Understanding research on herbicide impacts: Toxicology resources for today's habitat restoration worker

Pesticide Research Institute

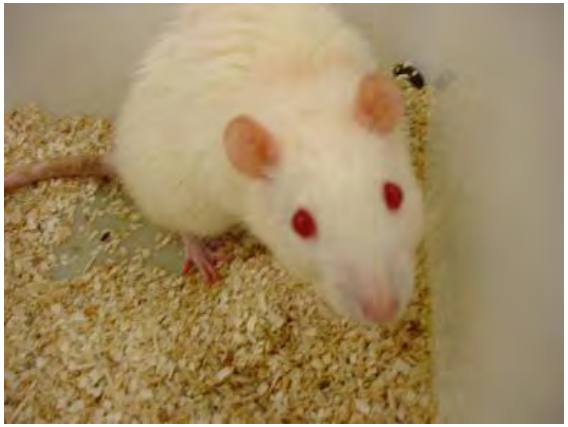
Susan E. Kegley, Ph.D.
skegley@pesticideresearch.com
www.pesticideresearch.com

Overview

- Risk assessment in a nutshell
- Data sources for risk assessments
- PRiME web-based tool

Current Risk Assessment Paradigm — US EPA

- Determine the nature of the toxic effects caused by the chemical through tests on animals



- Determine the dose at which no adverse effects are observed (NOAEL)
- Account for uncertainties in toxicity studies to obtain a Reference Dose (RfD, humans) or Toxicity Reference Value (TRV, wildlife)

Current Risk Assessment Paradigm — US EPA

- Estimate anticipated exposure for humans and wildlife
- Compare RfD (or TRV) with anticipated exposure

Sources for US EPA Risk Assessments

- **Reregistration Eligibility Decisions (REDs):** http://www.epa.gov/pesticides/reregistration/status.htm
- **New Pesticides Factsheets:** http://www.epa.gov/opprd001/factsheets/
- **Biopesticides Factsheets** http://www.epa.gov/pesticides/biopesticides/ingredients/
- **Federal Register** http://fdsys.gpo.gov:80/fdsys/search/advanced/advsearchpage.action
- **E-Docket** http://www.regulations.gov

Each Location is Unique

- Estimating exposure for humans, birds, fish, mammals, aquatic invertebrates, non-target plants for different pesticides and different locations can be a time-intensive and expensive process.

- Risk assessor must be familiar with methods of risk assessment for aquatic, terrestrial organisms, as well as dermal, oral and dietary risk assessment for humans.

US Forest Service
Exposure Assessment Worksheets

www.fs.fed.us/foresthealth/pesticide/worksheets.shtml

- Used to assess herbicide exposures from common uses
- Varies assumptions to obtain a range of anticipated concentrations
- Uses GLEAMS model to estimate herbicide runoff
- Can be customized to local conditions: Soils, weather

PRI explanation and critique of USFS worksheets, Chapter 2:
http://www.marinwater.org/controller?action=menuclick&id=437

PRiME beta

Pesticide Risk Mitigation Engine

A project of the IPM Institute of North America

Thanks to major funders to date including:

- USDA NRCS Conservation Innovation Grant Program
- Unilever
- General Mills
- US EPA Region V
- US EPA Region X

Project Team

- Tom Green, IPM Institute of North America
- Chuck and Karen Benbrook, BCS-Ecologic
- Paul Jepson, Michael Guzy, Kellie Vache, Oregon State University
- Susan Kegley, Erin Conlisk, Pesticide Research Institute
- Pierre Mineau, Environment Canada
- Thomas Green, Wade Pronschinske, Amrita Batra, Abidullah Mahmood, IPM Institute of North America
- Marty Williams, Mark Cheplik, Waterborne Environmental
- Scott Martin, University of Illinois
- Jonathan Kaplan, Natural Resources Defense Council

NRCS Advisor: Joe Bagdon

PRiME beta
Pesticide Risk Mitigation Engine

Vision

- Web-based tool to help pesticide users select the least-toxic pesticide for their particular site.
- Science-based approach to assess potential risks on a site and use-specific basis.
- Identify and prioritize opportunities for risk reduction/mitigation.
- Evaluate, document performance in risk reduction over time.
- Broad access, user-friendly format.

