

Comparison of Agricultural Run-off between Biological Farming and Conventional Chemical Farming

Abstract

Grants from the California State Water Resources Control Board (SWRCB) are being used for outreach, education, technical support, and political advocacy for farmers trying alternatives to pesticides. Best Management Practices (BMPs) that are being implemented include organic pesticides and pheromone disruption, cover crops, filter strips, beneficial insects, and monitoring of insects and fertility. Sustainable cotton and organic walnuts are two out of several projects in the Central Valley of California which examine alternatives that benefit the farmer, the consumer, and protect water quality. The San Francisco Estuary Institute is providing scientific technical support and is conducting water and sediment quality monitoring for these SWRCB-funded projects with the goal of evaluating potential differences in pesticide and nutrient concentrations running off from various biological/organic and conventional fields. Limited bioassessment samples are also being evaluated. These projects are ongoing and the results from the first year are presented.

Introduction

To achieve sustainability, to avoid the depletion of topsoil and the contamination of water and sediments, we have to start from the bottom. A variety of potentially useful BMPs have been identified. These existing practices have to be documented and evaluated to raise awareness and to demonstrate BMP implementations that result in the reduction of runoff and pollutants.

The SWRCB funded the Sustainable Cotton and the Organic Walnuts Projects mainly for outreach and education for interested farmers to learn about best management practices in meetings and demonstration projects. In this study, water and sediment quality were monitored in two demonstration projects with the goal of associating pesticide and nutrient load numbers with different growing practices.

Cotton is grown on 700,000 acres in CA with nearly seven million pounds of pesticides applied annually to this acreage. The sampling sites for the cotton farms were all located in and near Fresno County. Walnuts are grown on 250,000 acres in CA with over 3.6 million pounds of pesticides applied annually. All monitored walnut orchards for this study were located in or near Yolo County



Map. Highlighted areas indicate where samples were collected without further detail to maintain anonymity of participating farmers

Best Management Practices



Sustainable Cotton (Basic)

- Biological Agricultural System in Cotton (BASIC) Implementing economic chemical reduction techniques
- Biointensive Integrated Pest Mangement
- Scouting to monitor beneficial and pest insects
- Alfalfa or other beneficial habitat on field margins
- Early release of natural pest predators
- Crop rotation breaks cycle of harmful insects, plant diseases, and parasitic nematodes
- Soil fertility and nutrient monitoring



Organic Walnuts

- Organic pesticides: Oil (insecticide), sulfur (fungicide), copper (fungicide)
- Cover crops (to protect soil from erosion and weeds and to improve its health through maintaining soil organic matter)
- Monitoring of insects and insect fertility
- Pheromone disruption
- Beneficial insect release
- Filter strips

Sampling Methods

All samples were collected from the lower end of each field out of the tail ditch during flood irrigation events and also during the first winter storm that caused runoff from the walnut orchards. Samples were analyzed for nutrients, pesticides, and for the walnut orchards also for pathogens. All pesticides analyzed were selected based on application rates and toxicity and where differences between conventional growing practices and BMP implementations would be expected.

