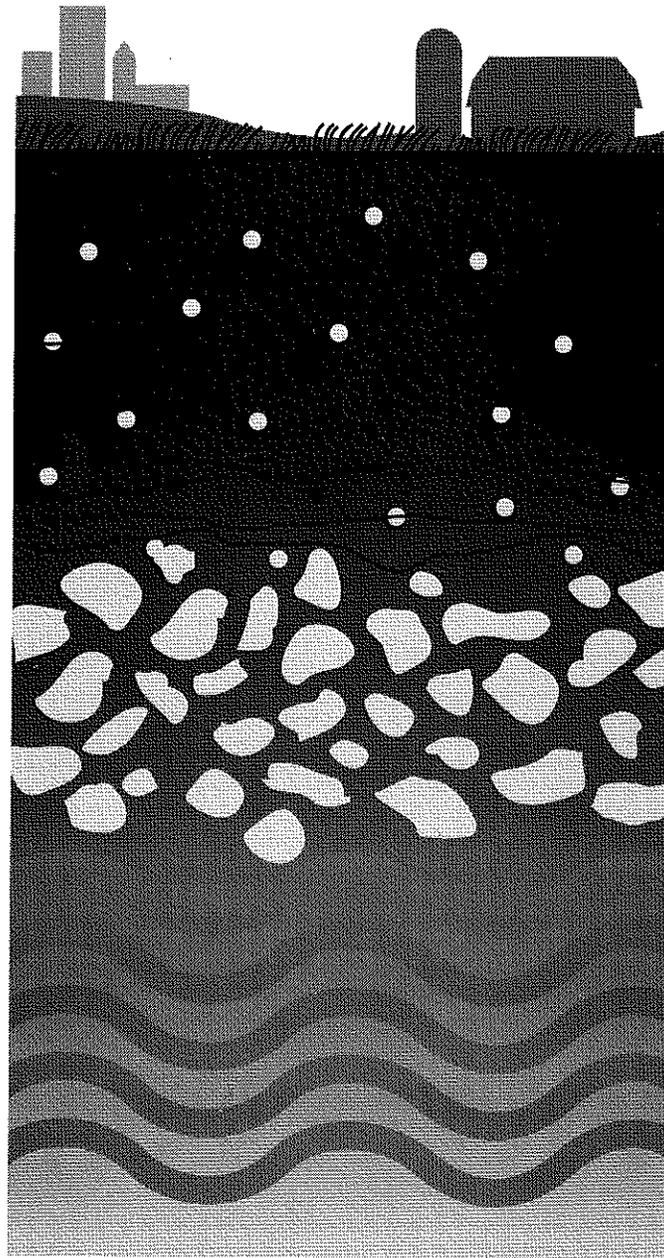


Groundwater Protection



An Evaluation of Wisconsin's Atrazine Rule

Wisconsin Department of Agriculture, Trade and Consumer Protection

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Evaluation of Wisconsin's Atrazine Rule

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Executive Summary

Evaluation of Wisconsin's Atrazine Rule

Overall Conclusions and Recommendations

The Atrazine Rule limits how atrazine can be used on a statewide basis and prohibits its use in areas where the amount of atrazine contamination in groundwater exceeds the state's health-based standard.

The level of atrazine contamination in Wisconsin's groundwater is declining. Wisconsin's Atrazine Rule has helped bring about this improvement. The department found that most farmers who use atrazine are following the Atrazine Rule.

The department also found that between 1994 and 1996, statewide, about the same percentage of wells have atrazine contamination. Current use of atrazine still causes the herbicide to reach groundwater in some areas. In a few of these areas, the amount of atrazine in groundwater continues to be above Wisconsin's health-based standard.

Based on these conclusions, the department recommends the actions below.

- Continue current limits on atrazine use, including the creation of atrazine prohibition areas around wells found to be contaminated above the state's health-based standard.
- Continue to research and monitor groundwater quality and identify areas where atrazine contamination exceeds the standard.
- Continue to evaluate our efforts to protect Wisconsin's groundwater through the Atrazine Rule.

Background

Over two-thirds of Wisconsin residents rely on groundwater for their drinking water. A 1989 study of Wisconsin groundwater detected atrazine, a herbicide which is used to control weeds in corn, in 66 (12%) of 534 wells tested. The enforcement standard was exceeded in three (less than 1%) of the 534 wells, but this number of wells was insufficient to make a statistically reliable statewide estimate. In response, the Department of Agriculture, Trade and Consumer Protection (DATCP) developed the first version of the Atrazine Rule for the 1991 growing season. This rule reduced the amount of atrazine that farmers could use per acre and limited the time period when farmers could use atrazine. The rule also prohibited the use of atrazine when found in groundwater at unsafe levels. Additional groundwater sampling in 1996 shows that 5 to 12% of private drinking water wells in Wisconsin continue to contain detectable levels of atrazine. Further, about 1% of private drinking water wells continue to contain atrazine above the enforcement standard

Some agricultural groups felt that the rule was too restrictive while environ-

mental interests were concerned that the rule did not adequately protect groundwater. Because of this controversy, the Wisconsin Legislature suggested and the Board of Agriculture, Trade and Consumer Protection adopted a provision to evaluate the effectiveness of the Atrazine Rule in 1996.