Project Status

- Limited release Beta version now available
- Full version to be released in early 2011

www.ipmprime.org

PRiME is a risk-based – not a hazard-based indicator

- **Hazard:** inherent property of an agent or situation capable of having adverse effects on something. Hence, the substance, agent, source of energy, or situation having that property

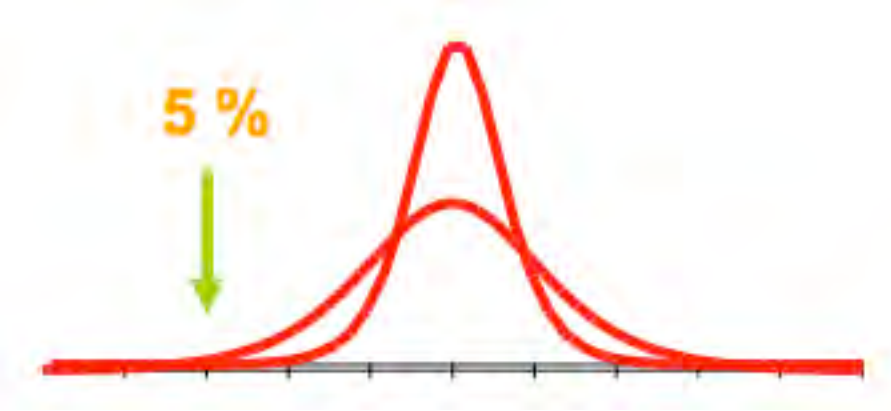
- **Risk:** the probability of adverse effects under specified circumstances caused by an agent in an organism, a population, or an ecological system

Risk indicators included in PRiME

- **Terrestrial Environment**
  - Birds – acute
  - Birds – chronic
  - Small mammal acute
  - Earthworm acute
  - Pollinator acute
- **Aquatic Environment**
  - Crustacea – acute
  - Algae – acute
  - Fish – chronic
- **Human safety**
  - Worker – dermal
  - Bystander – inhalation
  - Consumer – food residues
  - VOC production (California)
- **In various planning stages**
  - IPM/bio-control
  - Resistance management
  - Ground-water leaching

Ecotoxicity:
PRiME Uses All Available Toxicity Data

- Addresses interspecies differences in toxicological susceptibility
- Uses literature studies as well as registrant-submitted studies, many based on documented field impacts
- Guiding principle: Use of Species Sensitivity Distributions (SSDs)

