Explaining Reduced Pesticide Use in Almonds

by
Rachael E. Goodhue and Karen Klonsky

Downward trends in dormant organophosphate (OP) use in almonds are explained by previous year's price, inventory, exports to Japan and educational programs. OP use varied significantly by region in California.

The California Department of Pesticide Regulation (DPR) began full-use reporting of all agricultural pesticides in 1990. The program requires monthly reporting of all agricultural pesticide use to the county agricultural commissioners, who transfer the information to DPR. The reports include the date and time of the application, commodity treated, acres planted, acres treated, pesticide product and quantity applied, application method and other grower identification information. Observation of downward trends in pesticide use led to questions as to the reasons for the decline. This study develops a methodology to determine the factors influencing levels of pesticide use for classes of materials and applies the methodology to a specific example—dormant organophosphate (OP) use in almonds.

Pesticide use can decrease in several ways. First, the number of growers using the pesticide can decrease; second, growers can continue to use a pesticide but on only a portion of their planted acreage; and third, growers can continue to use the pesticide but at lower rates than before. These three together give a complete picture of the changes in pesticide use over time.

Dormant Season OP Use in Almonds

OP dormant sprays control overwintering pests including navel orange worm (NOW), San Jose scale, peach twig borer (PTB) and early season mites. The use of OPs in California first came under scrutiny in the late 1980s when they began to show up in groundwater. Applications during the winter rainy season were identified as the major source of OP runoff into surface water. In response, alternatives have been developed and encouraged through private and public research and education programs. Spring application of pyrethroids is one alternative for control of NOW and PTB, although these materials increase the risk of high mite populations later in the season. *Bacillus thuringiensis* (Bt) is a second alternative control method for NOW and PTB, and is considered to have reduced risk of environmental harm.

DPR conducted an extensive statistical analysis of trends in dormant OP use in California from 1992 to 2000. The analysis confirmed a downward trend in OP use in California over the past ten years, measuring OP use as total pounds applied, percentage of total acreage treated and numbers of growers who applied dormant OPs.

Dormant OP Use Hypotheses

Hypotheses as to factors influencing the use of dormant OPs in almonds evolved from individual interviews with University of California Cooperative Extension farm advisors with almond responsibilities in Kern, Butte, Glenn and Fresno counties, and interviews with DPR researchers. In addition, hypotheses emerged from a focus group of private pest control advisers and growers active in the northern Sacramento Valley.

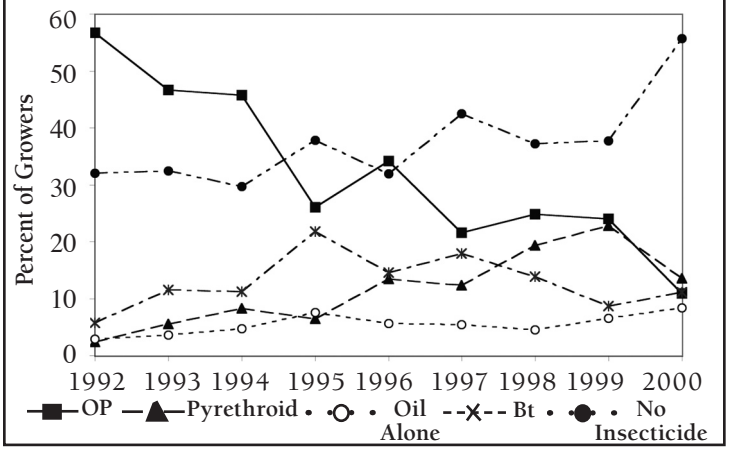
The hypotheses formed fall into the categories of weather, economics, physical, education and risk. Weather impacts OP spray decisions in several ways. In extremely wet years, it is difficult or impossible to get equipment into the orchard to apply a dormant spray in the winter. Consequently, we expected the number of acres treated with a dormant spray to increase the year following the high rain year.

Profitability was the number one reason given for skipping sprays. All almond handlers give bonuses for low reject levels. Growers are more likely to apply a dormant insecticide following a year of relatively high rejects and are more willing to take risks (skip sprays) in a low price/high crop year.

