which they were most comfortable, based on the monitoring and support from team members.

Table 1 is a summary of the monitoring and harvest results in the demonstration blocks in 2009, the only year for which we have complete information. The data in the table is consistent with studies by UC researchers with navel orangeworm well controlled by either Warrior™ (a pyrethroid) at hullsplit, or Belt™ or Intrepid™ (reduced risk materials) at pink bud, in May or at hullsplit. Because there are no paired controls or replications, this is a not scientific trial. Each of the treatments were applied by the growers under the advice of their PCAs and based on monitoring reports from the PMA project. The "San Joaquin B" blocks are the most easily compared, because they are in the same orchard and under the same management. These blocks most clearly demonstrate that Intrepid™, an insect growth regulator, applied in the May NOW generation or at hullsplit, controlled this pest equally as well as the pyrethroid Warrior™.

The PMA team also tried to convince growers to avoid prophylactic applications of the miticide abamectin, and to rely on monitoring thresholds that indicate a need for treatment. (The materials in these threshold treatments are selected from a variety of options.) It is hard for growers to abandon prophylactic sprays in areas that have historically experienced consistent mite flare-ups even though the PMA team agrees that as growers move to reduced-risk pest management programs, the need for miticides should be diminished.

The best indication of success in demonstration orchards is the assessment of the individual growers who in our surveys consistently expressed satisfaction with the level of control and the confidence they have in their treatments.

Table 1. Monitoring Results from 2009 Demonstration Blocks

Almond Pest Management Alliance II

Demonstration Orchards		Mummy Nut Count[a]		Ground Nuts	Mite[c]	Worm Treatment[d]		Ave. total[d]	Block	Harvest	Serious Harvest Defects (%)[e]					Other[f]
Grower	Block	Nuts/tree	% w/NOW	% w/NOW	Treatment	Material	Timing	NOW eggs	Varieties	Date	Mold	NOW	Ants	PTB/OFM	Bug	Defects
Merced	1	2.2	11	2	Threshold	Belt	Hullsplit	40	Nonpareil	8/26	0	3.2	0	0	0	2.1
									Carmel	9/16	0.1	0.5	0	0	0.4	0.2
									Monterey	9/24	0.3	1.4	0	0	0	0.7
Merced	2	1.2	5	1	Threshold	Belt	Hullsplit	139	Nonpareil	8/26	2.3	1.7	0	0	0	2.3
									Sonora	9/2	0	1.7	0	0	0	2.8
									Carmel	9/16	1.2	0.7	0	0	0	1.5
San Joaquin A	1	1.1	13	6	Preventive	Intrepid	Pink+Hull	185	Nonpareil	9/9	0	2.3	0.1	0	0	1.2
									Carmel	10/2	0	0.4	0	0	0	0.5
									Monterey	10/12	0	1.2	0	0	0	0.4
San Joaquin B	1	0.8	7[b]	0.5	Preventive	Intrepid	May	52	Nonpareil	9/3	0.1	0.2	0	0	0	1.0
									Aldrich	9/29	0	0.4	0	0	0	0.2
									Monterey	10/23	-	-	-	-	-	-
San Joaquin B	2	0.7	7[b]	6	Preventive	Intrepid	Hullsplit	57	Nonpareil	9/3	0	0.9	0	0	0	1.3
									Sonora	9/29	0.1	1.2	0	0	0.1	3.0
									Monterey	10/9	0	2.4	0.1	0	0.1	1.1
San Joaquin B	3	0.9	7[b]	4	Preventive	Warrior II	Hullsplit	133	Nonpareil	8/28	0	0.8	0	0	0	1.9
									Carmel	10/2	0	0.3	0	0	0	1.6
									Monterey	10/23	-	-	-	-	-	-
Sutter A	1	-	-	-	Preventive	Untreated		115	Nonpareil	-	-	-	-	-	-	-
									Carmel	9/11	-	0	1.9	0	0.6	2.1
Sutter B	1	1-2	-	-	Untreated	Untreated		97	Nonpareil	8/21	-	0.6	0	0	0	0.2
									Carmel	-	-	-	-	-	-	-
Yolo	1	-	-	-	Threshold	Belt	Hullsplit	29	Nonpareil	8/25	1.6	0.2	1.6	0.8	0.4	2.0
									Sonora	8/25						
									Monterey	10/2	0.6	0	0.2	0.4	0.8	1.8

[a] Dormant period sampling in January. Mummy nuts were counted in 20 trees throughout each block. For the most part, where growers practiced winter sanitation, the target of < 2 per tree was reached. 100 mummies and 100 ground nuts were collected and examined for overwintering navel orangeworm (NOW).

[b] In the interest of time, with so few mummies to be found, a composite sampling of 100 mummy nuts was collected across the three San Joaquin B blocks.

[c] Orchards were either treated with a preventive mite spray or treated after mite flareups were observed through presence/absence sampling. Miticide materials used were Abba, Agrimek, Ecotrol and Onager. In the end, all but the Sutter B orchard were treated for webspinning mites. In the untreated Sutter B block, there was some harvestime defoliation partially due to mite activity.

[d] Included here are average per-trap totals of NOW eggs caught over the entire season. Egg traps were used to identify periods of egg laying and, along with degree-day models to time treatments. Totals do not necessarily reflect the degree of NOW pressure or predict harvest damage.

[e] Harvest samples of 500-1000 nuts were collected from each variety in each block before the nuts were swept into windrows. These were evaluated for pest damage and other defects.

[f] Includes shrivel, gumming and discoloration.

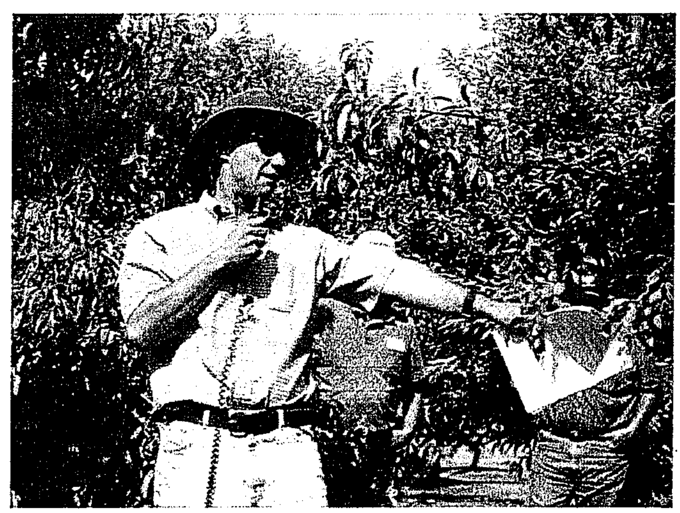
Outreach

The outreach elements of the Almond PMA II project began with an outreach plan, developed by CAFF with input from the Management Team. The plan addressed the four important audiences we were trying to reach:

- Growers
- PCAs
- Crop protection companies
- UCCE Farm Advisors

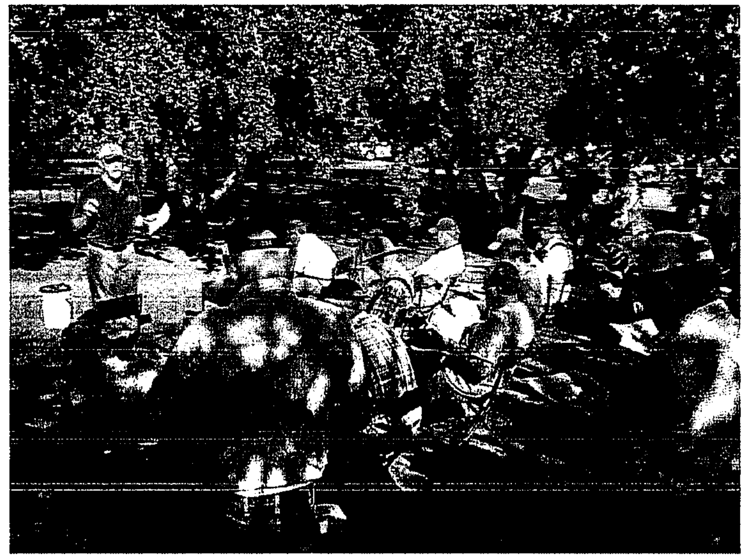
The conventional outreach methods used in the past, and employed for this project are meetings in the field and in classrooms, fact sheet handouts, direct mail newsletters—both a stand-alone PMA newsletter and UCCE Farm Advisor newsletters—and intensive workshops or short courses. In addition, the team noted that adoption of Internet technology and smart phones is having an impact among farmers, so it was important to this project to identify methods to reach our audiences electronically.

Field days and workshops. Over the course of this project, the PMA team held 14 grower meetings, with a total of 56 presentations for growers in orchards or in classrooms in each of the original four counties—Fresno, Merced, San Joaquin and Sutter. A total of about 400 growers attended these meetings, some of which included lunches sponsored by crop protection companies. These meetings emphasized practical applications of IPM including good pest and beneficial organism monitoring, choosing reduced risk materials, and other best practices that promote healthy, pest-resistant trees. After each meeting, participants filled out brief questionnaires, scoring each presentation on the usefulness of the material. All of the meetings were well received by participants. On a scale of one to five (five being the most useful), the average score of all the presentations was 4.26. A list of meeting topics and speakers is included as Appendix D.



UCCE Farm Advisor Brent Holts leads a discussion in at a field day in Mendota.

Additionally, the project partners created an all-day intensive class geared toward pest control advisors, covering essential pest management topics with an understanding of the environmental and economic risks associated with pest control practices. Participants were handed a large binder of materials created for these meetings, including the almond Pest Management Guidelines from UCIPM, other UC pest management publications for almonds, fact sheets and handouts from the presenters. This course was presented at two different locations—Kearney Ag. Center in Parlier, and the Cabral Center in Stockton—with a total attendance of 280, the majority of whom are practicing PCAs. The meeting evaluation consisted of a quick survey performed with an audience response system, and a brief written evaluation completed at the end of the day. Audience response system results are included in Appendix E. A small sampling of comments from participants is below.



UC IPM Advisor Walt Bentley explains mite sampling techniques for almond growers in a Durham Orchard.

Comments received from the Almond Pest Management Comprehensive Course evaluation survey:

- Great meeting, great presenters – the best Almond Pest Management meeting I have ever attended.
- Very good education overall today, very helpful for me.
- One of the best extension workshops I've ever attended.
- A great day had by all. A good location, good food, seeing good friends. Oh yes – we learned some new things too.
- Excellent – repeat annually.
- Excellent meeting, very well designed.

Publications. The Almond PMA II project produced two kinds of publications (other than the Comprehensive Course binder,) an Almond PMA newsletter, and a series of fact sheets highlighting best practices for reduced risk almond production. Four editions of the newsletter were direct mailed to over 5,000 almond growers and PCAs around the state. These four-page newsletters featured new information from UC IPM and UCCE Farm Advisors as well as information developed at the demonstration sites or presented at grower meetings. The project distributed four project fact sheets to meeting participants covering navel orangeworm monitoring, good nitrogen fertilizer practices, natural enemies and PMA program highlights.

Internet. Early in the project, the management team identified electronic media as a new outreach area to pursue. The project teamed up with Owen Taylor, who publishes agricultural information online, via email and by fax.

Among his many email newsletters is *AgFax: Almonds*, a weekly publication sent for free to PCAs and growers in California. Owen interviews practitioners around the state to create this timely communication on the progress of the almond crop, the pest issues and other practices that growers and PCAs are implementing through the year. PMA partners are now regular contributors to this newsletter, while the AgFax service has been advertised in the PMA newsletter. It should be noted that during the period of this project, UCCE Farm Advisor David Doll started his own blog called "The Almond Doctor," that he updates regularly with seasonally appropriate information and observations on all aspects of almond production.

Outreach to Crop Protection Companies

The Almond Board took responsibility for project relations with crop protection companies, with consultant Chris Heintz taking the lead. Over the course of the project, Chris coordinated over 19 meetings with crop protection company staff and representatives of the Almond Board. These meetings included discussions of reduced risk materials available to growers, the risks of pest control materials to honey bees, and the evolving regulations around maximum residue levels (MRLs) that are important considerations for internationally traded commodities and influence the materials that can be used on food crops like almonds. Locally, the project partners worked to include crop protection companies in grower meetings by offering sponsorships to companies who provided funding for food at these meetings. These sponsorships made it possible to attract larger audiences to meetings and to provide a more comfortable and welcoming atmosphere.

UCCE researcher Sarah Goldman Smith describes the proper use of the NOW egg trap.

Chris has observed that interest and opportunity is rising when it comes to pesticides and honey bees. At the North American Beekeeping Conference this past January in Orlando, Florida almost 20% of the presentations had something to do with pesticide exposure to honey bees. In almonds, pesticides are mainly applied in the dormant season or post-bloom, so bees should not be a factor. However, we suspect there is some pesticide persistence in the soil that could be a factor. Fungicides are a main concern in almonds and we are in dire need of knowing more about the sub-lethal impacts of fungicides on honey bees. One outstanding question is who should provide funding for this research? These issues will be a source of much work and debate in the future in these two linked industries: honey bees and almonds.

Administration

The Almond PMA II project was

administered by the Community Alliance with Family Farmers (CAFF). CAFF staff coordinated with members of the management team on all aspects of the project. Coordination took place through frequent communication, including monthly phone conference meetings. These calls were open to all project participants and featured updates from the demonstration sites, and planning for field days, publications and other project activities. This project was also supported by the Almond Board of California through a grant to UCCE, who hired a full time researcher, Dan Rivers, in San Joaquin County to work with growers and monitor demonstration sites.

Pesticide Use in Almond Orchards

The Almond PMA II project was funded to reduce the risks associated with pesticide use in almond orchards. The simplest way to reduce environmental risks is to reduce the use of the most toxic pesticides, and those that easily move off site. However growers must decide if they are willing to take the perceived economic risks they might encounter with a change in practices. There are practices that reduce pesticide risk without reducing pesticide use, such as better spray practices, maintaining ground cover in the winter. This project promoted IPM practices that can result in reduced pesticide use, or the use of lower risk pesticides. With careful monitoring and a good understanding of pest pressure and phenology, it is possible to avoid unnecessary sprays. Even if a grower is interested in maintaining pesticide applications, it is good practice to use a variety of chemicals in order to manage pesticide resistance in pest populations.

The best large-scale measure we have to estimate pesticide risk is the reported usage of various pesticides. We use the pesticide use reporting database (PUR) maintained by DPR, to approximate pesticide risk because we can see not only how many pounds of each chemical has been reported, but also the pounds per acre and the time of year. In the beginning of this project, we asked Sarah Gatzke at UC Davis to provide a report of pesticide use trends on almonds in the major almond growing counties. We used this information to design the program, choosing county areas to work in based on trends in pesticide use and almond planting. In 2010, we contacted Patti TenBrook, a scientist at USEPA Region 9, to update these trends through the most recently available year, 2008. Patti reported on the five counties in which there were PMA demonstration sites. Because data is only available through the first year of this project, it is impossible to draw conclusion about the influence of the program, however, we can get a good sense of what trends may have been underway when the project started and establish new baseline information for future work in this area. All acreage data reported below are taken from the National Agricultural Statistics Service and include both bearing and non-bearing acres. The products tracked in the 'reduced risk' category are oil, Intrepid™ (Methoxyfenozide), Dimilin™ (Diflubenzuron), *Bacillis thuringiensis*, Delegate™ (Spinetoram), Success™/Entrust™ (Spinosad). This data is show in Appendix C of this report.

- Fresno County has seen a dramatic increase in almond acreage: From 62,431 in 1999 to 93,187 in 2008. At the same time the pounds of OPs applied in the dormant season has generally dropped while pyrethroid applications have increased, mirroring the growth in acreage. In the growing season, OPs are still preferred over pyrethroids, while the use of reduced risk materials has increased dramatically.

- Merced County, as the county in project with the largest almond acreage has shown slow but steady growth in acreage. With a steady decline in dormant and in-season OP usage, the county has seen an increase in pyrethroid use, with a relatively high use of reduced risk materials during the growing season.
- San Joaquin County, with a relatively stable number of acres devoted to almond production has experienced reduced dormant sprays overall, while showing a consistent reliance on pyrethroids for in-season treatments. San Joaquin had a relatively low level of reduced risk material usage.
- Yolo County has a relatively small, but growing almond acreage. Pesticide use in this county is remarkable for the very small number of dormant applications, and the very high proportion of reduced risk material usage both in both dormant and in-season applications.
- Sutter County is another small producer of almonds but with a relatively high use of pyrethroids in the dormant season, a high use of OPs in the growing season, and relatively low use of reduced risk materials.

The data in Appendix C shows that pesticide choices and overall use are not functions of price and efficacy alone. Other factors are likely to play important roles in these outcomes. It is likely that local differences in the informational infrastructure (How thin are UC Cooperative Extension resources stretched? Is there a county farm advisor for almonds?) as well as historical practices and farming culture have a strong influence on pest management practices across a region. For example, there recently has been no UCCE Farm Advisor for almonds in Fresno County while the almond acreage has increased rapidly. Fresno County almond acres receive more organophosphate treatments than any other county we looked at.

Conclusions

The Almond Pest Management Alliance II operated as a collaborative project in five counties over two years. In that time, hundreds of farmers and pest control advisors learned from leading industry experts essential pest management information that will help them in their continuing efforts to reduce the environmental and human health risks associated with pest management practices. These farmers and PCA's were reached through an intensive outreach program that featured on-farm and classroom meetings and workshops; all-day short courses; direct mail newsletters and email information updates.

Growers and PCAs gained new understanding and insights about the control of the most damaging arthropod pests in almonds, including navel orangeworm, peach twig borer and webspinning spider mites. Demonstration sites in grower orchards showed that reduced risk pesticides and practices achieve levels of control comparable to more traditional practices. The project was well received throughout the five counties with ratings and comments on surveys that reflect high levels of satisfaction with the delivery of information.

The Almond PMA II project established a new baseline of reduced-risk pest management practices by which future projects can be compared. Despite the success of this program, there is room for improvement in almond pest management practices across the state. While the use of the highest risk pesticides is decreasing, growers and PCAs need continued support to implement environmentally responsible pest management. Every year brings new challenges, changing pest pressures and new opportunities. New reduced-risk materials will continue to be developed and our understanding of the biological and ecological underpinnings of the orchard system will continue to improve. Support of this economically and environmentally important crop must continue.

Appendices:

A. Project team members
B. *Pesticide-Use Comparison Between Major Almond Producing Regions*
C. *Reported Pesticide Applications on Almond Orchards in Five Counties, 2006 – 2008*
D. List of presenters and topics
E. PCA training audience response tables

Appendix A
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Pesticide-Use Comparison Between Major Almond Producing Regions
PUR Analysis

High risk pesticide use in the counties of Butte, Colusa, Fresno, Glenn, Kern, Madera, Merced, San Joaquin, Stanislaus, Sutter, Tehama, Tulare and Yolo were compared on the basis of use high risk chemicals and acres of almond orchards planted in each county for the years 2000 to 2006. Comparison rankings have been assigned to each county based on the trend in Organophosphate (OP) use, Pyrethroid (PY) use and acres of almonds planted. The trend in Carbamate use was fairly consistent throughout the time period with the exception of Yolo County, and did not greatly influence rankings. Four general trends in pesticide use were determined from the analysis of the data included in the Appendix of this document. Each county was placed in one of the four groupings, and then ranked within the group to determine the overall rank (Rank of 1 denotes most significant pesticide use trends). The four groups have been defined as displaying the following trends:

Group A: Increasing use of OP, increasing use of PY, and increasing acres of almonds planted

Group B: Increasing use of OP, increasing use of PY, and decreasing acres of almonds planted

Group C: Decreasing use of OP, slight increasing to fluctuating use of PY, increasing or stable number of acres of almonds planted

Group D: Limited trend in OP and PY use, relatively few acres of almonds planted with some counties showing a decreasing trend of total acres planted

Group A

1. Fresno

In Fresno County, both OP and PY use in pounds per acre planted shows an increasing trend (Figures 5&6). Dormant season and in-season pesticide use for all chemical classes are consistently high when compared to all thirteen counties (Tables 2–13). The change in percentage of acres of almonds planted is over 100%, and the largest of all counties (Table 1b.).

2. Madera

In Madera County, both OP and PY use in pounds per acre planted have been increasing since 2000 (Figures 11&12). Dormant season and in-season pesticide use for the OP and PY chemical classes are high when compared to the other counties (Tables 2-13). Madera County has a strongly increasing trend of acres of almonds planted (Figure 32.).

3. San Joaquin

Uses of the OP and PY chemical classes in pounds per acre planted have been increasing since 2000 in San Joaquin County (Figures 15&16). As seen in Table 7, the use of OPs during the dormant season is particularly high. Of the thirteen counties, San Joaquin County has the sixth largest area of almond crop. As seen in Figure 34, the number of acres planted has been increasing, especially in recent years.

4. Tulare

The use in pounds of active ingredient (AI) applied per acre planted of OP and PY chemicals has increased in Tulare County since 2000 (Figures 23&24). Use of in-season OP chemicals is especially high in Tulare County (Table 6.). In comparison to the other counties, Tulare does not have a large number of acres of almonds planted, however there is a significant increase in the number of acres planted from 2000 to 2006 (Figure 38.).

Group B

5. Merced

In Merced County, both OP and PY use in pounds per acre planted have been increasing since 2000 (Figures 13&14). In-season pesticide use for the OP and PY chemical classes is high when compared to the other counties (Tables 2-13). In recent years, the acres of almonds planted in Merced County have decreased.

Group C

6. Kern

The use of OP chemicals in pounds per acre planted has decreased. PY use in the county has remained fairly constant (Figures 9&10). Tables 2-13 show that dormant season chemical use, especially OP use, in Kern County is significantly high. Kern County has the second largest number of acres of almonds planted with an increasing trend (Figure 31).

7. Stanislaus

The use of OP chemicals in pounds per acre planted has decreased. PY use in the county has remained fairly constant (Figures 17&18). It can be seen from Tables 2-13, that both in-season and dormant season use of high risk chemicals is problematic in Stanislaus County. Stanislaus County has the largest number of acres of almonds planted with a stabilizing trend of acres planted in recent years (Figure 35).

8. Glenn

The use of OP chemicals in pounds per acre planted has decreased in Glenn County. PY use in the county has remained fairly constant (Figures 7&8). As seen in Figure 30, there has been a steadily increasing trend in acres of almonds planted since 2003.

Group D

9. Tehama

The use of OP chemicals in pounds per acre planted has decreased in Tehama County since 2002. PY use in the county has remained fairly constant (Figures 21&22). As seen in Figure 37, there has been a slight decrease in the number of acres of almond orchards.

10. Colusa

For both the OP and PY chemical groups, the trend in pounds of AI applied per acre are unclear (Figures 3&4). In Colusa County, dormant season and in-season use of OP and PY chemicals is consistently low compared to the other counties (Tables 2-13). In 2006, Colusa County had the fourth fewest number of acres of almond orchards (Table 1b). However, the trend in number of acres planted is increasing (Figure 28).

11. Butte

For both the OP and PY chemical groups, the trend in pounds of AI applied per acre are unclear (Figures 1&2). In Butte County, dormant season use of OP and PY chemicals is consistently low compared to other counties (Tables 2-13). There has been a decreasing trend in number of acres planted with almonds since 2000 (Figure 27).

12. Sutter

The trend in pounds of OP and PY chemical groups applied per acre is unclear in Sutter County (Figures 25&26). Use of Op and PY chemicals in the dormant season and in-season is low compared to other counties (Tables 2-13). In 2006, Sutter County had the fewest acres of almond orchards (Table 1b). The trend in number of acres planted has decreasing since 2000 (Figure 36).

13. Yolo

The trend in pounds of OP and PY chemical groups applied per acre is unclear in Yolo County (Figures 25&26). Use of Op and PY chemicals in the dormant season and in-season is very limited (Tables 2-13). In 2006, Yolo County had the third fewest acres of almond orchards (Table 1b). The trend in number of acres planted has been increasing since 2003 (Figure 39).

APPENDIX

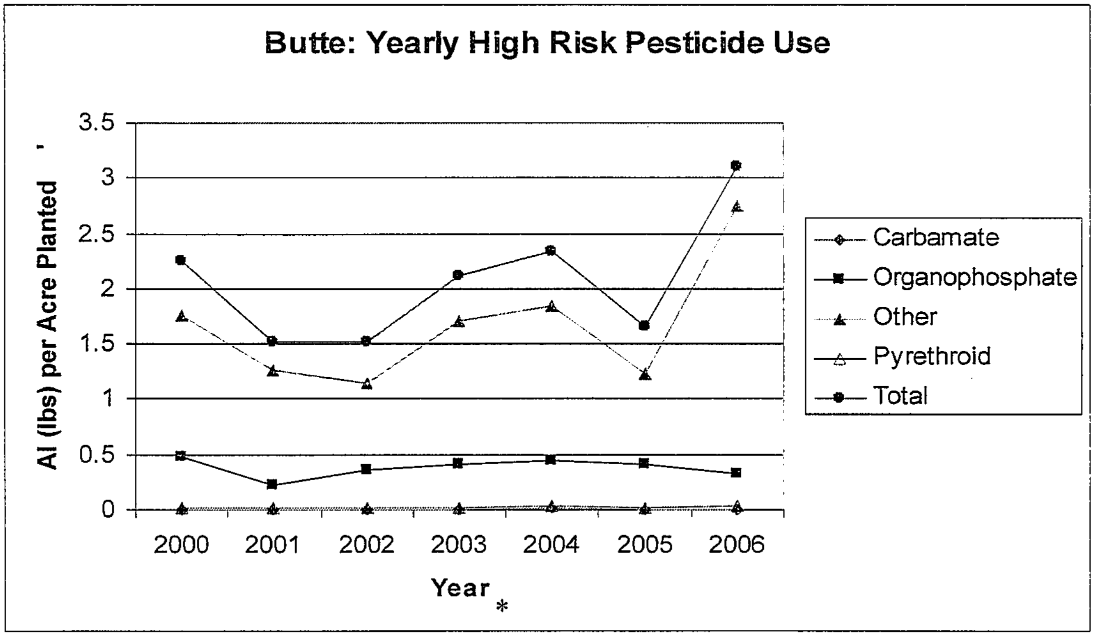


Figure 1.

