The Pesticide Matrix Project: Developing a Data Base Tool to Guide Environmentally Responsible Pesticide Selection

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Objectives:

1. To develop a software tool to help golf turf managers make more informed decisions regarding the environmental risk of choosing a particular pesticide.

Start Date: 2006
Project Duration: two years
Total Funding: $90,000

Golf course superintendents consider many factors when selecting a pesticide for a specific use, including cost, efficacy, and turf safety. However, it is currently much more difficult for a superintendent to assess environmental risk and its relevance to his/her own golf course. What is the risk to groundwater supplies when a particular pesticide is used? What is the risk to surface water, bees, or humans?

These are complex questions requiring not only data, but also a method to put the data into context. The purpose of this project is to first collect relevant data on environmental fate, toxicology, and environmental endpoints and to compile these data into a database that will be available to golf course superintendents. To date, we have collected the majority of the data for the database.

The second part of the project is to develop a model, or software program, that calculates the risk to specific environmental features from using a particular pesticide. For example, a stream flows through a local golf course. The golf course superintendent may want to know whether a pesticide intended for use use is likely to reach surface water bodies, and if it does, what is the likelihood that it will cause problems for the trout in the stream? A rudimentary risk assessment determines the likely concentration of the pesticide in a stream, and whether this concentration is high enough to cause concern.

Integral to our process of building this tool has been the solicitation of feedback from end-users and colleagues. To this end, presentations and discussions were held with the following groups in 2007.

o Golf course superintendents: National GSCAA meeting.
o EPA: Assessment and modeling personnel and regulatory and economic staff.
o Society of Environmental Toxicology and Chemistry (SETAC)
o Crop Life America (CLA) and Responsible Industry for a Sound Environment (RISE): Pesticide industry toxicologists and modelers.

The challenge of this project is to develop a tool that is easy to use, while retaining a sound scientific basis for estimating the risk of using a particular pesticide. At this point, several components of the final model have been selected. We expect the model to ultimately yield four individual risk categories for each of the over 100 turfgrass pesticides in our database. The categories will be risk to groundwater, surface water, birds, and non-target invertebrates. The risk determination for each category will be based on risk ratios and presented using a color-code system (see sample output).

Categories of risk factors included in the pesticide matrix model include risks to groundwater, surface water, birds, and non-target invertebrates.

Recommendations for best management practices will be given for medium and high-risk determinations-alerting superintendents to potentially risky pesticide uses and ways to mitigate the risk. The output will also enable superintendents to compare among the various active ingredients they are considering to treat a specific pest, and will thereby serve as a pesticide selection tool for superintendents to use along with their knowledge of efficacy, cost, and ease of application.

Data Obtained/to be Obtained		Numbers to be Calculated
Environmental Fate Properties	*Toxicological Endpoints*	*Toxicological Reference Points*
Koc	Ref. dose (RfD), cancer slope factor	HAL (drinking water Health Advisory Level) (calculated when MCLs or HALs unavailable)
Aerobic soil metabolism $t_{1/2}$	LC_{50} aquatic invertebrates	Acute MACs (.1 x LC_{50} or EC_{50}, or NOEC) for invertebrates
Turf dissipation $t_{1/2}$	LC_{50} aquatic vertebrates	Acute MACs (.1 x LC_{50} or NOEC) for vertebrates
Vapor pressure	LC_{50} and/or LD_{50} for birds	Avian exposure to "short rangegrass" (Pfleeger et al., 1996 modification of Kenaga approach)
Water solubility	LC_{50} earthworms	Amphibian MACs based on Lam & Cohen (2006).

The development of a pesticide matrix involves obtaining pesticide environmental fate and toxicological endpoints and calculating toxicological reference points when necessary.

Summary Points

- A database of pesticide properties needed for risk assessment is being compiled.
- The database will serve as the foundation for a method of assessing environmental riskiness of pesticide use.
- The ultimate result of this research will be a simple tool to estimate and compare the risk of using one or more pesticides on the golf course.