PESTICIDES AND WATER QUALITY:
WDATCP RESEARCH & REGULATORY HOT BUTTONS

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Background

The Wisconsin Department of Agriculture, Trade and Consumer Protection (WDATCP) is responsible for managing pesticides to protect water quality. Until recently, groundwater quality concerns, predominantly related to atrazine contamination, have driven the research funded by WDATCP and the regulations adopted by the department to achieve compliance with groundwater standards. While the department has shown the presence of herbicides in surface water through joint studies with the U.S. Geological Survey, the lack of surface water standards for most pesticides has prevented an assessment of potential or actual environmental impacts. Currently, no WDATCP regulations have been developed based on surface water contamination due to pesticide use. However, during 2003, the U.S. Environmental Protection Agency (EPA) issued new health and environmental risk assessments for atrazine which placed greater concern on potential surface water impacts versus groundwater impacts. In response, WDATCP has expanded its surface water monitoring efforts while maintaining groundwater monitoring and pesticide management activities. This paper will touch on recent research developments, proposed Wisconsin atrazine regulations, and pending federal actions which will affect the management of pesticides in Wisconsin.

The use of a root-zone model (PRZM) to evaluate the effect of application timing on groundwater quality

Current WDATCP rules prohibit applications of atrazine prior to April 15 of any growing season to protect water quality. This provision assumes that the risk of atrazine leaching to groundwater increases as applications are made earlier in the spring. Cooler spring conditions, which depress atrazine degradation, along with increased rainfall after early applications were thought to increase leaching potential. But, growers wished a rule revision that would allow the increased flexibility of applying atrazine as early as April 1st of a growing season. It was unknown what impact the additional two weeks of application time would have on water quality. In cooperation with WDATCP, Syngenta, a manufacturer of atrazine, evaluated the impact of early spring applications of atrazine on groundwater quality through the use of a model.

Syngenta engaged Stone Environmental, Inc. to conduct a modeling study using the U.S. EPA model, PRZM3.22, to examine whether the rule revision, which would allow atrazine applications up to two weeks earlier in a given season, might appreciably change leaching potential. A modeling effort was chosen because it would permit the use of many years of historical climate data which would hopefully capture the range of conditions that might be expected to occur. This analysis could also be accomplished in a

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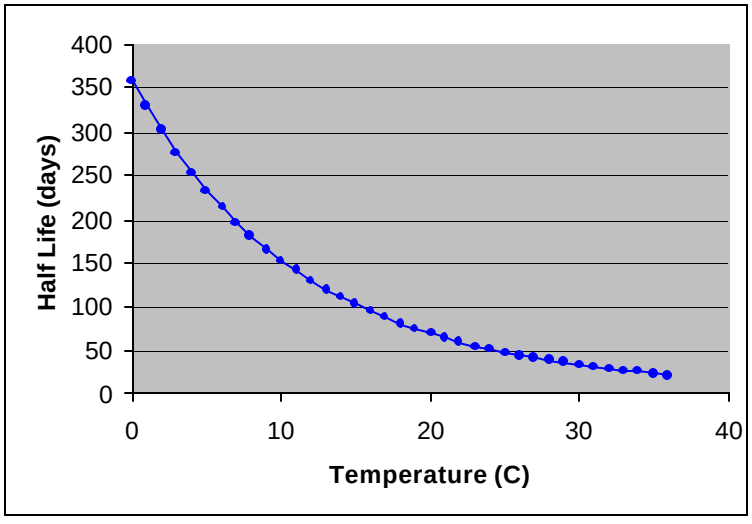
relatively short time frame that could then be used in the rule revision process. A field monitoring study would likely take several years to complete, require considerable resources to implement, and could run the risk of capturing data based on extreme weather conditions due to the relatively small number of sample years. The modeling study included 36 continuous atrazine application years of daily weather data modeled independently for each planting/application date scenario between April 1 through April 15. Two different soil/site scenarios were modeled. This included a very coarse sand at Hancock, Wisconsin and a silt loam at Arlington, WI.

The Arlington scenario modeled a soil profile as a silt bam through 5 feet with a very coarse sand (field capacity = 0.018) for the next 10 feet below to maximize potential leaching. This would represent a worst-case scenario for leaching potential in this area. Organic matter was modeled as 2.0% for the interval 0 - 25 cm, 0.5% for the 25 - 90 cm interval and 0.0% below 90 cm. The atrazine application rate of 1.5 lbs active ingredient per acre (1.68 kg ai/ha) was used based on the maximum rate allowed by Wisconsin rules for medium textured soils.