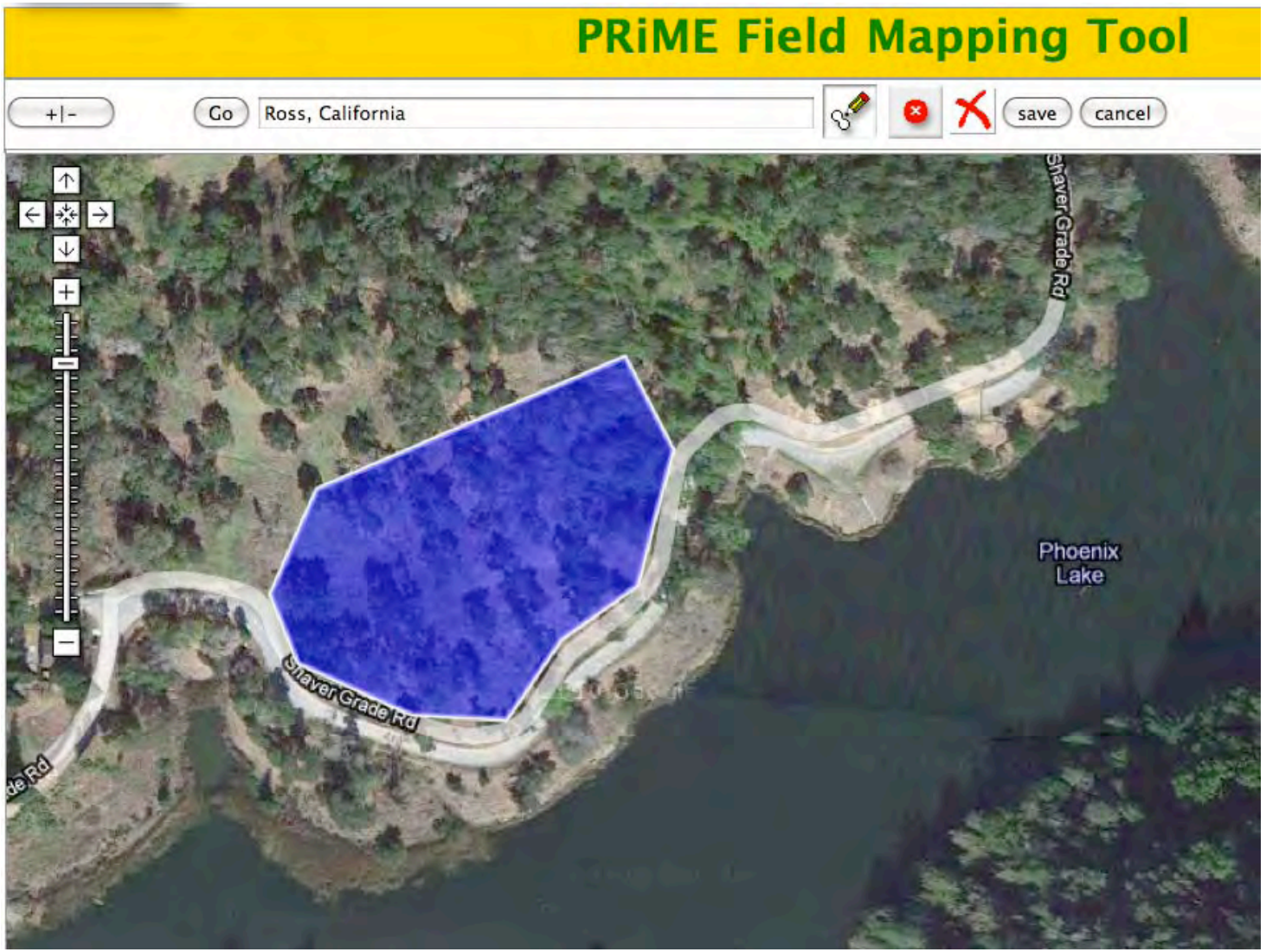


Human Indices: Dermal, Inhalation, Dietary

- Where field data not available, PRiME adopts a solution closer to regulatory assessments.

- Reference doses (RfDs) or Reference concentrations (RfCs) are used to compare to estimated exposures.

PRiME Uses Local Conditions to Produce an Individualized Risk Score



Landscape Features (Sites and Parcels) — collapse panel

Sites

New

	Name	Dwellings ?	Surface Waters ?	Narrative
☑	Wade's Orchard	☐	☐	
☐ Edit	Smith Orchard	☐	☐	

First 1 Last

Parcels (management units) within the selected Site

New GIS

	Name	Type	Area	AreaUnits	Lon.Centr.	Lat.Centr.	Narrative
☐ Edit Soil	Block 2	Cropping Area	29.928	acre	-89.449	42.986	
☐ Edit Soil	Block 1	Cropping Area	33.478	acre	-89.444	42.989	
☐ Edit Soil	House	Residence	3.046	acre	-89.446	42.987	

