Recommended Risk-indicator Tools for Evaluating Environmental Effects of Pesticides in IPM Projects

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Pesticide Risk Indicators & AFT

During the Last 10 Years:

- Identified common pesticide risk indicators used internationally and in the U.S.

- Tested the use of pesticide risk indicators on approximately 20 different fields with eight years of application data.

- Implemented the use of pesticide risk indicators within EPA's Strategic Agricultural Initiative Program.

Pesticide Risk Indicators

- Mathematical equations that consider a variety of data inputs (application rates, meteorological data, active ingredient toxicity, proximity to water bodies, etc.).
- Calculate potential risk scores or predicted environmental concentrations (PECs).
- Show how pesticide applications are impacting the environment.

Pesticide Risk Indicators

Ranking

- CHEMS 1 **(USA)**
- EIQ **(USA)**
- MATF **(USA)**
- PERI **(Sweden)**

PEC

- EPRIP **(Italy)**
- EYP **(The Netherlands)**
- SyPEP **(Belgium)**
- SYNOPS_2 **(Germany)**

Research Questions

- Are these indicators accurate?
- Are these indicators consistent?
- Are they applicable at either the farm or governmental level for assessment?

Methodology

- Collected 2 years of application data from 4 IPM fields
- Soil samples collected and analyzed.
- County weather data collected.
- Data inputs collected from the literature.

Results (accuracy)

Spearman's Rho Correlation Analysis

- Only EIQ, MATF, and SYNOPS generated results that were consistently valid*

- Only EIQ, MATF, and SYNOPS generated results that were reliable

a.i.	Rate	Chems	EIQ	EPRIP	EYP	MATF	PERI	Synops	Sypep
a.i. A	1	4	1	1.5	2	1	1	3	1.5
a.i. B	2	5	2	3	3	2	6	4	6
a.i. C	3	3	3	6	1	4	7	2	1.5
a.i. D	4	1	4	1.5	4	5	3	1	5
a.i. E	5	2	5	4.5	7	3	4	5	7
a.i. F	6	6	6	4.5	6	8	5	6	3.5
a.i. G	7	7	8	7.5	5	7	8	7	8
a.i. H	8	8	7	7.5	8	6	2	8	3.5

	Rate	Chems	EIQ	EPRIP	EYP	MATF	PERI	Synops
Chems	0.524							
EIQ	0.976**	0.500						
EPRIP	0.122	0.415	0.122					
EYP	0.619	0.238	0.690	0.122				
MATF	0.857**	0.667	0.905**	0.000	0.667			
PERI	-0.667	-0.619	-0.643	-0.659	-0.381	-0.571		
Synops	0.881**	0.786*	0.857**	0.415	0.643	0.810*	-0.762*	
Sypep	0.488	0.439	0.415	0.125	0.537	0.342	-0.220	0.683

Results (usability)

- Indicators employing ranking methodologies are easier to use.
- Indicators with PEC methodologies are more data intensive and involve complex equations.
- PEC methodologies give a more complete picture of environmental risk.

Indicators and Water

- All of the models consider potential risk to aquatic organisms.
- Some of the models calculate potential groundwater leaching.
  - SYNOPS: PEARL or PELMO

EIQ and Water

Ecological Component

- LC_{50} values
  - Rainbow trout
  - Bluegill

Consumer Component

- Leaching potential (Koc and Kd values)
- Runoff potential (half-life values)

