Surface Water Monitoring for Pesticides in Agricultural Areas of California, 2013

Xin Deng, Kevin Kelley, Keith Starner, Kenneth D. King, Yina Xie, Kean S. Goh

Surface Water Protection Program, Department of Pesticide Regulation, California Environmental Protection Agency

INTRODUCTION

Surface water monitoring for pesticides in agricultural areas of California is one of the California Department of Pesticide Regulation's (CDPR's) key environmental monitoring activities. This project was initiated in 2008 with a long-term goal of collecting data to better assess potential impacts of pesticides in agricultural runoff on aquatic environments of California. Project findings help guide CDPR in the development and implementation of regulatory and non-regulatory mitigation activities. In the past six years, the project has identified geographic areas with heavy pesticide uses via the Pesticide Use Report (PUR) database and selected sites adjacent to agricultural fields with high runoff potential for long-term monitoring efforts. The Salinas, Santa Maria and Imperial valleys have previously been designated as high priority areas for long-term surface water monitoring due to high pesticide use (Starner 2013). This study is a continuation of the agricultural monitoring project.

Over 750 pesticide active ingredients (AIs) in a total amount of 175.3 million pounds were applied in agricultural areas of the state in 2011 (CDPR 2013). Those pesticide AIs possess a wide range of toxicity to aquatic organisms (US EPA 2014). In order to conduct the statewide monitoring effectively and better use limited resources, CDPR recently developed a pesticide Monitoring Prioritization Model (MPM) that automates the process of identifying potential monitoring candidates (Luo et al. 2013). The model develops a ranking of AIs based on their use amounts that were reported to the CDPR's PUR database and their toxicity "Aquatic Life Benchmarks" that were developed by US EPA (US EPA 2014). Pesticide AIs that were selected as monitoring candidates for 2013 were identified using the MPM based on the statewide PUR data from 2009-2011. Additional region-specific assessments were conducted to identify AIs that have significant aquatic toxicity and high use within a specific geographic region, but for which use was not high enough on a statewide basis to rank in the statewide analysis.

Figure 1. Agricultural areas of monitoring sites in California

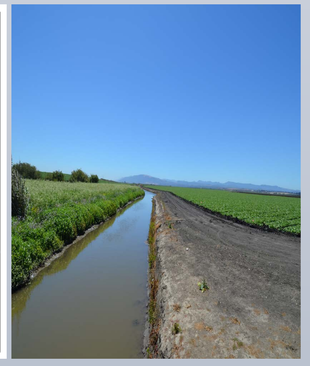

Figure 2. Sampling site at Tembladero Slough in Monterey County

OBJECTIVES

The goal of the project is to provide data for a long-term assessment of surface water pesticide contamination in agricultural areas of California. Specific objectives of the project are:

- Measure chemical occurrences and concentrations of highly prioritized pesticides in runoff samples
- Characterize pesticide compositions in agricultural waterways
- Analyze chemistry data to evaluate potential impacts on aquatic environments

MATERIALS AND METHODS

Sampling events: Agricultural areas with heavy pesticide uses were identified as high priority for long-term monitoring (Figure 1). Grab samples were collected monthly from March to October in 5 regions:

- Salinas - 16 Sites in Monterey County
- Santa Maria - 5 sites in Santa Barbara and San Luis Obispo counties
- Imperial - 9 sites in Imperial County
- Palo Verde - 5 sites in Imperial and Riverside counties
- Central Valley - 15 sites in San Joaquin and Merced counties

Chemical analysis: 24 pesticides from 9 chemical groups were analyzed by the California Department of Food and Agriculture (Table 1). Reporting limits were 0.001-0.005 µg/L for pyrethroids, 0.01-0.05 µg/L for organophosphates, and 0.04-0.05 µg/L for the rest of the chemicals.