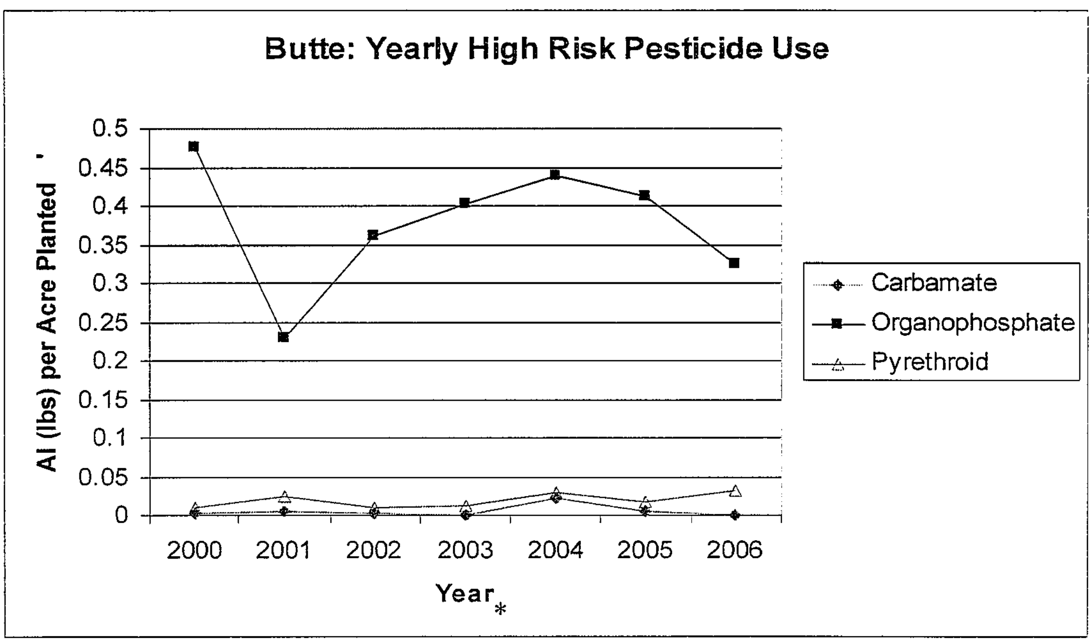
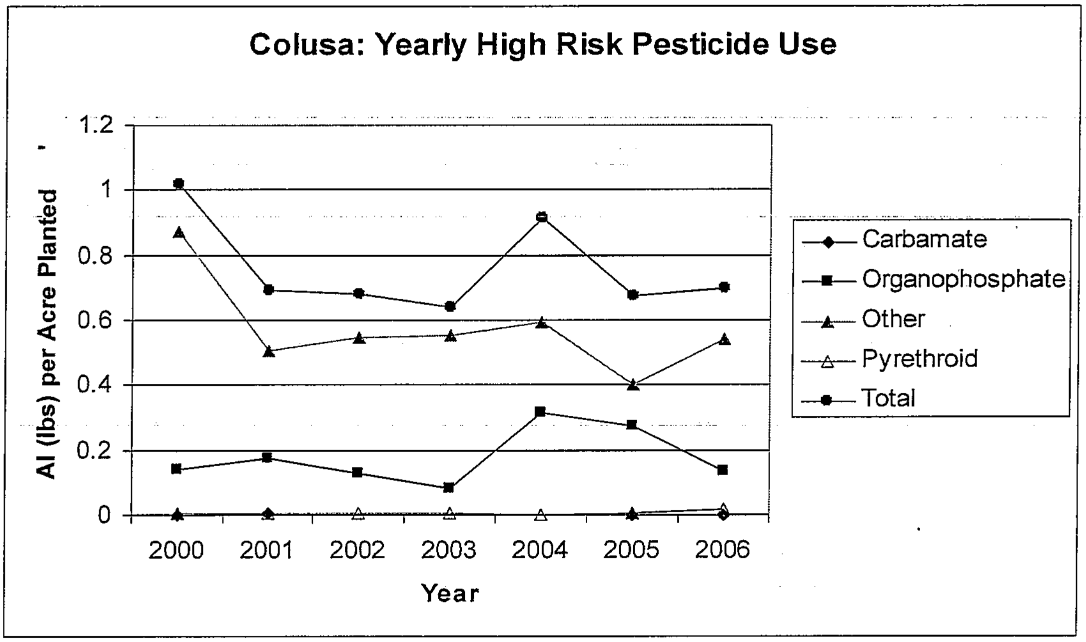


Figure 2.

* Year denotes one growing season. November and December of the previous year are included in the growing season year.



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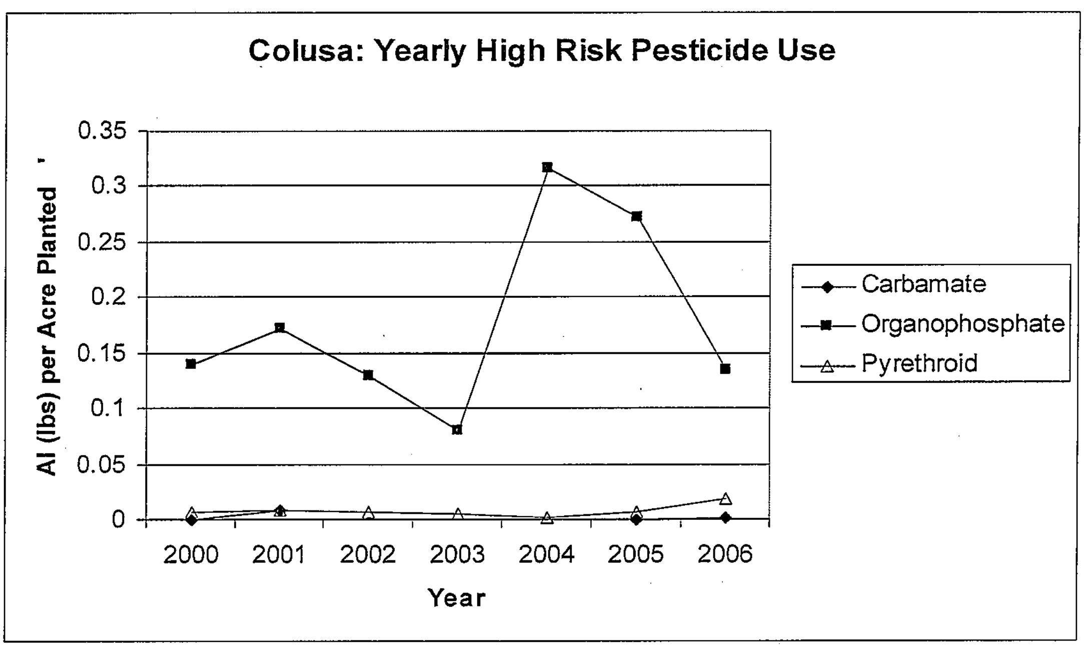

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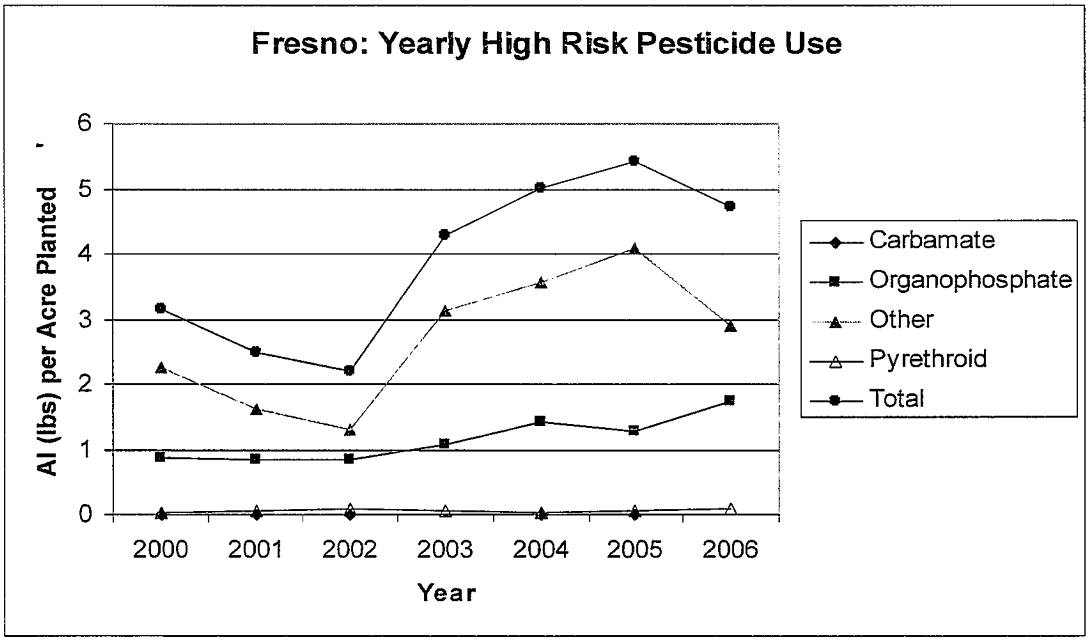

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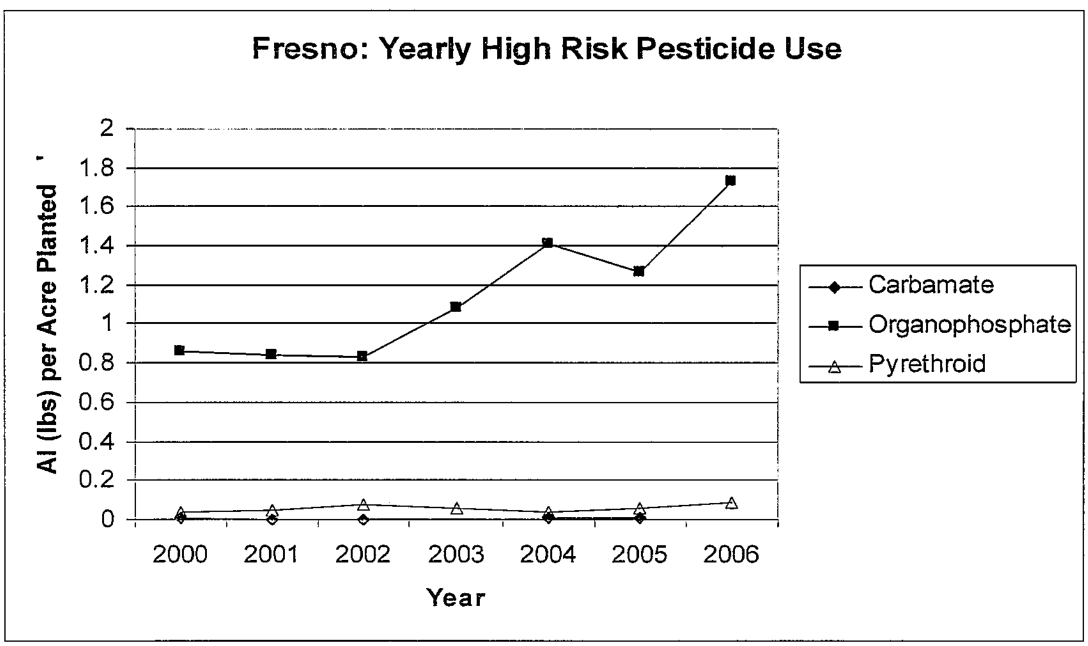

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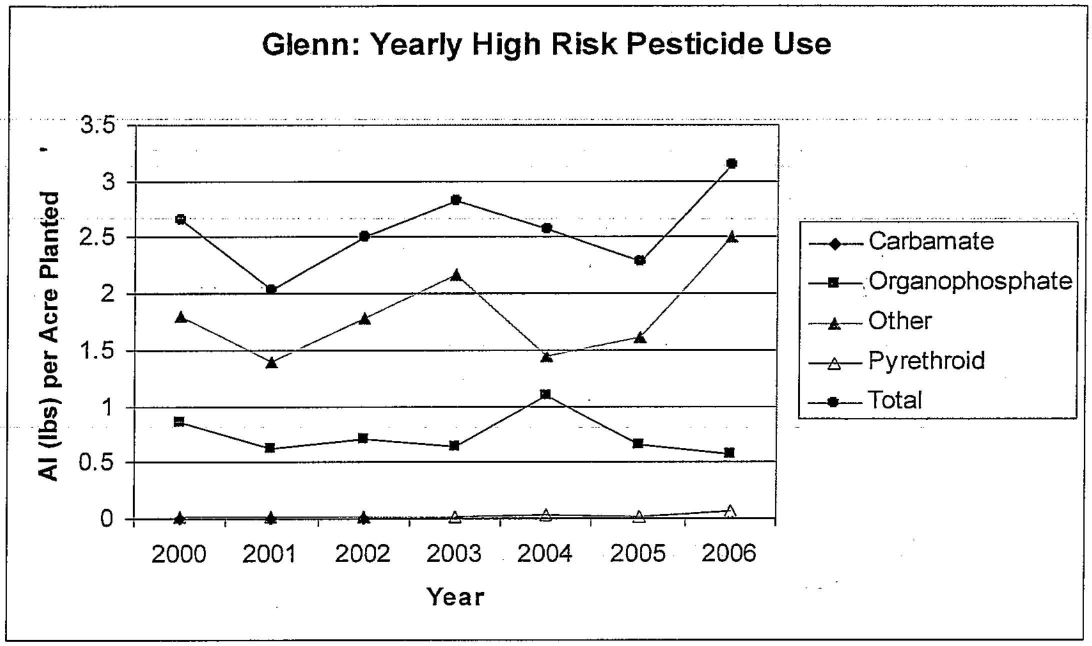

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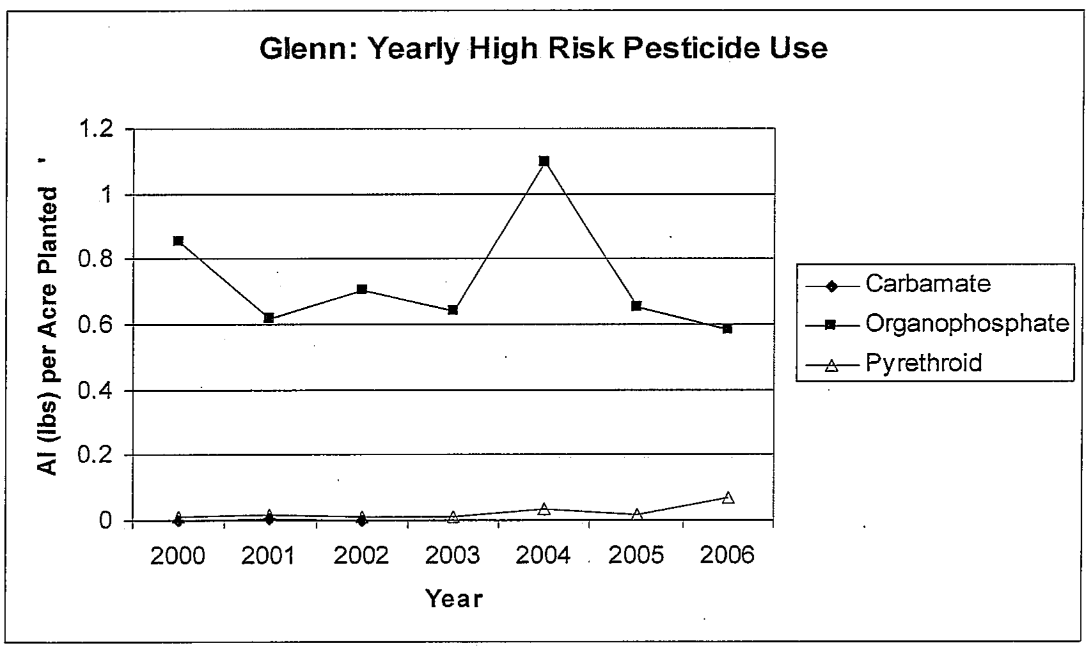

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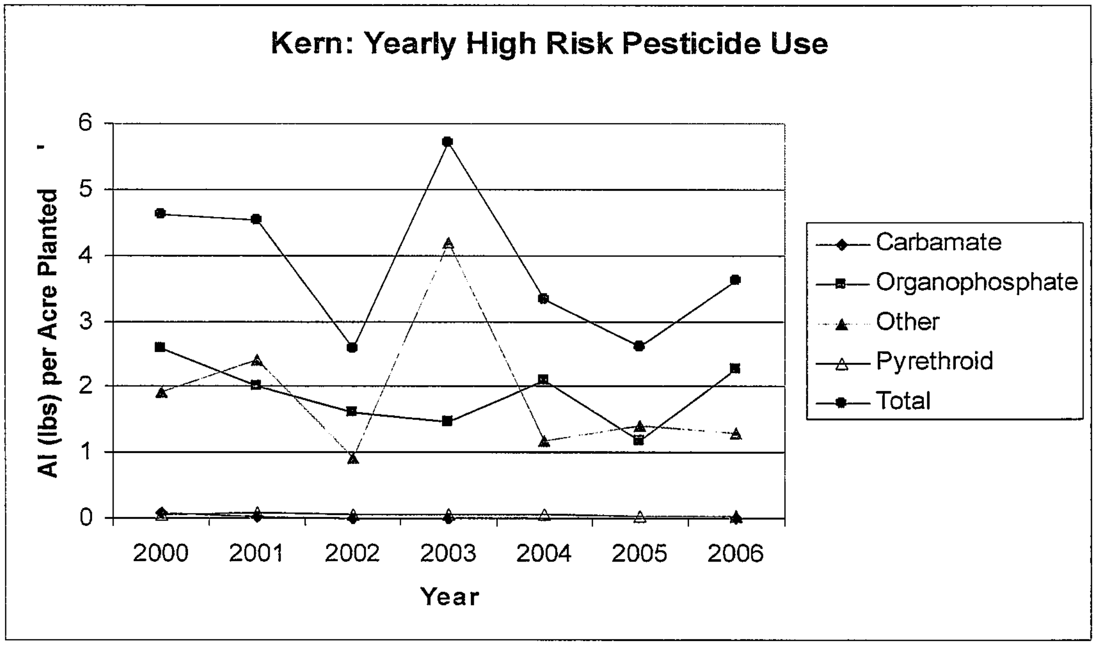

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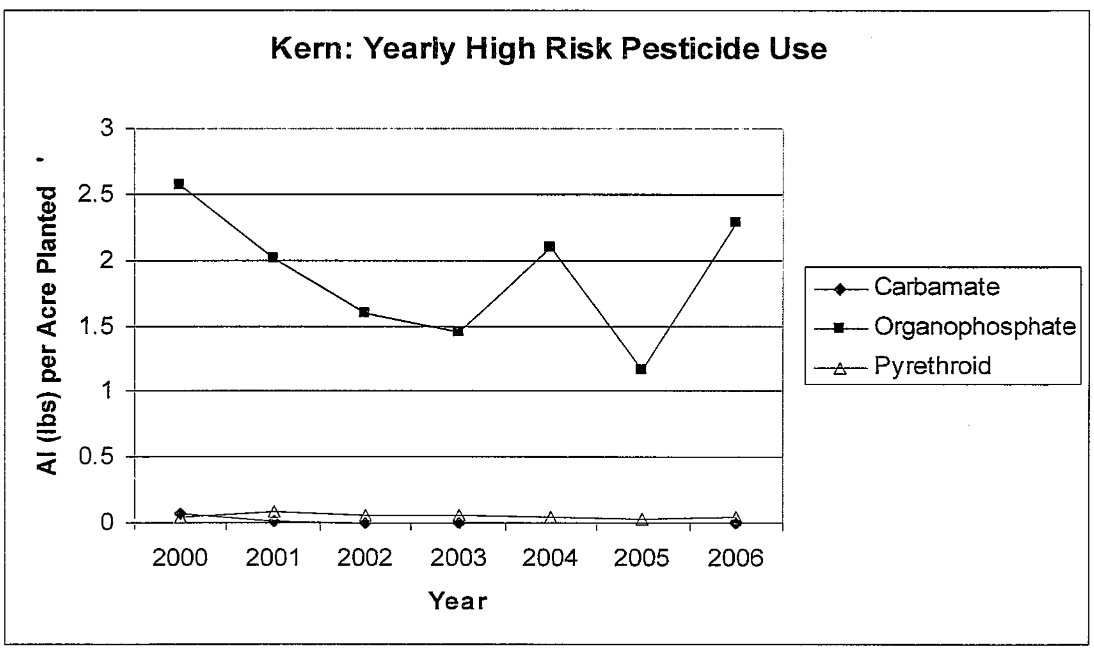

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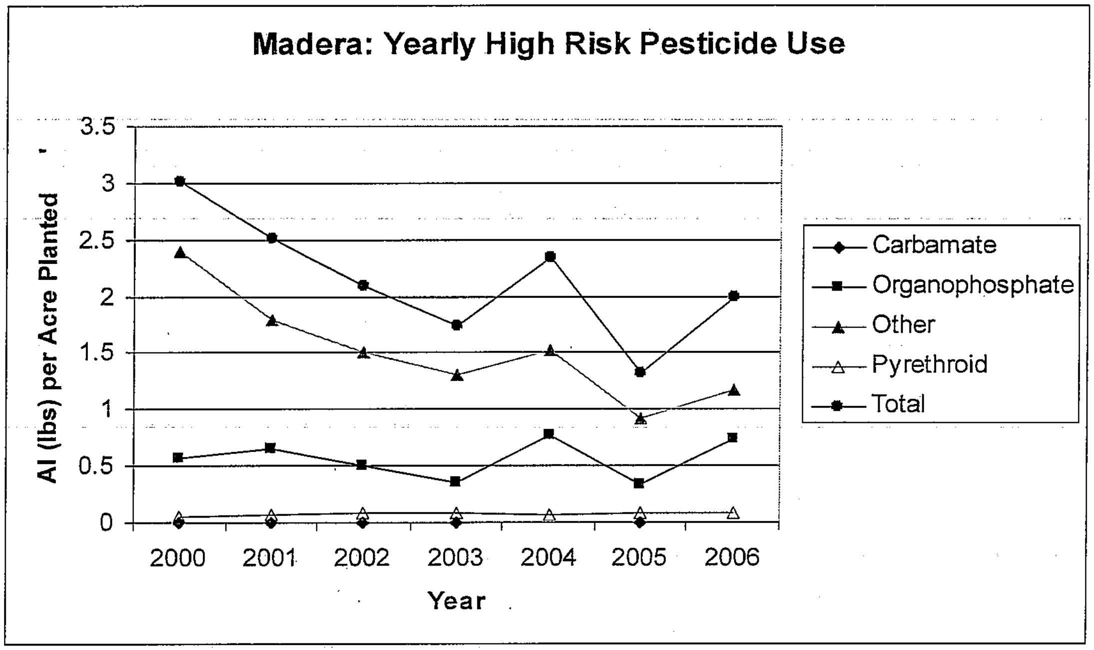

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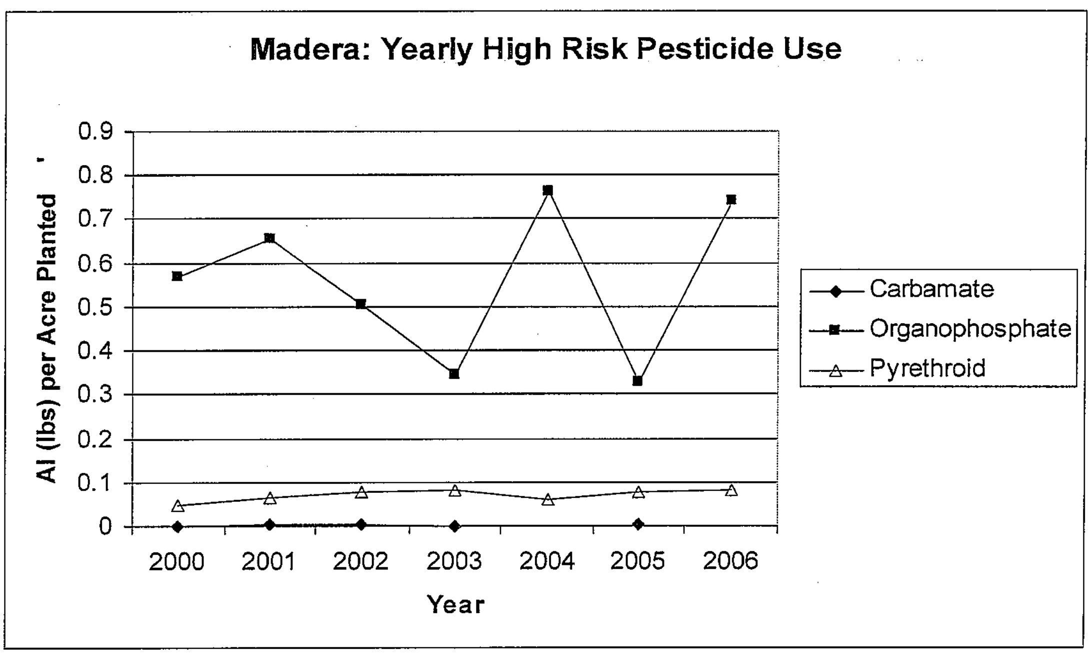

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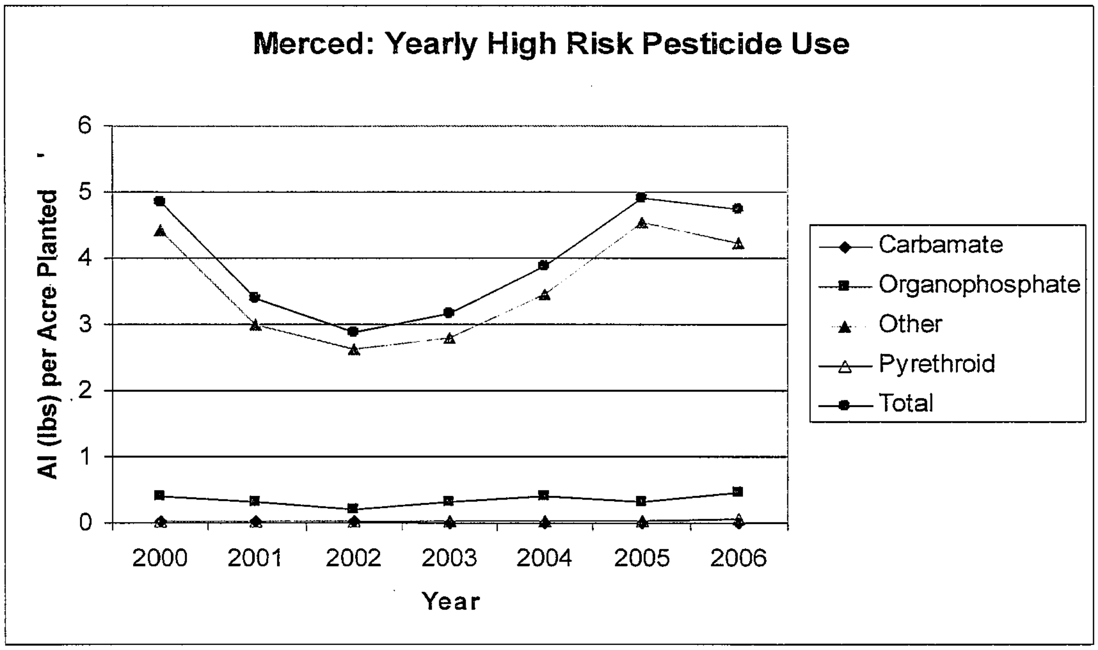