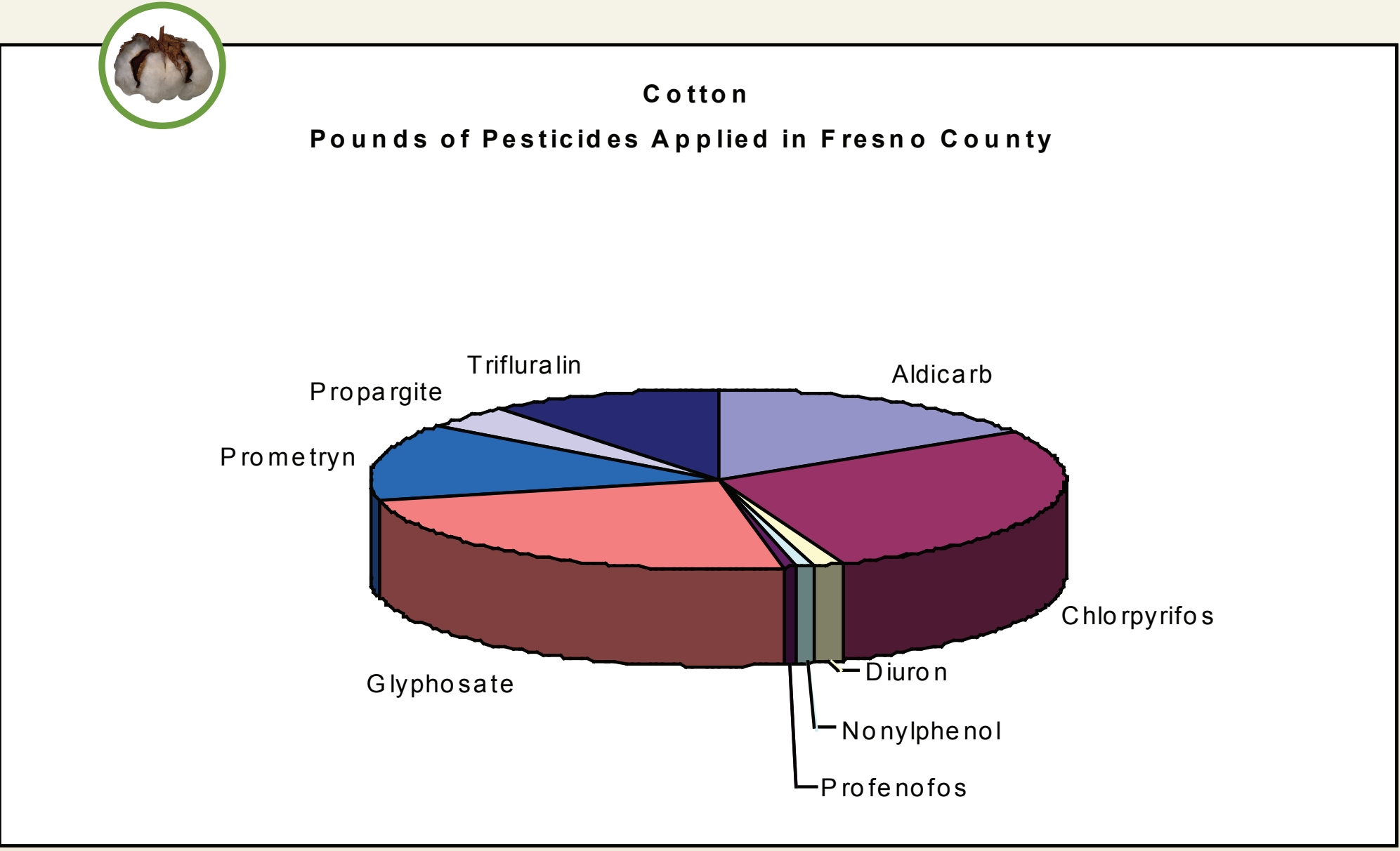


Figure 1. Monitored pesticides in Sustainable Cotton Project and their relative application rates based on the 2005 Pesticide Use Report.

