Water Quality Concerns With Synthetic Pyrethroids

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Overview

- Background on OPs and water quality.
- Approaches used by Regional Boards and DPR to address OPs in surface water.
- Recent concern about pyrethroids and potential toxicity to aquatic organisms.
- Monitoring of pyrethroids in aquatic environments.
- Regulatory options for pyrethroids.
Organophosphate Insecticides
A Key Water Quality Concern in the 1990s

• Diazinon and chlorpyrifos were found in the Sacramento and San Joaquin Rivers, their tributaries, and urban creeks.

• Source: Irrigation and rain runoff agricultural and urban sites.

• Concentrations exceeded water quality criteria developed by DFG.
Concentrations of diazinon were high enough to explain results of bioassays with sensitive arthropods.
Organophosphate Insecticides
A Key Water Quality Concern in the 1990s

- Regional Boards determined diazinon and chlorpyrifos caused violations of water quality standards in rivers, the Delta, and urban creeks.
- California’s 2002 list of impaired water bodies (required by CWA section 303[d]) included 144 water body/pesticide-specific combinations.
- 94 listings are related to diazinon; 28 to chlorpyrifos.
Organophosphate Insecticides

A Key Water Quality Concern in the 1990s

CWA section 303(d) also requires states to:

• For water bodies on the list, establish TMDLs, which must account for pollution from point sources (permitted discharges) and non-point sources (e.g., runoff).

• Incorporate TMDLs into water quality control plans (i.e., basin plans).
Organophosphate Insecticides

*Total Maximum Daily Loads*

- **San Francisco Bay Region:** Diazinon and pesticide-related toxicity in urban creeks
- **Los Angeles Region:** Toxicity, chlorpyrifos, and diazinon in Calleguas Creek, its tributaries, and Mugu Lagoon
- **Central Valley Region:**
  - Diazinon in Sacramento and Feather Rivers
  - Diazinon and chlorpyrifos in San Joaquin River
  - Diazinon and chlorpyrifos in urban creeks in Sacramento County
  - Diazinon and chlorpyrifos in the Delta
Organophosphate Insecticides

Total Maximum Daily Loads

- Santa Ana Region: Diazinon and chlorpyrifos in the Upper Newport Bay Watershed
- San Diego Region: Diazinon in Chollas Creek
Organophosphate Insecticides

DPR’s Response

DPR’s staff analysis of 1991-2001 data

- 22 studies
- 7,862 concentration measurements of diazinon and chlorpyrifos
- 488 Ceriodaphnia dubia toxicity tests
- Conclusion: diazinon from dormant spray runoff continued to exceed DFG water quality criteria.
Organophosphate Insecticides

DPR’s Response

- DPR reviewed chlorpyrifos data available after the previous review.
- Conclusion: chlorpyrifos was frequently found in waters of the San Joaquin and Salinas Valleys and in the Delta concentrations that exceeded DFG water quality criteria.
Organophosphate Insecticides

DPR’s Response

- DPR put diazinon (dormant spray products) and chlorpyrifos (agricultural use products) into reevaluation.

- Reevaluations emphasize demonstration of management practices that reduce or eliminate runoff to surface waters.
DPR’s Response: Proposed Dormant Spray Regulations

- Need to reduce offsite movement of dormant sprays in a comprehensive way, reducing opportunities for movement into surface waters.
- Not limited to OPs, in recognition of increasing concern about environmental effects of OP “replacements” (e.g., synthetic pyrethroids).
- Use drift management and other means to prevent pesticide movement off the site of application.
Diazinon and Pyrethroid Use

* Bifenthrin, cyfluthrin, cypermethrin, esfenvalerate, lambda-cyhalothrin, permethrin
Pyrethroid Insecticides

General Characteristics

- Broad spectrum insecticide.
- Low toxicity to mammals and birds.
- Applied at low rates.
- They are typically inexpensive to use.
Pyrethroid Insecticides

General Characteristics

- Highly toxic to aquatic invertebrates and fish.
- High affinity for particles and surfaces.
- Difficult to sample and analyze.
- Toxic levels are near or below detection limits.
Pyrethroids in California Waters

Monitoring prior to 2003

• 941 pyrethroid/location/date specific samples were analyzed. (Not an exhaustive review)
• No pyrethroids were detected except 40 detections of bifenthrin in Orange County; almost all were associated with discharges from a major nursery.
## Pyrethroids in Stanislaus County Waters 2003 (17 sample dates, prelim. results)

