Insecticide Market Trends and Potential Water Quality Implications

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Final Report available on two web sites:

www.swrcb.ca.gov/rwqcb2/urbancrksdiazinontmdl.htm

www.tdcenvironmental.com/Pesticides.html

Project Elements

- Purpose: to evaluate water quality implications of urban diazinon & chlorpyrifos replacements
- Identify urban diazinon/chlorpyrifos replacements
- Assemble relevant data
  - Products, formulations, & urban uses
  - Chemical properties & environmental fate
  - Chemical analysis methods
  - Aquatic toxicity
  - Regulatory status
- Evaluate potential water quality implications

Approach to Evaluation

- Literature review
  - Incidents of toxicity
  - Surface water concentration data
- Qualitative risk assessment
  - Pesticide use analysis
  - Transport and fate review
  - Comparison to diazinon and chlorpyrifos
- Weight of evidence analysis

Diazinon and Chlorpyrifos

- Most common urban insecticides
- Frequently found in urban creeks (nationwide) at levels of concern
- Ants were primary target pest
- Applications on outdoor impervious surfaces probably most important for urban creeks

U.S. EPA is phasing out most urban uses

Replacements in Urban Insect Control Marketplace

- Carbaryl
- Imidacloprid
- Malathion
- Pyrethroids
  - Bifenthrin, Cyfluthrin, Cypermethrin, Deltamethrin, Esfenvalerate, Permethrin, (λ-Cyhalothrin)
- Pyrethrins

These are most common, but other alternatives exist

Malathion and Carbaryl Evaluation

- Among the most frequently detected pesticides in urban surface waters
- Commonly detected at concentrations known to cause adverse effects to aquatic ecosystems

Use should be avoided

Imidacloprid, Pyrethrins, and Synergists Evaluation

- Less toxic to fresh water species than other study list pesticides
- Many data gaps
- Imidacloprid is very soluble in water—readily washed away from application location; has potential to cause groundwater contamination
- Synergists may enhance the toxicity of other pesticides in surface water or sediments—not enough information to evaluate risk

Pyrethroids Evaluation

- Extremely toxic to aquatic life at part per trillion concentration levels
- May cause adverse effects in the water column and/or in sediments
- Cumulative toxicity likely
- Many data gaps

Method Development Recommendations (Pyrethroids)

- Develop chemical analysis methods
  - Environmentally relevant detection limits
  - Suitable for contract analytical laboratories
  - One method for all pyrethroids preferable
- Develop standard methods for
  - Sample collection & storage
  - Toxicity testing
  - Toxicity Identification Evaluations (TIEs)

Recommendations: Data Gaps

- Sediment toxicity studies
- Toxicity testing data gaps
  - Little sub-lethal toxicity data
  - Major gaps in aquatic toxicity data

Fathead minnow. Photo by Konrad Schmidt, courtesy Univ. of Minnesota

Toxicity Testing Data Gaps

Pesticide	Invertebrates										Vertebrates						Plants	
	Ceriodaphnia dubia	*Daphnia magna*	*Daphnia pulex*	*Hyalella azteca*	*Gammarus lacustris*	*Gammarus fasciatus*	*Americamysis bahia*	*Penaeus sp.*	*Crassostrea virginica*	*Crassostrea gigas*	*Pimephales promelas*	*Oncorhynchus mykiss*	*Salvelinus fontinalis*	*Lepomis macrochirus*	*Cyprinodon variegatus*	*Menidia beryllina*	*Selenastrum capricornutum*	*Skeletonema costatum*
Bifenthrin			X	X	X	X		X		X			X		X	X	X	X
Cyfluthrin			X	X	X	X		X		X			X			X	X	X
Cypermethrin	X		X	X	X	X					X		X			X	X	X
Deltamethrin	X		X	X	X	X		X		X	X		X			X	X	X
Esfenvalerate	X		X		X	X		X	X	X			X			X	X	X
Permethrin				X	X	X											X	X

Recommendations: Data Gaps

- Make all information necessary to evaluate and prevent surface water quality impacts available for every registered pesticide
  - Chemical analytical methods
  - Wash-off rates (impervious surfaces)
  - Fate in wastewater treatment & sludge
  - Toxicity data, including sub-lethal effects

Monitoring Recommendations

- Urban surface water monitoring:
  - Measure toxicity
  - Both water column & sediments
  - Creeks, bay, & “bay margins”
- Monitor urban pesticide sales & use
- Statewide pesticide surveillance monitoring program needed

Regulatory Recommendations

- Develop ecological risk assessment methods for urban pesticide uses
  - Surface water
  - Sediments
  - Wastewater/sludge
- Maximize ability of registration process to prevent water quality impacts

Outreach Recommendations

- Avoid—Diazinon, Chlorpyrifos, Carbaryl, Malathion, Pyrethroids
- Caution—Pyrethrins, Imidacloprid, *(Other "low-risk" alternatives may be preferable)*
- Manage Urban Pests with IPM
  - Non-toxic and least-toxic controls
  - Use uncontained chemical pesticides only as a last resort