Pyrethroids are ubiquitous in California's urban streams

When homeowners or building managers decide to get rid of ants or other pesky insects, they usually turn to synthetic pyrethroids. The broad application of these pesticides in urban settings has gone relatively undocumented, while concerns mount over collateral damage to their unintended targets. In the first documentation of the pesticides' urban presence for a large region of the U.S., data published in *ES&T* (DOI 10.1021/es801346g) now confirm that the widely used agricultural and household chemicals are common in California's urban stream sediments.

The information comes in the midst of the state's reevaluation of pyrethroid products. Published as part of that process by researchers from California's Department of Fish and Game, State Water Resources Control Board, and other state laboratories, the results indicate that some of the synthetic pyrethroids show up at relatively high concentrations and are universally toxic to the most sensitive organisms in these urban ecosystems.

Originally patterned after natural pyrethrins in chrysanthemum flowers and intended to replace more toxic organophosphate and carbamate insecticides, the synthetic pyrethroids have been tweaked stepwise over time, says Joel Coats, an insect toxicologist at Iowa State University. Each version has become slightly more persistent and therefore potentially more of a concern for toxicity in the environment.

Coats notes that pyrethroids have long been known to be highly toxic to fish but less so to mammals and birds, which have the ability to detoxify the chemicals quickly. Despite pyrethroids' relatively benign standing, California decided in 2006 to review the pesticides, after data showing negative impacts on sediment-dwelling and other insects started to trickle into the scientific literature (e.g., *Environ. Sci. Technol.* **2005**, DOI 10.1021/es0506354).

The new California assessment found bifenthrin, one of the most toxic of the pyrethroids, to be the most common and to occur at the highest concentrations in urban areas. Pyrethroids appeared most often in urbanized streams in Los Angeles, San Diego, and the highly agricultural Central Valley but also showed up in California's less urban areas, such as the North Coast region and Lake Tahoe.

Led by Robert Holmes of California's Department of Fish and Game, the researchers examined 30 urban streams in eight geographic regions of the state. They analyzed sediment samples for 8 pyrethroids, 30 organochlorine pesticides, and piperonyl butoxide (better known as PBO), which makes pyrethroids toxic at lower concentrations.

After determining occurrence levels, the team exposed the native amphipod *Hyalella azteca* to the sediment samples at 23 and 15 °C to assess how the tiny shrimp responded at environmentally relevant temperatures. The researchers found that at cooler temperatures, the pyrethroids were more toxic, a finding that has implications for the timing of urban applications of the pesticides.

Past research from Don Weston of the University of California Davis has shown that with every 5 °C drop in temperature, pyrethroid toxicity doubles. "It was really good that they did the temperature sensitivity," says Kathryn Kuivila of the U.S. Geological Survey (USGS). That analysis further confirms that pyrethroids were present and were the actual toxic agent, she says.

Kuivila and USGS colleagues planned to present a national view of pyrethroid occurrence in November at the North American meeting of the Society of Environmental Toxicology and Chemistry. The team planned to report data from representative portions of urban streams in seven cities across the U.S.

Jason Belden of Oklahoma State University and co-workers have published results similar to those of Holmes and colleagues in *Environmental Pollution* (DOI 10.1016/j.envpol.2008.07.023); these are the first data to document pyrethroid occurrence and toxicity from sediments in several urban streams in Texas. Climate and other conditions in Texas mirror those in California, Belden says, but conditions are "different enough to indicate problems [with pyrethroids] across the country."

These problems probably are more acute in urban rather than agricultural settings and could occur "any time you find a manicured yard, across the U.S.," says Michael J. Lydy, an aquatic toxicologist at Southern Illinois University Carbondale. "A farmer is much more cognizant of the fact that he's spending thousands of dollars to apply [pyrethroids] to his crop," leading to limited use in agriculture, he comments. But homeowners are less likely to be trained on careful pesticide use or might even overapply the chemicals to ensure their effects.

California's Department of Pesticide Regulation, which is responsible for the reevaluation, has asked members of the Pyrethroid Working Group, an organization representing manufacturers, to examine differences between household versus professional use. Other questions to be resolved include bioavailability, whether waterborne pyrethroids are as toxic as sediment-borne ones, and the role played by hard concrete surfaces in urban runoff.

Meanwhile, the California review process is being watched and informed by the U.S. EPA, which plans to have a federal-level reevaluation of pyrethroid products completed by 2010.

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