# Imidacloprid Use and Contamination in Surface Waters in the Salinas, Santa Maria, and Imperial Valleys, California

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## INTRODUCTION

Imidacloprid is the most used neonicotinoid insecticide in the agricultural regions in California. It is a pesticide of major concern for contaminating surface water due to its high solubility and persistence in the aquatic environment. The insecticide has been regularly monitored in California's Salinas, Santa Maria, and Imperial valleys since 2010. The three regions represent croplands dominated by row crops. Typically, irrigation practices on row crops tend to generate relatively higher pesticide runoff that has the potential to pollute aquatic environments adjacent to pesticide-treated fields. This poster presents preliminary analyses of imidacloprid use patterns and monitoring results from the three regions.

## MATERIALS AND METHODS

### Sampling Events

Grab water samples were collected from March to October between 2010 to 2016 during the irrigation season in 3 regions (Figure 1):

- Imperial – 2 times in March and October at 13 sites (3 mainstem and 10 tributary sites)
- Salinas –monthly from April to September at 18 sites (3 mainstem and 15 tributary sites)
- Santa Maria – 3 times in May, July and September at 9 sites (3 mainstem and 6 tributary sites)

### Chemical Analysis

Imidacloprid concentrations were analyzed in unfiltered water samples by the California Department of Food and Agriculture's Center for Analytical Chemistry. The reporting limit (RL) was 0.05 µg/L.

### Data Analysis

- Use records were retrieved from the Pesticide Use Reporting Database managed by California Department of Pesticide Regulation (CDPR)[1] .
- The lowest US EPA acute aquatic life benchmark (BM) of 0.385 µg/L and the lowest chronic BM of 0.01 µg/L were compared to the monitored concentrations to calculate BM exceedance frequencies.
- Statistical analyses were performed with JMP software (Version 13, SAS Institute). Significant differences ($p<0.05$) in use trends, detection and exceedance frequencies across regions and years were evaluated using Pearson's test and Maximum Likelihood Estimation.


## OBJECTIVES

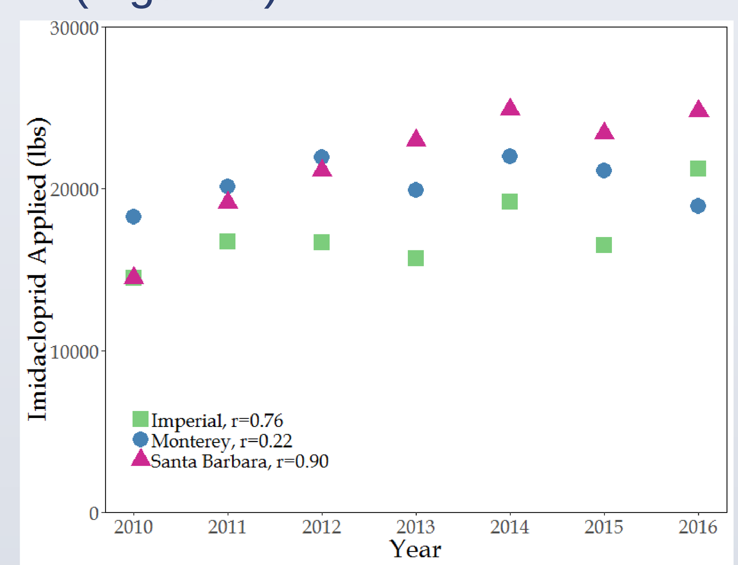
- Measure occurrence and concentration
- Evaluate potential impacts on aquatic environments
- Analyze spatial differences in detection and benchmark exceedance frequencies
- Assess temporal trends of monitoring results

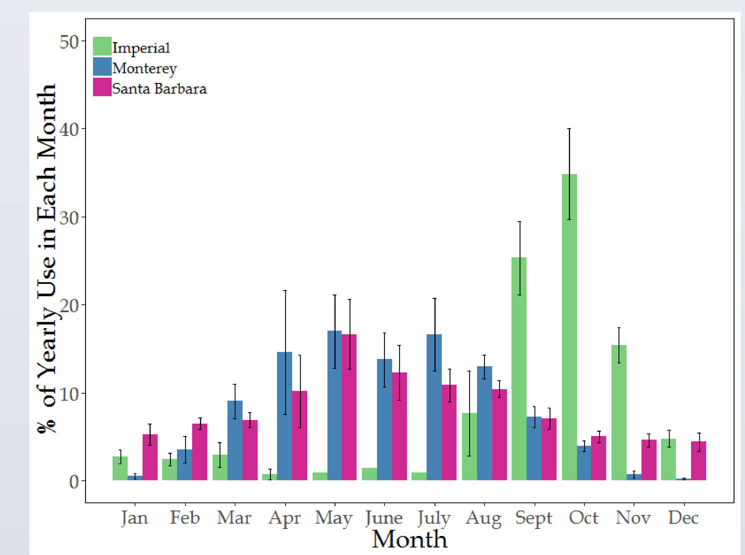
Figure 1. Agricultural monitoring regions: Imperial, Salinas and Santa Maria valleys