In the early 1990s, growers observed that they did not usually have a San Jose scale problem on almonds and that early season mites were not bad on almonds. They began to experiment with dropping OP sprays. Many growers adopted the strategy of letting populations of mites and scale build up over a few years before spraying, to reduce costs and resistance to pesticides by target pests. The overall consensus was that Kern County had more in-season insect problems than the other regions of the state, due to a longer growing season.

Growers adopted Bt after bloom, once Bt products were available, as an alternative to OP dormant sprays. However, the efficacy of Bt is now perceived by many

Figure 1. Percent of Growers Using Different Dormant Seaons Practices



to be too variable. In the mid 1990s, growers started to use pyrethroids plus oil for control of PTB. This treatment offered longer control than Bt products.

Growers expressed concern about the future availability of OPs due to pesticide regulations and have tried to find alternatives before losing the materials. Thus, over time, any given grower would be less likely to apply OPs for relatively routine pest problems that can be controlled using alternatives.

Data and Variables

We tested the hypotheses using data for the years 1992-2000. Pesticide use report (PUR) data was obtained from DPR. Each grower has a unique identification number for the PUR database, and reports the annual number of almond acres planted and the total acres treated with each specific pesticide, along with the date and location of each application.

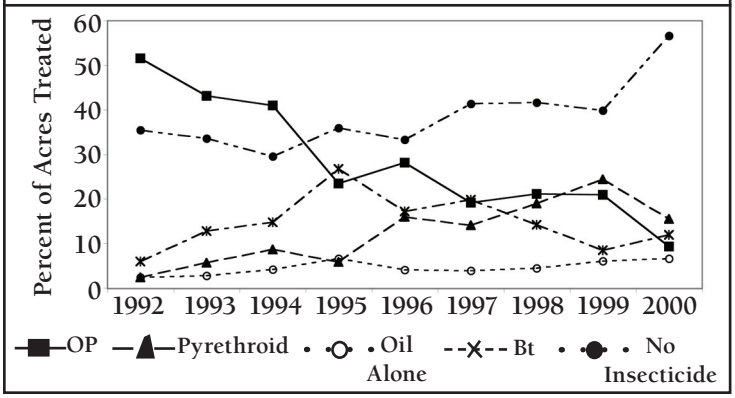
Weather variables for two time periods were included: the full dormant season (November 1 to March 20), and the critical dormant season (January 15 to February 15). Weather variables used data from the National Weather Service.

We aggregated counties into four growing regions to reflect differences in pest pressure, microclimate and other factors. Kern County was treated as its own region, Fresno and Tulare counties were aggregated into the south region, San Joaquin, Stanislaus, Yolo, Madera and Merced counties comprised the central region, and Butte, Colusa, Glenn, Sutter and Tehama counties comprised the north region.

We calculated an annual price measure for OPs, pyrethroids, carbamates, oils and Bt. Prices for individual products within each class were weighted by the recommended label application rate per acre. Almond price and quantity information was obtained from the Almond Board of California including the current and lagged price of almonds, carry-in from the previous year, carry-out to the next year, as well as the state aggregate pounds of almonds rejected for the current and previous year. Annual almond production was reported separately by county for the current and lagged year.

One specific objective was to test whether or not integrated pest management programs had a significant effect on pesticide use. Arguably, the most important research and educational effort directed at developing and promoting alternatives to dormant OP use is the Biologically Integrated Orchard Systems (BIOS), a program resulting from a collaboration among the Community Alliance with Family Farmers, growers, licensed pest control advisers, University of California Cooperative Extension researchers and DPR. The BIOS program was a focused outreach, education and demonstration program providing assistance to growers wishing to reduce synthetic pesticide use. The presence of a BIOS program in a county was expected to have an impact on OP use regardless of whether or not a grower actually enrolled in the program. The BIOS program was in effect in Merced, Stanislaus, Madera, San Joaquin and Colusa counties during some part of 1993 - 1999.

