Chemical Degradation Inputs for Pyrethroid Exposure Modeling

Data for pyrethroid degradation are available for the class. PWG has used mean half-life data from high quality recent literature comparable water column and sediment studies and regulatory soil degradation programs. For some pyrethroid soil photostability can be significant.

Characteristic Pyrhythm Behavior in Water Bodies has Significant Implications

Because pyrethroids have a remarkable and unique set of properties — especially their extreme hydrophobicity — this has led to a very detailed conceptual model of their behavior in aquatic systems has been developed — see Figure 2. Key implications include:

- Some pyrethroid residues in water bodies are likely to be chemically adsorbed to sediment and their behavior in water bodies is driven by adsorption/desorption to particulates
- Effects of sediment transport & all sources of adsorption in water bodes become significant. Vegetative filter strips ver
- High statistical confidence due to size of catchment populations
- Potential for Volatile loss
- Receiving waters are an important and quantifiable source of variability in lower tier aquatic assessments. Additionally, fo
- The mass balance of water and sediment in receiving waters (e.g. inflow/outflow and burial)

Standard Lower Tier Aquatic Exposure Approach

Lower tier exposure estimates use three key inputs:

- Crop-specific pesticide label and required mitigations.
- Regulatory aquatic exposure modeling at lower tiers typically uses standard scenarios based on assumptions designed to ensure model output is extremely conservative. To improve the accuracy of these lower tier approaches, these assumptions need to be examined to prioritize opportunities for refinement. Selected refinements should be quantifiable as numerical distributions of real-world variability which could be incorporated into exposure screening frameworks.
- Equilibrium partitioning models for cases incorporating multiple agricultural applications each season, the real-world ocurrence of wind speed/direction across sequential seasonal applications has significant potential to reduce variability in exposure estimates. Pyrethroid specific use data has been abstracted from


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Abstract

Regulatory aquatic exposure modeling at lower tiers typically uses standard scenarios based on assumptions designed to ensure model output is extremely conservative. To improve the accuracy of these lower tier approaches, these assumptions need to be examined to prioritize opportunities for refinement. Selected refinements should be quantifiable as numerical distributions of real-world variability which could be incorporated into exposure screening frameworks.

Background

In the 1990’s Steven Johnson at USEPA listed some important questions for risk assessors including:

- What are the effects of concern? Why are they of concern? What’s the magnitude and probability of those effects? Examination of the potential aquatic exposure of pyrethroids using parameter ranges and potential magnitudes for cases of exposures that might cause effects. The USEPA PFRDA (Federal Insecticide Rodenticide and Fungicide Act) process uses a blended approach to cost-effectively evaluate potential aquatic risk. The process starts with an extremely conservative single-point estimate of exposure for comparison with worst-case effect scenarios. Where this indicates the potential for risk, more sophisticated lower-tier model scenarios are used to estimate crop-specific exposures. The lower-tier model is used as a basis for Tier II model scenarios. The Tier II model scenarios are used for Tier III model development. This Tier II model scenarios are used for Tier III model development. The Tier II model scenarios are used for Tier III model development.

- By addressing default assumption that all watersheds
- Assumptions regarding chemical inputs given the comprehensive data available for pyrethroids
- Pyrethroid specific use data has been abstracted from
- Daily time step repartition of chemical between sediment and water phase.
- 10-11 Chemical behavior from laboratory studies.
- Post processing computes annual maxima for each of 30 years for instantaneous and 24hr, 21day and many other time steps.
- 10-11 Efficiency of sediment transport & all sources of adsorption in water bodies become significant. Vegetative filter strips ver
- 10-11 High statistical confidence due to size of catchment populations
- 10-12 Potential for Volatile loss
- 10-12 Receiving waters are an important and quantifiable source of variability in lower tier aquatic assessments. Additionally, fo
- 10-12 The mass balance of water and sediment in receiving waters (e.g. inflow/outflow and burial)

Standard Lower Tier Aquatic Exposure Approach

Lower tier exposure estimates use three key inputs:

- Crop-specific pesticide label and required mitigations.
  - Chemical behavior from laboratory studies.
  - Environmental runoff at angle (e.g. soil, slopes), illegal
  - Corresponding 30-year history of precipitation/temperature.
  - Standard levels of drift for every application based on drift potential

The lower-tier model uses a standard field pond scenario (see Fig 1) and compute daily concentrations in receiving water body based on:

- Inputs of chemical on certain days:
  - Dissolved/leached loads in model driven rain runoff from treated fields.
  - Aerial drift loads on application dates (slug hearings for each application)
  - Wind drift load concentration of chemical from each application
  - Separate daily time step concentration of chemical degradation in receiving water phase.

Models are run using local daily weather for 30 yrs with chemical applied to the same crop each year:

- Water column, pore water and sediment concentrations estimated daily.
- Post processing computer annual drift totals of each 30 years and many other temperature weighted average metrics.
- 10-12 Availability of amendment options to deliver

Results Basic Model Refinements – Pyrethroid Tier IIAR

- Soil photolyzed when soil is unsaturated and best available mean laboratory soil and water/sediment degradation data used
- Pyrethroid coefficients are used for modeling water column and pore water EECs.
- AgroTrak in place of EXAMS as receiving water model – sediment drift and coagulated pyrethroid field data.
- Pyrethroid labels specify drift rate and all sources of adsorption in water bodies become significant. Vegetative filter strips ver
- For many crops, early season application target soil are therefore applied by ground. AgroTrak (AEM) is used to specify ground transport loads for each applied treatment but maximum numbers of applications and maximum rate retention.

Additional Factors Influence EEC Distributions in Exposed Ponds

- Some factors tend to reduce standard EECs for water bodies e.g.:
  - Field water body degradation rates – Fig 2
  - Field measured wind speed, TUR & temperature for estimating drift load from multi-application events.

Conclusions

PWG has analyzed the factors that influence the standard lower tier models and has identified several key quantitative and non-quantifiable landscape, receiving water and chemical related details for detailed evaluations. These require sophisticated assessment models or as a result, a combination of risk factors and parameter estimates.

Acknowledgement and References

The Pyrethroid Working Group (PWG) is a US task force whose members include eight primary pyrethroid registrants (AHP Chemical, Chemical Crop Protection, CropLife America, Syngenta Crop Protection, FMC Corporation, Syngenta Crop Protection, LLC, Valent U.S.A. Corporation, Bayer Crop Science, and Dean Desmarteau). The Working Group (PWG) has been tasked with developing decision support tools for agricultural professionals. For this purpose, PWG has been provided with a framework for the development of a probabilistic approach to pyrethroid exposure assessments. The approach takes a tiered scheme that starts with an extremely conservative standard lower tier exposure assessment approach to estimating potential aquatic risk. The tiered scheme starts with an extremely conservative standard lower tier exposure assessment approach to estimating potential aquatic risk.