## RESULTS

### Imidacloprid Use by Year and Month in 2010-2016

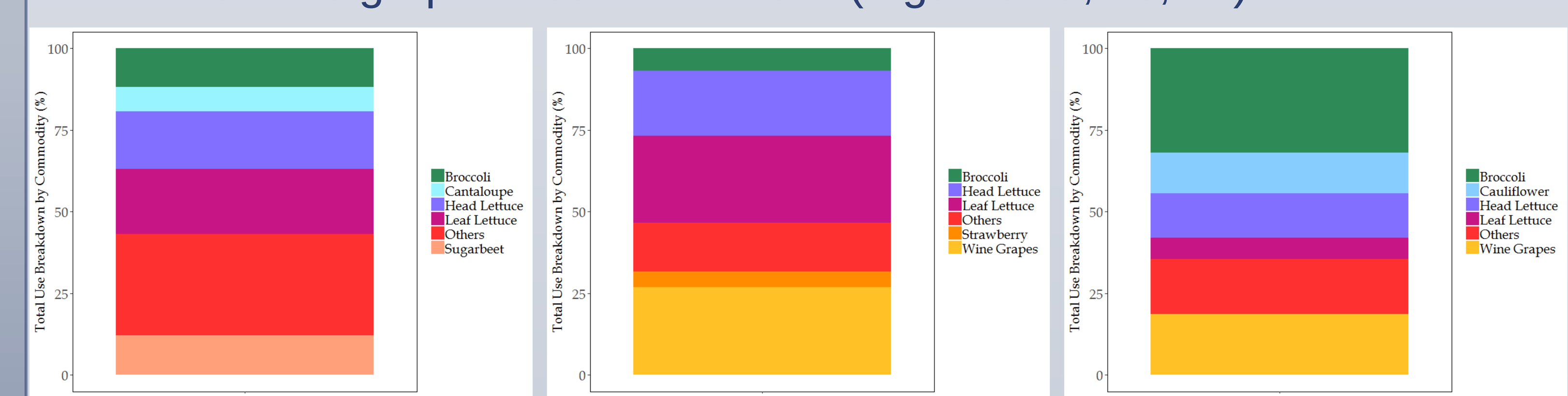
- Yearly uses in the three major counties monitored showed significant uptrends in Imperial and Santa Barbara ($p<0.05$) and a stable trend ($p=0.64$) in Monterey (Figure 2).
- Average monthly uses were higher during the irrigation season from April to August in Monterey and Santa Barbara counties. In Imperial County, monthly uses peaked in September and October (Figure 3).




### Top 5 Commodities with Imidacloprid Use in 2010-2016

- Broccoli, head lettuce and leaf lettuce were the three top commodities in the three counties (Figures 4a, 4b, 4c).
- Other top commodities included cantaloupe and sugar beet in Imperial, strawberry and wine grape in Monterey, and cauliflower and wine grape in Santa Barbara (Figures 4a, 4b, 4c).




### Monitoring Records and Statistical Summary

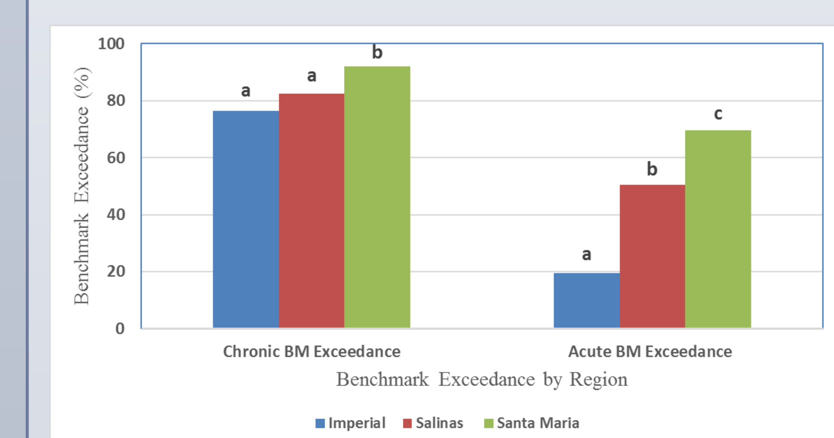
- A total of 391 samples were collected in the Imperial, Salinas and Santa Maria valleys from 2010 to 2016[2].
- Mean concentrations significantly differed among the three regions with the highest being in the Santa Maria Valley. Mean and median concentrations were estimated using log-normal distribution with censored data.

