Surface Water Monitoring Results for Pesticides in Agricultural Areas of Central Coast and Southern California, 2011-2015

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INTRODUCTION

Agricultural areas in the Central Coast and Southern California represent croplands with heavy pesticide uses and irrigation practices of high pesticide runoff potentials. To collect data for long-term assessments of surface water pesticide contamination and to provide scientific supports to make regulatory decisions, the Surface Water Monitoring Program of the California Department of Pesticide Regulation (CDPR) identified three regions, namely, Salinas, Santa Maria and Imperial valleys for long-term monitoring. Thirty-seven locations in the major watersheds of the three regions were monitored since 2008. Water samples collected were analyzed for concentrations of over 30 pesticides from five groups of insecticides (organophosphate, pyrethroid, diacylhydrazine, carbamate and neonicotinoid), three groups of herbicides (dinitroaniline, nitrophenyl ether and triazine), and two groups of fungicides (chloronitrile and strobilurin). This study focused on monitoring datasets collected from the recent 5 years (2011-2015) to reflect use patterns of current use pesticides.

MATERIALS AND METHODS

Sampling Events

Grab water samples were collected from March to October during the irrigation season in 3 areas (Figure 1):

- Imperial - 2 sampling events per year in a total of 12 sites
- Salinas – 6 sampling events per year in a total of 16 sites
- Santa Maria – 3 sampling events per year in a total of 9 sites

Chemical Analysis

Fifty pesticides and degradates were analyzed by the California Department of Food and Agriculture. 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 all others.

Data Analysis

- Pesticides that were monitored for at least two years and had detection frequencies greater than 5% in five years were analyzed.
- The lowest US EPA aquatic life benchmark for a particular pesticide was compared to the monitored concentrations to calculate benchmark exceedance rate.
- Significant differences ($p<0.05$) in detection and exceedance rates across areas and years were tested using Chi-square test.

OBJECTIVES

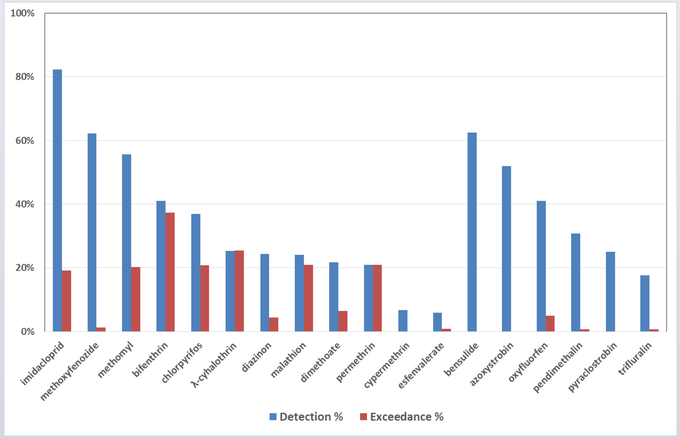
The goal of the project is to provide data for short- and long-term assessment of surface water pesticide contamination in agricultural areas of California. Objectives of the project are to:

- measure pesticide occurrences and concentrations
- evaluate potential impacts of pesticide runoff on aquatic environments
- analyze spatial differences in detection rates
- assess temporal patterns and trends of monitoring results