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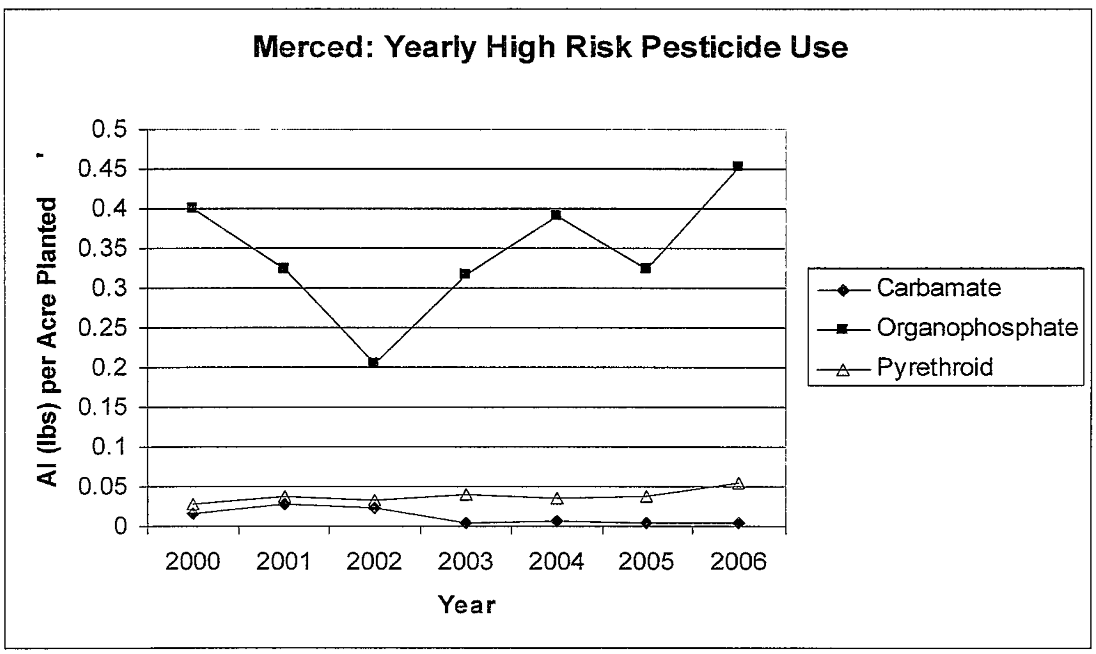

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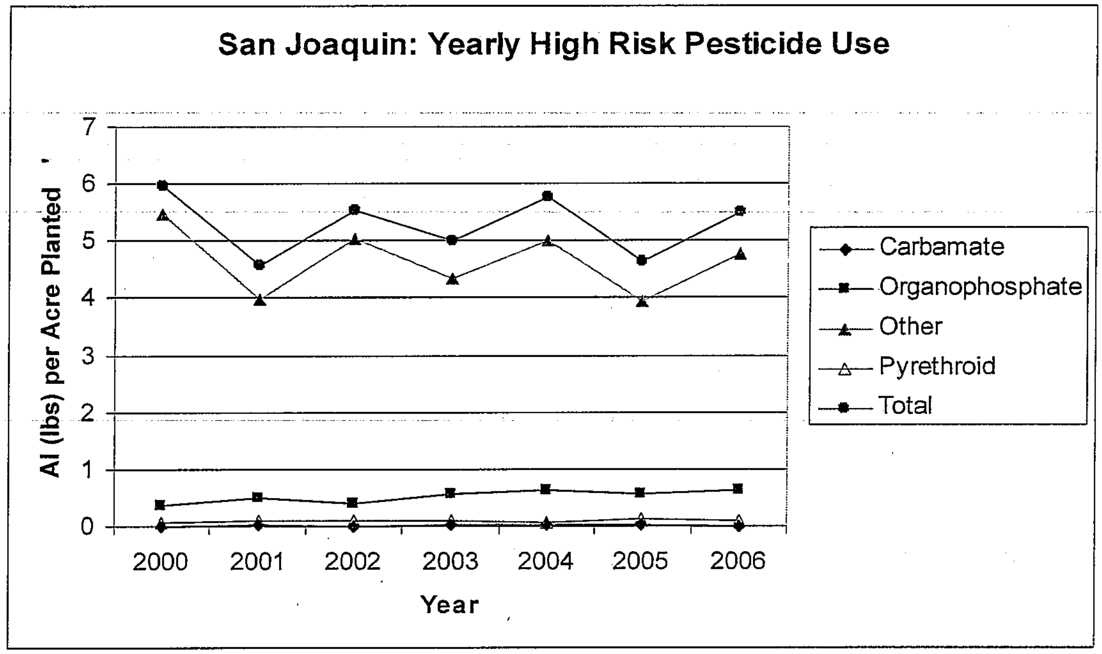

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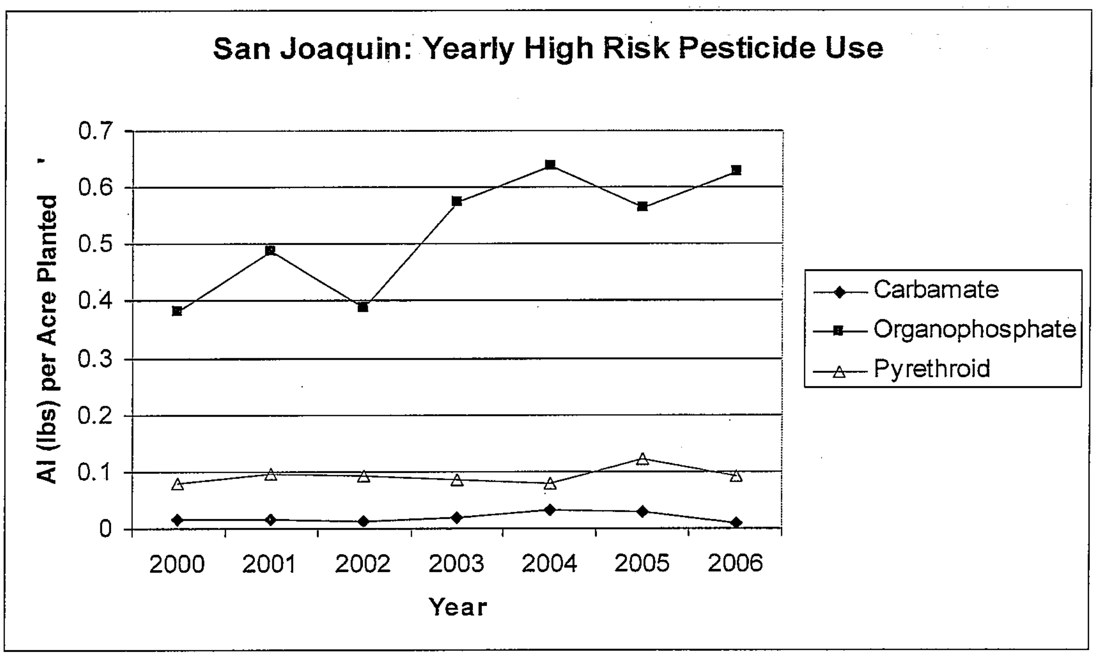

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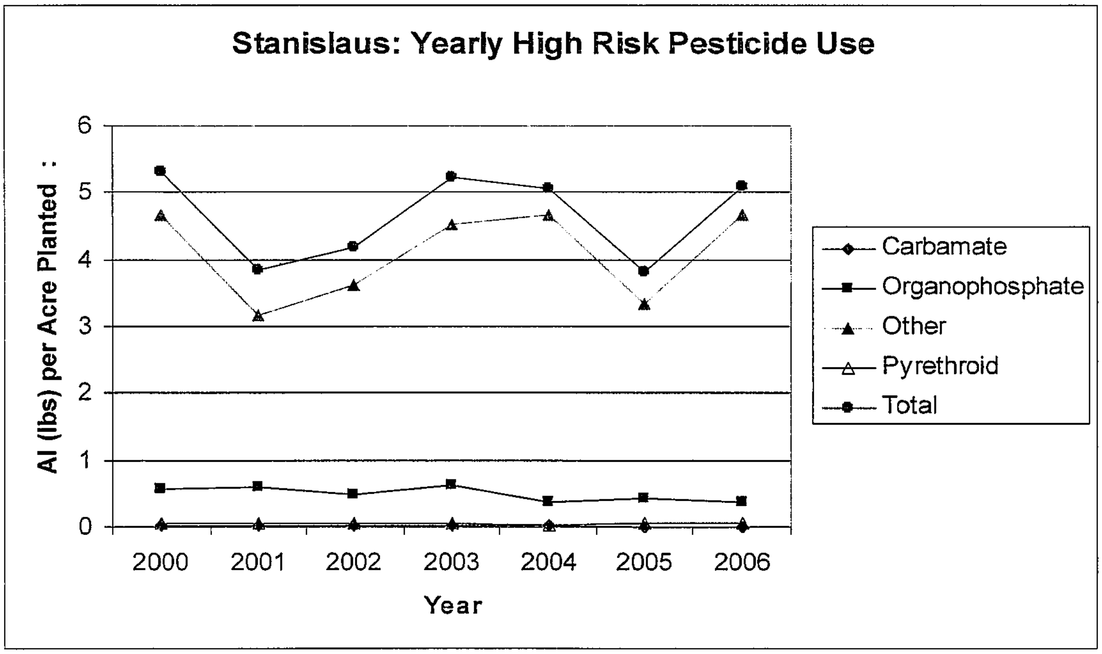

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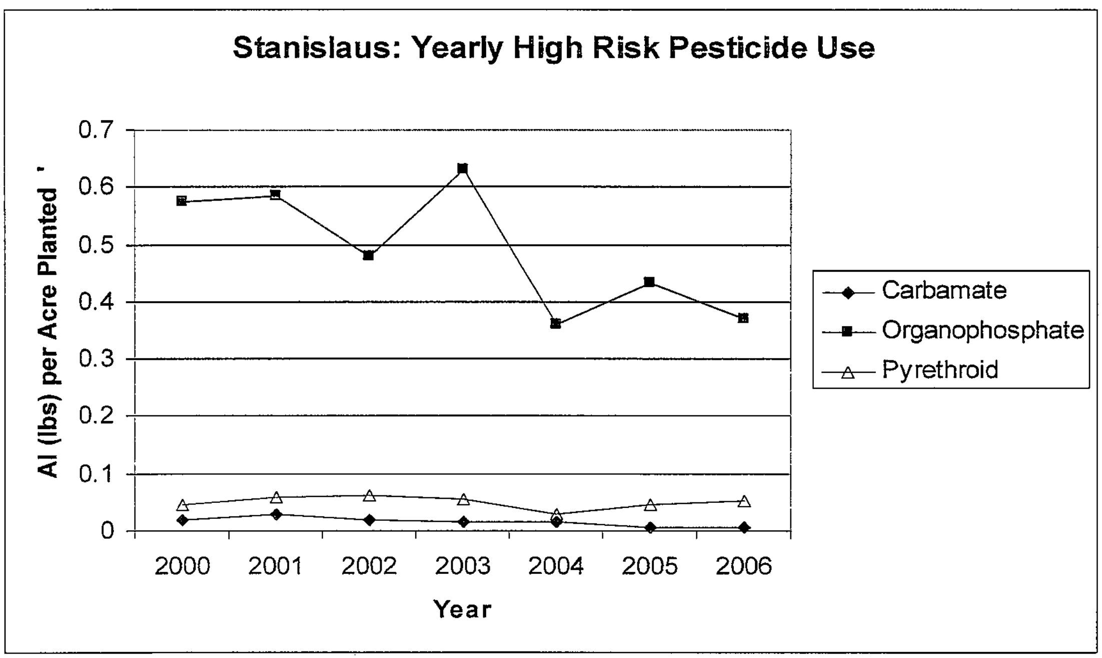

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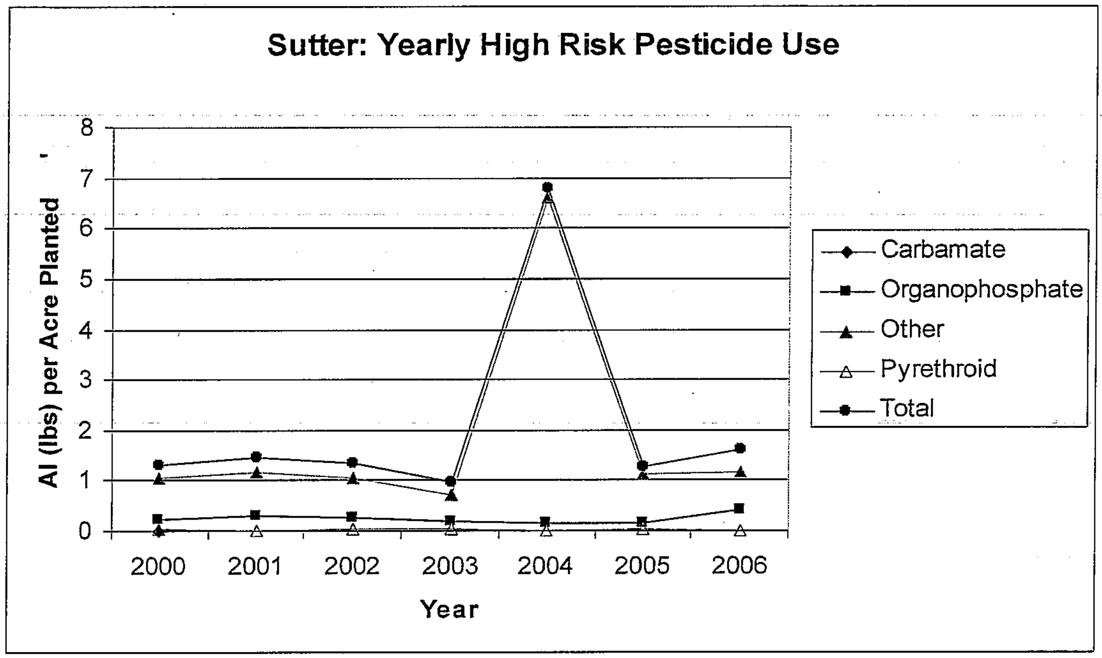

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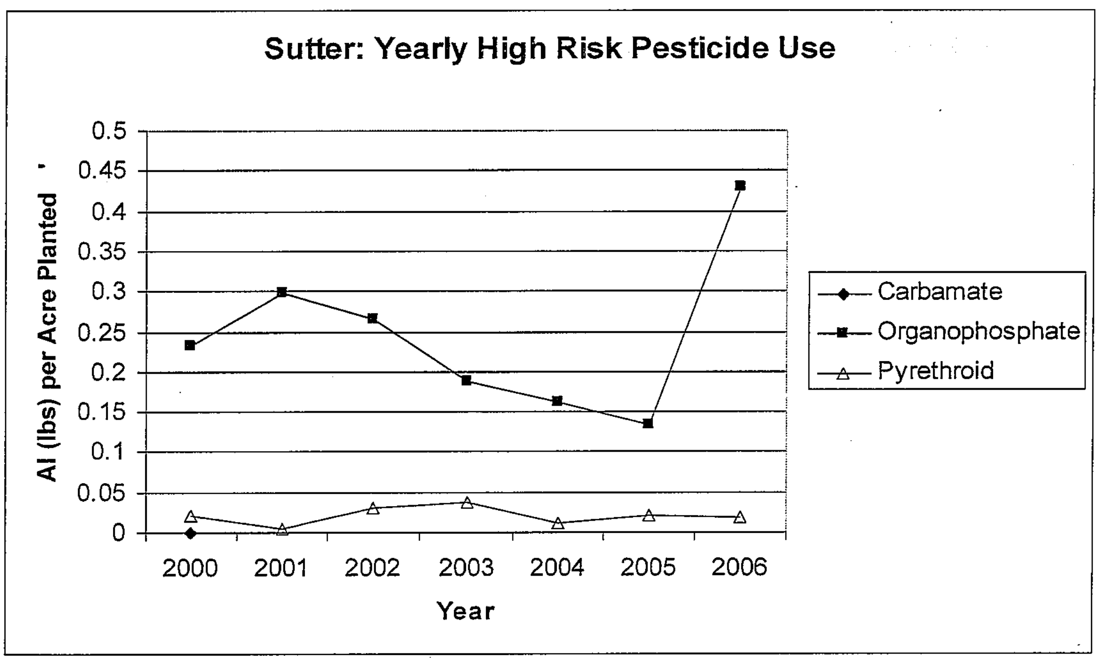

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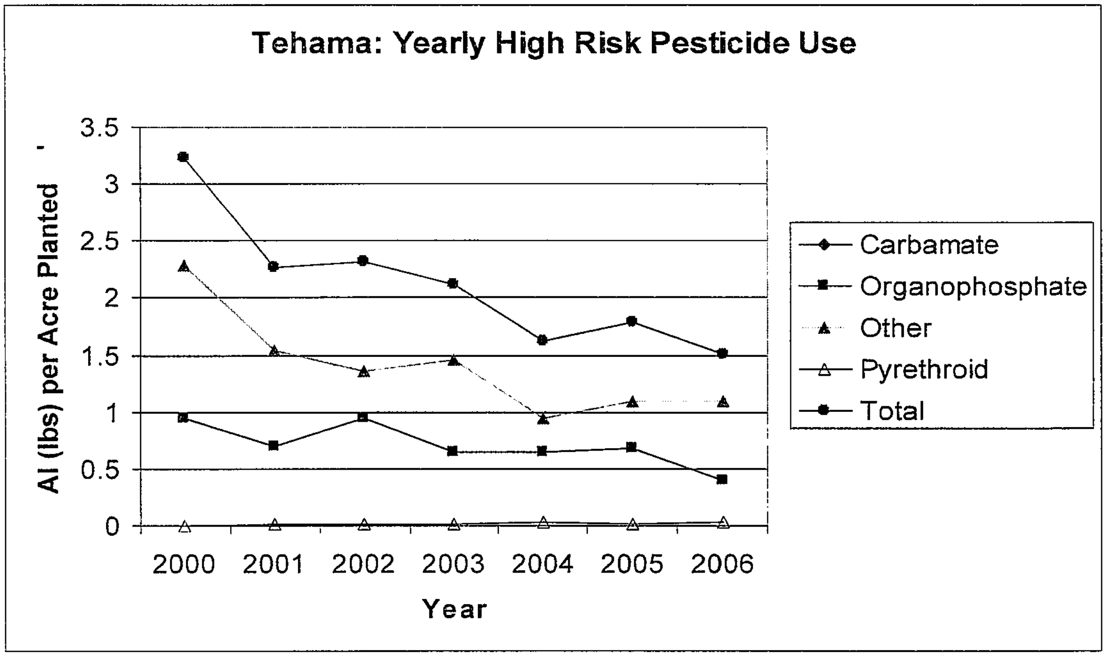

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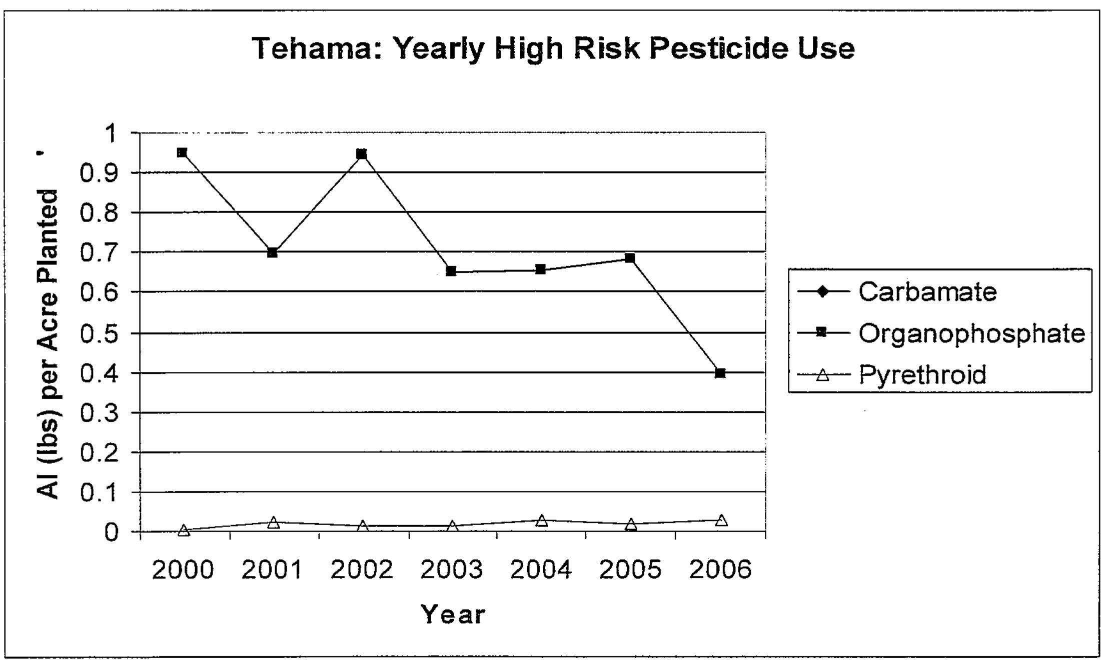

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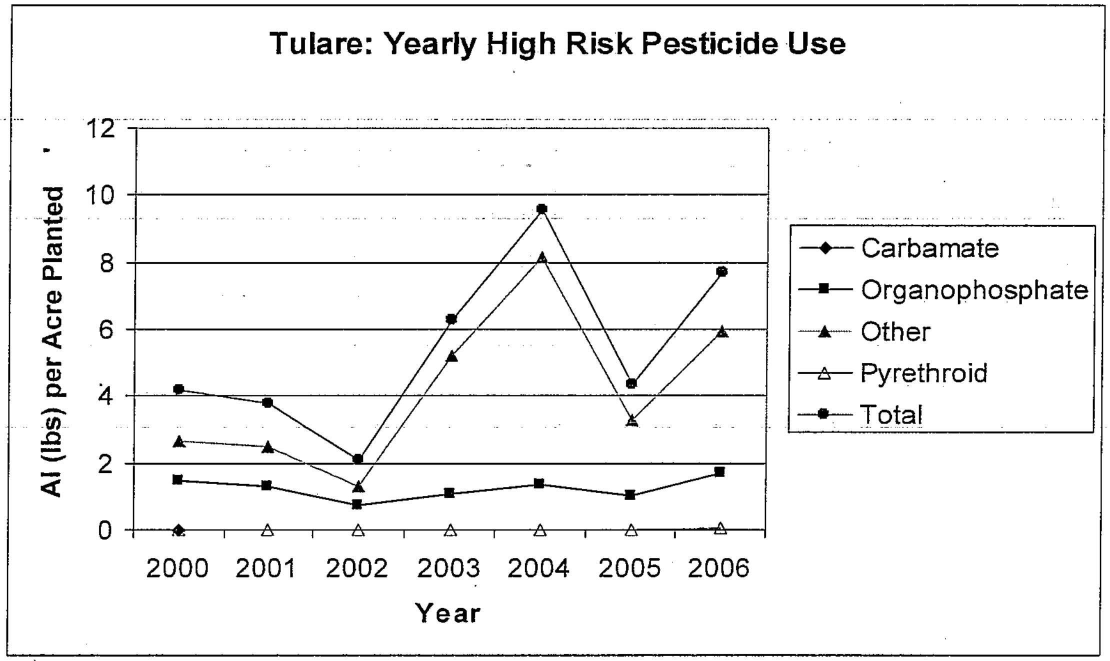

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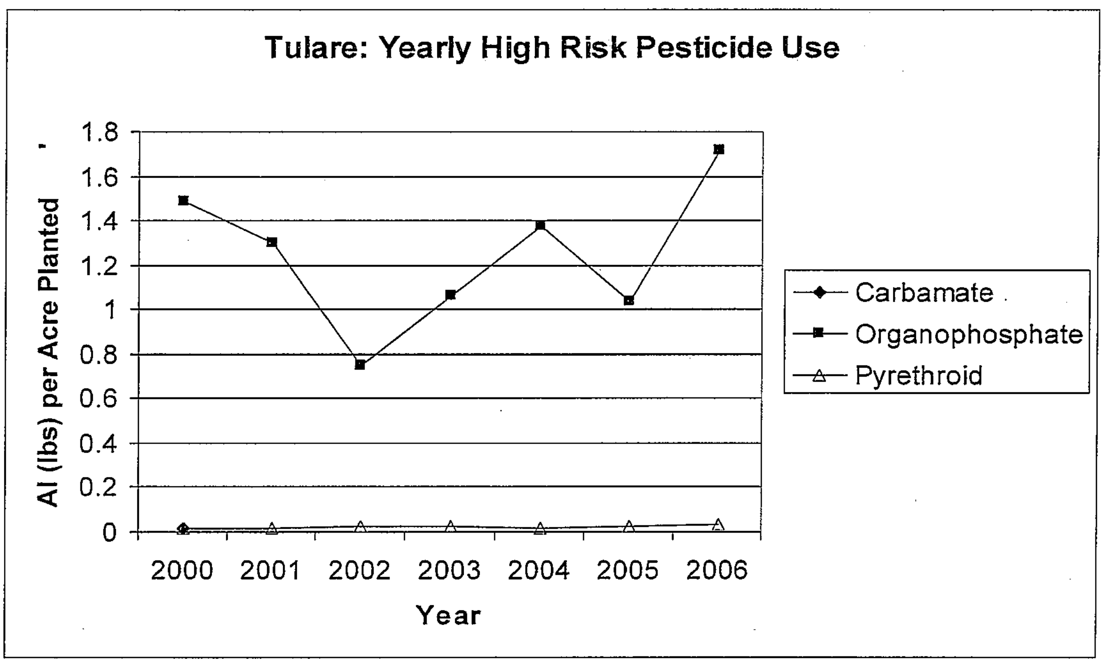