Figure 2. Percent of Almond Acres Treated with Various Dormant Season Insecticide Practices



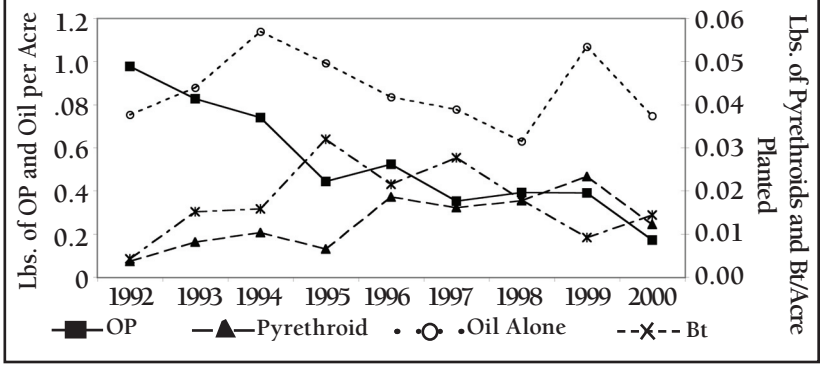
Empirical Analysis

To test our hypotheses, we completed three sets of statistical analyses. The first set examined whether or not individual producers chose to use any OPs in a given year. The second set examined the acres to which individual producers applied OPs in a given

year. The third set examined application rates.

Figure 1 shows the trends in growers' decisions to use dormant control practices over the study period. The previous year's price of almonds was positively correlated with OP use, and was highly significant. This implies that growers expect a high price last year to translate into a higher price this year. As predicted, OP use increased with a higher reject level the previous year. Higher current year Japanese exports significantly increased OP use, as predicted, although the magnitude of the effect was quite small. However, higher current year total exports significantly decreased OP use.

Figure 3. Pounds of Active Ingredient per Almond Acres Planted



The BIOS program consistently reduced the probability that a producer used OPs. The BIOS variable evaluates the effect that the program had when it was active. The "BIOSbeg" variable, which evaluates the effect the program had when it was active and after it ended, also reduced OP use, indicating that BIOS continued to impact OP use after the program officially ended.

The second analysis examined the determinants of the number of acres to which a grower applied OPs. Figure 2 shows the trend in acreage treated with various dormant season practices. Region was an important determinant of application acres, consistent with differences in farm sizes. Growers in the central region applied OPs to significantly fewer acres than growers in the northern region. Conversely, growers in Kern County applied OPs to significantly more acres than growers in the northern region. Also, growers in the south region applied OPs to more acres than growers in the northern region, although the difference was not always significant in this analysis.

We performed a third analysis to investigate the determinants of the application rate. Figure 3 shows the trends in pounds of active ingredient (AI) applied per acre for alternative dormant season materials. The mean application rate for OP was 1.82 pounds per acre, or approximately half the recommended label rate of four pounds per acre. The time trend variable was significant and positive in these specifications. Farms with more total almond acres used significantly lower application rates than those with fewer acres, although the effect is small in magnitude.

Growers in the south region and Kern County used significantly higher application rates than growers in the north region. Growers in the central region had application rates that were not significantly different than in the north region.

This analysis provided evidence that the BIOS program reduced OP use. The rate of OP application decreased in counties and years when the BIOS program was active and remained lower in the years following the end of the formal program.

Conclusion

This study shows that over time, growers are less likely to use environmentally unfriendly pesticides, especially when effective alternatives are available. Growers are more likely to use harmful pesticides in years when they expect yields to be low and more likely to use them when price expectations are high. Educational and demonstration programs are effective in reducing the use of targeted pesticides. Growers are more likely to reduce the use of pesticides by avoiding use altogether than using pesticides on only part of their acreage. Interestingly, application rates for those using pesticides may be increasing over time even though the percentage of growers using that pesticide is decreasing. This is consistent with education measures encouraging growers to limit pesticide use to serious pest problems. The results make the case for increased public/private partnerships to develop and execute education and demonstration programs related to pesticide use.

Rachael Gooodhue is an assistant professor in the agricultural and resource economics department at UC Davis. She can be contacted by e-mail at: goodhue@primal.ucdavis.edu. Karen Klonsky is a UC Cooperative Extension economist at UC Davis. She can be reached by telephone at (530)752-3563 or by e-mail at klonsky@primal.ucdavis.edu.