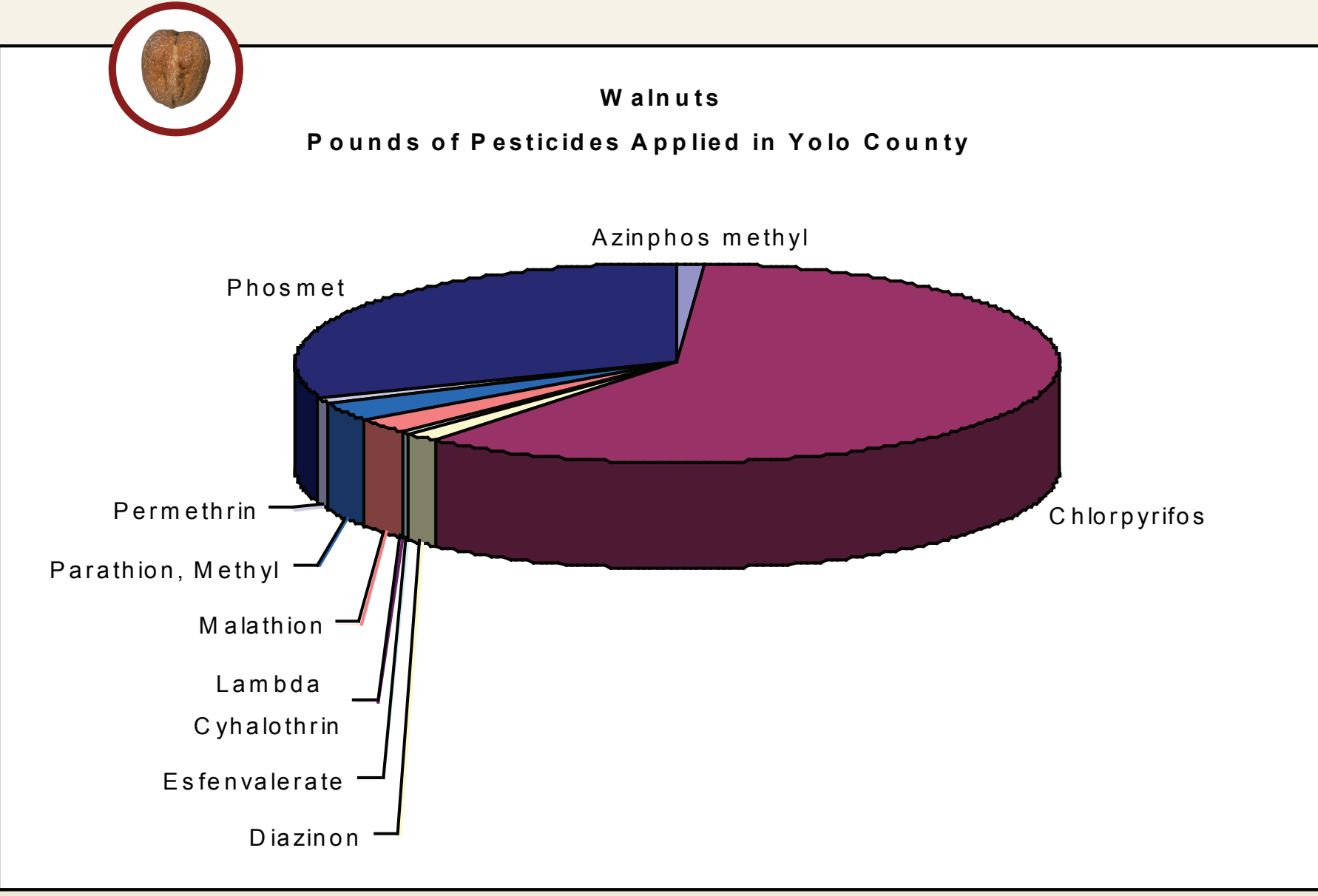


Figure 2. Monitored pesticides in Organic Walnuts Project and their relative application rates based on the 2005 Pesticide Use Report.

Results

Results from this study to date provide a preliminary basis for making predictions regarding water quality in runoff from biologic and organic growing practices versus conventional practices. Problems resulting in difficult data interpretation included.

- 2006/07 winter was very dry, followed by a late and mild warm season created a very mild pest problem in the earlier part of the growing season
- Water shortage (due to the dry winter and water supply curtailment) resulted in reduced irrigation in the later part of the growing season.

Pesticides

Sustainable Cotton

The majority of samples showed no detectable concentrations for most pesticides and no significant differences could be found between biological and conventional growing practices. Concentrations of the herbicide Diuron and the insecticide chlorpyrifos in cotton showed similar concentration patterns over the course of the sampling period at both site types. However, all samples were well below LC₅₀ for sensitive species. Prometryn, a photosynthetic inhibitor, showed slightly higher concentrations at the conventional sites, with all concentrations remaining below the thresholds of concern (Figure 3).