The Hancock scenario modeled a soil profile as a loamy sand in the first foot (field capacity = 0.125) with sand below (field capacity = 0.091). Organic matter content was modeled as 1.26% 0 – 20 cm, 0.62% 20 - 40 cm, 0.31% 40-100 cm, and 0.00% below 100 cm. The atrazine application rate of 0.75 lbs active ingredient per acre (0.84 kg ai/ha) was used based on the maximum rate allowed by Wisconsin rules for coarse textured soils.

The effect of soil temperature is an important factor in the degradation rate of atrazine and was included in this modeling effort. Soil temperature at 2" depth and 4" depth for the years 1988 through 2001 was obtained from WI-MN Cooperative Extension Agricultural Weather (http://www.soils.wisc.edu/wimnext/awon). Average soil temperatures were examined for April 1 compared to April 15 for the years 1988 through 2001. The degradation of atrazine is depicted in Figure 1.

Figure 1. Atrazine degradation (half life in days) as a function of soil temperature.



Study Results

To determine the impact of early applications of atrazine the model predicted annual atrazine mass (kg/ha) leached below the root zone (3 ft) for each application scenario between April 1, April 7, April 15, and April 20.

The following table shows the percent difference between April 1 and April 15 in the mass of atrazine leached below the root zone under the Arlington, silt loam scenario. It is expected that once in every ten years there will be a 12% increase in the mass of atrazine leached if applications are made April 1 vs April 15.

Arlington Scenario

Recurrence Frequency	Increase in Amount Leached Apr. 1 vs. Apr. 15
1 in 2 Years	0.6%
1 in 5 Years	7.8%
1 in 10 Years	12.3%

The following table shows the percent difference between April 1 and April 15 in the mass of atrazine leached below the root zone under the Hancock, coarse soil scenario. It is expected that once in every ten years there will be a 22% increase in the mass of atrazine leached if applications are made April 1 vs April 15.

Hancock Scenario

Recurrence Frequency	Increase in Amount Leached Apr. 1 vs. Apr. 15
1 in 2 Years	-3.5%
1 in 5 Years	12.9%
1 in 10 Years	21.8%

Regulatory implications

The results of this study were reviewed by WDATCP staff and the department's Atrazine Technical Advisory Committee. The Atrazine Technical Advisory Committee believed that the study was well conducted and reached reasonable conclusions. While the model did predict increased leaching under the earlier application scenarios, it was relatively modest. The Committee recommended that the department revise its rules to allow April 1 applications of atrazine. Based on this recommendation, the department has proposed rule revisions which have been approved by the Wisconsin Board of Agriculture, Trade and Consumer Protection. Assuming positive Legislative Review, Wisconsin farmers should have the option of April 1 applications of atrazine in 2004.

The Status of Alachlor (LASSO) Management to Protect Water Quality

Currently, Wisconsin has no restrictions on the use of alachlor based on water resource concerns beyond those listed on the Federal label. Many years of groundwater monitoring of both private wells and monitoring wells located near agricultural fields indicate that normal field use of alachlor is not a widespread threat to groundwater quality as far as the parent compound of alachlor is concerned. In cases where parent alachlor is found to exceed groundwater standards, investigation has shown that spills or other point sources of contamination account for the problems. However, since 1994, analysis of groundwater samples for a breakdown product of alachlor, ethane sulfonic acid (alachlor ESA), has shown widespread groundwater contamination of groundwater throughout corn growing areas of Wisconsin.

The latest groundwater survey conducted by WDATCP indicated that 27.8% of private wells are expected to contain detectable levels of alachlor ESA (Agricultural Chemicals in Wisconsin Groundwater, May 2002). This compares to 11.6% of private wells expected to have a detectable level of atrazine residues. Given the frequency of alachlor ESA detections, WDATCP requested the Wisconsin Department of Health and Family Services (WDH&FS) recommend a groundwater standard for alachlor ESA to the Wisconsin Department of Natural Resources (WDNR) for inclusion in NR 140 *Groundwater Standards,* Wis. Adm. Code. WDH&FS recommended an alachlor ESA enforcement standard of 20 ug/l and preventive action limit of 4 ug/l for inclusion in NR 140. WDNR has taken this proposed standard to public hearing and expects to take the Final NR 140 rule, including the proposed alachlor ESA standard to the Board of Natural Resources in Spring or Summer of 2004.

