Mitigating Pesticides Impacts on Water Quality

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Central Coast Water Quality Impairments:

- nutrients (P and N)
- sediments
- pesticides
- aquatic toxicity
- bacterial pathogens
- salts
Aquatic Toxicity Test Organisms

Water column toxicity

*Ceriodaphnia dubia* (water flea)

Sediment toxicity

*Hyalella azteca*
Elkhorn Slough
Regulatory Process

Federal Clean Water Act:
- 303d list of impaired water bodies
- Total Maximum Daily Load

State Porter Cologne Water Quality Control Act:
- Discharge Permit
- Agricultural Discharge Waiver (Agricultural Order)
Chlorpyrifos and Diazinon

TMDL for lower Salinas watershed (chlorpyrifos, diazinon) approved May 5, 2011

Water quality targets:
Chlorpyrifos:
  Acute\(^1\) toxicity, 25 ppt (ng/L)
  Chronic\(^2\) toxicity 15 ppt (ng/L)
Diazinon:
  Acute toxicity, 160 ppt (ng/L)
  Chronic toxicity 100 ppt (ng/L)

1. 1 hour average
2. 4 day average
Lower Salinas OP Pesticide TMDL area
16. **Tier 3** — Applies to all Dischargers whose individual farm/ranch meets one of the following sets of criteria (3a) or (3b):

3a. Discharger grows crop types with high potential to discharge nitrogen to groundwater (as defined in Attachment A) at the farm/ranch, and operation farm/ranch total irrigated acreage is greater than or equal to 4000-500 acres;

3b. Discharger applies chlorpyrifos and diazinon at the farm/ranch, and operation the farm/ranch discharges irrigation or stormwater runoff to a waterbody listed for toxicity or pesticides on the 2010 List of Impaired Waterbodies (Table 1);
Pyrethroid Pesticides

- Cause of sediment toxicity in the Lower Salinas Watershed
- Label Re-evaluation EPA/DPR
- Vegetative Buffer requirement (10 ft) between field and aquatic habitat
RESTRICTED USE PESTICIDE
Due to Toxicity to fish and aquatic organisms
For retail sale to and use only by certified applicators or persons under their direct supervision, and only for those uses covered by the certified applicator's certification.

Pounce®
25 WP Insecticide

PRECAUTIONARY STATEMENTS
Hazards to Humans (& Domestics)
Causes substantial but temporary eye injury and skin irritation. Harmful if swallowed. Wash thoroughly after handling and before eating, drinking, or smoking. Remove and wash contaminated clothing.
BUFFER ZONES

Vegetative Buffer Strip
Construct and maintain a minimum 10-foot-wide vegetative filter strip of grass or other permanent vegetation between the field edge and down gradient aquatic habitat (such as, but not limited to, lakes; reservoirs; rivers; permanent streams; marshes or natural ponds; estuaries; and commercial fish farm ponds).

Only apply products containing permethrin onto fields where a maintained vegetative buffer strip of at least 10 feet exists between the field and down gradient aquatic habitat.

For guidance, refer to the following publication for information on constructing and maintaining effective buffers: Conservation Buffers to Reduce Pesticide Losses. Natural Resources Conservation Services. USDA, NRCS. 2000. Fort Worth, Texas. 21pp.

http://www.in.csusda.v/technical/agronom/newconbuf.pdf
Vegetated buffers may not be a suitable practice for vegetable and row crops.