Rule Evaluation Methods

The department used a variety of methods to evaluate the Atrazine Rule. The focus of the evaluation consisted of three private well sampling programs aimed at

***Enforcement Standard** - a health-based level set for the amount of pesticide in groundwater that requires the department to act to prohibit the activity or practice which causes or contributes to the contamination. Pesticide levels that are above the enforcement standard are unacceptable and are considered unsafe. Well owners are advised not to drink the water from a well that contains atrazine amounts that are above the enforcement standard. The enforcement standard is referred to as the ES. The enforcement standard for atrazine is 3 parts per billion or 3 ppb.*

measuring changes in atrazine levels in groundwater:

(1) The *Atrazine Rule Evaluation Survey* (LeMasters and Baldock, 1997) consisted of two statewide, statistically designed surveys conducted two years apart to determine whether levels of atrazine in groundwater were changing.

(2) The *Exceedence Survey* (Postle, 1995) resampled private wells that had exceeded the atrazine enforcement standard in order to see if levels were declining.

(3) The *Paired Well Survey* (LeMasters and Baldock, 1997) evaluated the prohibition areas (PAs), which are areas where products containing atrazine cannot be used. The survey compared changes in atrazine levels in private wells inside PAs to matched wells outside the PAs.

In addition to these private well sampling surveys, other information was analyzed as part of the rule evaluation. Two monitoring well projects provide information on atrazine in groundwater

next to agricultural fields. Pesticide use surveys provide information on atrazine use trends throughout the history of the rule. Compliance and survey work conducted by the department and the University of Wisconsin show how well atrazine users are following the rule.

Evaluation Results

The *Atrazine Rule Evaluation Survey* was the primary method used to evaluate the statewide limits on atrazine as directed by the rule. This survey showed that atrazine concentrations de-

clined in Wisconsin groundwater between 1994 and 1996. The department believes the limits placed on atrazine use in the rule have contributed to the decline in atrazine levels in groundwater. The percentage of wells contaminated with atrazine, however, remained the same during this time period.

Water samples from monitoring wells next to agricultural fields indicate that current use of atrazine continues to

The Atrazine Rule Evaluation Survey showed that atrazine concentrations in groundwater declined between 1994 and 1996.

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contribute atrazine to groundwater. In some cases this contamination exceeds the enforcement standard.

The *Exceedence Survey*, the *Paired Well Survey*, and the *DATCP Groundwater Monitoring Well Project* (Postle, 1995) were used to evaluate atrazine prohibition areas. These studies show that prohibiting atrazine use can reduce atrazine levels in groundwater. However, it may take several years for this improvement to occur. Based on the time needed for water to move from the surface of an agricultural field to groundwater and subsequently to a well, it will take several more years to further evaluate the impact of prohibition areas on groundwater quality.

In the *Exceedence Survey*, atrazine concentrations went down in 84% of the wells sampled. Statewide, however, about 1% of wells continue to exceed the atrazine enforcement standard. Furthermore, all areas where contamination exceeds the enforcement standard may not have been identified. Well owners are advised not to drink the water from a well containing atrazine above the enforcement standard.

Total atrazine use in Wisconsin declined during the history of the Atrazine Rule. Since 1985, when the annual amount of atrazine applied statewide peaked at over 5 million pounds, the amount of atrazine used dropped to under 1.4 million pounds in 1996. This is the result of fewer acres being treated with atrazine and less atrazine used on each acre. The Atrazine Rule and an awareness of groundwater problems have contributed to these reductions. Atrazine does remain one of the most used corn herbicides in Wisconsin. In 1996 nearly one-half of Wisconsin's 3.9 million acres planted with corn were still treated with atrazine.

The department has expended considerable resources to make sure that atrazine users understand the Atrazine Rule. As a result of these educational efforts, there is a high level of awareness and compliance with the rule. A University of Wisconsin survey and a variety of department oversight activities have shown that Wisconsin farmers are following the provisions of the rule. The department has taken enforcement actions against the small number of atrazine users found in violation of the rule.

Introduction

Evaluation of Wisconsin's Atrazine Rule

Background

In 1984, the Wisconsin Legislature created the Wisconsin Groundwater Law, Chapter 160 of the Wisconsin Statutes. This law assigned responsibility for the protection of Wisconsin groundwater to appropriate state agencies including DATCP. The law established a process for the development of groundwater standards by the Department of Natural Resources (DNR) including standards for pesticides in groundwater.

In the mid-1980s, Wisconsin groundwater sampling programs began to detect atrazine in groundwater. Some of these detections were attributed to atrazine spills but in other cases scientists suspected that normal use of atrazine was causing the contamination. Beginning in 1985, results of the *DATCP Groundwater Monitoring Well Project* confirmed the presence of atrazine in monitoring wells next to sandy agricultural fields where atrazine was being used. In 1988, DATCP conducted a farm well survey (LeMasters and Doyle, 1989), the first statistically-designed groundwater sampling program in Wisconsin. The

results of this study indicated that between 10 and 16% of these wells were contaminated with detectable levels of atrazine and the wells represented most areas of the state where atrazine had been used. This contamination has been confirmed through additional well testing including the department's *Rural Well Survey* (Brady *et al*, 1995) and *Atrazine Rule Evaluation Survey*. Wells with detectable levels of atrazine have been found in 65 of the state's 72 counties. A map of atrazine test results for Wisconsin wells is in Appendix A.