RESULTS

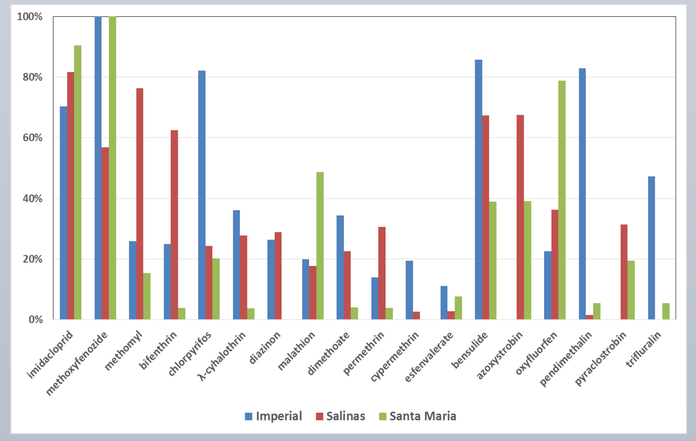
Detection and Exceedance Rates

- Top 5 most detected insecticides: imidacloprid, methoxyfenozide, methomyl, bifenthrin, chlorpyrifos
- Top 5 most detected herbicides and fungicides: bensulide, azoxystrobin, oxyfluorfen, pendimethalin, pyraclostrobin
- Top 5 insecticides with highest benchmark exceedance rates: bifenthrin, λ-cyhalothrin, permethrin, malathion, chlorpyrifos
- Less than 5% benchmark exceedance rates for herbicides and fungicides



Pesticides with Significant Higher Detection Rates across Areas

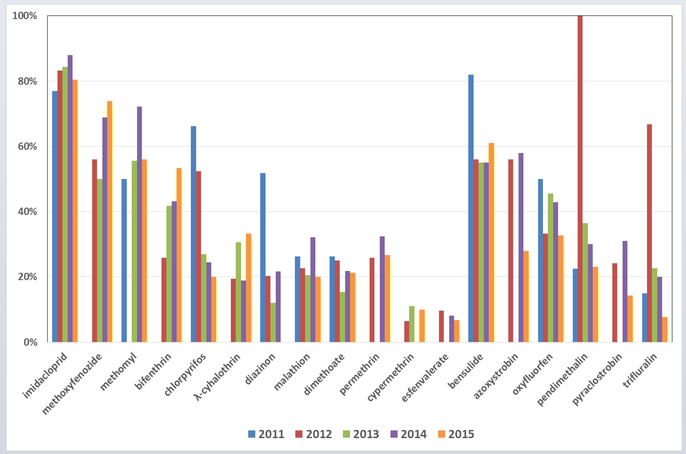
- Imperial: methoxyfenozide, chlorpyrifos, dimethoate, cypermethrin, bensulide, pendimethalin, trifluralin
- Salinas: bifenthrin, methomyl, permethrin, azoxystrobin
- Santa Maria: methoxyfenozide, malathion, oxyfluorfen



RESULTS

Changes of Annual Detection Rates

- Insecticides: Diazinon and chlorpyrifos detection rates significantly decreased after 2011 and 2012, respectively. No diazinon was detected in 2015.
- Herbicides and fungicides: Bensulide detection rates significantly decreased after 2011; Pendimethalin and trifluralin detection rates were significantly higher in 2012 than the rates in other years.
- No significant changes in annual detection rates for the remaining pesticides over 5 years.



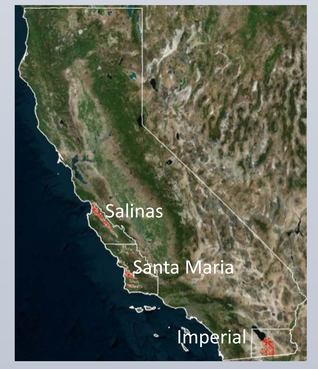


Figure 1. Imperial, Salinas and Santa Maria Valleys were the major areas for monitoring contamination of agricultural pesticide runoff

CONCLUSIONS

- Imidacloprid has consistently showed high detection rates in each area for 5 years. Recent updates on its toxicity endpoint indicated that its detections in runoff can result in high risks to sensitive aquatic organisms.
- Bifenthrin had the highest benchmark exceedance rates among all the pesticides detected, indicating higher risks to aquatic environments.
- Methoxyfenozide detection rates remained high in Imperial and Santa Maria Valleys. Although its benchmark exceedance rates were low, the concurrent appearance with other insecticides could raise concerns to enhance risks to non-targeted aquatic organisms.

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