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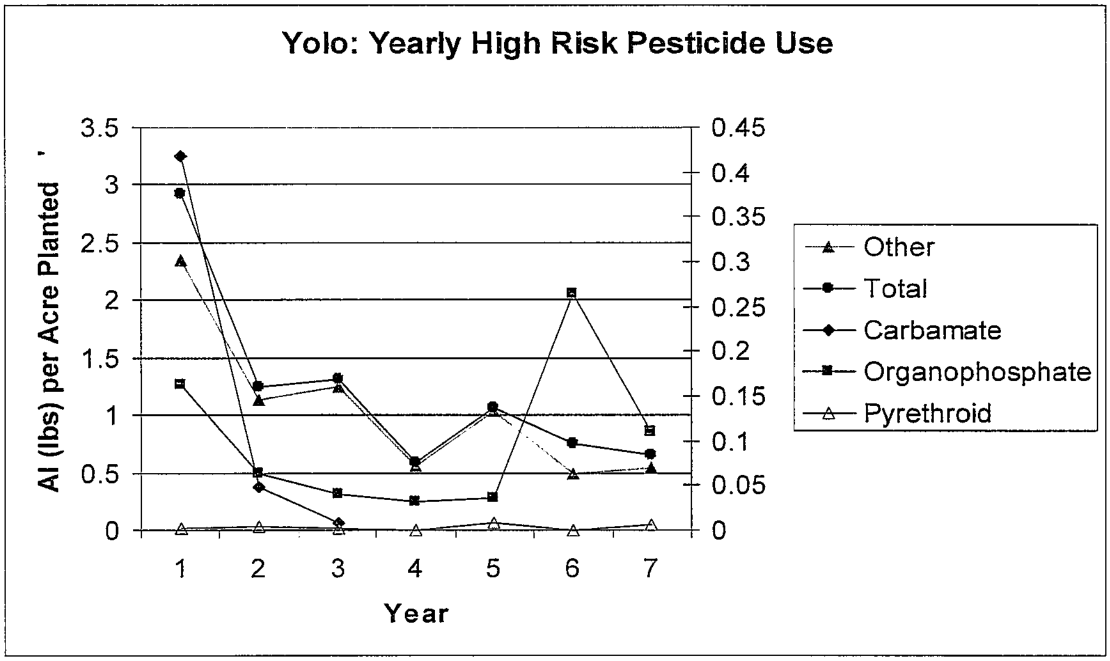

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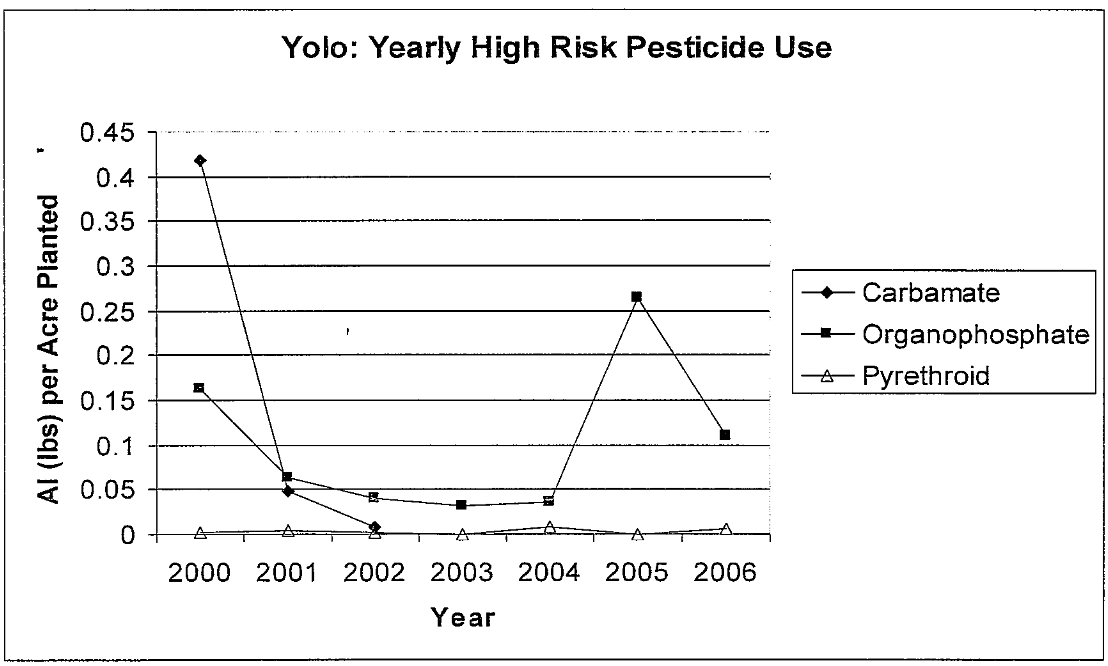

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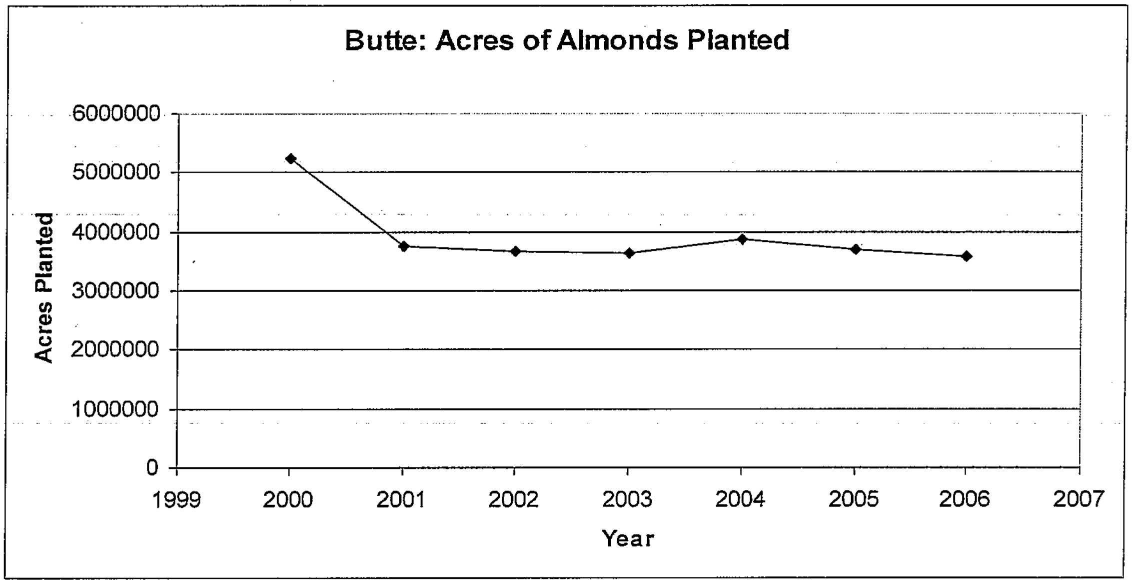

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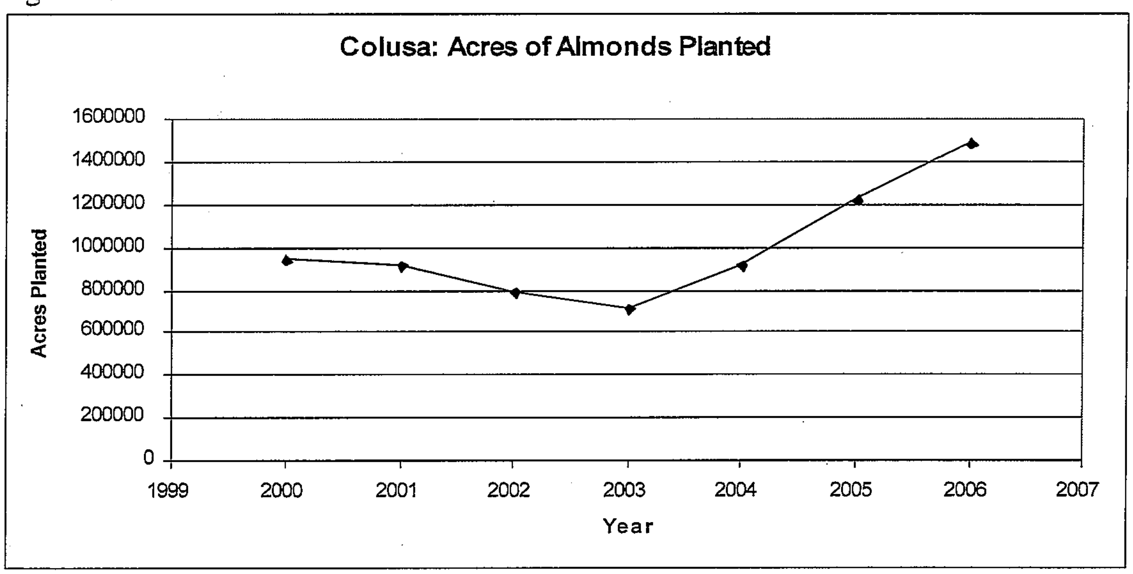

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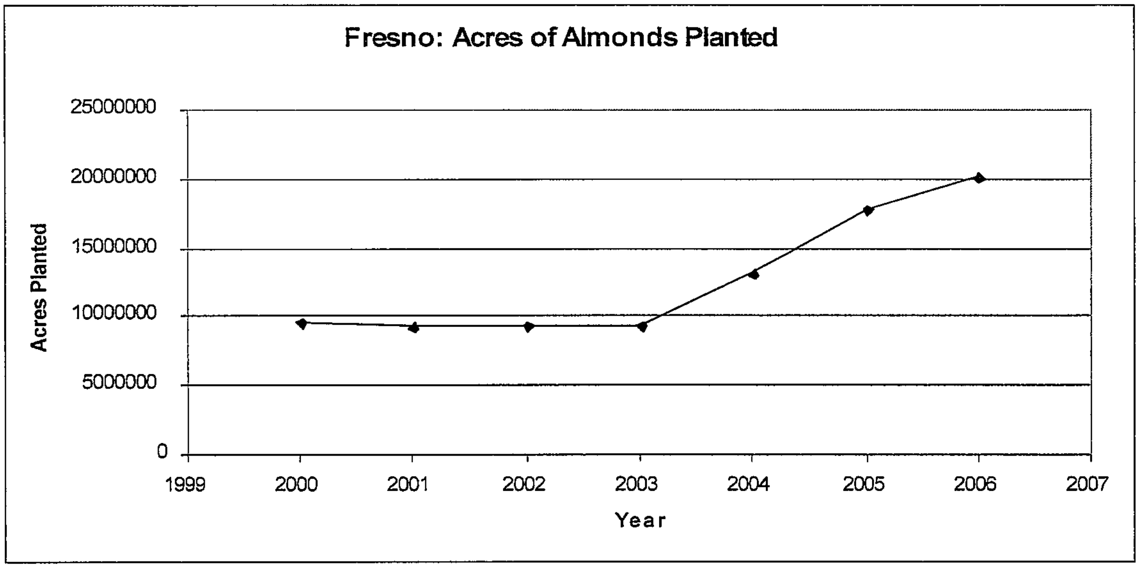

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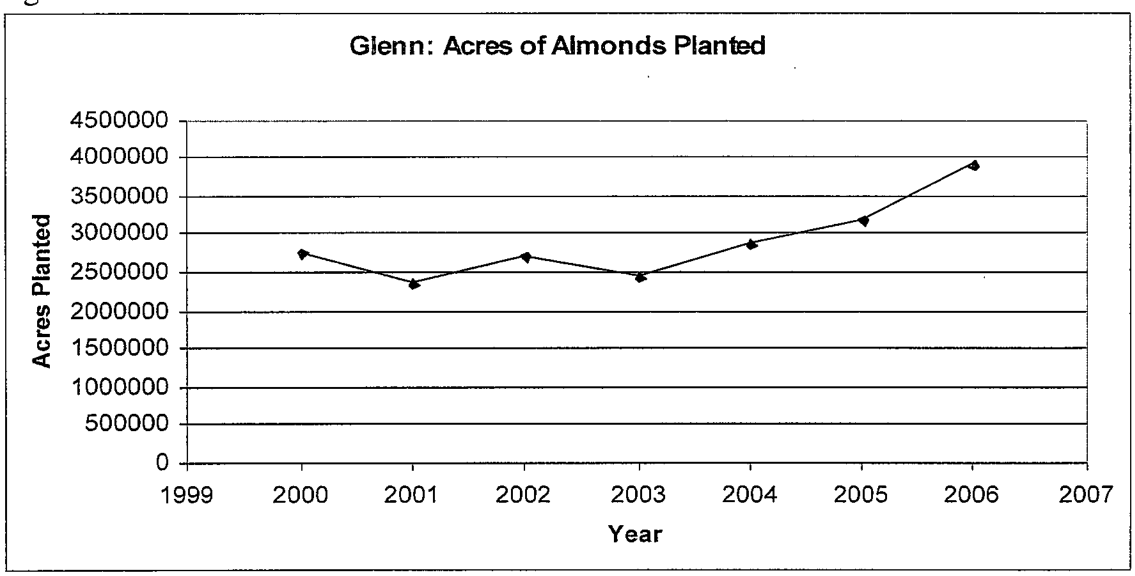

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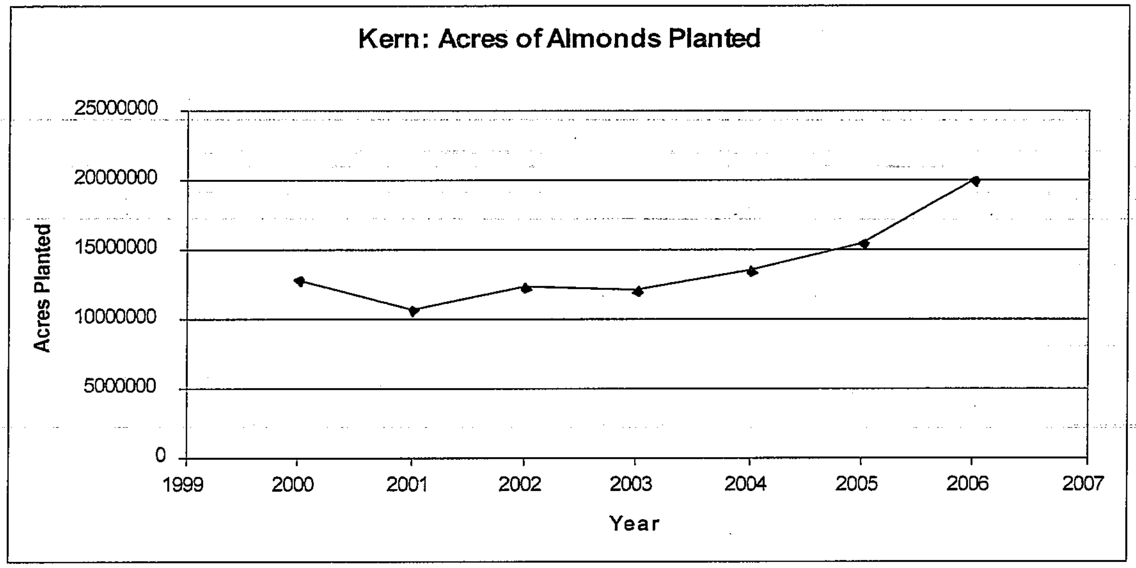

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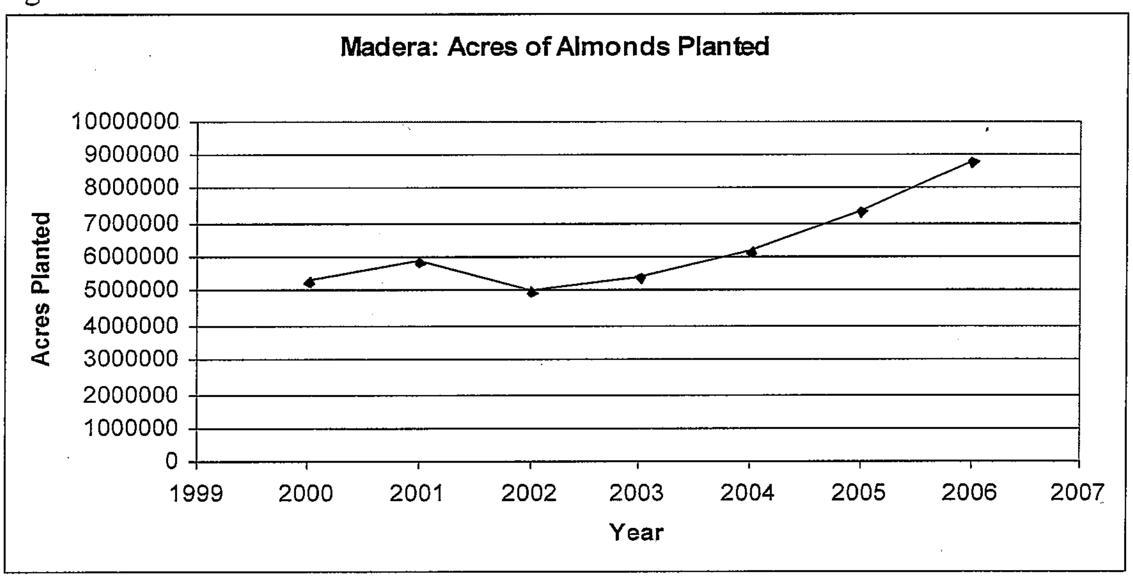

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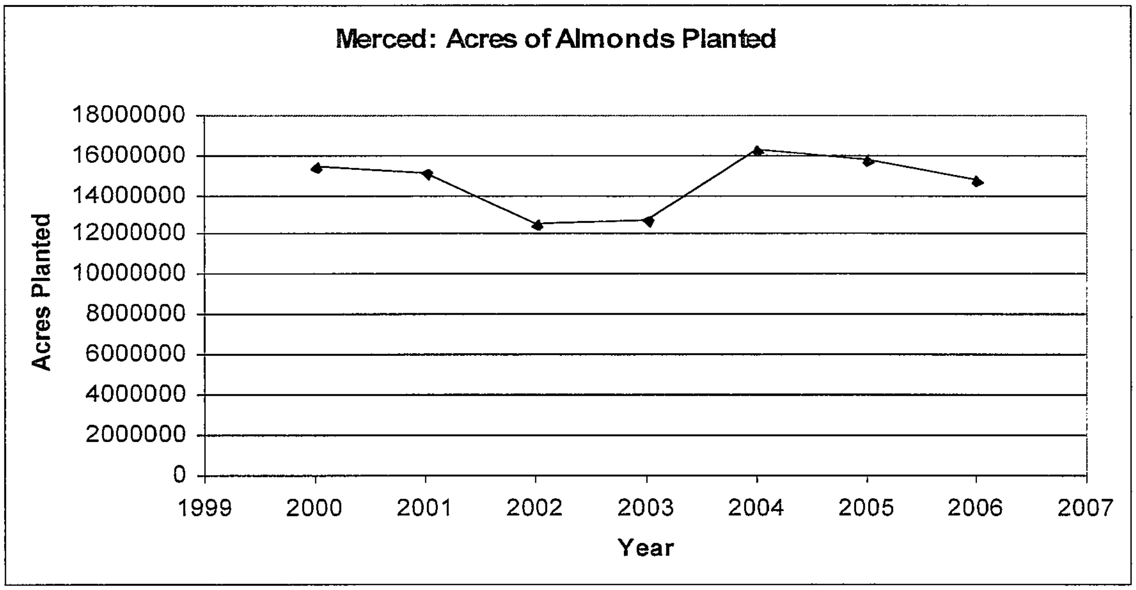

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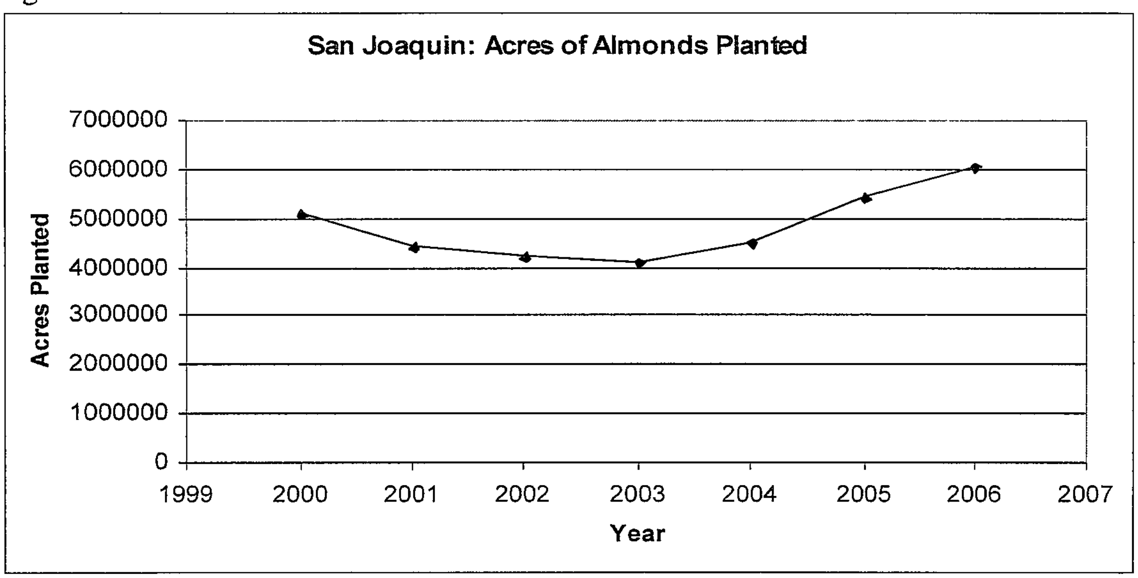

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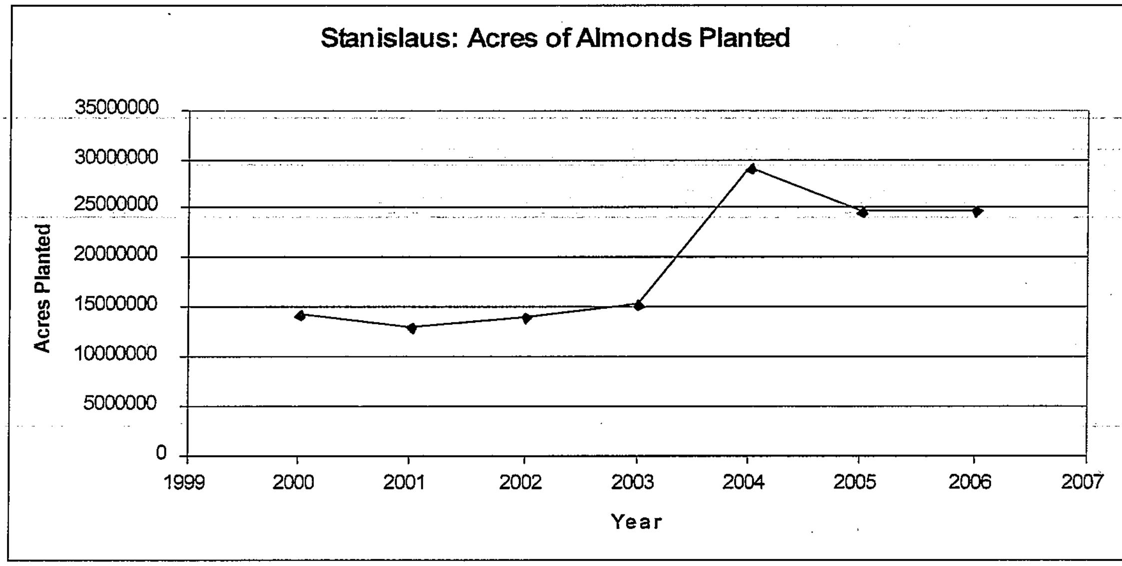

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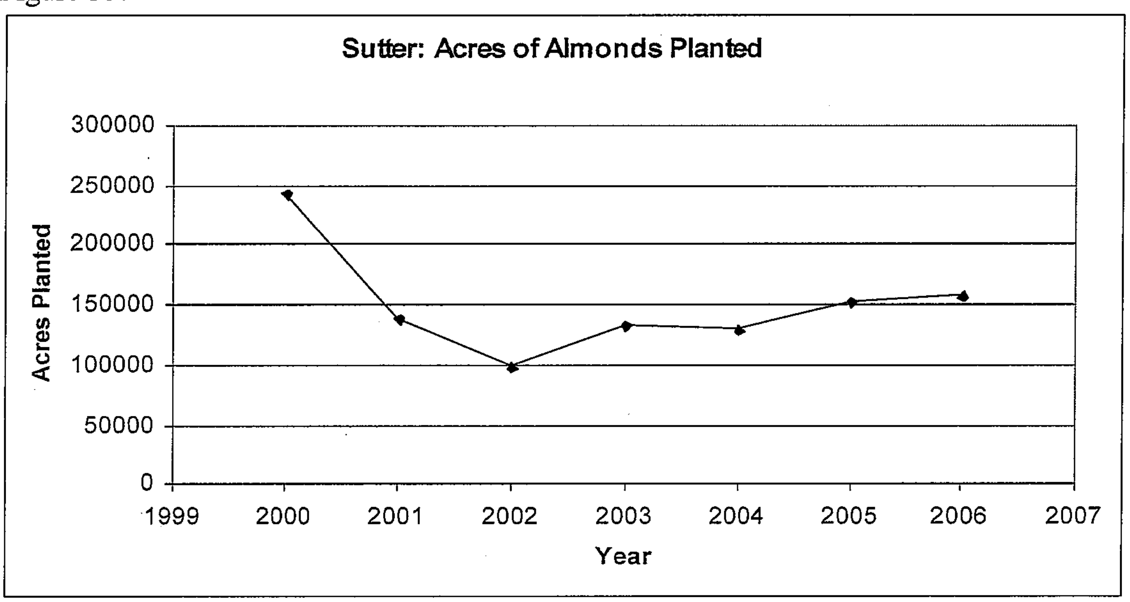

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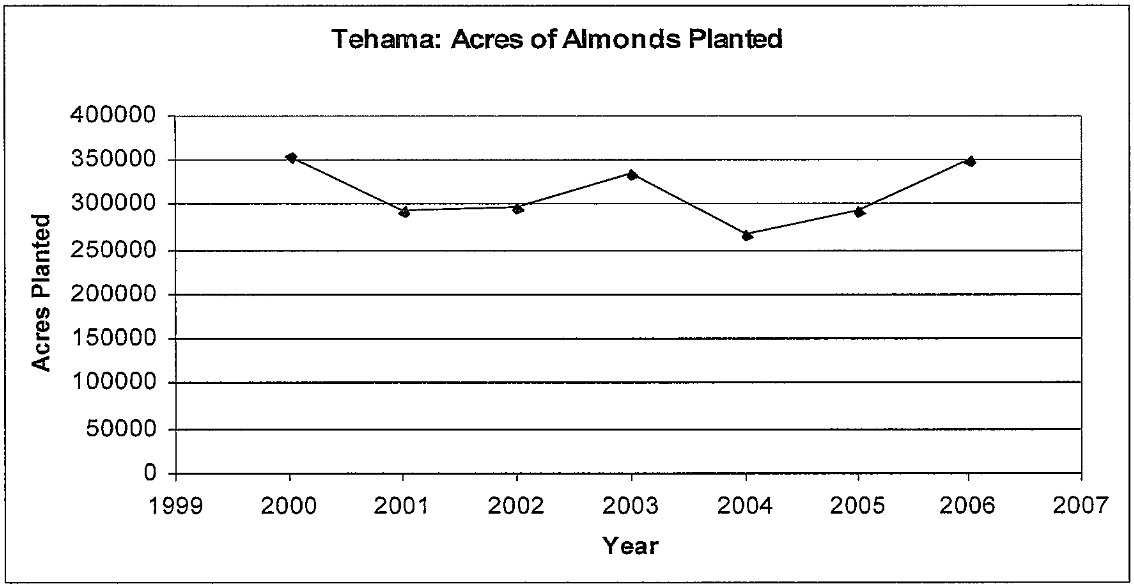

