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Monitoring Pesticides in Surface Water in Urban Areas during Baseflow and Storm Events in California

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Stormdrain

Abstract

In 2008, the California Department of Pesticide Regulation initiated an urban monitoring study to determine the pesticides present in urban runoff, and to assess the differences of water-body type (receiving waters vs. stormdrains) and seasonal conditions (baseflow vs. stormwater) on pesticide concentrations. Four metropolitan areas were chosen for monitoring sites: Sacramento, San Francisco Bay, Orange County, and San Diego. Each urban area consists of four to seven sampling sites representing a mix of receiving waters and storm drains. Water samples were collected during baseflow and storm events. The samples were analyzed for 41 insecticides (pyrethroids, carbamates, organophosphates, fipronil and degradates) and 21 herbicides (dinitroanilines, photosynthetic, and auxin herbicides). Sediment samples were only collected during baseflow events and analyzed for pyrethroids. Preliminary results show fipronil (and degradates) were the most prevalent insecticides followed by carbaryl and malathion; several pyrethroids were also detected in sediment. The most frequently detected herbicides were the auxin herbicides followed by diuron and pendimethalin. Overall, there are more pesticide detections in stormwater versus baseflow, with stormdrains exhibiting higher concentrations than receiving waters.

Receiving Water

Methodology

The study areas were chosen to meet the following parameters:

- large urban area
- stormdrain system greater than 200 residences
- minimal agricultural inputs
- likely to have flow during dry season
- available historical water quality data

The locations meeting these requirements were within four metropolitan areas: Sacramento, the Bay Area, Orange County, and San Diego (Figure1). Each of the four areas contained four to seven sampling sites for a total of 25 storm-drains and receiving waters. Field methods consisted of collecting water quality parameters, flow measurements, and water and sediment samples. The water quality parameters included temperature, pH, conductivity, DO, and turbidity. Water samples were collected during three base-flow events, and three storm events. Sediment samples were collected during base-flow events. Water samples were analyzed for seven groups of insecticides and herbicides. The insecticides included 15 organophosphates (OP), 11 pyrethroids (PY), nine carbamates (CB), and fipronil (FP) and degradates. Herbicides included 11 photosynthetic herbicides (TR), six dinitroanilines (DN), four auxin herbicides (PX), and two miscellaneous. Sediment samples were analyzed for pyrethroids. For quality control, 10% of the samples collected were field duplicates and blind spikes, and 5% were field blanks. There was one laboratory matrix spike for each batch of sampling events. All water and sediment analyses were conducted by the California Department of Food and Agriculture Center for Analytical Chemistry (Table 1).

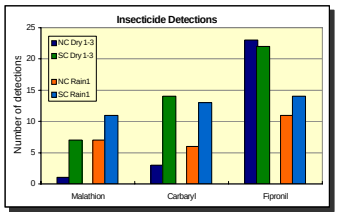

Figure 2. Insecticide detections during storm events and baseflow periods in Northern (NC) and Southern California (SC).

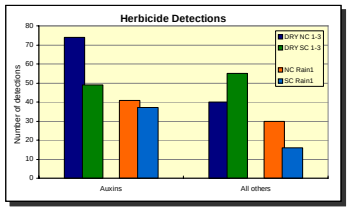

Figure 3. Herbicide detections during storm events and baseflow periods in Northern (NC) and Southern California (SC).

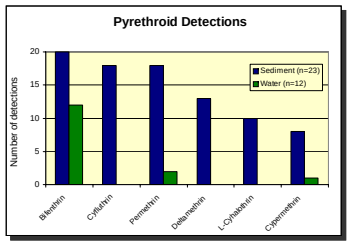

Figure 4. Pyrethroid detections during storm events and baseflow periods in Northern (NC) and Southern California (SC).

Objectives

The study objectives were to:

1. Determine the pesticide concentrations in urban runoff.
2. Assess the differences of water-body type (receiving waters vs. stormdrains) and seasonal conditions (baseflow vs. storm event) on pesticide concentrations.

Results

The preliminary results are from three baseflow sampling events and one storm sampling event. In general, there was a higher frequency of detections in Orange County and Sacramento than in the Bay Area and San Diego for all pesticides. Higher concentrations were detected in stormdrains than in receiving waters. The most frequent insecticide detections in water were fipronil and degradates (Figure 2). For all sampling sites, detections of fipronil were approximately 80% during storm events and 55% during baseflow events. The second most prevalent insecticide detected was carbaryl, followed by malathion. Overall, there were more insecticide detections from the southern Californian sampling sites than from the northern sites. More insecticides were detected in the storm sampling event than in the baseflow events. The most prevalent herbicide detections were the auxin herbicides (Figure 3). The auxin herbicides accounted for an estimated 70% of detections during the storm sampling event. The baseflow sampling results showed 36% detections for the auxin herbicides. The second most frequent detected herbicide was diuron, followed by pendimethalin.The northern Californian sites had more frequent herbicide detections than southern California. Pyrethroids were detected in sediment and water (Figure 4). Bifenthrin accounted for over 80% of all samples analyzed for pyrethroids. Bifenthrin was most frequently detected in sediment, followed by cyfluthrin and permethrin.

Figure 1. Sampling Sites

Table 1. Pesticide Analytical Methods

Analyte Group	Analytical Method	Method Detection Limit (ug/L)	Reporting Limit (ug/L)
CB Screen	HPLC	0.01-0.02	0.05
DN Screen	GC-MS/MS	0.010-0.015	0.05
	LC-MS/MS (oryzalin)	0.0048	
FP Screen	GC-MSD (SIM)	0.003-0.005	0.05
OP Screen	GC-FPD	0.008-0.0142	0.03-0.05
	GC-MS	0.0008-0.0012	0.01
PX Screen	GC-MS	0.064	0.1
PY Screen	GC-ECD	0.0661-0.183	1
PS Screen	LC-MS/MS	0.01-0.031	0.05

* Sediment in ug/kg

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Full report and poster available at http://www.cdpr.ca.gov/docs/sw/index.htm