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THE PESTICIDE DECISION TOOL: A FIELD-LEVEL APPROACH TO INTEGRATING ENVIRONMENTAL FACTORS IN PESTICIDE DECISION MAKING

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Introduction

The Institute for Agriculture and Trade Policy (IATP) is working to reduce the environmental impacts of agriculture and improve water quality through the voluntary adoption of on-farm assessment and decision tools. The objective of the Pesticide Decision Tool (PDT) project is to facilitate the integration of environmental risk assessment in the selection and management of pesticides in arable crop production. It is designed for use by agricultural professional such as co-op and elevator agronomists, independent crop consultants, and Natural Resources Conservation Service (NRCS), Soil and Water Conservation District, and university Extension specialists, as well as by farmers.

We take a broad-based approach that considers both environmental criteria and agronomic factors (such as application rate, crop tolerance, carry over ratings, and resistance risk ratings.) The environmental focus is ground and surface water protection, but other environmental and human health risks are considered. We currently have materials for field corn and soybeans, with an emphasis on production in the Midwestern states. Herbicides are the major pesticide inputs in these crops.

The Pesticide Decision Tool consists of a set of documents and associated software. Both the documents and the software can be downloaded over the Internet. The tool features two approaches: 1) a screening tool for assessing the likelihood of water contamination and 2) Reference Tables for easy comparison of the environmental and agronomic characteristics of the products available for a certain type of application (e.g., preemergence herbicides, soybeans).

Detailed description

NRCS Windows Pesticide Screening Tool

We use screening tool software from the USDA NRCS called the Windows Pesticide Screening Tool. By taking into account the properties of both soils and pesticide active ingredients, one can obtain a preliminary assessment of the potential for ground and surface water contamination. The user can then go a step further and assess risk to aquatic organisms (and humans—drinking water) by incorporating toxicology information. For downloading and installation instructions for the software, see the WinPST homepage at ftp://ftp.ma.nrcs.usda.gov/outgoing/winpst/index.htm (Go to "WIN-PST Software"). WinPST was developed by the NRCS Water and Climate Center's National Agricultural Pesticide Risk Analysis (NAPRA) team in Amherst, MA. NAPRA released official version 2.0 in October 1999.

The user comes to WinPST having already selected a product or combination of products that he expects to use or a larger group from which he will make a selection. The user should also know the soil types in the field(s) where the pesticide(s) will be applied. In the first step of WinPST, the user looks up ratings for the active ingredients in the pesticide(s) selected. Then, the user
finds an equivalent set of ratings for the soil type (map unit symbol of the field(s) where the pesticide will be applied. The ratings are in the form of qualitative categories, representing the relative likelihood that a pesticide will leave the site of application via runoff or move down through the soil below the root zone. The ratings can also be obtained from spreadsheets developed by IATP.

Three modes of potential water contamination are considered: groundwater via leaching, surface water via dissolved pesticides, and surface water via pesticides sorbed to soil particles. For both soil type and pesticide active ingredient, there are three possible rating classes—"high," "intermediate," and "low"—for each mode of contamination (plus a "very low" class for leaching). The ratings reflect the physico-chemical properties of the soils and the pesticide active ingredients. Combining the two ratings results in an average or interaction rating for the potential for contamination to occur, again: high, intermediate, or low. (For example, a pesticide rating of low and a soil rating of high, averages to an interaction rating of "medium").

A rule-based protocol is used to adjust the ratings so that the procedure is responsive to the effects of case-specific conditions such as the method of pesticide application, the depth to the water table, field slope, and the probability of rainfall. [For example, "if applied by banding, reduce all three pesticide ratings by one class," (e.g., from "intermediate" to "low")]. At each of the three steps of the procedure—pesticide, soil, and interaction—there are specific rating adjustments that can be applied.

Reference Tables

The pesticide Reference Tables are spreadsheets with environmental information and other decision factors such as production cost. Herbicides, insecticides, and fungicides are covered. For each active ingredient (trade names also given), the environmental information includes WinPST water contamination potential ratings, various toxicity ratings (see below), and a carcinogenicity rating. The herbicide tables include ratings for crop tolerance, persistence/carry over, and resistance risk.

