Methodology for Evaluating Pesticides for Surface Water Protection
Yuzhou Luo, Xin Deng, Frank Spurlock, Sheryl Gill, Kean S. Goh
Department of Pesticide Regulation, California Environmental Protection Agency

INTRODUCTION
- Evaluation of the potential effects of pesticides to surface water is required by Department of Pesticide Regulation (DPR) for pesticide registration.
- Historically, these evaluations have been based principally on professional judgment and experience gleaned from past assessment of the conditions and mechanisms responsible for the offsite transport of pesticides to surface water and their associated toxicological impacts on aquatic life.
- The DPR Surface Water Protection Program (SWPP) has recently developed a more consistent and transparent method for evaluating registration packages.

MODEL TESTING
New procedure results were compared to previous evaluations on 2008-2010 new pesticides. The model-based recommendations were generally consistent with those by best professional judgments, but more consistent and transparent. Results for 5 chemicals are shown below; see the reports (Luo and Deng, 2012) for complete results of 21 chemicals.

METHODOLOGY
Indicators developed in this study:

<table>
<thead>
<tr>
<th>Indicators developed in this study:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Runoff potential: Adsorption coefficient (KOC), field dissipation half-life (FD), water solubility (SOL).</td>
</tr>
<tr>
<td>Aquatic persistence: Half-lives (HL) in water and sediment.</td>
</tr>
<tr>
<td>Aquatic toxicity: Acute toxicity (LC50) for the most sensitive species.</td>
</tr>
<tr>
<td>Pesticide use pattern: Use patterns in the product labels.</td>
</tr>
<tr>
<td>Risk Quotient: Label rate (RATE), use pattern, KOC, aerobic soil metabolism half-life (AERO), LC50.</td>
</tr>
</tbody>
</table>

Approaches for classification:
- In water: USEPA criteria
- In sediment: DPR criteria
- Meta-modeling of PRZM
- USEPA Tier I Rice Model

Details of indicators for stage II:

Pesticide use patterns with high exposure potentials to surface water:
- Aquatic and rice pesticides
- Urban/residential uses
- Crops with gravity irrigation (DWR irrigation survey)
- Crops with top acreages (PUR database and DWR landuse survey)
- Winter rain season application
- Pre-emergent application

Risk Quotient (RQ) at the edge of field

- RQ = EI (exposure index) LC50; classified by comparing to the LOC (level of concern) of 0.5 (USEPA, 2004)
- EI = f (label rate, chemical properties)

Use-exposure relationship for dissolved pesticides relating exposure index (EI) and chemical properties and use (Luo et al., 2011):

\[ \text{ln}(EI)_{BASE} = b_0 + b_1 \text{ln}(AERO) + b_2 \text{ln}[\max(KOC, KOC^*)] \]

where EI (µg/L): 4-d moving average of edge-of-field concentrations in 3-y return period; BASE (kg/ha): a base application rate to normalized EI; KOC*: a breakpoint KOC; b's are regression coefficients from the meta-modeling of PRZM with USEPA Tier 2 scenarios for California.

OPTIMIZATION
A two-stage procedure was developed, including stage I evaluation with initial screening, and stage II evaluation with refined modeling.
- Initial screening is conducted solely on chemical properties and aquatic toxicology data of the active ingredient. For pesticides requiring additional evaluations, stage II uses a more refined modeling approach based on risk characterization of the product-specific information (use pattern and application rate).

OVERVIEW
- A two-stage procedure was developed, including stage I evaluation with initial screening, and stage II evaluation with refined modeling.
- Initial screening is conducted solely on chemical properties and aquatic toxicology data of the active ingredient. For pesticides requiring additional evaluations, stage II uses a more refined modeling approach based on risk characterization of the product-specific information (use pattern and application rate).

SELECTED REFERENCES