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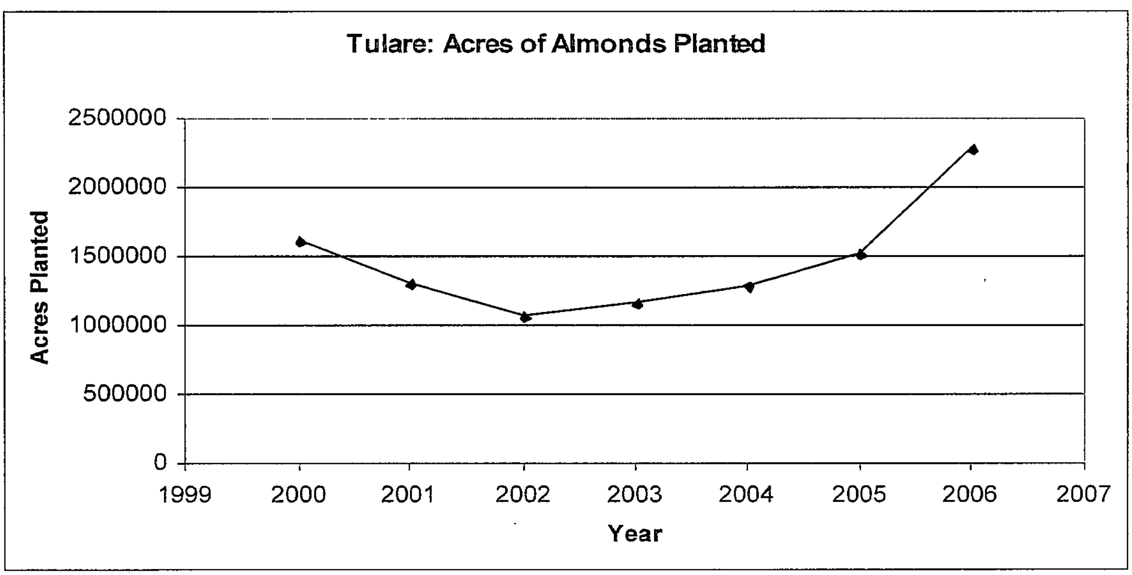

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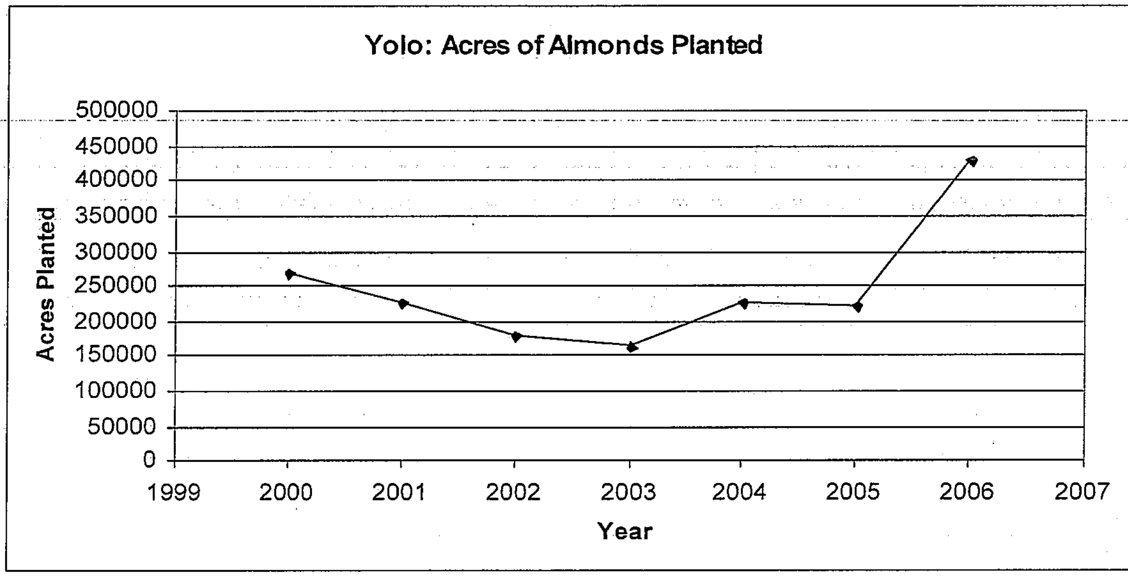

Yolo: Acres of Almonds Planted
500000
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
Acres Planted
1999
2000
2001
2002
2003
2004
2005
2006
2007
Year

Figure 39.

Acres of Almonds Planted

County	Year 2000	2001	2002	2003	2004	2005	2006	Change 2000-2006	% change
STANISLAUS	14369158.2	13176510.7	14172333.1	15325382.3	29141988.1	24780374	24925549.5	10556391.3	73.47%
FRESNO	9652621.8	9387920.35	9459062.6	9422652.36	13112837.2	17818463.7	20117177.1	10464555.28	108.41%
KERN	12908827.7	10760772.6	12371225	12119588.4	13533462.5	15593224.9	20143409	7234581.32	56.04%
MADERA	5337898.36	5899745.25	5035940.16	5453761.92	6200572.95	7412913.72	8837685.04	3499786.68	65.56%
GLENN	2769804	2362280.6	2727624.9	2452447.8	2879400.9	3198023	3924200.09	1154396.09	41.68%
SAN JOAQUIN	5096678.2	4414891.8	4223271.25	4113760.8	4505905	5438330.04	6067026.16	970347.96	19.04%
TULARE	1606910	1293292	1064363.3	1158514.4	1285364.08	1512325.43	2273062	666152	41.46%
COLUSA	942887.4	921640.44	798755.49	717263.36	917566.2	1223573.4	1483083.42	540196.02	57.29%
YOLO	272113	229390	182474.6	165699	227900.8	224723.1	431243	159130	58.48%
TEHAMA	354131.46	291804	296793.9	333469.3	266159.5	291555.05	348944.4	-5187.06	-1.46%
SUTTER	243158.4	139224	98509.5	133612.5	129318	153552	157991.5	-85166.9	-35.03%
MERCED	15395502.6	15113095.4	12547203	12812260.8	16201652.5	15760721.8	14748486	-647016.6	-4.20%
BUTTE	5240851.25	3769138.1	3659120.14	3642907.65	3881340	3691160.7	3571905.04	-1668946.21	-31.84%

Table 1a.

County	2006
STANISLAUS	24925549.5
KERN	20143409
FRESNO	20117177.1
MERCED	14748486
MADERA	8837685.04
SAN JOAQUIN	6067026.16
GLENN	3924200.09
BUTTE	3571905.04
TULARE	2273062
COLUSA	1483083.42
YOLO	431243
TEHAMA	348944.4
SUTTER	157991.5

Table 1b.

County	% change
FRESNO	108.41%
STANISLAUS	73.47%
MADERA	65.56%
YOLO	58.48%
COLUSA	57.29%
KERN	56.04%
GLENN	41.68%
TULARE	41.46%
SAN JOAQUIN	19.04%
TEHAMA	-1.46%
MERCED	-4.20%
BUTTE	-31.84%
SUTTER	-35.03%

Table 1c.

High Risk Carbamates - Use in Pounds per Acre Planted
Dormant Season

County	Year 2000	2001	2002	2003	2004	2005	2006	Yearly Average
KERN	0.07035582	0.01605515	0.00548075				0.00078719	0.01323985
STANISLAUS	0.00037859		0.00329939		0.00025741			0.00056220
MADERA			0.00217950					0.00031136
FRESNO	0.00158009		0.00038733					0.00028106
BUTTE		0.00019315						0.00002759
MERCED							0.00015127	0.00002161
TULARE	0.00000420							0.00000060

Table 2.

High Risk Pyrethroids - Use in Pounds per Acre Planted
Dormant Season

County	Year 2000	2001	2002	2003	2004	2005	2006	Yearly Average
KERN	0.02210258	0.03603418	0.03842582	0.04699985	0.03666261	0.02730109	0.02163721	0.03273762
FRESNO	0.01694045	0.02526619	0.04238805	0.02502983	0.02651669	0.02790813	0.03164235	0.02795595
MADERA	0.00831935	0.02014774	0.01952990	0.02602544	0.01795159	0.03162339	0.03151952	0.02215956
TULARE	0.01628322	0.01154265	0.02686231	0.02211662	0.01709587	0.02115188	0.02378086	0.01983334
SAN JOAQUIN	0.01052319	0.03176092	0.02365114	0.01509218	0.01374023	0.01608112	0.01787968	0.01838978
SUTTER	0.00509311	0.00347688	0.02413906	0.02782104	0.01192937	0.02006529	0.01359613	0.01516012
STANISLAUS	0.01025283	0.01600783	0.01267085	0.01197396	0.00838272	0.01091068	0.01139937	0.01165689
MERCED	0.00877930	0.01315590	0.01208306	0.00716609	0.00969185	0.01394012	0.00952076	0.01061958
GLENN	0.00884248	0.00365578	0.00322828	0.00300868	0.00983163	0.00986666	0.00316329	0.00594240
TEHAMA	0.00386291	0.00974446	0.00842040			0.00637486	0.00466851	0.00472445
COLUSA	0.00629793	0.00442274	0.00486109	0.00501762	0.00113967	0.00288127	0.00219403	0.00383062
BUTTE	0.00059550	0.00175560	0.00116987	0.00082645	0.00370282	0.00102655	0.00178774	0.00155208
YOLO	0.00034377				0.00569344		0.00245497	0.00121317

Table 3.

High Risk Organophosphates - Use in Pounds per Acre Planted
Dormant Season

County	Year 2000	2001	2002	2003	2004	2005	2006	Yearly Average
SAN JOAQUIN	0.15899116	0.32560279	0.20530370	0.34415314	0.39423560	0.32942288	0.47409180	0.31882872
KERN	0.45221100	0.56493727	0.31990346	0.28781736	0.23712848	0.20114497	0.16053239	0.31766785
TULARE	0.36314090	0.36183967	0.35475958	0.15273579	0.23117744	0.10819325	0.09307912	0.23784654
GLENN	0.08312163	0.30654173	0.24659513	0.12613241	0.29812846	0.11436788	0.03099908	0.17226948
SUTTER	0.19598944	0.27071743	0.16396944	0.11449155	0.05304042	0.00124514	0.00117233	0.11437511
TEHAMA	0.05274039	0.09236888	0.13726964	0.14998011	0.14528508	0.07301827	0.06691528	0.10251109
FRESNO	0.21308220	0.19413815	0.06591482	0.04689092	0.08856848	0.02728396	0.07308490	0.10128049
MADERA	0.09419635	0.23329413	0.22954495	0.04643216	0.03550677	0.02862109	0.02851670	0.09944459
STANISLAUS	0.07757495	0.07382429	0.10275378	0.14806525	0.09684043	0.10549139	0.08163707	0.09802674
MERCED	0.03329443	0.10403173	0.05931266	0.06549970	0.08638487	0.05802749	0.09050560	0.07100807
BUTTE	0.07698056	0.06041959	0.09500386	0.02174075	0.07473700	0.06457352	0.01779712	0.05875034
COLUSA		0.00720020		0.01510675	0.01926012	0.00091535		0.00606892

Table 4.

High Risk Carbamate - Use in Pounds per Acre Planted
In-Season

County	Year 2000	2001	2002	2003	2004	2005	2006	Yearly Average
YOLO	0.41740433	0.04882514	0.00948109					0.06795865
SAN JOAQUIN	0.01493381	0.01707855	0.01405622	0.01920591	0.03318595	0.03016863	0.01056294	0.01988457
STANISLAUS	0.01938827	0.03018931	0.01784505	0.01775137	0.01589436	0.00679141	0.00533774	0.01617107
MERCED	0.01690189	0.02969369	0.02383796	0.00567602	0.00596746	0.00365363	0.00557511	0.01304368
BUTTE	0.00258850	0.00352223	0.00315166	0.00019402	0.02237781	0.00433472	0.00086228	0.00529017
FRESNO	0.00901414	0.00001226	0.00020894		0.00551695	0.00699120		0.00310621
TULARE	0.01437226							0.00205318
COLUSA	0.00055624	0.00802048				0.00057269	0.00126224	0.00148738
KERN	0.00524318	0.00020122	0.00138686	0.00198922				0.00126007
MADERA	0.00038734	0.00303274		0.00026431		0.00223277		0.00084531
GLENN	0.00027846	0.00375239	0.00041643					0.00063533
SUTTER	0.00009813							0.00001402

Table 5.

High Risk Organophosphate - Use in Pounds per Acre Planted
In-Season

County	Year 2000	2001	2002	2003	2004	2005	2006	Yearly Average
KERN	2.1186047	1.4448316	1.2761759	1.1670258	1.8536128	0.9669829	2.1166684	1.563414594
FRESNO	0.6427518	0.646595	0.7663332	1.0360076	1.3199296	1.2388265	1.657778	1.044031678
TULARE	1.1258173	0.9406134	0.3953006	0.9056526	1.1431775	0.9318408	1.6201997	1.008943144
TEHAMA	0.8933632	0.6033591	0.807495	0.50091	0.5096818	0.6073489	0.3268213	0.60699704
GLENN	0.7719521	0.3109271	0.4570192	0.5145393	0.79966	0.5388689	0.5495062	0.5632104
MADERA	0.4746507	0.4207168	0.2762693	0.2977861	0.727963	0.298796	0.7137304	0.458558891
STANISLAUS	0.496054	0.5112782	0.3747444	0.481487	0.2628092	0.3286777	0.2883188	0.391909911
BUTTE	0.3981982	0.1694418	0.2669535	0.3814147	0.3652365	0.348619	0.3076339	0.31964249
MERCED	0.3656436	0.2192729	0.1466303	0.2522555	0.3032495	0.2655281	0.3625726	0.273593193
SAN JOAQUIN	0.2223956	0.1622613	0.1813594	0.2310175	0.2414061	0.2352955	0.1518873	0.203660365
COLUSA	0.1397561	0.1647506	0.1286103	0.0654342	0.2970359	0.2701851	0.1338151	0.171369611
SUTTER	0.036165	0.0264093	0.1020241	0.0744629	0.1080609	0.1327975	0.4285576	0.12978247
YOLO	0.1623219	0.0636097	0.0407309	0.0315038	0.0362392	0.263532	0.1098776	0.101116445

Table 6.

High Risk Pyrethroid - Use in Pounds per Acre Planted
In-Season

County	Year 2000	2001	2002	2003	2004	2005	2006	Yearly Average
SAN JOAQUIN	0.0680627	0.0636849	0.0708821	0.0709499	0.067488	0.1067826	0.0765378	0.074912568
MADERA	0.0390557	0.0441447	0.0598134	0.0546339	0.044476	0.0463935	0.0501424	0.048379958
STANISLAUS	0.0367112	0.0419859	0.0486976	0.0434222	0.0205223	0.0360331	0.0419515	0.038474814
FRESNO	0.023678	0.0226925	0.0346615	0.0371869	0.012627	0.026881	0.0573942	0.030731593
MERCED	0.0206194	0.0254704	0.0215902	0.0344296	0.0267346	0.0237568	0.0451517	0.028250368
KERN	0.0233791	0.0499624	0.0184315	0.0055775	0.0088511	0.0061291	0.0179524	0.018611875
GLENN	0.00373	0.013815	0.0090575	0.0081931	0.0222215	0.008641	0.063898	0.018507998
BUTTE	0.0102325	0.0215189	0.0092935	0.0112058	0.0249463	0.0158101	0.0294356	0.017491813
TEHAMA	0.0022932	0.0138193	0.0072441	0.0159552	0.0268044	0.0105858	0.021466	0.014023985
SUTTER	0.0150159	0.0013327	0.0064994	0.0105309	0.0009038	0.0018033	0.0048217	0.005843951
TULARE	0.0043827	0.0082807		0.0059623	0.0016282	0.0003545	0.0096992	0.004329653
COLUSA	0.0003986	0.0042048	0.0018287	0.0007341	0.001	0.0033229	0.0172385	0.004103931
YOLO	0.0022497	0.003599	0.0017868	0.0003976	0.0024171	0.0003649	0.0042138	0.002146988

Table 7.

High Risk Carbamate - Use in Total Pounds of AI

Dormant Season

Year

County	2000	2001	2002	2003	2004	2005	2006	Yearly Average
KERN	8109.03	1775.77	574.61				121.97	1511.63
STANISLAUS	32.00		280.00		40.77			50.40
FRESNO	124.00		30.03					22.00
MADERA			119.30					17.04
MERCED							13.12	1.87
BUTTE		8.00						1.14
TULARE	0.07							0.01

Table 8.

High Risk Organophosphate - Use in Total Pounds of AI

Dormant Season

Year

County	2000	2001	2002	2003	2004	2005	2006	Yearly Average
KERN	52042.98	61153.46	33538.96	30135.19	26306.56	28133.94	24835.77	36592.41
SAN JOAQUIN	5706.63	10928.29	6935.21	11798.03	14206.86	12501.39	19402.77	11639.88
STANISLAUS	6551.59	6206.41	8716.12	14076.63	13938.08	15340.79	11000.29	10832.84
FRESNO	16721.97	15689.25	5134.70	3965.56	8477.00	3156.87	9388.31	8933.38
MERCED	2949.25	9066.58	4961.39	5670.26	7907.22	5399.61	7855.27	6258.51
MADERA	5178.29	13082.28	12564.94	2637.81	2223.86	1922.77	2172.60	5683.22
GLENN	2390.26	8907.46	7391.42	3772.36	9230.44	3846.55	1181.03	5245.65
TULARE	5755.40	5212.45	4916.93	2211.83	3822.64	2074.83	2115.75	3729.97
BUTTE	3228.23	2505.68	3698.20	851.61	2901.16	2543.77	718.11	2349.54
TEHAMA	397.84	673.84	1044.64	1163.11	1045.11	495.09	555.95	767.94
SUTTER	992.84	1256.35	598.24	437.07	244.97	5.97	5.97	505.92
COLUSA		158.00		338.61	435.56	32.00		137.74

Table 9.

High Risk Pyrethroid - Use in Total Pounds of AI

Dormant Season

Year

County	2000	2001	2002	2003	2004	2005	2006	Yearly Average
KERN	2545.66	3889.43	4028.12	4920.21	4159.84	3644.70	3334.51	3788.92
FRESNO	1327.19	2040.56	3304.22	2124.75	2519.81	3119.19	4097.23	2647.57
MADERA	456.84	1127.27	1071.21	1477.11	1119.97	2092.11	2386.71	1390.18
STANISLAUS	866.20	1344.33	1074.11	1138.08	1254.26	1482.71	1536.14	1242.26
MERCED	780.28	1149.43	1012.60	620.36	886.35	1295.16	827.52	938.82
SAN JOAQUIN	377.71	1069.21	798.99	517.38	494.91	609.49	729.52	656.75
TULARE	257.11	167.93	371.65	319.86	275.82	411.91	536.85	334.45
GLENN	260.27	106.27	96.76	89.98	304.40	332.15	120.52	187.19
COLUSA	140.92	97.24	99.88	112.47	29.05	99.90	83.43	94.70
SUTTER	24.36	16.22	88.07	106.21	55.10	96.28	69.29	65.07
BUTTE	24.97	72.74	45.54	32.37	143.72	40.52	72.56	61.78
TEHAMA	29.74	71.09	64.08			43.22	38.79	35.27
YOLO	2.03				40.55		27.86	10.06

Table 10.

High Risk Carbamate - Use in Total Pounds of AI
In-Season

County	Year 2000	2001	2002	2003	2004	2005	2006	Yearly Average
STANISLAUS	1638.78	2533.69	1514.41	1689.73	2517.35	919.64	719.17	1647.54
MERCED	1495.48	2579.10	1994.00	491.37	546.23	342.76	483.67	1133.23
SAN JOAQUIN	536.01	571.21	474.91	658.40	1196.26	1147.32	433.01	716.73
FRESNO	707.40	1.00	16.20		528.05	808.91		294.51
BUTTE	108.53	145.89	122.68	7.60	868.56	172.04	35.00	208.61
KERN	604.32	21.02	145.40	207.83				139.80
MADERA	21.32	170.40		15.02		153.25		51.43
COLUSA	12.49	176.00				20.02	48.00	36.64
TULARE	228.66							32.67
GLENN	8.21	108.10	12.48					18.40
SUTTER	0.50							0.07

Table 11.

High Risk Organophosphate - Use in Total Pounds of AI
In-Season

County	Year 2000	2001	2002	2003	2004	2005	2006	Yearly Average
KERN	244184.85	150946.64	133795.42	121929.94	212591.52	137076.20	327976.29	189785.84
FRESNO	50440.98	52784.19	59416.35	87945.40	126335.93	143337.57	216557.23	105259.66
STANISLAUS	41928.70	42909.96	31802.41	45832.13	41623.82	44506.86	38845.97	41064.26
MADERA	26119.97	23639.26	15122.56	16917.23	45593.81	20508.79	54376.93	28896.94
MERCED	32352.11	19045.36	12265.33	21837.59	27757.87	24910.20	31455.27	24231.96
GLENN	22746.34	8957.28	13698.65	15388.79	24758.51	18140.16	20935.65	17803.63
TULARE	17911.75	13368.00	5464.20	13115.14	19083.11	18301.90	36828.14	17724.61
BUTTE	16695.18	7018.13	10391.65	14940.41	14176.07	13836.65	12486.81	12792.13
SAN JOAQUIN	7982.25	5427.01	6127.44	7919.59	8702.02	8948.35	6226.38	7333.29
COLUSA	3137.48	3615.26	2634.06	1466.67	7570.84	9445.47	5088.69	4708.35
TEHAMA	6877.57	4401.57	6145.12	3884.61	3666.40	4118.04	2715.30	4544.08
SUTTER	183.20	122.56	372.23	284.26	499.08	637.23	2184.14	611.82

Table 12.

High Risk Pyrethroid - Use in Total Pounds of AI
In-Season

County	Year 2000	2001	2002	2003	2004	2005	2006	Yearly Average
STANISLAUS	3102.99	3523.74	4132.69	4133.30	3250.32	4879.31	5652.23	4096.37
FRESNO	1858.17	1852.48	2687.42	3156.75	1208.58	3110.25	7497.47	3053.02
MADERA	2149.23	2480.41	3274.10	3103.75	2785.62	3184.36	3820.19	2971.10
SAN JOAQUIN	2442.91	2130.02	2394.83	2432.26	2432.76	4060.97	3137.54	2718.76
MERCED	1824.40	2212.28	1805.98	2980.55	2447.14	2228.71	3917.17	2488.03
KERN	2694.61	5219.75	1932.38	582.73	1015.14	868.84	2781.72	2156.45
BUTTE	429.02	891.29	361.76	438.94	968.25	627.50	1194.79	701.65
GLENN	109.91	397.99	271.49	245.04	688.01	290.89	2434.45	633.97
COLUSA	8.95	92.27	37.45	16.45	25.49	116.17	655.54	136.05
TEHAMA	17.65	100.81	55.13	123.73	192.82	71.78	178.34	105.75
TULARE	69.73	117.69		86.34	27.18	6.96	220.47	75.48
SUTTER	76.07	6.18	23.71	40.20	4.17	8.65	24.57	26.22

Table 13.