Should WDNR adopt the proposed alachlor ESA standard, WDATCP would be obliged to investigate exceedences of the preventive action limit and enforcement standard as it does now for atrazine. Currently, thirteen wells exceed the proposed 20 µg/L enforcement standard and over 100 wells exceed the proposed 4 µg/L preventive action limit. If the department concludes that use has contributed to the observed contamination then some action is required. This could involve management actions similar to those taken for atrazine including broad use rate reductions and localized use prohibitions. The earliest these actions might take effect would be during crop year 2005.

The Status of Atrazine at State and Federal Levels

<u>Wisconsin Restrictions</u>

Atrazine is still the most widely and heavily used corn herbicide in Wisconsin in 2001, applied to 59% of corn acres totaling 1.8 million pounds of active ingredient, according to Wisconsin Agricultural Statistics Service (May 2002). Wisconsin specific restrictions on the use of atrazine are contained within ATCP 30 *Pesticide Use Restrictions* Wis. Adm. Code. The primary restrictions include prohibition of use on over 1.2 million acres of land and statewide use-rate reductions to protect groundwater quality. Use is typically prohibited in an area when a drinking water well exceeds the 3 µg/L enforcement standard. The standard includes parent atrazine and its three chlorinated metabolites.

One additional prohibition area is proposed for crop year 2004 and as mentioned earlier, atrazine is proposed to be allowed to be applied as early as April 1.

Atrazine Reintroduction to Prohibition Areas

WDATCP, with financial and laboratory assistance from Syngenta, the primary atrazine manufacturer, is completing the fifth year of a monitoring study to determine the impact of Wisconsin's lower use-rates on groundwater quality and to determine whether atrazine can be safely reintroduced into atrazine prohibition areas. In 1998, three in-field monitoring wells were installed at each of 17 sites around the state within atrazine prohibition areas. By locating monitoring sites within prohibition areas it was hoped that background levels of atrazine in shallow groundwater would be low since atrazine had not be used at these sites for at least 5 years. Sites were sampled prior to reintroduction of atrazine use and then quarterly over the 5-year course of the study. Atrazine was to be applied for at least 3 out of 5 years.

Four years of data are now available. At least one well at each site has shown a higher concentration of total chlorinated residues of atrazine (TCR) after atrazine reintroduction than the initial sample result. At some point during the study, TCR levels have exceeded the enforcement standard (3 µg/L) at 13 of 17 sites. Over 5 years, TCR concentrations have significantly increased in groundwater under sites with coarse-textured soils (Figure 2.) but TCR levels in groundwater under sites with medium-textured soils have not increased with statistical significance (Figure 3.)

Figure 2. Median total chlorinated residues (TCR) of atrazine at coarse-textured soil sites.

