Understanding and Minimizing Impacts of Agricultural Pesticides on Small Water Systems Using Surface Water

Small water systems that use surface water are vulnerable to pesticide contamination. Atrazine, a pesticide used to treat weeds, is used on more than 80% of corn grown in Midwest states. It is highly effective and relatively inexpensive. However due to its widespread use and moderately high solubility, it is widespread in surface water across the Midwest, including source water for community public water systems. Atrazine was identified in an informal survey we conducted in 1998 as the top water quality concern of operators of surface water systems in Indiana.

Systems using surface water systems are much more vulnerable to pesticide contamination than systems using ground water, and small systems are more likely than large systems to have atrazine exceeding 3 ppb (the MCL) in finished water. Although large systems that use surface water face high pesticide levels in the source water at times, most of them have the capacity to treat the water.

Protecting source water from the risk of pesticide runoff is difficult. The complexity of the task is one of the reasons a detailed susceptibility analysis to agricultural pesticides is not included in most source water assessments, and is not something that the individual water systems, particularly small water systems, can easily do. The goals of this project were to:

1. Assess the water quality impacts of potential changes to pesticide application and management practices in watersheds used by small community water systems.
2. Compile information on levels of atrazine in community water systems in Indiana that use surface water, and make the information accessible to the public.
3. Educate pesticide applicators and the public about watersheds used by community water supply systems, and the importance of knowing about these watersheds in making pesticide applications.

Water quality impacts of management changes

Impacts on water quality of changes in agricultural management practices are not easily known because they are site-specific. The impacts in a specific location depend on soil, topography, local rainfall patterns, and specific management practices. Since all potential “best management practices” (BMPs) cannot be tried, simulation models are the most effective technology to use in estimating and comparing various management practices.

We used two existing hydrologic and water quality models in this study: GLEAMS (Groundwater Loading Effects of Agricultural Management Systems; Knisel et al., 1994) and SWAT (Soil and Water Assesment Tool; Arnold et al., 1998). GLEAMS has the most detailed pesticide transport and transformation components of commonly-used existing models, and is stronger at predicting the effects of mangement practices at the field scale. SWAT is much more developed as a watershed-scale model, and therefore is stronger at predicting concentrations at the watershed outlet.

We used the NAPRA WWW system (National Agricultural Pesticide Risk Analysis), developed by the USDA NRCS and extended by ABE at Purdue University. The system uses GLEAMS to assess the potential risk of pesticide loss to shallow ground or surface water as a result of various agricultural management practices. Three practices were assessed by running the model for 30 years: incorporation, post-emergence application, and reduced application rates. We found significant reductions in runoff from incorporating atrazine in the soil instead of applying it to the surface, and by applying atrazine after weeds begin to emerge in the corn-field. Atrazine losses in runoff and percolation were reduced roughly in proportion to the amounts.

We used the Soil Water Assessment Tool (SWAT) model to study the impacts of various management practices on atrazine runoff at the watershed scale. The model was calibrated for flow and atrazine concentration using existing data, then five different management practices for atrazine were simulated. Conservation tillage (no-till) was not predicted to have a significant effect on atrazine concentration in this watershed. More effective management practices are reducing the rate of application, and particularly the implementation of filter strips (riparian buffers).

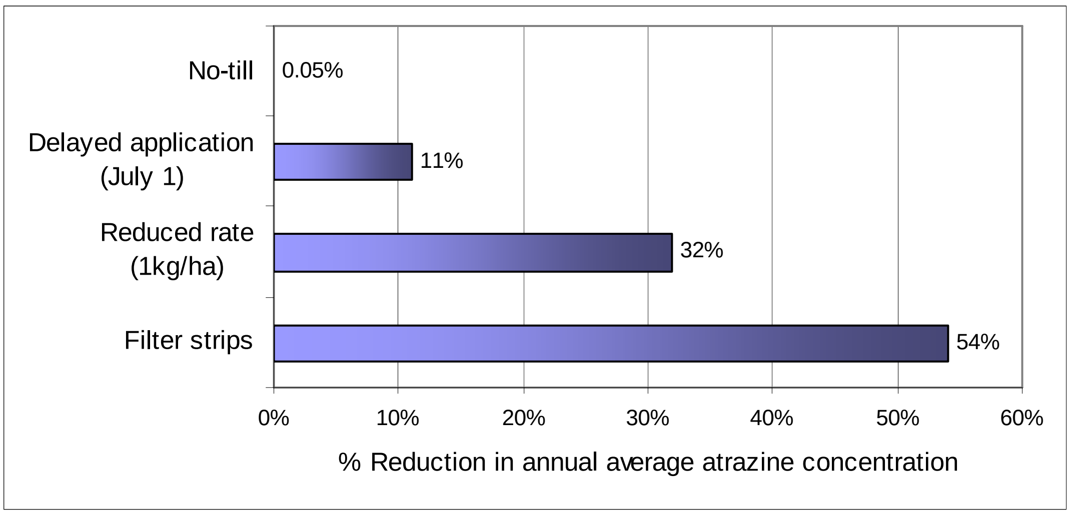

Fig. 1: Predicted reduction in annual average atrazine concentration from a baseline of typical atrazine management practices, using SWAT

Knowing the impacts of various management practices will allow producers and the agencies who work with them to choose application strategies that will keep atrazine and other pesticides below levels of concern. It will also help target pesticide management cost-share programs to support practices that have the greatest impact. Data assembled and made available to the public in this project will help to educate the pesticide applicator community of the results of their activities, and will encourage them to improve their pesticide application stewardship.

References

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