Methodology for Evaluating Pesticides for Surface Water Protection

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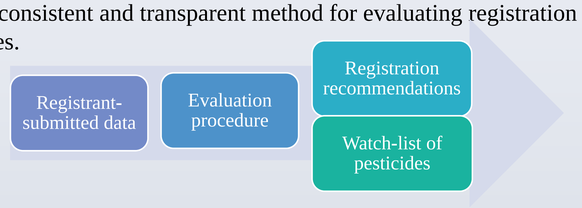
INTRODUCTION

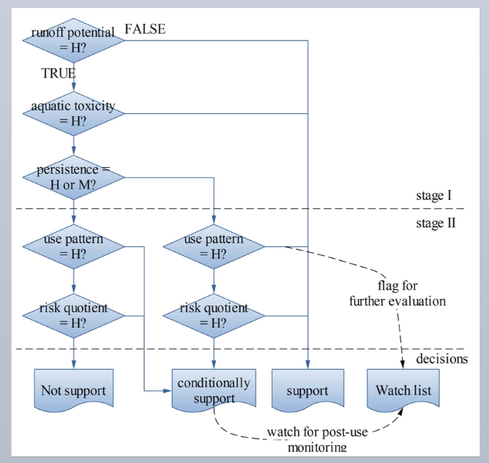
- Evaluation of the potential effects of pesticides to surface water is required by Department of Pesticide Regulation (DPR) for pesticide registration
- Historically, these evaluations have been based principally on professional judgment and experience gleaned from past assessment of the conditions 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.



Procedure	Data/Methods	Results
Data preparation	Select inputs based on registrant-submitted data	Chemical properties, toxicity data, product labels
Evaluation	▪ Develop indicators by ✓ Well-accepted criteria & models ✓ Development & improvement	Five indicators, with descriptive classification “high” (H), “intermediate” (M), “low” (L)
Decision making	Integrate indicators for appropriate decisions	▪ Registration recommendations ▪ A watch list (request analytical methods; flag for re-evaluation)

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).



METHODOLOGY

Indicators developed in this study:

Indicators	Inputs	Approaches for classification
Runoff potential	Adsorption coefficient (KOC), field dissipation half-life (FD), water solubility (SOL)	USDA models (Goss, 1992), modified for organophosphates and pyrethroids
Aquatic persistence	Half-lives (HL) in water and sediment	Critical values of 30 and 100 days of HL’s
Aquatic toxicity	Acute toxicity (LC50) for the most sensitive species	▪ In water: USEPA criteria ▪ In sediment: DPR criteria
Pesticide use pattern	Use patterns in the product labels	▪ High-exposure patterns identified by DPR scientists
Risk Quotient	Label rate (RATE), use pattern, KOC, aerobic soil metabolism half-life (AERO), LC50	▪ Meta-modeling of PRZM ▪ USEPA Tier I Rice Model

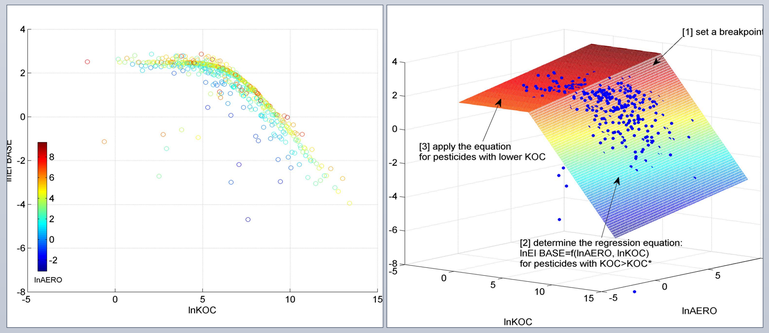
Details of indicators for stage II:

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):

$$\ln(EI\_BASE)=b_1+b_2\ln(AERO)+b_3\ln[\max(KOC,KOC^*)]$$
$$EI=EI\_BASE\times(RATE/BASE)$$

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.

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.

A.I.	Stage I Recommendations		Product	Stage II Recommendations		Best professional judgment based recommendations
	Dissolved	Adsorbed		Dissolved	Adsorbed	
“A”	S	S	“A1”			S
“B”	R	-	“B1”	C	-	S
			“B2”	C	-	
			“B3”	C	-	
“C”	R	R	“C1”	S	N	C
“D”	S	-	“D1”			S
“E”	S	-	“E1”			S

Notes: R= **r**equire stage II, S = **s**upport registration with no condition, C = support **c**onditional registration, N= **n**ot to support registration, “-” (in stage I): KOC<1000, and evaluations are only conducted for dissolved phase, and blank cells (in stage II): registration has been supported by stage I.

Demonstration of evaluation processes

Example 1 (product “A1”):

Input data	Indicators	Recommendation
Use pattern: mosquito control in standing water	Runoff potential=H	Support registration with no conditions; Not require additional evaluations in stage II.
Hydrolytic half-life=30 days	Persistence=M	
Lowest LC50=5940ppb	Toxicity=M	

Example 2 (product “B1”):

Input data	Indicators	Recommendation
SOL=2.8ppm; KOC=459L/kg[OC]; FD=69days	Runoff potential=H	Require additional evaluations in stage II.
HL in water=45days	Persistence=M	
Lowest LC50=320ppb	Toxicity=H	
Use pattern: pre-emergent herbicide for commercial turf	Use pattern=H	Support conditional registration, request analytical method, and place into the watch list.
Maximum application rate	0.1kg[A.I.]/ha/season	
Risk Quotient	0.002 (RQ<0.5, Risk=L)	

SELECTED REFERENCES

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