First 1 Last

Soil Attributes for ParcelId, 1951, with ParcelName, Block 2

AREASYMBOL	SPATIALVERSION	MUSYM	MUKEY	area m^2
WI025	2	PoA	753559	69575
WI025	2	PoB	753560	38305
WI025	2	WxD2	753608	2294
WI025	2	PnC2	753558	10939

cokey	compname	comppct_r	slope_r	hzdept_r	hzdepb_r	om_r	sandtotal_r	silttotal_r	claytotal_r
753558:582311	Plano	100	9	0	28	4	9.5	68	22.5
753559:582312	Plano	100	1	0	28	4	9.5	68	22.5
753560:582313	Plano	100	4	0	28	4	9.5	68	22.5
753608:582373	Whalan	100	16	0	25	1.5	26.1	52.4	21.5

Pesticide Management Scenarios — expand panel

Pesticide Application (Products and Use Patterns) — expand panel

Showing products registered for:

Search for: (•) Product Name ( ) Epa Registration Number

Search by: (•) StartsWith ( ) Contains

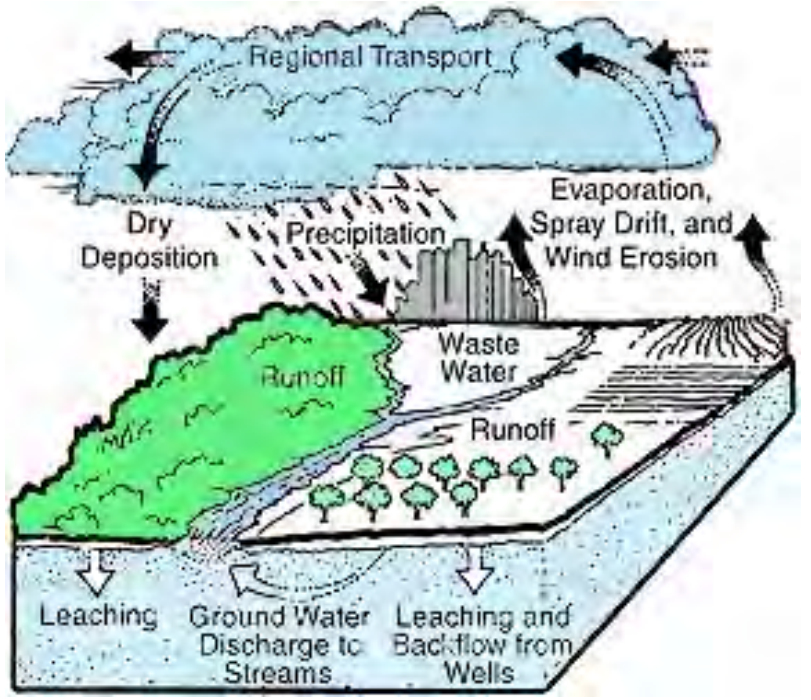
Search: Succ

	PRODUCT_NAME	EPA_REG_NR	label_unit
select	Success	62719-292	gal

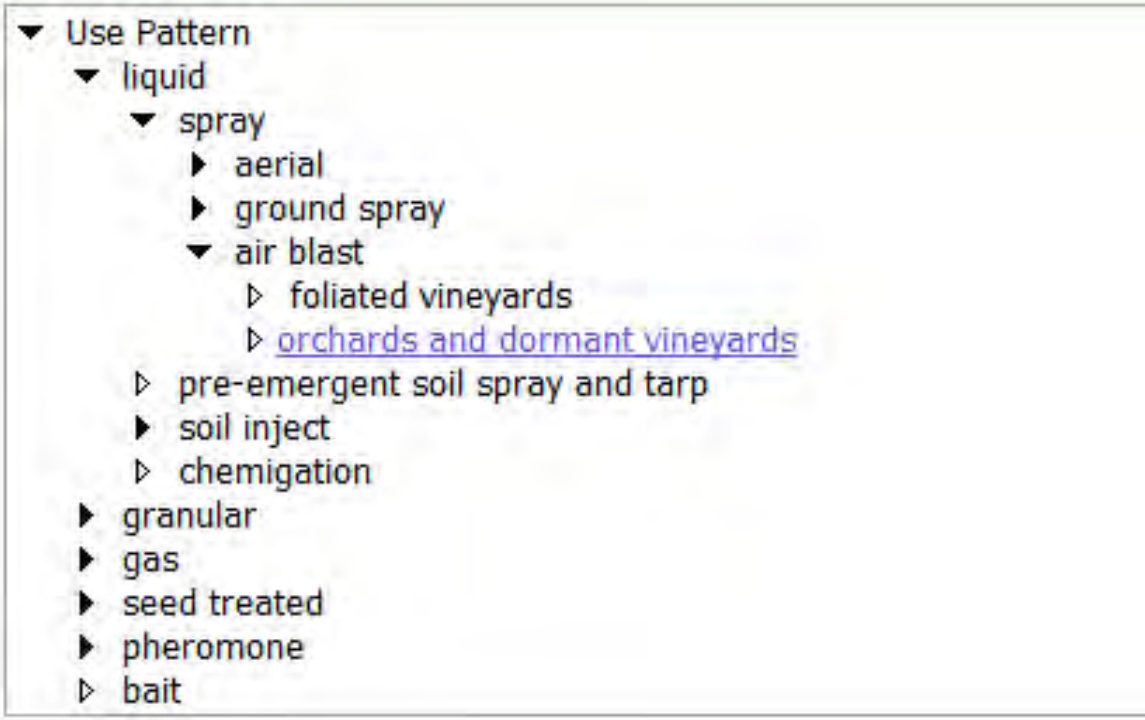
First 1 Last

Example: Local estimation of aquatic runoff for aquatic indices

- EXPRESS is an *off the shelf* package
- Includes dozens of agronomic scenarios
- Define crop, soil, and climate data representative of agricultural regions and crops
- Modular: Open to expansion
- New scenarios can be created as needed