The following is a more detailed description of the herbicide Reference Tables (RT). There are separate herbicide tables for corn and soybeans. The herbicide tables have separate subsections for each use category (i.e., the timing of application: no-till, preplant, preemergence, postemergence). In each subsection, the first column contains the active ingredients listed according to their mode of action (as indicated by shading). Within these groups, they are listed alphabetically by active ingredient. Major brand names and general target groups (broadleafs, grasses, perennials) are given in the second and third columns. From left to right, the other columns are: crop tolerance rating, rate range (lb. a.i./acre), price range ($/acre broadcast), the three screening tool ratings, four screening tool toxicity ratings, four on-farm exposure hazard ratings, carcinogenicity rating, carry over rating, and a section on resistance management.

The screening tool toxicity section has ratings for effects on nontarget groups (humans—drinking water, fish, free-swimming invertebrates (crustaceans), and benthic invertebrates) via long-term exposure. The on-farm exposure hazards section gives the signal word, acute toxicity ratings (oral, dermal), and acute irritation ratings (eye, skin). Although, the focus of WinPST is water contamination, there are other environmental concerns that should not be neglected. However, risks to nontarget groups such as soil organisms, terrestrial vertebrates, native plants, and beneficial insects are relatively difficult to evaluate in a formal or standardized way because of serious data gaps and/or the lack of satisfactory and practical measures of exposure. The RTs currently include ratings for acute toxicity to honeybees and birds (plus honeybee application recommendations in the insecticide tables). The carcinogenicity column has US EPA rating categories such "not classified," "not carcinogenic," "possible," "probable".
For the "carry over" (persistence) column, we have adopted a three-category rating system (from North Dakota State Univ. Extension) for likelihood of crop injury twelve months after application (N = never, S = seldom, O = often). Under resistance management, there are three subcolumns: mode of action, risk rating, and chemical class. Mode of action is given as an abbreviation such as "CMD" for cell membrane disrupters and "GR" for growth regulators. The second subcolumn has a qualitative, relative risk rating (low, medium, high) for likelihood for resistance to develop (from Univ. of Wisconsin-Extension).

The following Reference Tables are available:

- Herbicides, corn
- Herbicides, soybeans
- Corn and soybean insecticides, summary
- Corn and soybean fungicides, summary
- Pest-specific, corn insecticides
- Pest-specific, soybean insecticides

Other documents

The PDT is a set of documents designed to accompany the introduction of WinPST in hard copy form. The hardcopy version does not allow the user to fully avail of the analytical capabilities of the software respecting water contamination and related toxicity concerns. However, the PDT does offer convenience, additional training or educational benefits, and record keeping and evaluation components. In addition to the Reference Tables, the PDT includes:

- PDT Cover Sheet and Quick Guide
- Technical Project Description
- User Guide and Documentation
- County listings of soil types and WinPST ratings (sample listing for one Midwest county)
- Soil rating form: field by field listing (for record keeping)
- Soil-Pesticide Interaction Worksheet (for training)
- "Short cut" template for groundwater hazard, Herbicide leaching
- Decision Case Form (for project evaluation)
- Printing notes (instructions for printing a county soil listing from WinPST)

All of the documents are available at the Pesticide Decision Tool Homepage (See http://www.iatp.org/pesticide/; "PDT Documents" button). Updated materials can be obtained at any time by visiting and downloading from the website or by requesting that materials be sent by mail. PDT materials are currently available only for in corn and soybeans

Training, support, collaboration

ICM Conference participants will be trained to use the PDT set of materials. The limitations and appropriate interpretation and use of WinPST will be covered. The session will deal primarily with the technical aspects of PDT use. However, some time will be allowed to discuss the practicality or feasibility of using such environmental decision/assessment tools in the context of participants' current professional activities.

Technical support will be available for the coming field season. IATP is interested in collaborative efforts in other large acreage crops such as potatoes, sugarbeets, sweet corn, and wheat. We welcome inquiries from prospective cooperators.