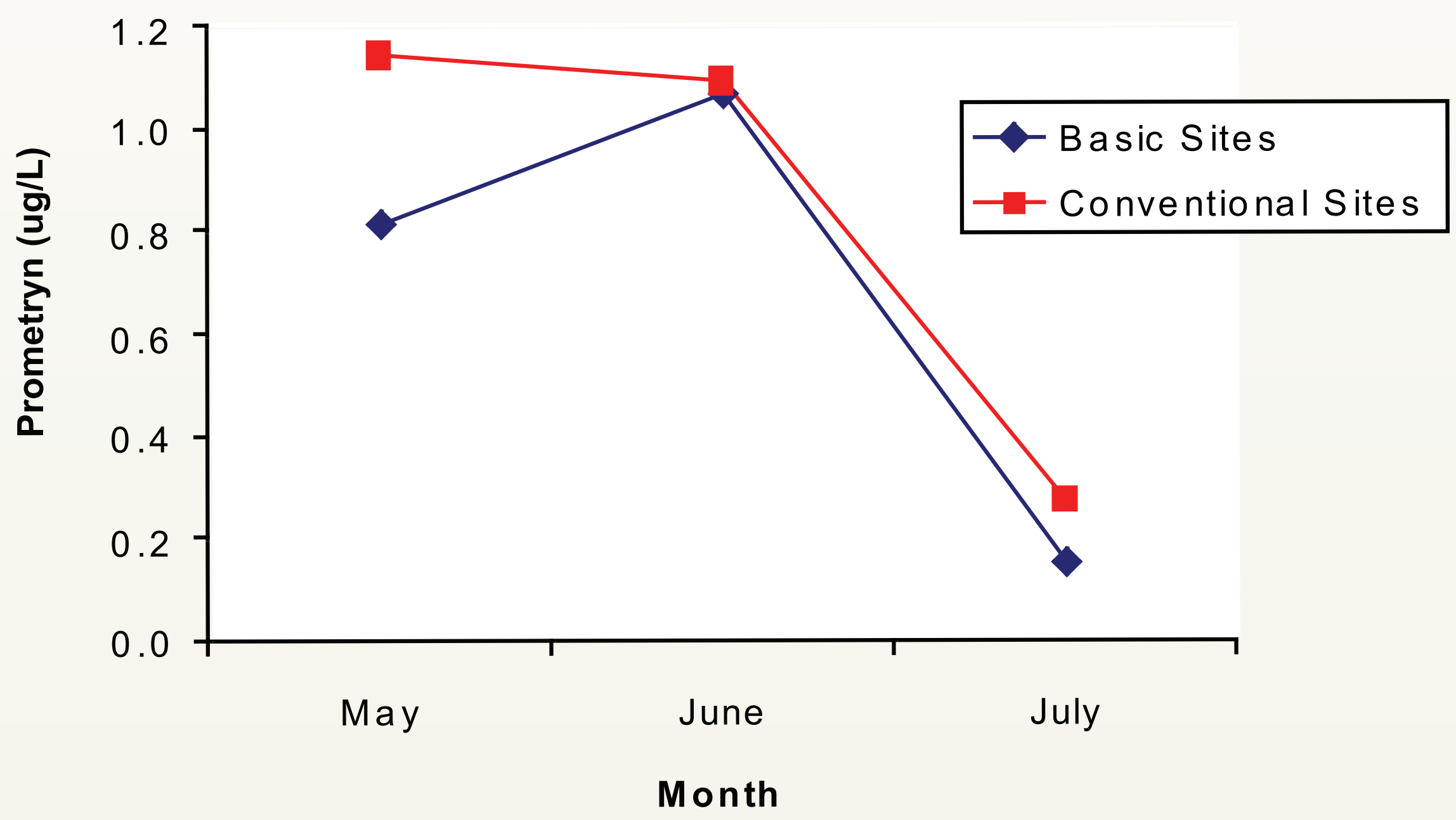


Figure 3. Prometryn concentrations in cotton field runoff at BASIC and conventional sites

Organic Walnuts

- Detected in water samples
 - One pyrethroid (lambda-cyhalothrin)
 - Two organophosphate pesticides (diazinon and chlorpyrifos)
- All but one concentration below LC₅₀ for *Oncorhynchus mykiss* and *Daphnia*
 - One sample at conventional site 8 x higher chlorpyrifos concentration than LC₅₀ for *Daphnia*
- Two organic and one conventional site showed detectable chlorpyrifos concentrations in sediment but well below reporting limit

Nutrients

Almost all biological and organic growing practices resulted in a higher proportion of organic nitrogen and organic phosphorus in runoff while the conventional sites had a higher proportion of inorganic nitrogen and phosphorus.

- 88% of BASIC samples had lower NO_x:TN ratios
- 78% of BASIC samples had lower PO₄:TP ratios
- 100% of Organic samples had lower NO_x:TN ratios
- 50% of Organic samples had lower PO₄:TP ratios

However, differences in nutrient ratios in runoff from fields with different growing practices are within error margins showing an apparent trend but not a statistically significant difference.

Nutrient Loads

- 21% TN load reduction at organic sites
- 87% TP load reduction at organic sites
- 24% TN load reduction at BASIC sites
- 14% TP load increase at BASIC sites

Conclusions

1. Most chemicals showed very low or not detectable concentrations.
2. One chemical were above LC₅₀ for *Daphnia*.
3. Lower nutrient loads were estimated at the Basic and the organic sites.
4. The results from the second year of sampling will allow a better assessment of effectiveness of BMP implementations. Additional field samples that will be combined with data collected from the County Agricultural Commissioners and Pesticide Use Reports to better evaluate potential reductions of pesticides and nutrients in farm runoff.