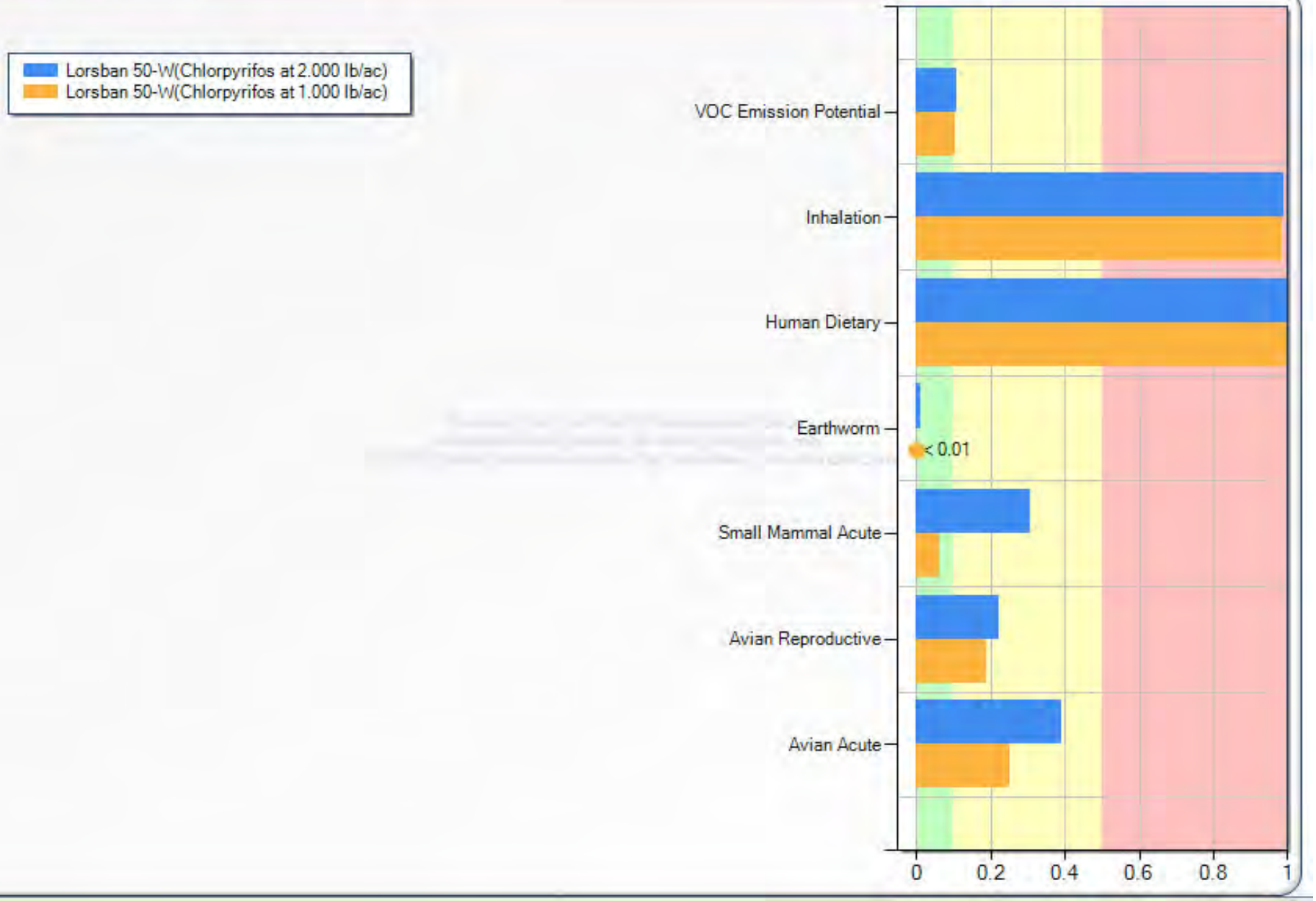
Select Application Method



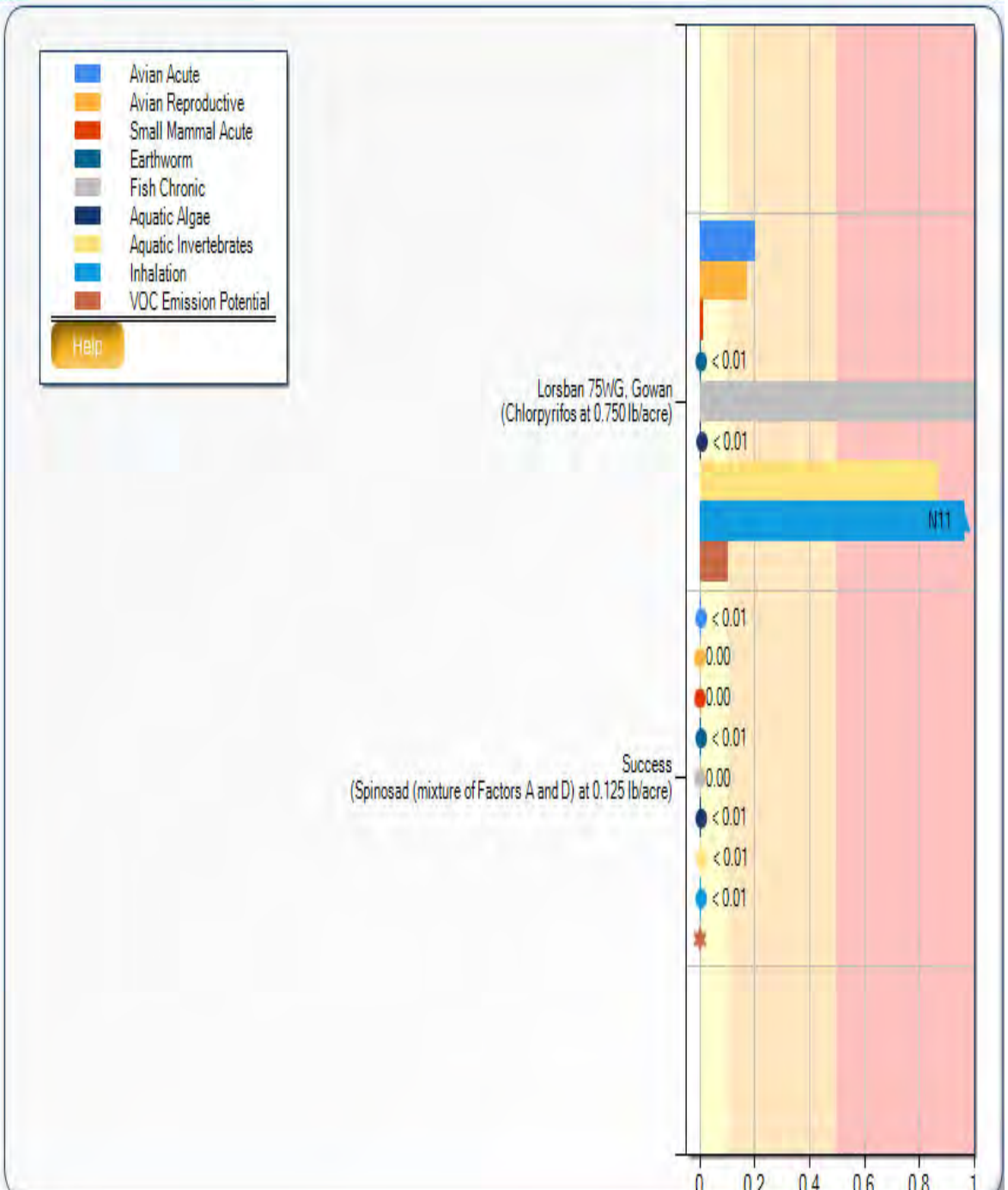
Use Pattern Adjustment Factors (UPAFs) Used to Adjust Risk According to Methods Used