Chemical	*Salinas*		*Santa Maria*		*Imperial*		*Palo Verde*	
	N	Detection %	N	Detection %	N	Detection %	N	Detection %
Chlorpyrifos	42	16.7	19	0	18	83.3	5	0
Diazinon	37	16.2	13	0	-	-	-	-
Dimethoate	42	14.3	19	0	18	38.9	5	20.0
Malathion	42	9.5	19	26.3	18	38.9	5	0
Methidathion	42	0	19	0	18	0.0	5	0
Methomyl	10	90.0	8	12.5	-	-	-	-
Methoxyfenozide	17	47.1	1	100	-	-	-	-
Tebufenozide	17	0	1	0	-	-	-	-
Imidacloprid	32	84.4	19	84.2	-	-	-	-
Bifenthrin	19	63.2	8	0	9	33.3	-	-
Cyfluthrin	19	0	8	12.5	9	0	-	-
λ-cyhalothrin	19	36.8	8	0	9	44.4	-	-
Cypermethrin	19	5.3	8	0	9	33.3	-	-
Fenvalerate	19	0.0	8	0	9	0	-	-
Permethrin	19	52.6	8	12.5	9	22.2	-	-
Bensulide	32	59.4	19	47.4	-	-	-	-
Benfluralin	10	0	4	0	9	0	5	0
Ethalfluralin	10	0	4	0	9	0	5	0
Oryzalin	10	0	4	0	9	0	5	0
Pendimethalin	10	0	4	25.0	9	88.9	5	40.0
Prodiamine	10	0	4	0	9	0	5	0
Trifluralin	10	0	4	0	9	55.6	5	0
Oxyfluorfen	10	50.0	4	75.0	9	22.2	5	0
Chlorothalonil	15	0	12	0	-	-	-	-

Table 1. Detections of 24 pesticides in Salinas, Santa Maria, Imperial and Palo Verde in 2013. Data from the Central Valley were not included because only chlorothalonil was measured in 15 samples with no detections

RESULTS

Pesticides with over 30% detections by regions (Table 1):

- Salinas - imidacloprid, befenthrin, λ-cyhalothrin, permethrin, methomyl, Methoxyfenozide, bensulide, oxyfluorfen
- Santa Maria - imidacloprid, methoxyfenozide, bensulide, oxyfluorfen
- Imperial – chlorpyrifos, dimethoate, malathion, befenthrin, λ-cyhalothrin, cypermethrin, pendimethalin, trifluralin
- Palo Verde – pendimethalin

Pesticides with over 20% exceedance of the lowest US EPA's chronic aquatic life benchmark statewide (Figure 3):

- Methomyl, bifenthrin, λ-cyhalothrin, permethrin

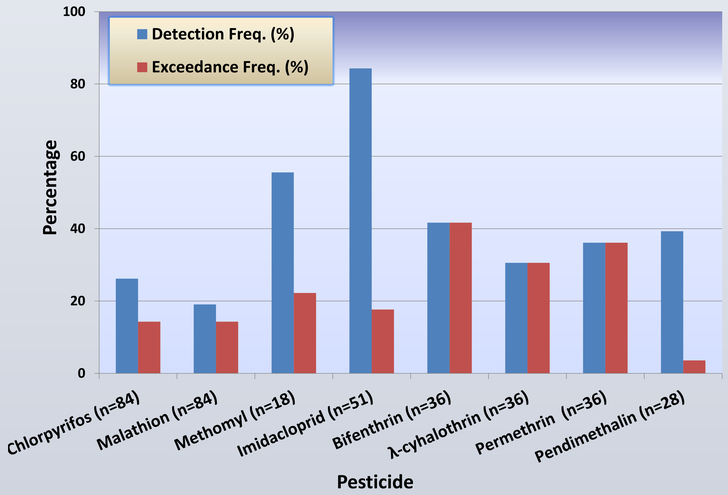

Figure 3. Detection and exceedance frequency of pesticides in surface water, as a percentage of the total number of samples (n) collected during the irrigation season in California, 2013. Only pesticides with an exceedance frequency of greater than 5 percent were included. Exceedance defined as a measured concentration of a pesticide greater than its lowest chronic aquatic life benchmark (US EPA 2014)

REFERENCES

CDPR 2013. California Department of Pesticide Regulation's Pesticide Information Portal, Pesticide Use Report (PUR) data. http://calpip.cdpr.ca.gov/

Luo, Y, et. al. 2013. Methodology for Prioritizing Pesticides for Surface Water Monitoring in Agricultural and Urban Areas. May 2013. http://www.cdpr.ca.gov/docs/emon/pubs/ehapreps/analysis_memos/prioritization_report.pdf

Starner, K. 2013. Study 282. Surface Water Monitoring for Pesticides in Agricultural Areas of California, 2013. http://www.cdpr.ca.gov/docs/emon/pubs/protocol/study282protocol.pdf

US EPA 2014. Office of Pesticide Programs' Aquatic Life Benchmarks http://www.epa.gov/oppefed1/ecorisk_ders/aquatic_life_benchmark.htm

ACKNOWLEDGEMENTS

The authors would like to thank Sue Peoples for sample coordination and organization between CDPR and CDFA, Jesse Ybarra for his support in logistics, and the staff at CDPR, Environmental Monitoring Branch for assistance in sample collection.

Contacts: xdeng@cdpr.gov.ca