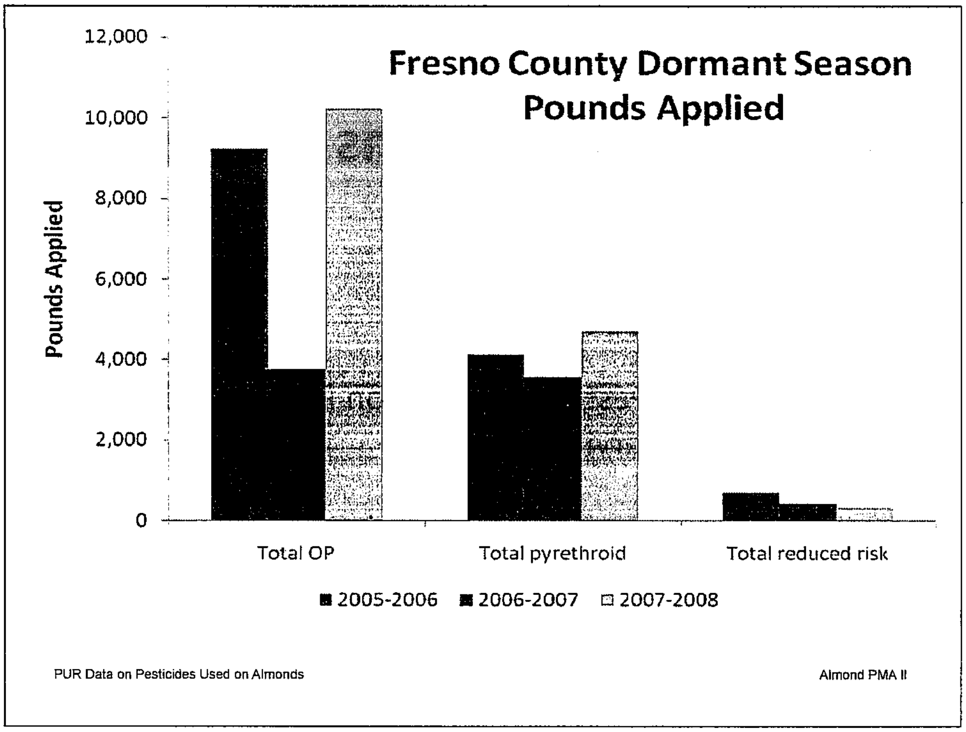
Reported Pesticide Applications on Almond Orchards in Five Counties, 2006-2008

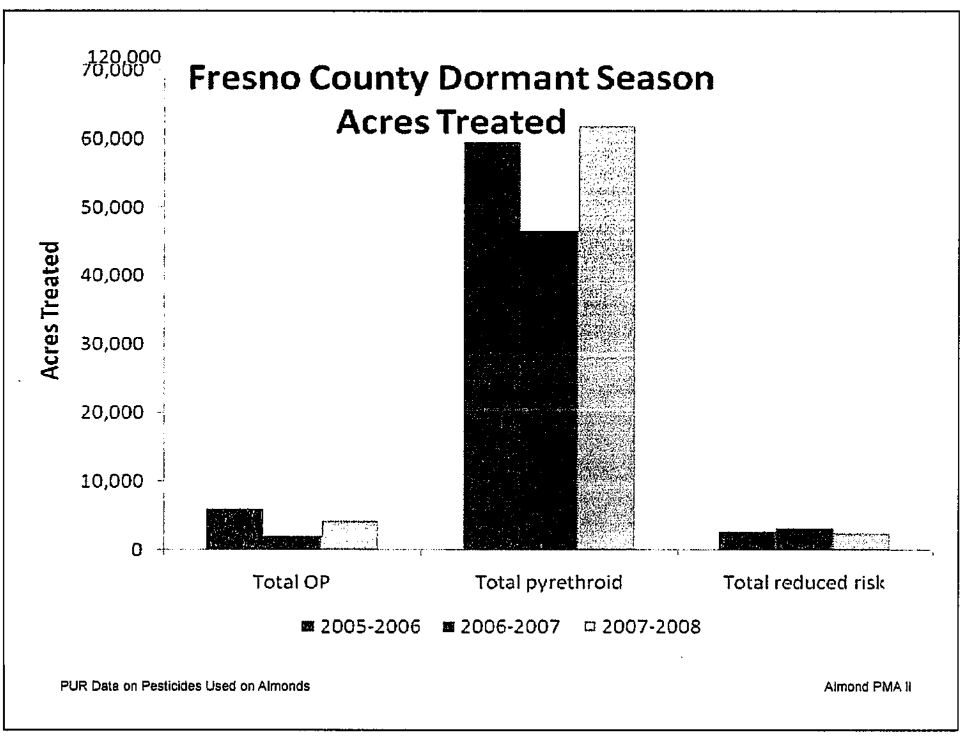
Data Compiled by Patti TenBrook, USEPA Region 9

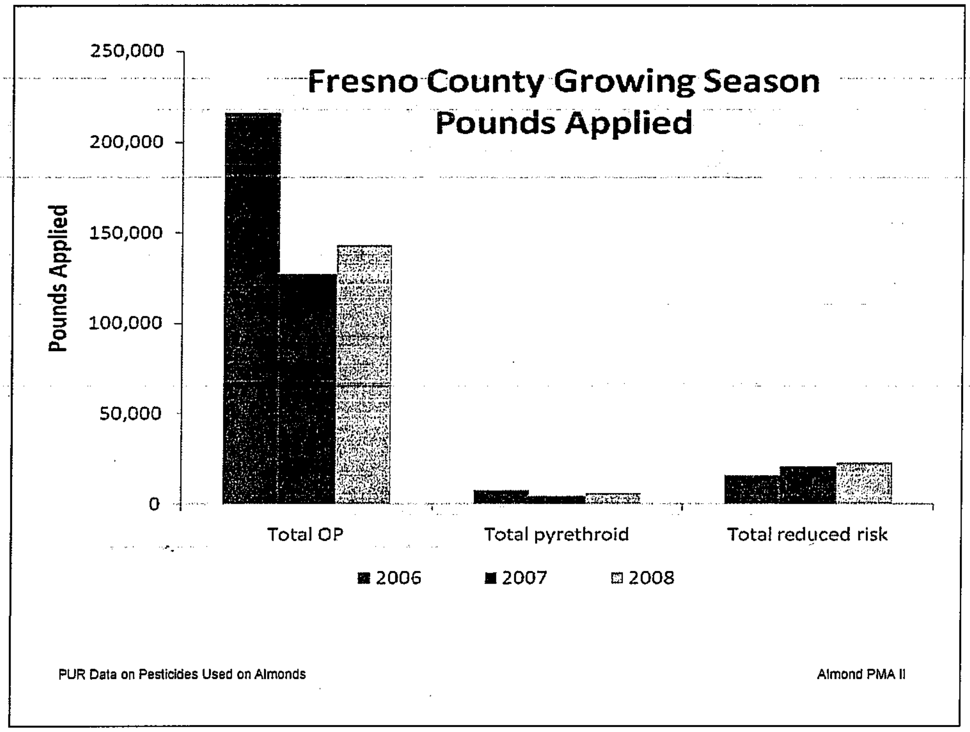
From the California Department of Pesticide Regulation Pesticide Use Reporting Database and the National Agricultural Statistics Service
April 2010

Reported Use in Fresno, Merced, San Joaquin, Sutter and Yolo counties of Organophosphate, pyrethroid and reduced risk pesticides. Reduced risk pesticides include

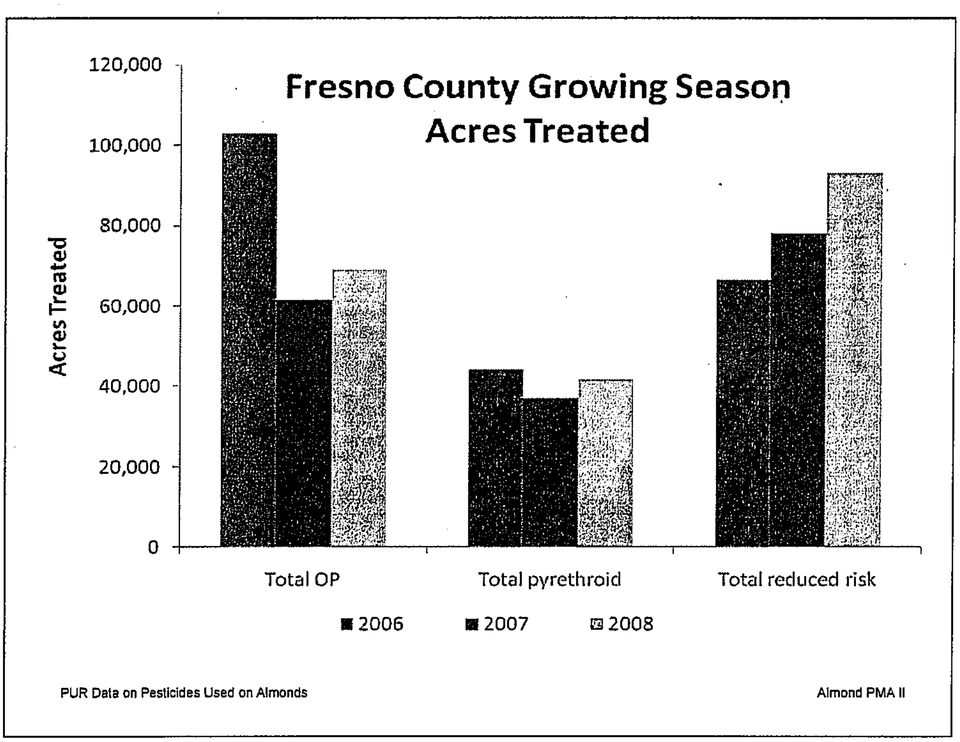
Intrepid™ – (Methoxyfenozide)
Dimilin™ – (Diflubenzuron)
Bacillis thuringiensis
Delegate™ – (Spinetoram)
Success/Entrust™ – (Spinosad)

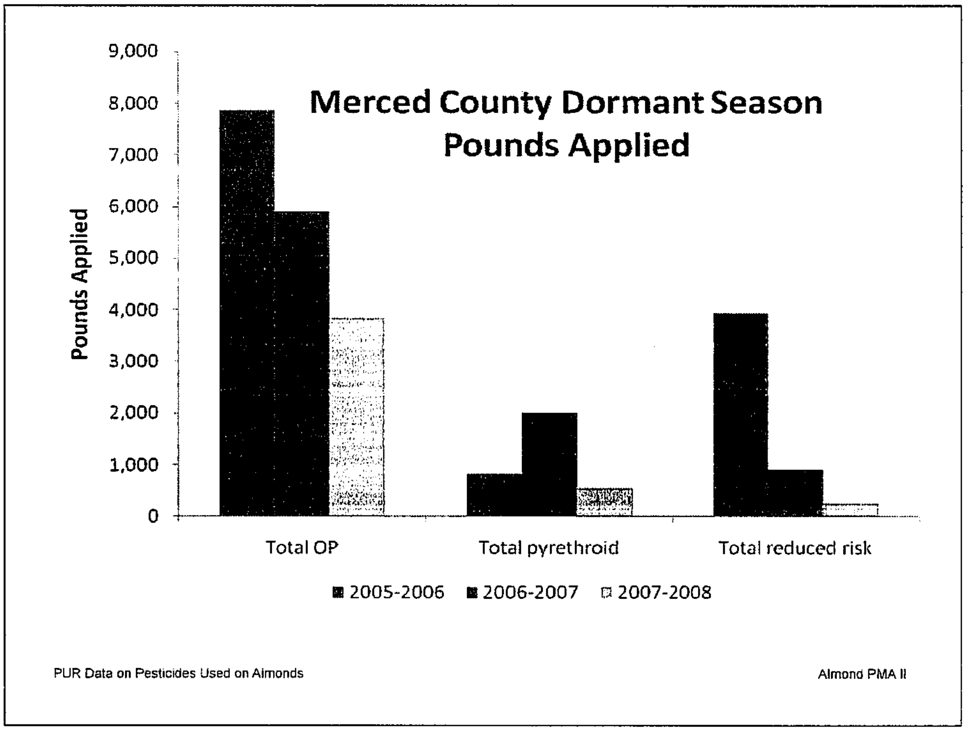

Fresno County Dormant Season
Pounds Applied
Pounds Applied
12,000
10,000
8,000
6,000
4,000
2,000
0
Total OP
Total pyrethroid
Total reduced risk
2005-2006
2006-2007
2007-2008
PUR Data on Pesticides Used on Almonds
Almond PMA II

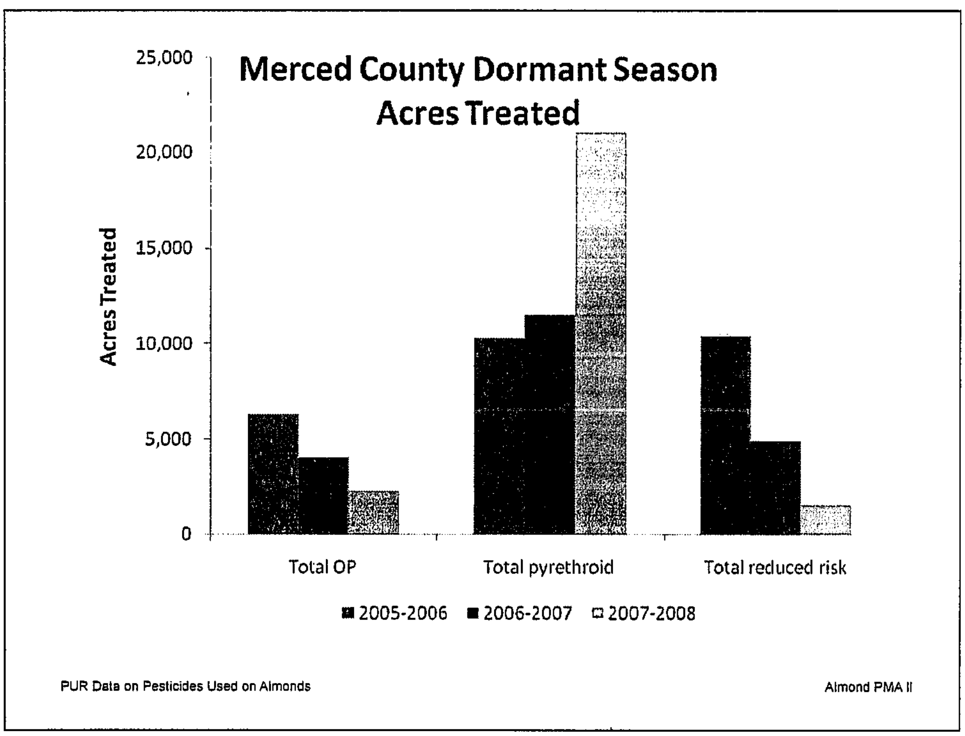

Fresno County Dormant Season
Acres Treated
Acres Treated
120,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Total OP
Total pyrethroid
Total reduced risk
2005-2006
2006-2007
2007-2008
PUR Data on Pesticides Used on Almonds
Almond PMA II

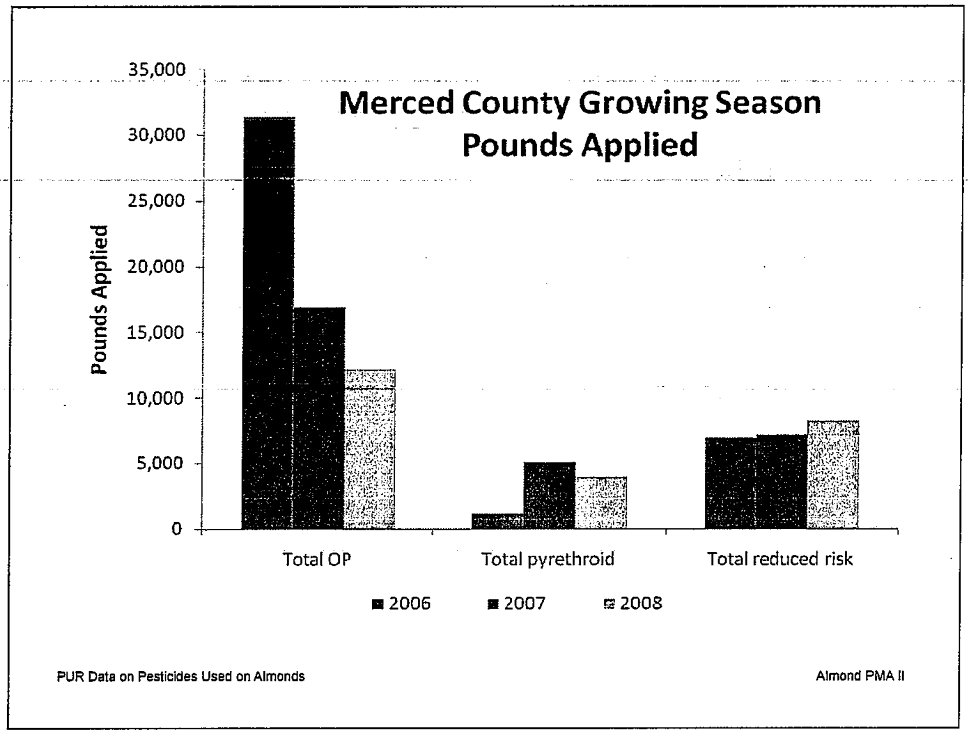

Fresno County Growing Season
Pounds Applied
250,000
200,000
150,000
100,000
50,000
0
Pounds Applied
Total OP
Total pyrethroid
Total reduced risk
2006
2007
2008
PUR Data on Pesticides Used on Almonds
Almond PMA II

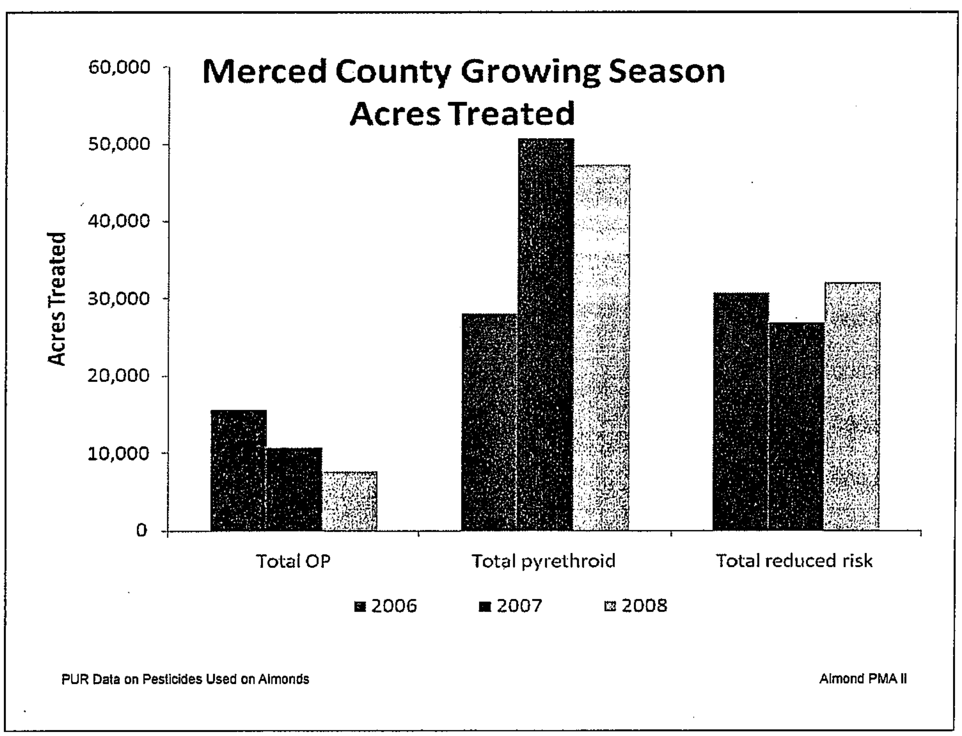
Almond

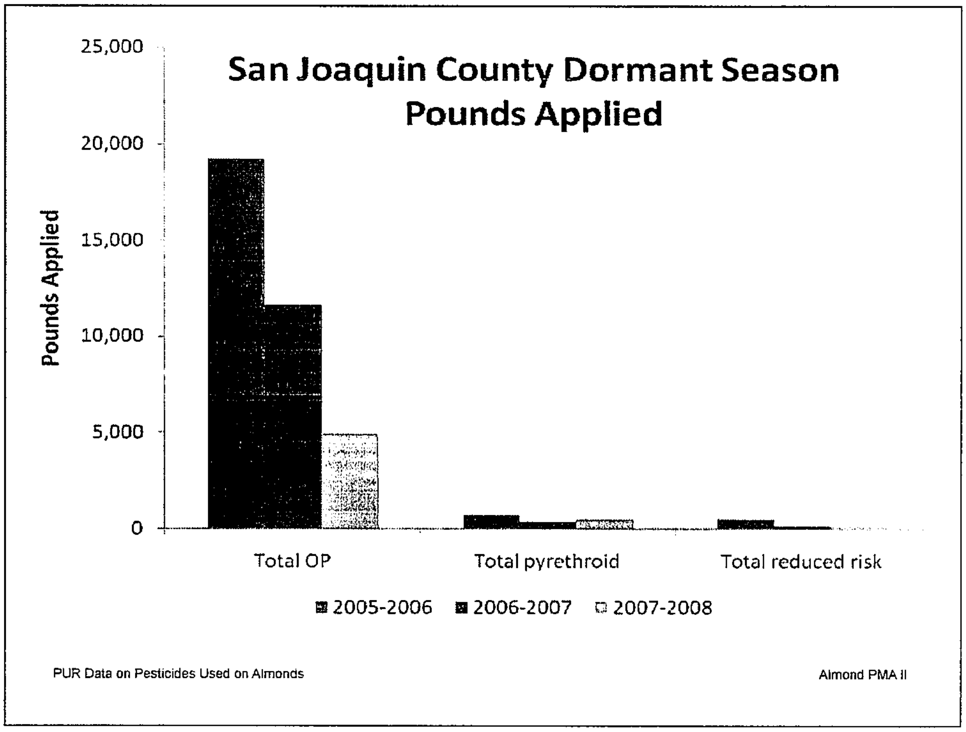

Fresno County Growing Season
Acres Treated
120,000
100,000
80,000
60,000
40,000
20,000
0
Acres Treated
Total OP
Total pyrethroid
Total reduced risk
2006
2007
2008
PUR Data on Pesticides Used on Almonds
Almond PMA II

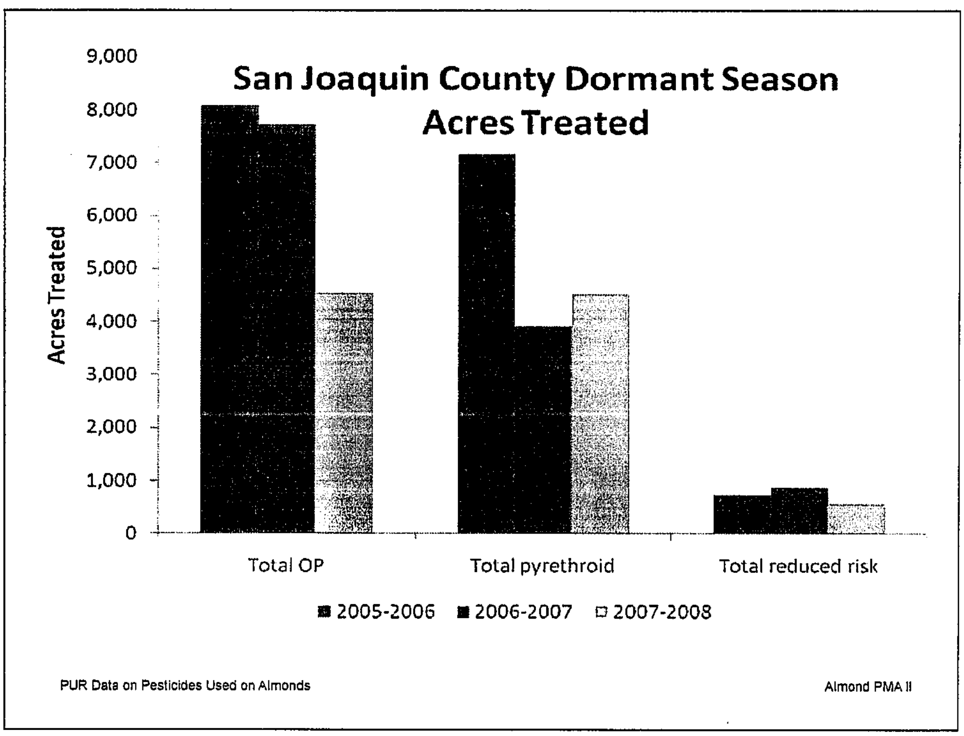

Merced County Dormant Season
Pounds Applied
Pounds Applied
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Total OP
Total pyrethroid
Total reduced risk
2005-2006
2006-2007
2007-2008
PUR Data on Pesticides Used on Almonds
Almond PMA II

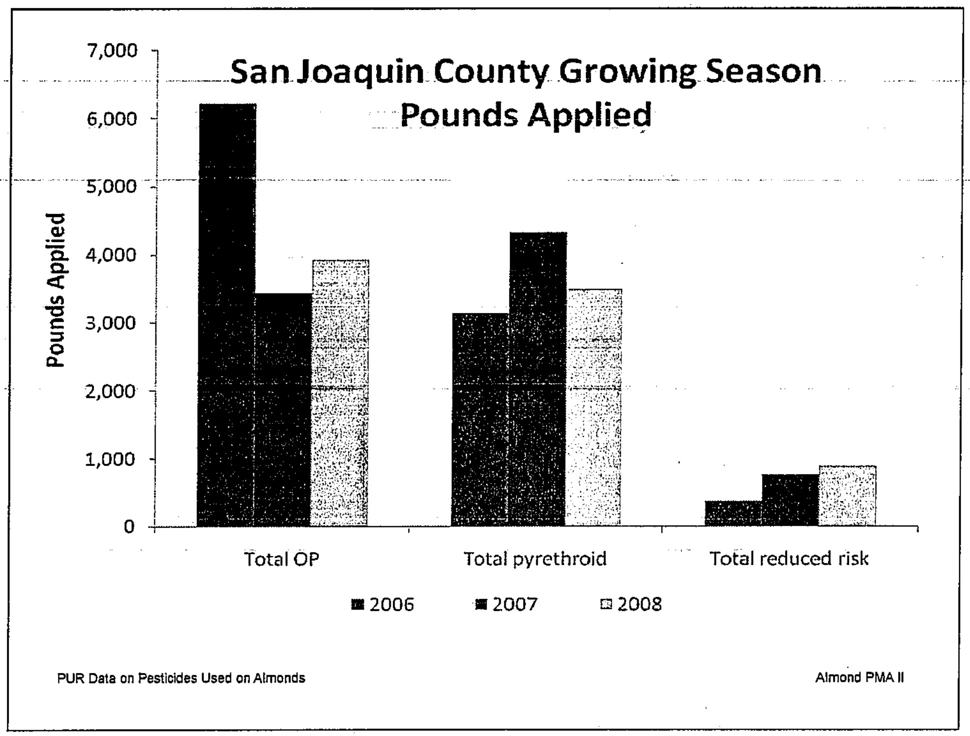

Merced County Dormant Season
Acres Treated
Acres Treated
25,000
20,000
15,000
10,000
5,000
0
Total OP
Total pyrethroid
Total reduced risk
2005-2006
2006-2007
2007-2008
PUR Data on Pesticides Used on Almonds
Almond PMA II

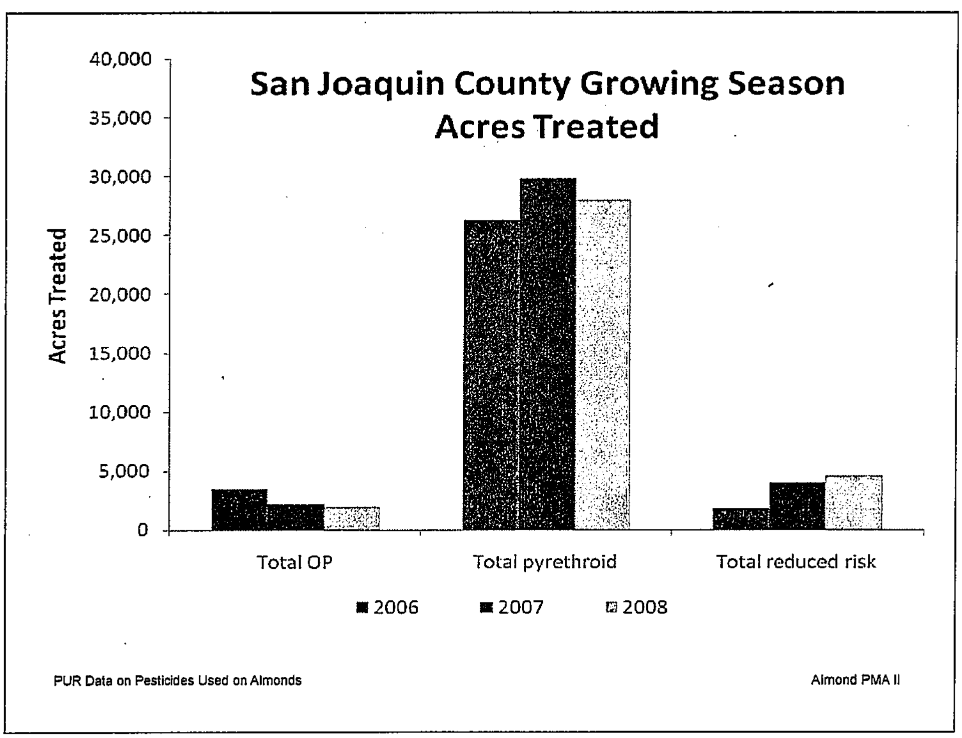

Merced County Growing Season
Pounds Applied
Pounds Applied
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Total OP
Total pyrethroid
Total reduced risk
2006
2007
2008
PUR Data on Pesticides Used on Almonds
Almond PMA II