| Parameter | Imperial | Salinas | Santa Maria | All Regions |
|---|---|---|---|---|
| N | 51 | 251 | 89 | 391 |
| Mean (µg/L) | 0.36 | 0.77 | 1.39 | 0.88 |
| Median (µg/L) | 0.15 | 0.27 | 0.63 | 0.30 |
| Max (µg/L) | 3.48 | 6.8 | 9.14 | 9.14 |

## RESULTS (continued)

### Detection and Benchmark (BM) Exceedance Frequencies

- Due to the recent lowering of the chronic invertebrate BM to 0.01 µg/L, all reported concentrations are considered to have exceeded the BM.
- Significantly higher acute and chronic BM exceedances were observed in the Santa Maria Valley ($p<0.0001$). Acute BM exceedance in Salinas was significantly higher than that in Imperial ($p=0.023$, Figure 5).
- Comparisons of detections between mainstems and tributaries indicated a significantly higher frequency in the mainstems of the Imperial watersheds ($p=0.004$) and in the tributaries of the Monterey watersheds ($p<0.0001$). There was no significant differences in the Santa Maria watersheds ($p=0.069$, Figure 6)





### Changes of Annual Detection Frequencies

- The annual detection frequencies showed a significance upward trend in the Imperial Valley ($p=0.033$) during the monitoring period (2010-2016) but no temporal trends were observed in the other two regions ($p>0.1$) (Figure 7).

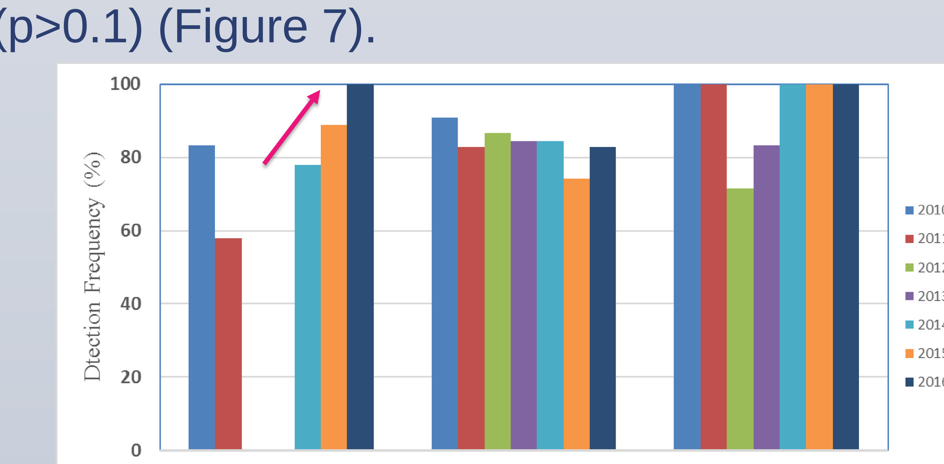



Figure 7

Note: No data collected in Imperial Valley in 2012-2013

## CONCLUSIONS AND DISCUSSIONS

- Imidacloprid had been consistently detected in high frequencies in surface waters of the three agricultural regions in 2010-2016, which makes imidacloprid an insecticide of major concern in local aquatic environments.
- Watersheds in the Santa Maria Valley had the highest reported concentrations, detection, and BM exceedance frequencies, indicating potentially higher risk to aquatic organisms
- High detection and BM exceedance frequencies are likely associated with the use patterns, irrigation practices, and high solubility and persistence of the insecticide.
- The three regions show similarities as well as differences in commodities of top uses. Future analysis on site-specific use pattern and watershed characteristics will help identify the most important factors contributing to the high concentrations.

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REFERENCES

1. CDPR *Pesticide Information Portal, Pesticide Use Report (PUR) Database* (http://www.cdpr.ca.gov/docs/pur/purmain.htm); California Department of Pesticide Regulation, Sacramento, CA, 2017.
2. CDPR Surface Water Monitoring Database (SURF) (https://www.cdpr.ca.gov/docs/emon/surfwtr/surfdata.htm); California Department of Pesticide Regulation, Sacramento, CA, 2017.

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