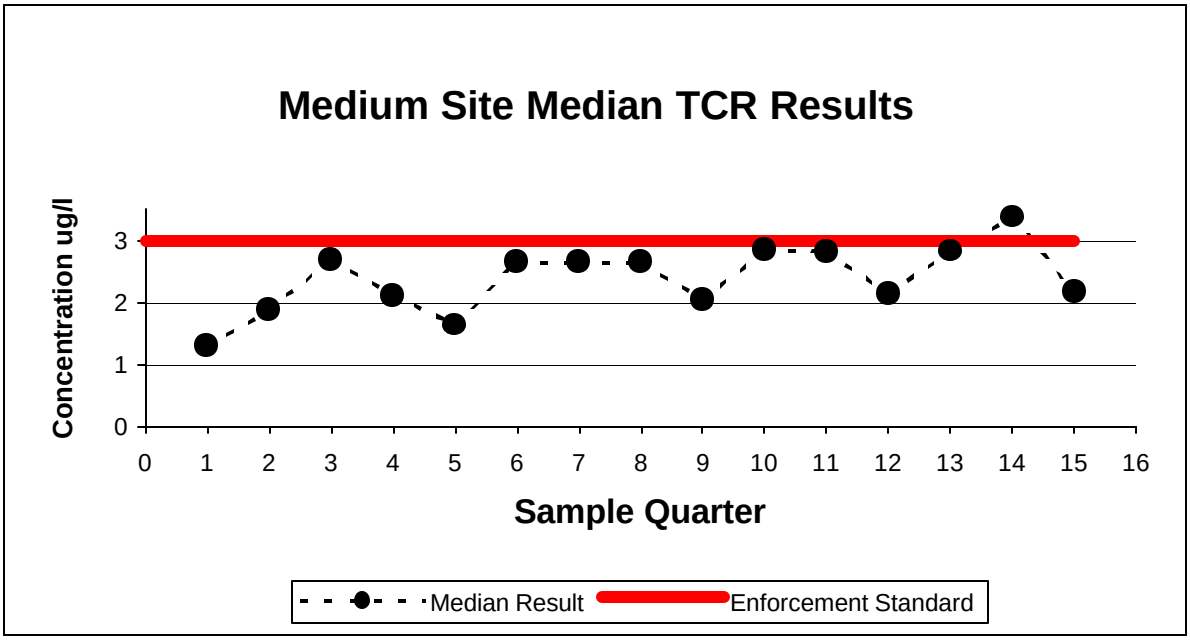
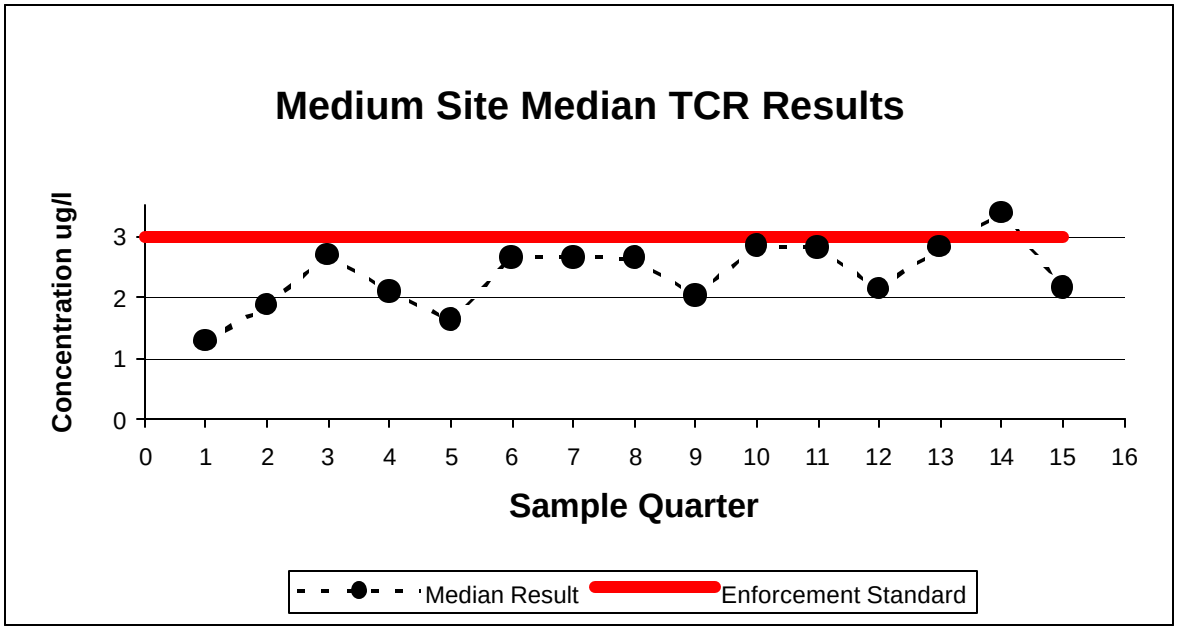


Figure 3. Median total chlorinated residues (TCR) of atrazine at medium-textured soil sites.



Federal Actions related to Atrazine

U.S. EPA has recently completed its risk assessments for atrazine and has raised its standard for human health concerns. Atrazine is no longer considered a likely human carcinogen. The level of concern for atrazine in drinking water has been raised to 37.5 ppb but the Maximum Contaminant Level, which is the level that community water suppliers must meet, remains at 3 ppb. Environmental risk assessments are now targeting surface waters and sampling of 40 watersheds throughout the Midwest, though not in Wisconsin, will begin in the summer of 2004. There are concerns that atrazine may affect aquatic plant communities if the chronic level of exposure in water reaches 10 to 20 ppb. Federal management actions may be taken if either the 37.5 ppb level is reached in watersheds supplying community drinking water or if modeling efforts show that aquatic plant communities could be affected. These modeling efforts will generate specific levels of concern based on the nature of specific watersheds.