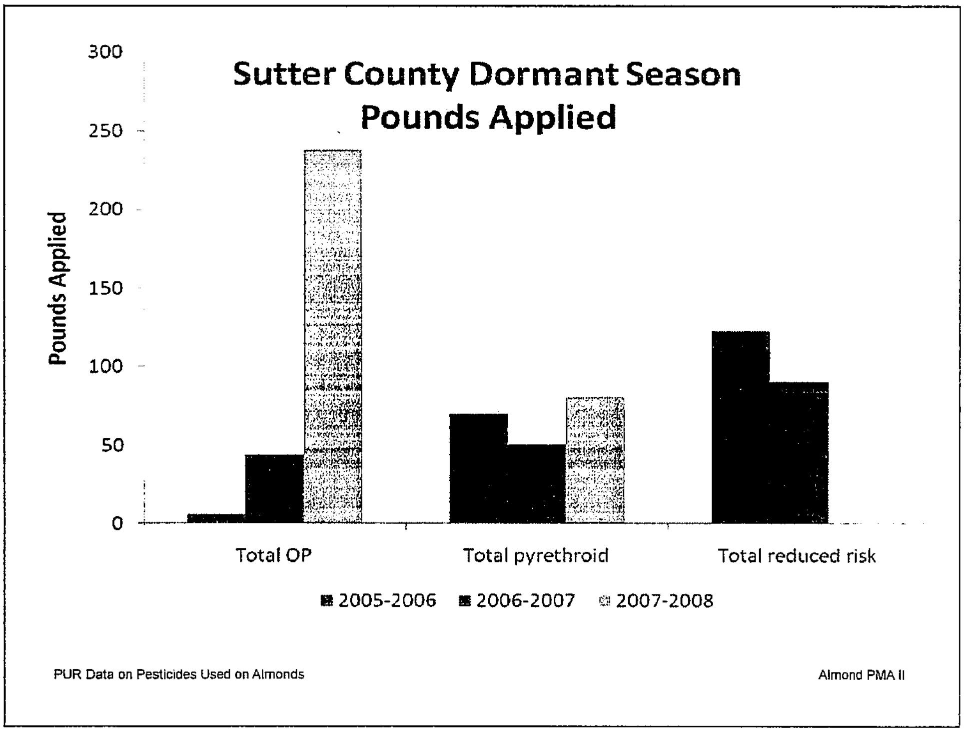

Merced County Growing Season
Acres Treated
Acres Treated
60,000
50,000
40,000
30,000
20,000
10,000
0
Total OP
Total pyrethroid
Total reduced risk
2006
2007
2008
PUR Data on Pesticides Used on Almonds
Almond PMA II

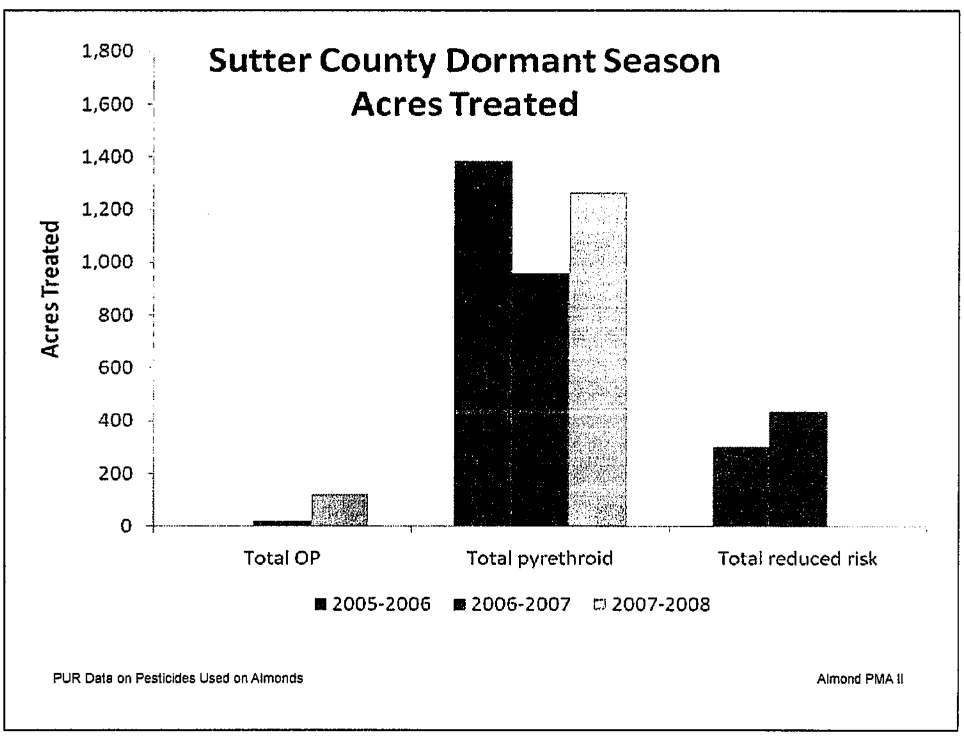

San Joaquin County Dormant Season
Pounds Applied
Pounds Applied
25,000
20,000
15,000
10,000
5,000
0
Total OP
Total pyrethroid
Total reduced risk
2005-2006
2006-2007
2007-2008
PUR Data on Pesticides Used on Almonds
Almond PMA II

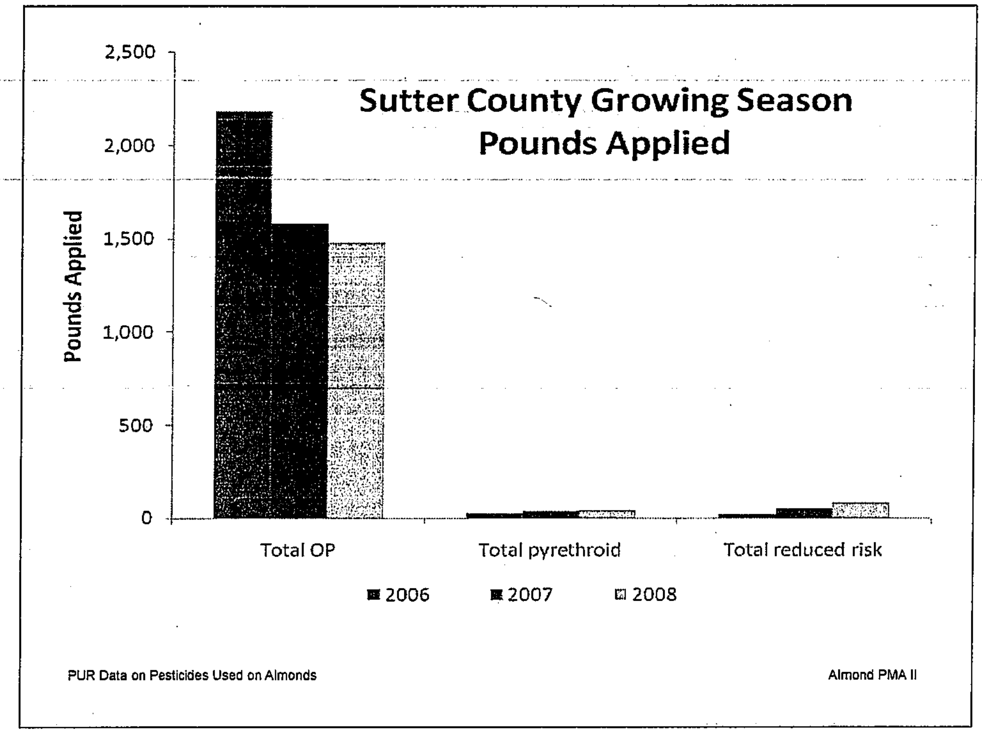

San Joaquin County Dormant Season
Acres Treated
Acres Treated
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Total OP
Total pyrethroid
Total reduced risk
2005-2006
2006-2007
2007-2008
PUR Data on Pesticides Used on Almonds
Almond PMA II


San Joaquin County Growing Season
Pounds Applied
Pounds Applied
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Total OP
Total pyrethroid
Total reduced risk
2006
2007
2008
PUR Data on Pesticides Used on Almonds
Almond PMA II

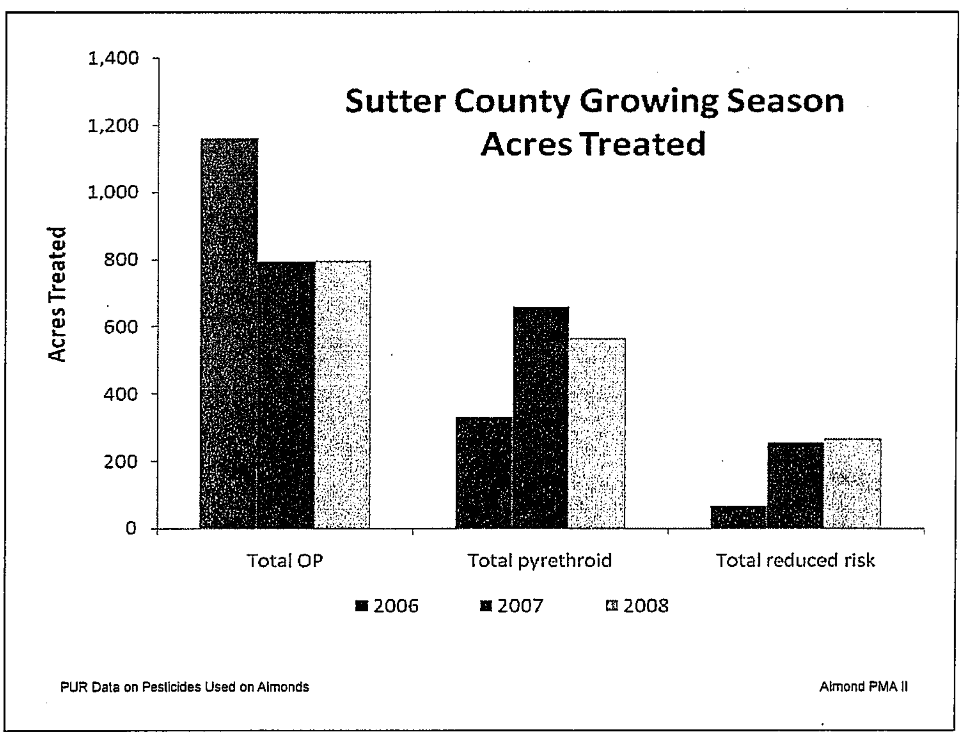

San Joaquin County Growing Season
Acres Treated
Acres Treated
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Total OP
Total pyrethroid
Total reduced risk
2006
2007
2008
PUR Data on Pesticides Used on Almonds
Almond PMA II


Sutter County Dormant Season
Pounds Applied
Pounds Applied
300
250
200
150
100
50
0
Total OP
Total pyrethroid
Total reduced risk
2005-2006
2006-2007
2007-2008
PUR Data on Pesticides Used on Almonds
Almond PMA II

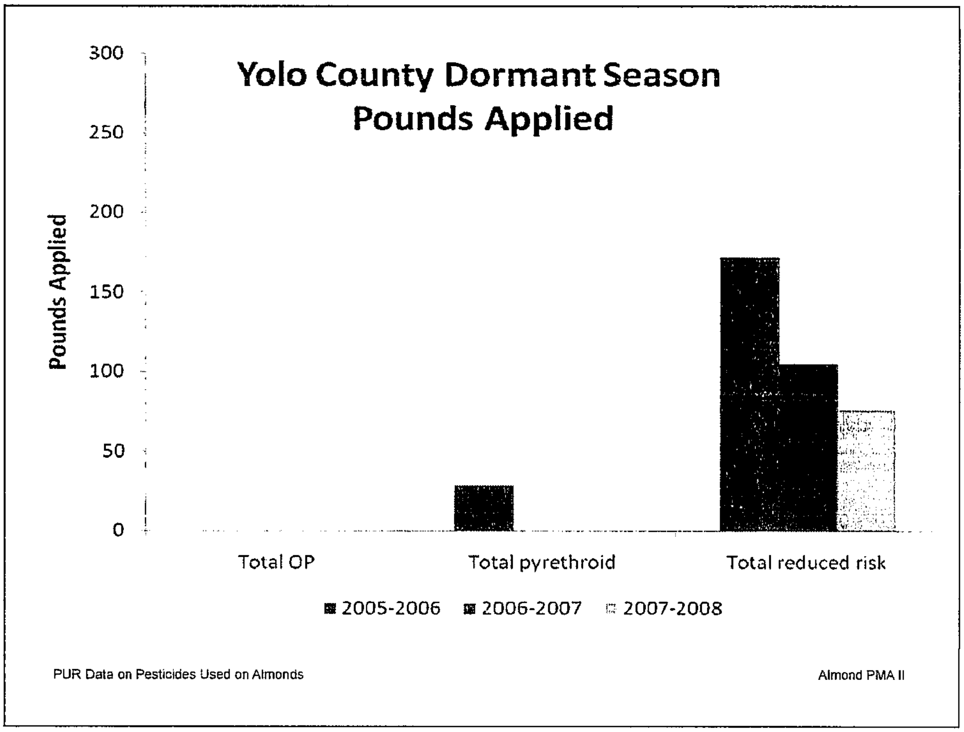

Sutter County Dormant Season
Acres Treated
Acres Treated
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
Total OP
Total pyrethroid
Total reduced risk
2005-2006
2006-2007
2007-2008
PUR Data on Pesticides Used on Almonds
Almond PMA II

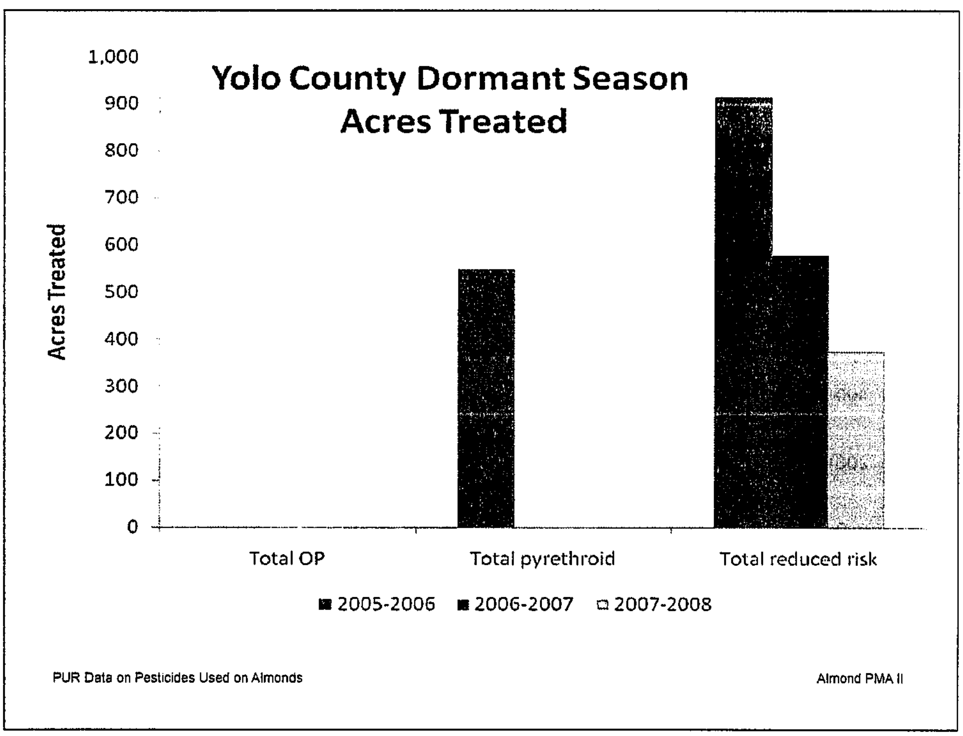


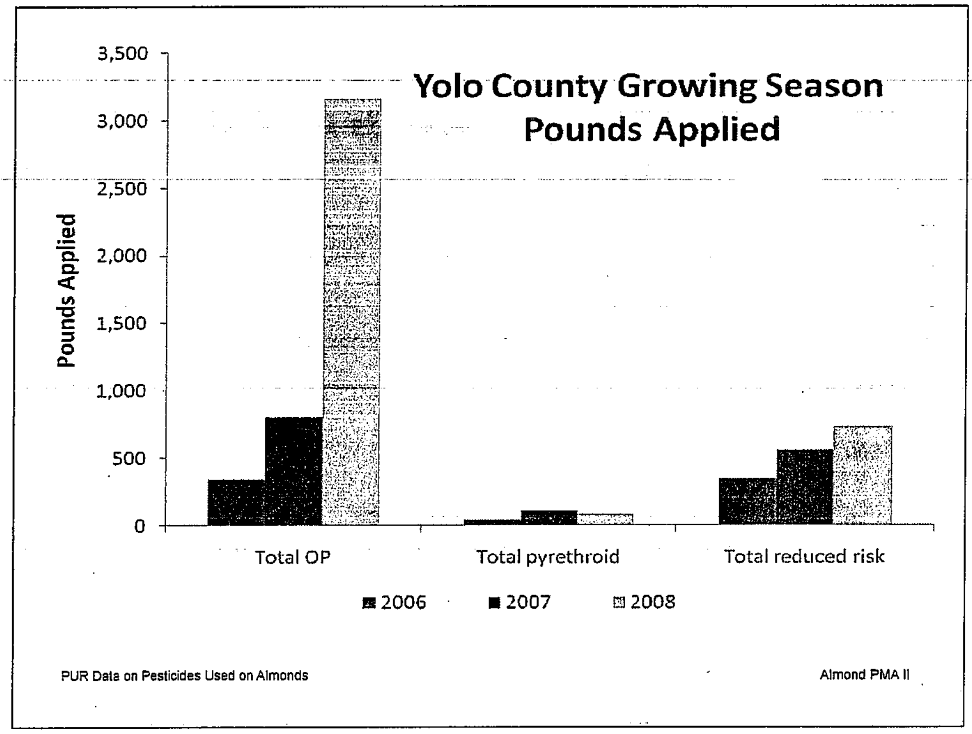
Sutter County Growing Season
Pounds Applied
Pounds Applied
2,500
2,000
1,500
1,000
500
0
Total OP
Total pyrethroid
Total reduced risk
2006
2007
2008
PUR Data on Pesticides Used on Almonds
Almond PMA II

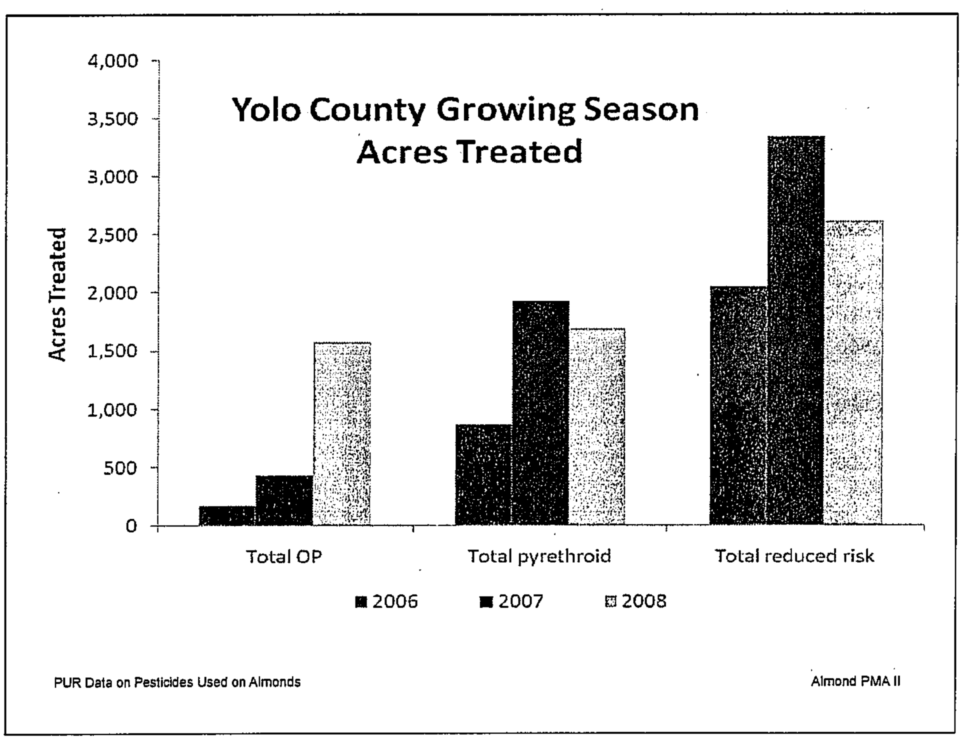


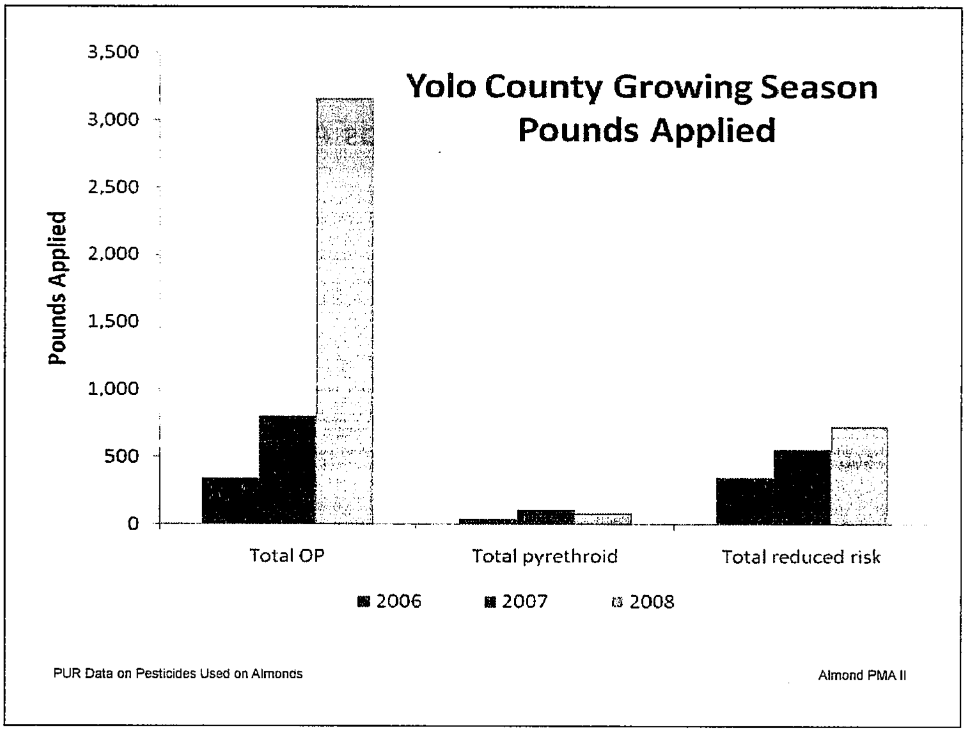
Sutter County Growing Season
Acres Treated
Acres Treated
1,400
1,200
1,000
800
600
400
200
0
Total OP
Total pyrethroid
Total reduced risk
2006
2007
2008
PUR Data on Pesticides Used on Almonds
Almond PMA II

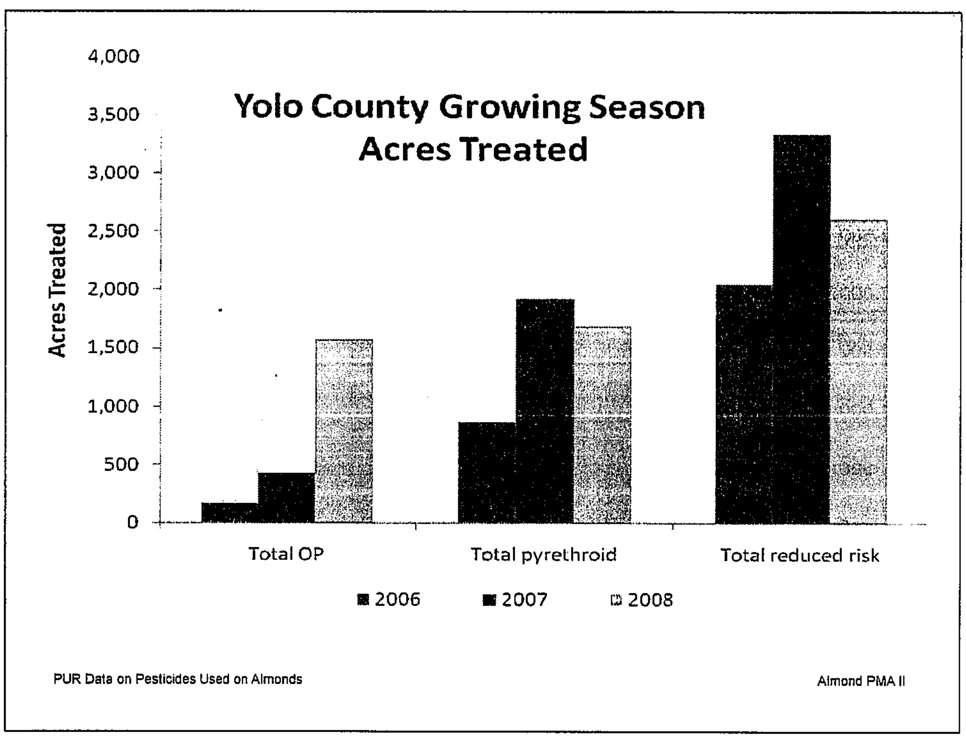

Yolo County Dormant Season
Pounds Applied
300
250
200
150
100
50
0
Pounds Applied
Total OP
Total pyrethroid
Total reduced risk
2005-2006
2006-2007
2007-2008
PUR Data on Pesticides Used on Almonds
Almond PMA II


Yolo County Dormant Season
Acres Treated
1,000
900
800
700
600
500
400
300
200
100
0
Acres Treated
Total OP
Total pyrethroid
Total reduced risk
2005-2006
2006-2007
2007-2008
PUR Data on Pesticides Used on Almonds
Almond PMA II

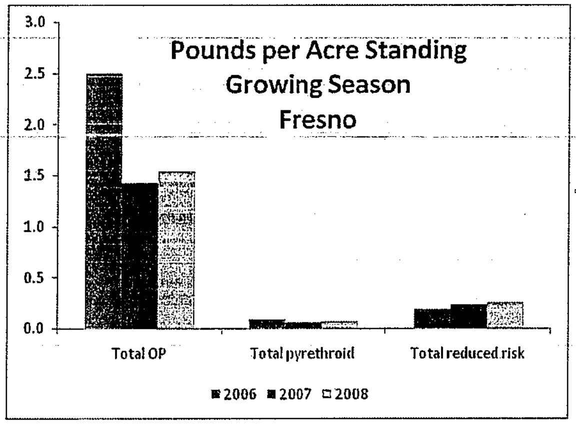

Yolo County Growing Season
Pounds Applied
Pounds Applied
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Total OP
Total pyrethroid
Total reduced risk
2006
2007
2008
PUR Data on Pesticides Used on Almonds
Almond PMA II