Pre-Plant or Pre-Emergence			Post-Emergence			Aerial application
Surface or unspecified	Incorporated	Tarped	Ground Foliar Applied	Surface soil-applied between rows	Incorporated soil-applied between rows	
0.5	0.1	0	1	0.5	0.1	1

Risk Summary



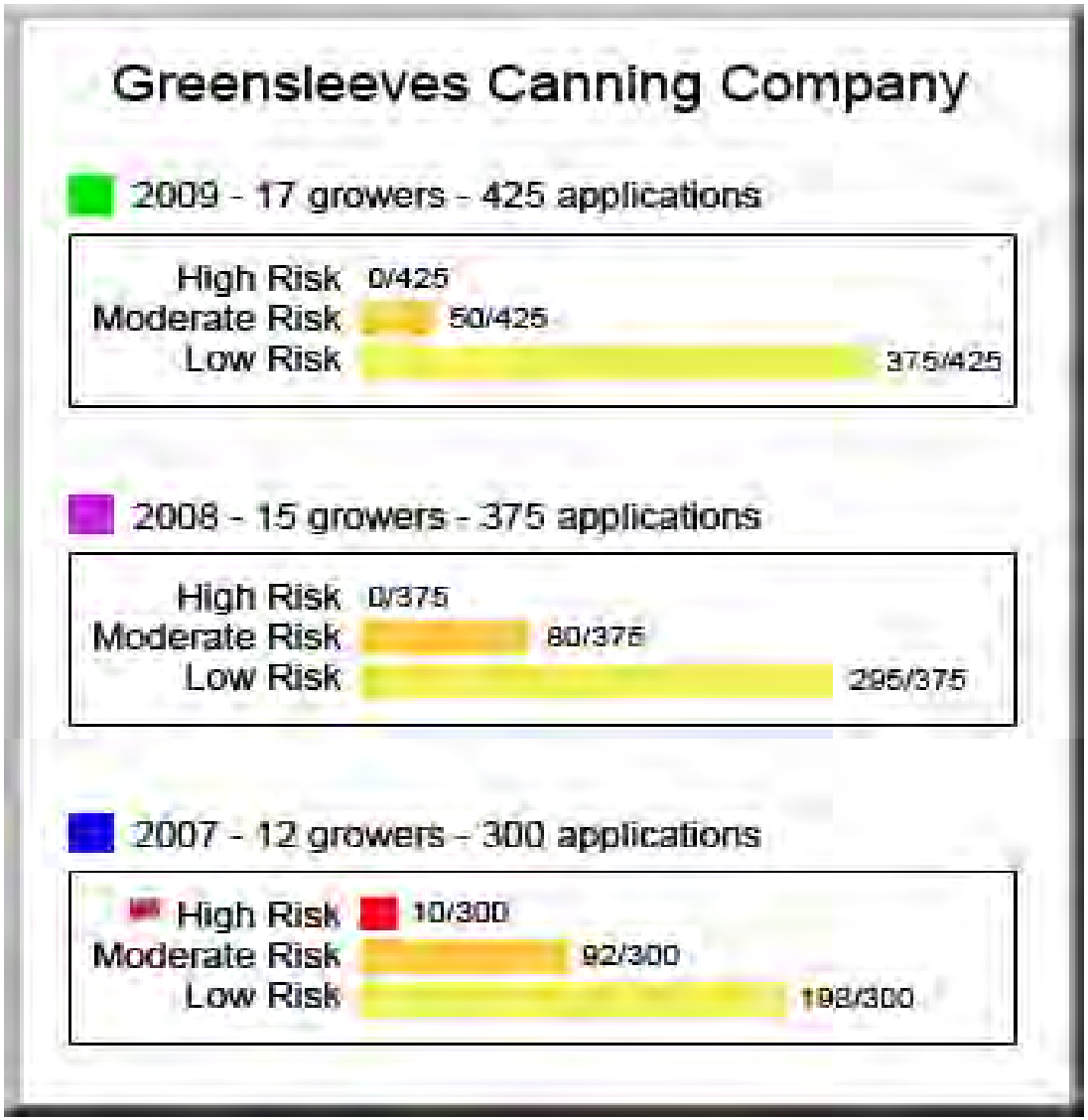
Risk Summary



Upcoming Features

Program Evaluation for Food Producers

PRiME will display a summary showing the total number of applications falling into each risk category in a given year, allowing program managers to report progress or compare program participants.



Summary Output & Mitigation

PRiME will provide users with a risk summary of the number of indices in the low, moderate and high risk categories for each product.

Users may also be alerted to indices demonstrating moderate and high risk ratings and pathways of exposure for each product.

Figure 1

Figure 3

Endofuran (4/28/07)

Resource at risk	Risk Level	How is the pesticide getting there?
Aquatic	High	80% spray drift, 20% runoff
Avian		spray drift
Earthworm		leaching
Mammalian		spray drift, direct contact
Bee		spray drift, direct contact
Beneficials		spray drift, direct contact

Additional Mitigation Strategies

- General IPM: Pest Identification, Scouting, Thresholds, Non-chemical methods - information

- Management Practices

- Use Alternate Pesticide - return to pesticide selection - information

☐ Reduce Application Rate: qt/ac -banded, perimeter or spot application?

- Reduce Runoff

	width	height	Located between spray zone and ...	efficacy
☐ Riparian Forest Buffer			select sensitive site	
☐ Riparian Herbaceous Cover		--	select sensitive site	
☐ Contour Buffer Strips	--	--	--	+
☐ Contour farm/orchard	--	--	--	+

- Reduce Spray Drift

	width	height	Located between spray zone and ...	efficacy
☐ High-Pressure Air Induced Nozzle	--	--	--	+++
☐ Low-Pressure Air Induced Nozzle	--	--	--	++
☐ Pre-Oriface Nozzle	--	--	--	+
☐ Riparian Forest Buffer			select sensitive site	
☐ Wind Break			select sensitive site	

- Reduce Leaching

	width	height	Located between spray zone and ...	efficacy

Apply hypothetical mitigation to which application?

☑ Endofuran 3EC

☐ Azachlorazine