MATF and Water

Ecological Toxicity Index

- LC_{50} Rainbow Trout
- LC_{50} Bluegill
- LC_{50} Daphnia

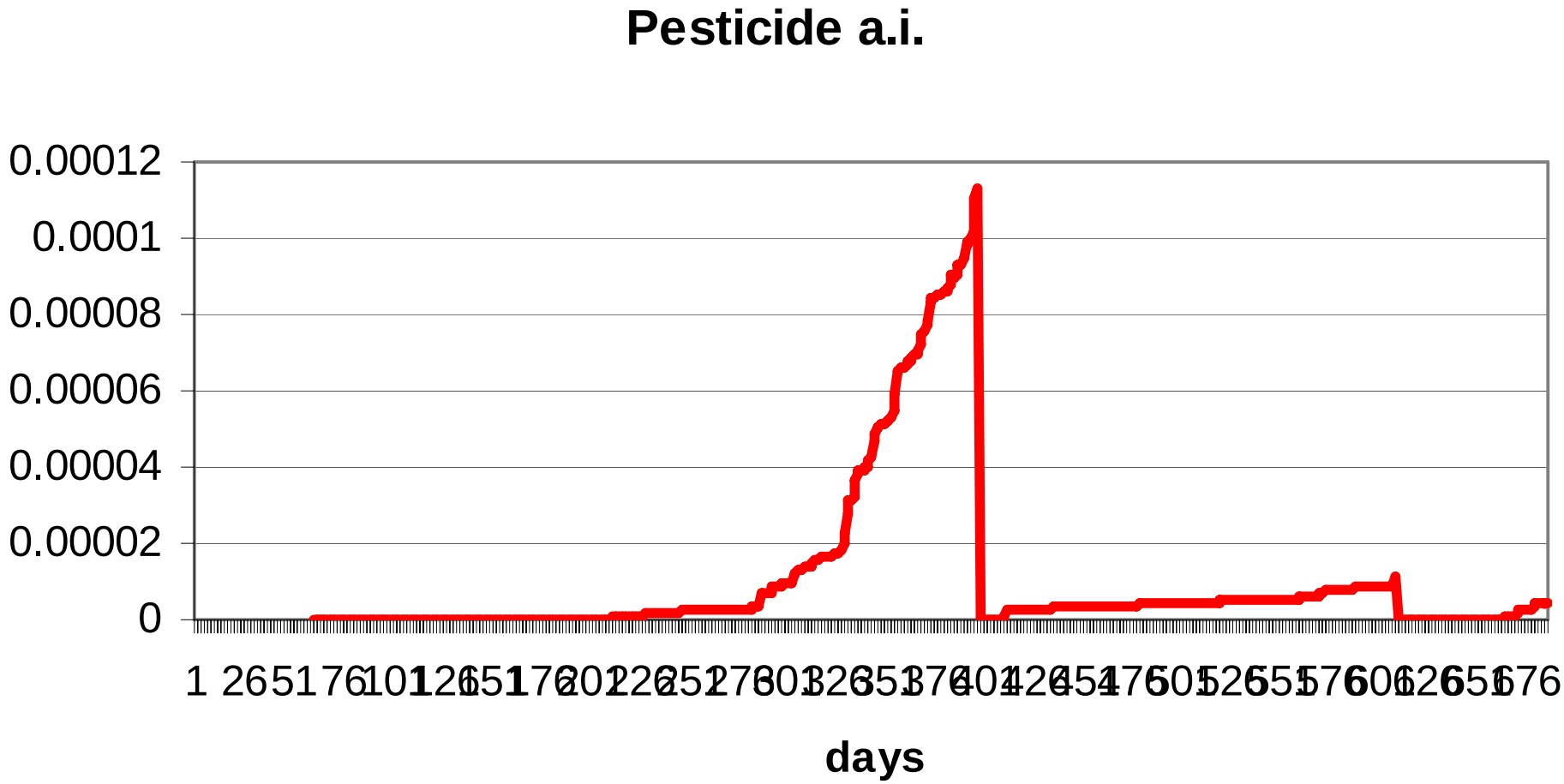
SYNOPS and Water

Data Needs

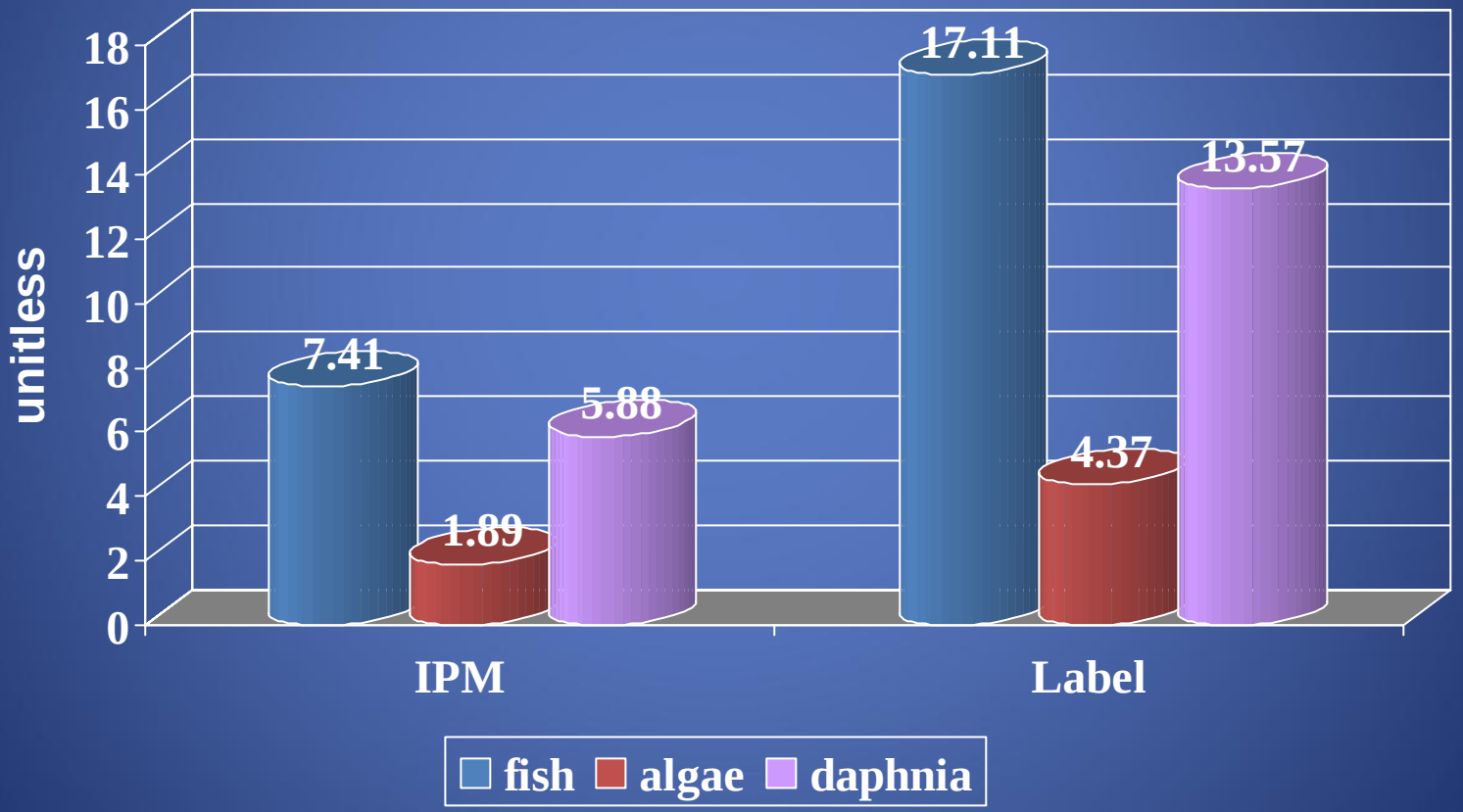
- Half-life in soil and water
- Koc and Kd
- Soil organic contact
- Rainfall patterns
- LC_{50} daphnia, trout, bluegill

Output

- PEC of the pesticidal active ingredient in groundwater and surface water
- Measure of eco-toxicity for aquatic organisms


Pesticide a.i.
0.00012
0.0001
0.00008
0.00006
0.00004
0.00002
0
1 26 51 76 101 126 151 176 201 226 251 276 301 326 351 376 401 426 451 476 501 526 551 576 601 626 651 676
days

Acute – Water Organisms*



Conclusions

- Pesticide Risk Indicator do consider water quality
- PEC vs. Ranking Protocols based on LC_{50}'s
- Research reveals that Ranking Indicators perform as well as PEC Indicators, *but they don't give a prediction of environmental concentration*