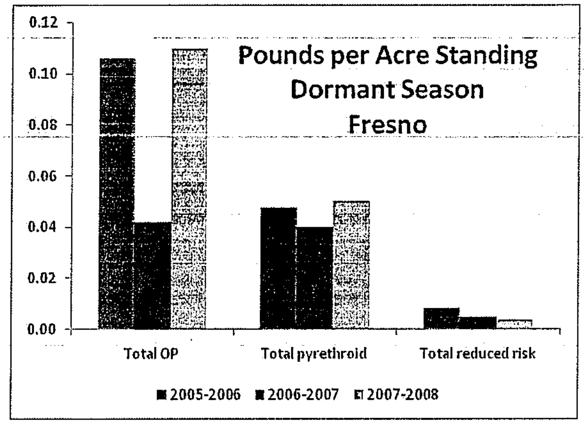

Yolo County Growing Season
Acres Treated
Acres Treated
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Total OP
Total pyrethroid
Total reduced risk
2006
2007
2008
PUR Data on Pesticides Used on Almonds
Almond PMA II

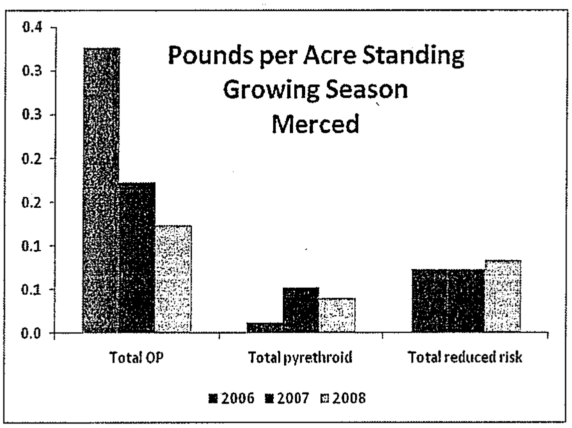

Yolo County Growing Season
Pounds Applied
Pounds Applied
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Total OP
Total pyrethroid
Total reduced risk
2006
2007
2008
PUR Data on Pesticides Used on Almonds
Almond PMA II

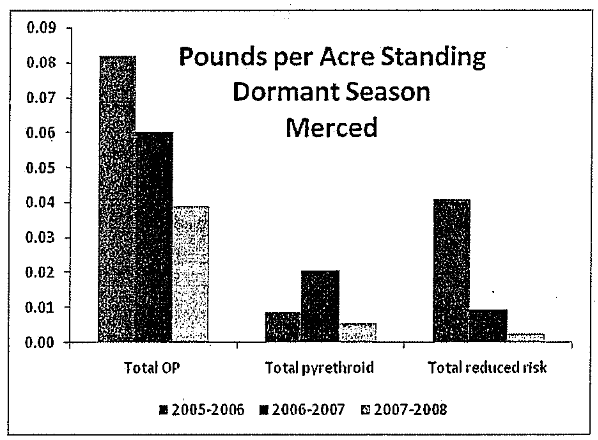

Yolo County Growing Season
Acres Treated
Acres Treated
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Total OP
Total pyrethroid
Total reduced risk
2006
2007
2008
PUR Data on Pesticides Used on Almonds
Almond PMA II

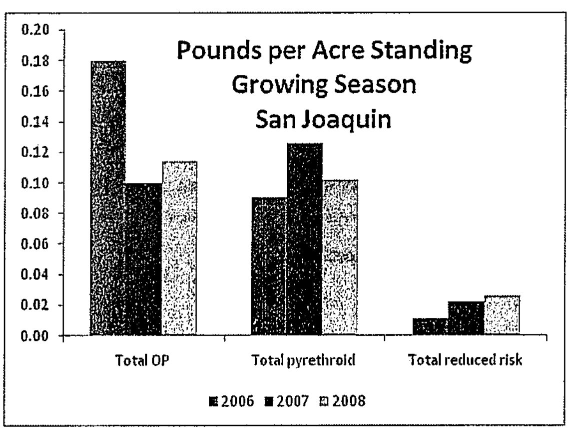
Pounds per acre standing
County by county

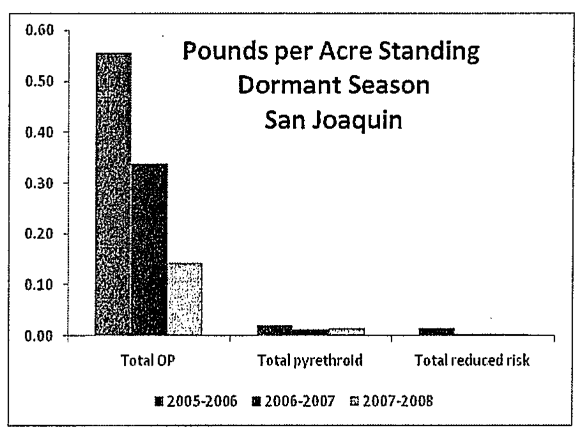


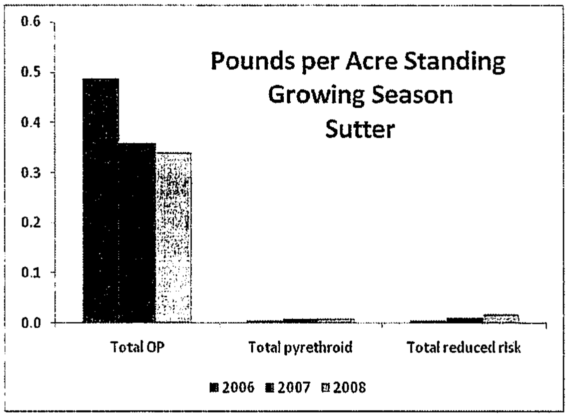


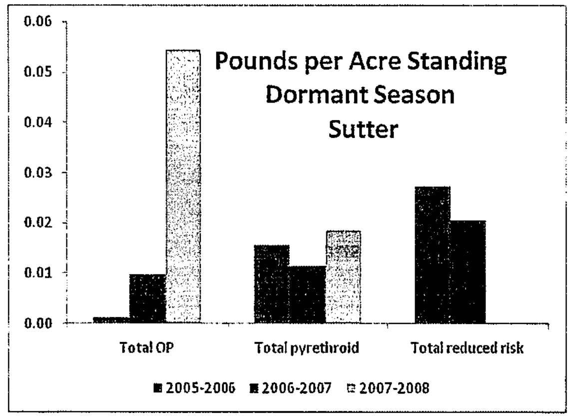


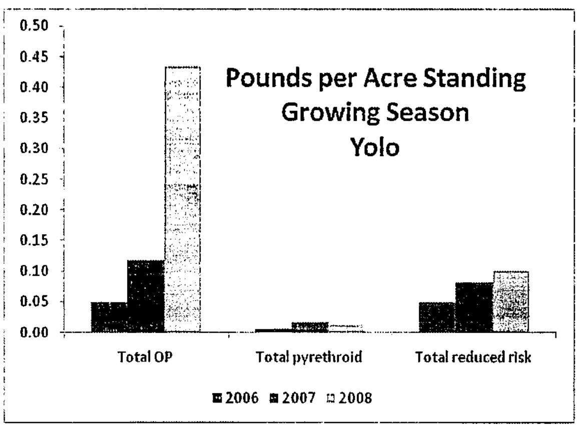


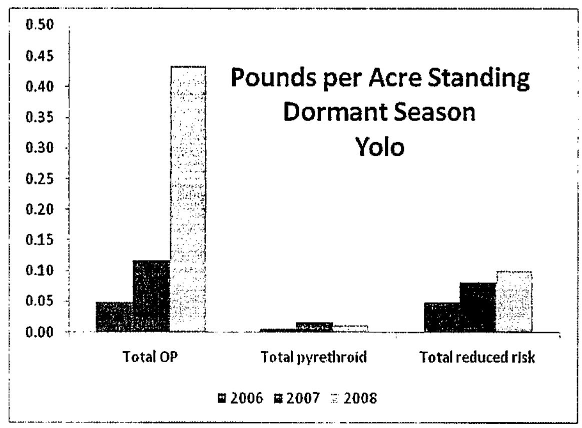


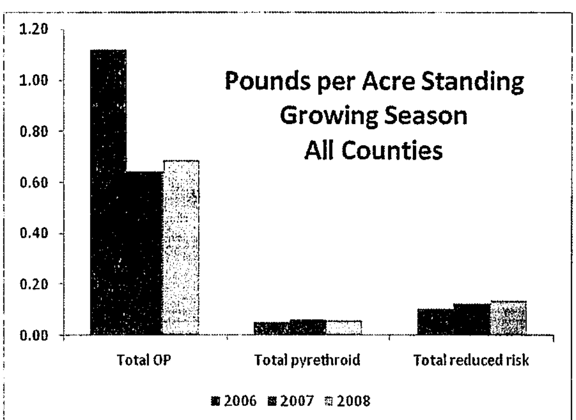


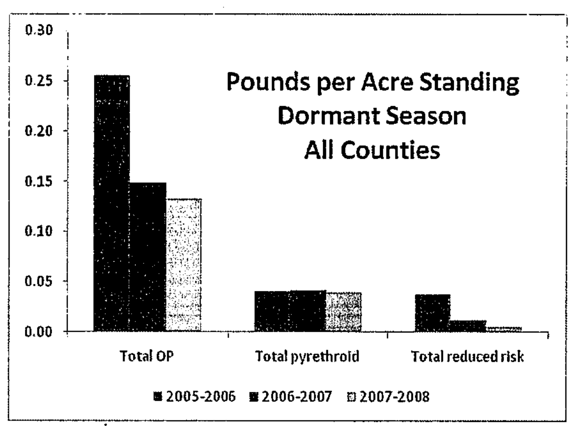

Pounds per Acre Standing
Growing Season
Sutter
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Total OP
Total pyrethroid
Total reduced risk
2006
2007
2008


Pounds per Acre Standing
Dormant Season
Sutter
0.06
0.05
0.04
0.03
0.02
0.01
0.00
Total OP
Total pyrethroid
Total reduced risk
2005-2006
2006-2007
2007-2008

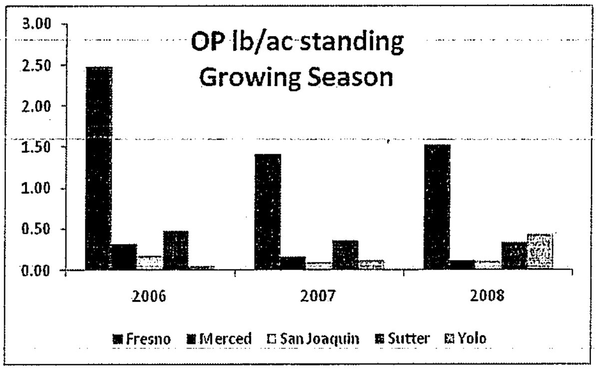

Pounds per Acre Standing
Growing Season
Yolo
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Total OP
Total pyrethroid
Total reduced risk
2006
2007
2008

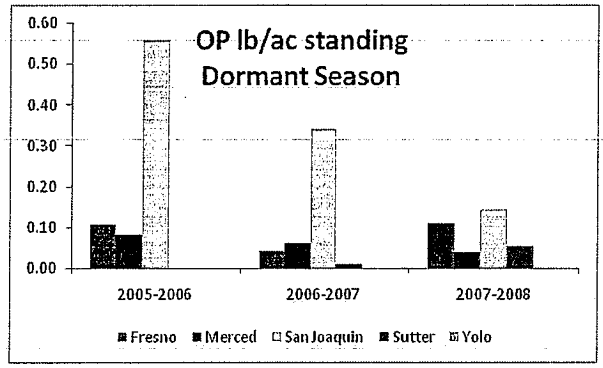

Pounds per Acre Standing
Dormant Season
Yolo
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Total OP
Total pyrethroid
Total reduced risk
2006
2007
2008

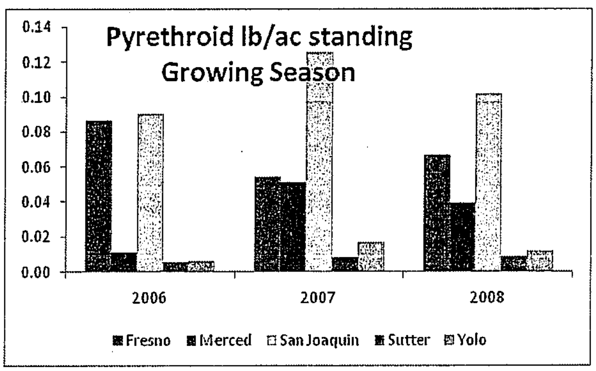

Pounds per Acre Standing
Growing Season
All Counties
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Total OP
Total pyrethroid
Total reduced risk
2006
2007
2008

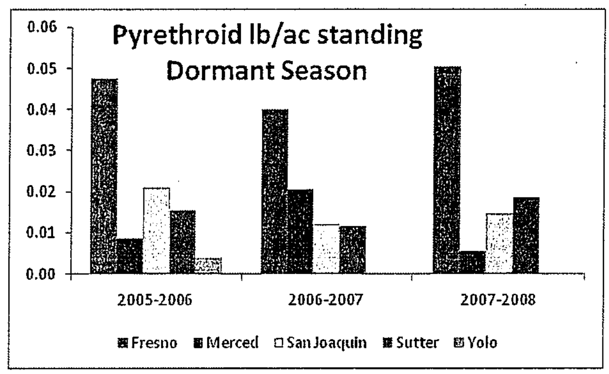

Pounds per Acre Standing
Dormant Season
All Counties
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Total OP
Total pyrethroid
Total reduced risk
2005-2006
2006-2007
2007-2008

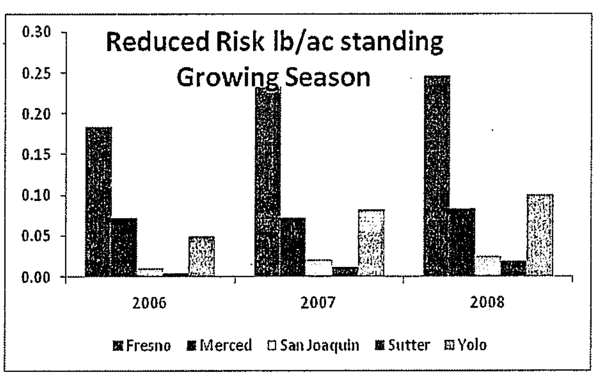
By Pesticide Class

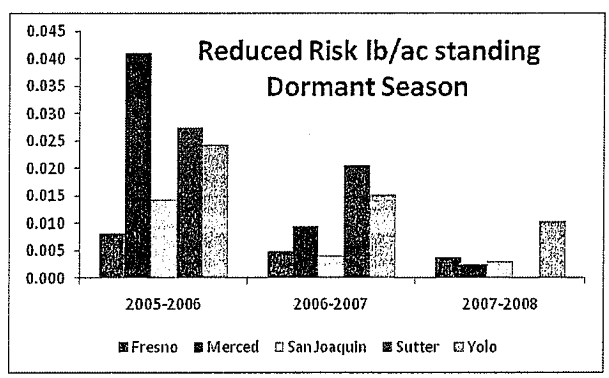










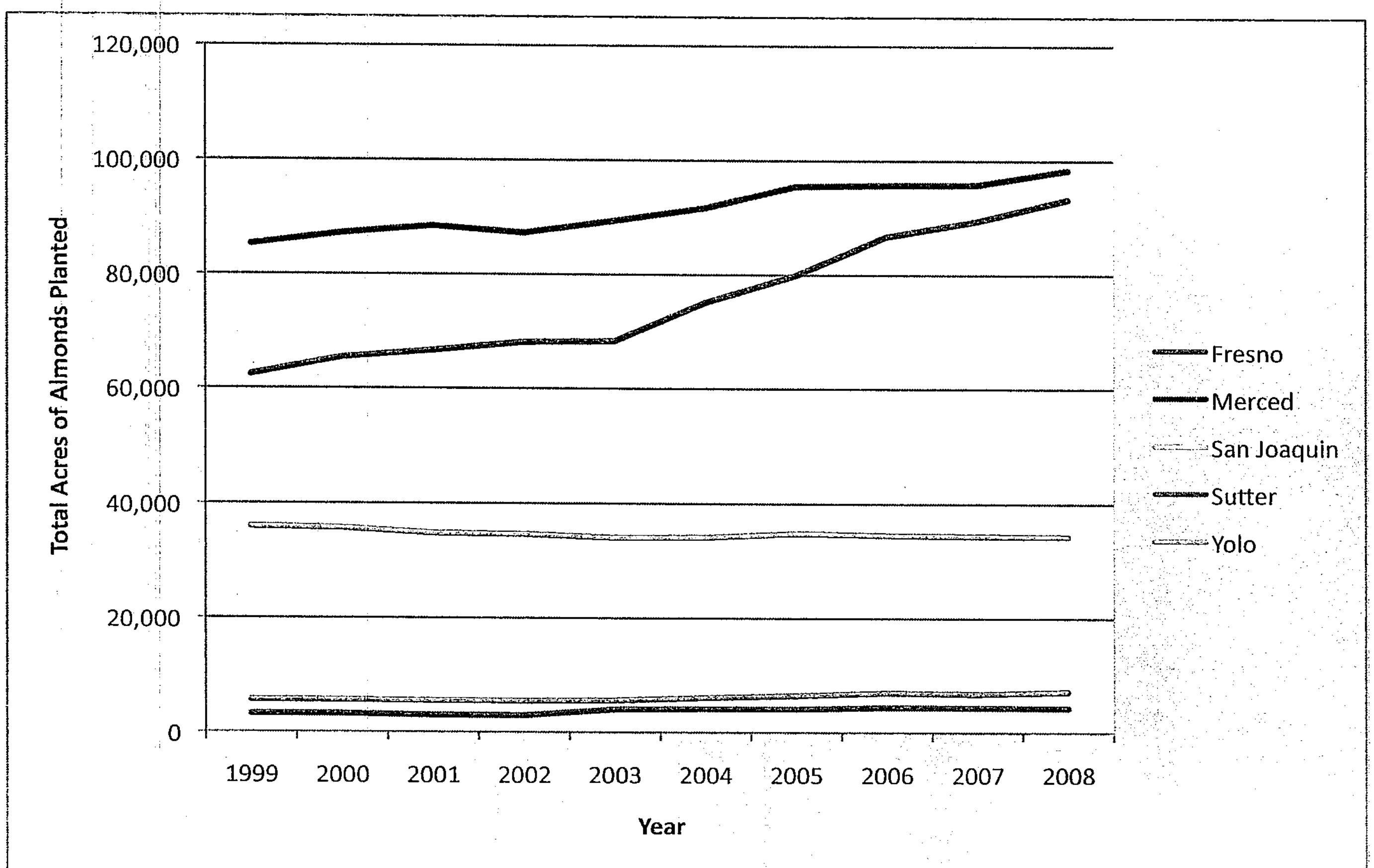


Almond PMA II, Final Report, Appendix C

Acres of Almonds planted (bearing and non-bearing) in PMA project counties

Source: National Agricultural Statistics Service

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Fresno	62,431	65,424	66,655	68,116	68,291	75,126	79,944	86,698	89,407	93,187
Merced	85,217	87,151	88,411	87,220	89,362	91,632	95,444	95,686	95,751	98,330
San Joaquin	35,991	35,722	34,839	34,663	34,082	34,157	34,884	34,563	34,422	34,339
Sutter	3,257	3,234	2,987	2,953	4,052	4,166	4,154	4,476	4,415	4,354
Yolo	5,804	5,749	5,625	5,567	5,695	6,177	6,562	7,066	6,882	7,282



Almond PMA Field day and grower meetings 2008-2010

Date	Location	Speaker	Topic
6/25/08	Mendota	Marcia Gibbs	Introduction to Almond PMA II
6/25/08	Mendota	Mario Viveros	Wind damage, pruning and training to avoid spreding fungal diseases
6/25/08	Mendota	Brent Holtz	Controlling Almond diseases: hull rot, phytophthera
6/28/08	Firebaugh	Frank Williams, Mark Fickett	Host farmers discuss role in project
6/28/08	Firebaugh	Walt Bentley	Using NOW egg traps to improve control; Reduced risk materials to control NOW
7/31/08	Live Oak	Bob Curtis	The roll of NOW in food safety
7/31/08	Live Oak	Joe Connell	Sacramento Valley outlook for NOW
7/31/08	Live Oak	Carolyn Pickel, Sarah Smith	Using NOW traps for monitoring
7/31/08	Live Oak	Franz Niederholzer	New chemistries for pest control in almonds
7/31/08	Live Oak	PCA/Crop protection rep.	Saving costs on in-season sprays
7/31/08	Live Oak	Rich Rosecrantz	Smart sprayer demonstration
9/23/08	Merced	Louie Bandoni, Chris Morgner	Host farmer and PCA discussion
9/23/08	Merced	Bob Curtis	Role of NOW in food safety, aflatoxin, and international markets
9/23/08	Merced	Walt Bentley	Post harvest evaluation, scale sampling, mites in winter, and twig borer
9/23/08	Merced	David Doll	Almond diseases and growing healthy trees
12/17/08	Firebaugh	Walt Bentley	Winter sampling and pest management (NOW, mite, scale, PTB)
12/17/08	Firebaugh	Kelly Covello	Aflatoxin and food safety issues
12/17/08	Firebaugh	David Doll	Fungal Diseases, band canker
12/17/08	Firebaugh	Frank Williams, Mark Fickett	Experiences in the orchard, plans for dormant season
12/17/08	Escalon	Walt Bentley	Winter sampling and pest management (NOW, mite, scale, PTB)
12/17/08	Escalon	Bob Curtis	Aflatoxin and food safety issues
12/17/08	Escalon	David Doll	Fungal Diseases, band canker
12/17/08	Escalon	Nick and Joe Bavaro, Mike Grohl	Experiences in the orchard, plans for dormant season
12/4/08	Yuba City	Carolyn Pickel	What is IPM? And how does it apply to tree crop production?
12/4/08	Yuba City	Franz Niederholzer	Almonds: Winter Monitoring to lower costs and improve quality
12/4/08	Yuba City	Franz Niederholzer	Stretching a dollar growing almonds and prunes in 2009
4/21/09	Manteca	Walt Bentley	Products for worm control
4/21/09	Manteca	Walt Bentley	May Sprays/timing
4/21/09	Manteca	Walt Bentley	Mite Sampling
4/21/09	Manteca	Paul Verdegaal	Drought Strategies
4/21/09	Manteca	Nick Gatzman	Host farmer orchard practices
4/21/09	Manteca	David Doll	Ant Monitoring
4/22/09	Mendota	Walt Bentley	Products for worm control
4/22/09	Mendota	Walt Bentley	May Sprays/timing
4/22/09	Mendota	Walt Bentley	Mite Sampling
4/22/09	Mendota	David Doll	Drought Strategies
4/22/09	Mendota	Barry Malm	Host farmer orchard practices
4/22/09	Mendota	David Doll	Ant Monitoring
6/23/09	Live Oak	Jerry Armour	Sustainability and message from the marketplace
6/23/09	Live Oak	Joe Connell	Current trap catches and DD predicitions to time harvest
6/23/09	Live Oak	Walt Bentley	Hull split spray options/materials
6/23/09	Live Oak	Franz Niederholzer	Targeting the tree: Getting the most from your hull split spray
6/24/09	Durham	Jerry Armour	Sustainability and message from the marketplace
6/24/09	Durham	Joe Connell	Current trap catches and DD predicitions to time harvest
6/24/09	Durham	Walt Bentley	Hull split spray options/materials
6/24/09	Durham	Franz Niederholzer	Targeting the tree: Getting the most from your hull split spray
2/7/10	Stockton	Walt Bentley	Using 2009 harvest results to plan for 2010, Winter monitoring
2/7/10	Stockton	Brent Holtz	Timing and Targets for Bloom sprays
2/7/10	Stockton	Paul Verdegaal	Fungicides and resistance management
2/7/10	Stockton	Matt Fossen	Pest control and Valley air quality
2/17/10	Mendota	David Doll	Choosing a fungicide for bloom & post bloom application
2/17/10	Mendota	Walt Bentley	Using 2009 harvest results to plan for 2010, spur sampling for PTB, SJS
2/17/10	Mendota	Themis Michaelides	Update on band canker and other botryosphaeria canker issues
2/22/10	Merced	David Doll	Almond bloom management strategies for 2010 conditions
2/22/10	Merced	Walt Bentley	Using results from last year to plan pest management for this year
2/22/10	Merced	Matt Fossen	Choosing pest control materials to maintain good air quality in the Valley

Almond Pest Management Comprehensive Course, Nov. 5, 2009
Selection of data from audience response system

Which of the Following Best Describes Your Occupation?

	Responses (percent)	Responses (count)
Farmer/Grower	13.79%	12
Ranch Manager	12.64%	11
PCA/Crop Consultant	54.02%	47
Crop Protection Rep	10.34%	9
Public Agency (State, Federal, County, University)	2.30%	2
Other	6.90%	6
Totals	100%	87

How Many Years Have You Been Involved in Almond Pest Management?

	Responses (percent)	Responses (count)
1 year or less	19.05%	16
5 yrs or less	22.62%	19
5-10 yrs	10.71%	9
More than 10 yrs	47.62%	40
Totals	100%	84

How Many Acres of Almonds are You Managing or Looking After?

	Responses (percent)	Responses (count)
None	17.44%	15
Less than 50 acres	8.14%	7
51 to 100 acres	10.47%	9
101 to 500	19.77%	17
More than 501 acres	44.19%	38
Totals	100%	86

How Familiar are You Seasonal Guide to Almond Pest Management?

	Responses (percent)	Responses (count)
Very Familiar	25.27%	23
Somewhat familiar	23.08%	21
Not familiar	27.47%	25
What is it?	24.18%	22
Totals	100%	91

How Closely Do You Follow the Guidelines Outlined in the Seasonal Guide?

	Responses (percent)	Responses (count)
Practice ALL Critical Pest Management Activities	14.63%	12
Practice SOME Critical Pest Management Activities	70.73%	58
Practice at least ONE Critical Pest Management Activity	7.32%	6
DO NOT Practice ANY Critical Pest Management Activities	7.32%	6
Totals	100%	82

How Relevant were Today's Topics?

	Responses (percent)	Responses (count)
Extremely Relevant	50.98%	26
Very Relevant	41.18%	21
Mostly Relevant	7.84%	4
Not Relevant	0%	0
Useless	0%	0
Totals	100%	51

I Gained Useful Information from This Meeting

	Responses (percent)	(count)
Strongly Agree	58.82%	30
Agree	41.18%	21
Neutral	0%	0
Disagree	0%	0
Strongly Disagree	0%	0
Totals	100%	51

Overall I Would Rate This Meeting:

	Responses (percent)	(count)
Excellent	51.92%	27
Very Good	38.46%	20
Good	9.62%	5
Poor	0%	0
Very Poor	0%	0
Totals	100%	52