- Don Weston, UC Berkeley
- UC Farm Advisors and Specialists
- 3 locations (UC Davis, Salinas, Chico)
Non-Vegetated Ditch (Control)
Vegetated Ditch
Mitigation practices for control of pyrethroids: Results

Sediment traps did not reduce pyrethroid or sediment concentration in the run-off

PAM reduced pyrethroid concentration in run-off by 80 to >95%

Vegetated ditches reduced pyrethroid concentrations the most at sites with low concentration of sediments in run-off
### Reduction in pyrethroid concentration in run-off

<table>
<thead>
<tr>
<th>Location</th>
<th>bare ditch</th>
<th>sediment trap</th>
<th>vegetated ditch</th>
<th>PAM</th>
</tr>
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<tbody>
<tr>
<td>Salinas</td>
<td>19</td>
<td>18</td>
<td>27</td>
<td>81</td>
</tr>
<tr>
<td>Davis</td>
<td>61</td>
<td>10</td>
<td>73</td>
<td>92</td>
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<tr>
<td>Chico</td>
<td>10</td>
<td>0</td>
<td>42</td>
<td>99</td>
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<tr>
<td>AVG</td>
<td>30</td>
<td>9</td>
<td>47</td>
<td>91</td>
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</table>
Can PAM reduce Chlorpyrifos concentration in irrigation run-off?
<table>
<thead>
<tr>
<th>Pesticide</th>
<th>Koc (ml/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diazinon</td>
<td>1000</td>
</tr>
<tr>
<td>Chlorpyrifos</td>
<td>6070</td>
</tr>
<tr>
<td>Permethrin</td>
<td>100,000</td>
</tr>
<tr>
<td>Bifenthrin</td>
<td>240,000</td>
</tr>
<tr>
<td>DDT</td>
<td>2,000,000</td>
</tr>
</tbody>
</table>
Field Trial in Broccoli

- Lorsban rate at planting: 1 lb ai/acre

Treatments:
1. PAM + Lorsban 15G
2. PAM + Lorsban 4E
3. No PAM + Lorsban 15G
4. No PAM + Lorsban 4E
PAM effects on Chlorpyrifos

Results

PAM did not reduce the concentration of chlorpyrifos in irrigation run-off.

PAM reduced run-off, thereby reducing the load of chlorpyrifos leaving the field.

Lowest concentration of chlorpyrifos was measured in run-off from plots treated with the granular Lorsban formulation.
PAM and pesticide formulation effects on cumulative chlorpyrifos load in run-off

* = statistically significant at $P < 0.10$ level
Other strategies for mitigating pesticide water quality impacts

- Minimize irrigation run-off
- Retain, treat, and/or dispose run-off
Low distribution uniformity can increase run-off

Irrigation Requirement = Crop Requirement/DU

1 inch/.85 = 1.2 inches
1 inch/.5 = 2 inches
<table>
<thead>
<tr>
<th>Irrigation method</th>
<th>1993</th>
<th>2010</th>
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<tbody>
<tr>
<td>Furrow</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Sprinkler/furrow</td>
<td>64</td>
<td>21</td>
</tr>
<tr>
<td>Hand move sprinklers</td>
<td>23</td>
<td>17</td>
</tr>
<tr>
<td>Solid set sprinklers</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Linear move sprinklers</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Sprinkler/drip</td>
<td>3</td>
<td>48</td>
</tr>
</tbody>
</table>

1. Sprinklers are used for establishing the crop (approximately 0 to 25 days after planting)
Drip Establishment of Vegetable Crops

- Eliminate sprinklers
- Elimates run-off
- Reduces costs
- Success depends on soil type and placement of tape
Drip on cole crops
Retention Pond
Vegetated Treatment System
(Pennywort)
Vegetated Waterway
Compost Socks
Landguard™ Enzyme

- Developed by CSIRO (Australian Government)
- Enzyme developed to degrade OP pesticides
- Originally used to breakdown Diazinon in sheep dip
- Used for winter dormant sprays
- Efficacy on central coast for diazinon and chlorpyrifos in irrigation run-off
Management strategies for sediment bound pesticides

- Minimize irrigation run-off
- Settle suspended sediments in retention basins
- Use PAM to minimize suspended sediments
- Use vegetated ditches to remove suspended sediments
Management strategies for water soluble OP pesticides

- Minimize irrigation run-off
- apply tail water to non-cropped area
- Enzyme treatment (Landguard)
More Info on the Fate of Pesticides in the Environment

- Extoxnet
- Win-PST (USDA-NRCS)
- UCIPM
Questions?