<table>
<thead>
<tr>
<th>Location</th>
<th>Whole water</th>
<th>Bed sediment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pomelo Drain</td>
<td>2 bifenthrin</td>
<td>3 esfenvalerate</td>
</tr>
<tr>
<td></td>
<td>1 esfenvalerate</td>
<td>1 permethrin</td>
</tr>
<tr>
<td>Westport Drain</td>
<td>1 esfenvalerate</td>
<td>1 permethrin</td>
</tr>
<tr>
<td>Orestimba Creek</td>
<td>2 bifenthrin</td>
<td>8 esfenvalerate</td>
</tr>
<tr>
<td>Del Puerto Creek</td>
<td>11 bifenthrin</td>
<td>6 esfenvalerate</td>
</tr>
<tr>
<td></td>
<td>2 esfenvalerate</td>
<td>3 permethrin</td>
</tr>
<tr>
<td></td>
<td>1 permethrin</td>
<td></td>
</tr>
</tbody>
</table>
## Pyrethroids in Monterey County Waters 2003 (16 sample dates, prelim. results)

<table>
<thead>
<tr>
<th>Location</th>
<th>Whole water</th>
<th>Bed sediment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alisal Creek</td>
<td>2 bifenthrin, 1 esfenvalerate, 2 permethrin</td>
<td>15 permethrin</td>
</tr>
<tr>
<td>Blanco Drain</td>
<td>None detected</td>
<td>3 permethrin</td>
</tr>
<tr>
<td>Chualar Creek</td>
<td>None detected</td>
<td>3 permethrin</td>
</tr>
<tr>
<td>Quail Creek</td>
<td>11 permethrin, 1 esfenvalerate, 1 cypermethrin</td>
<td>15 permethrin, 6 cypermethrin</td>
</tr>
</tbody>
</table>
Pyrethroid Insecticides

Investigations in Agricultural Waters

- Don Weston, UC Berkeley
- 70 sediment samples from water bodies dominated by agricultural runoff
- 42 locations in 10 Central Valley counties
- Analyzed for
  - 5 pyrethroids
  - 18 “legacy” organochlorines
  - 2 currently-used organochlorines
Sediment bioassays were performed using a sediment-dwelling arthropod, *Hyalella azteca*.
Pyrethroid Insecticides

*Investigations in Agricultural Waters*

- Significant toxicity to *H. azteca* at 42% of sites.
- High correlation between toxicity and pyrethroid concentrations.
- Pyrethroid concentrations were near of above concentrations toxic to *H. azteca* in 70% of the toxic samples.
- Organochlorine concentrations were generally far below those toxic to *H. azteca*.
Pyrethroid Insecticides

Investigations in Urban Waters

• Don Weston, UC Berkeley.
• Several urban creeks in Roseville, CA.
Pyrethroid Insecticides

Investigations in Urban Waters

- 9 of 21 sites had >90% mortality of *H. azteca*.
- High correlation between mortality and pyrethroid concentrations. Both were highest near storm drain outfalls.
- Native populations of *H. azteca* were low or zero in areas with high pyrethroid concentrations.
- OP and organochlorine concentrations could not account for mortality.
Pyrethroid Insecticides

Investigations in Ag and Urban Waters

- Link between pyrethroid concentrations and sediment toxicity consists of:
  - Consistent correlations between predicted toxicity (toxic units based on sediment concentrations and LC50 values) and observed toxicity.
  - No alternatives could explain the toxicity.
Pyrethroid Insecticides

*DPR’s Regulatory Options*

- DPR announced intent to put pyrethroid insecticides into reevaluation.
- Reevaluation would be consistent with application of reevaluation authorities used with diazinon and chlorpyrifos (toxicity in receiving waters).
- Seeking input from Regional Water Boards on most significant informational needs.
- DPR’s overall regulatory goal is to help assure attainment and maintenance of Regional Boards’ water and sediment quality objectives.
Pyrethroid Insecticides

Regional Boards’ Regulatory Options

• Del Puerto and Ingram Creeks (San Joaquin Valley) are proposed for inclusion in the next CWA section 303(d) list. TMDLs would presumably follow.

• San Francisco Bay Regional Board’s recent basin plan amendments includes a “water quality attainment strategy” for pesticides. It includes provisions that promote interagency cooperation to prevent 303(d) listings and TMDL development for pesticides. DPR pledged support.
DPR’s Surface Water Program on the World Wide Web

http://www.cdpr.ca.gov > Programs and Services >

Surface Water Protection Program