Before 1988, an enforcement standard for atrazine did not exist but there was an unofficial health advisory

Metabolites - When pesticides are applied to fields they break down over time into other, chemically similar substances called metabolites. This breakdown is caused by sunlight, rain, and bacteria in the soil. Atrazine has three metabolites of concern: deethylatrazine, deisopropylatrazine, and diaminoatrazine, which have been found in Wisconsin groundwater.

level for atrazine of 215 parts per billion (ppb). In 1988, the DNR established the groundwater enforcement standard for atrazine at 3.5 ppb. In 1992, DNR changed the enforcement standard to 3.0 ppb and included three atrazine break-down products (metabolites). Sampling showed that many of the contaminated wells in the state had relatively low levels of atrazine, but a small percentage exceeded the enforcement standard.

A number of wells statewide were found to exceed the enforcement standard for atrazine when the standard was established in 1988. The Groundwater Law required the department to take action to limit further atrazine contamination when the standard is exceeded. DATCP developed the first version of the Atrazine Rule which went into effect in April, 1991. The rule imposed a variety of measures including limits on the amount of atrazine that can be used per acre, prohibiting use of atrazine in some areas, and other changes in the way atrazine is used to lessen groundwater contamination. As the department

learned more about the extent of contamination in groundwater around the state, the rule evolved. The rule history is in Appendix E.

Reason for the Evaluation

The Atrazine Rule required that the department evaluate the success of the rule at the end of five years using groundwater sampling programs to determine if atrazine levels were declining.

Adoption of the Atrazine Rule in 1991 was controversial. Atrazine was the most widely used herbicide in Wisconsin and there were many economic and environmental issues involved. Groups in favor of atrazine use stated the rule would

have too great an economic impact. There were few alternative herbicides for farmers to use in place of atrazine and the products available cost more. Farmers felt these increased costs put them at a competitive disadvantage with producers who could use atrazine. Environmental interests, however, believed that protecting Wisconsin's groundwater was the most important issue. They believed that alternatives to atrazine did exist, and the rule was not strong enough.

Because no one knew exactly how protective of groundwater the rule

would be, some members of the Legislature urged the Board of Agriculture, Trade and Consumer Protection to put an evaluation provision in the rule and the Board agreed. The provision stated that the department should report to the Board on the success of the rule five years after it was first put in place. The evaluation was to be done in 1996 and was to include groundwater sampling programs to determine if atrazine levels in groundwater were improving.

Evaluation Techniques

The department used a variety of methods to evaluate the Atrazine Rule. The focus of the evaluation consisted of three private well sampling projects to measure changes in atrazine levels in groundwater. The *Atrazine Rule Evaluation Survey* consisted of two statewide, statistically-based surveys conducted two years apart. This survey's purpose was to determine how levels of atrazine in groundwater were changing three and five years after the rule was put in place. The *Exceedence Survey* resampled wells that had been above the atrazine enforcement standard to see if atrazine levels were declining in those wells located within areas

where atrazine use was restricted or prohibited. Since these wells had exceeded the enforcement standard, they were generally located in atrazine prohibition areas (PAs). The *Paired Well Survey* further evaluated the PAs by comparing changes in atrazine levels in wells inside PAs to matched wells outside PAs.

In addition to these groundwater surveys, several other related activities were used to evaluate the Atrazine Rule:

- Two groundwater monitoring projects that use monitoring wells next to agricultural fields provided information on the impact of current atrazine use practices on groundwater;
- Pesticide use surveys conducted during the period 1978-1996 show how atrazine use has changed before and after the rule was put into place;
- Pesticide and groundwater research projects provided information on topics closely related to atrazine contamination in groundwater and the Atrazine Rule;

Introduction

- Compliance and survey work conducted by the department and the University of Wisconsin showed how well atrazine users have followed the Atrazine Rule.

Using the groundwater surveys and other supporting information, the department conducted a formal evaluation of the Atrazine Rule. This report describes in more detail how the department conducted the evaluation and what conclusions were made.

Chapter 1 - Evaluating Wisconsin Limits on Atrazine Use

Conclusions

The department used the *Atrazine Rule Evaluation Survey* and several other studies to evaluate the use limits imposed by the Atrazine Rule. These studies show a significant decline in the level of atrazine contamination in Wisconsin groundwater between 1994 and 1996. The department believes that limited use of atrazine under the rule is one reason for this improvement in groundwater quality. However, during this period, there was no significant decline in the percent of wells contaminated with atrazine. The department finds that farmers are following the rule. Farmers are using less atrazine and less is found in groundwater. The department also found that atrazine remains a popular weed control option and is still the most commonly detected herbicide in Wisconsin groundwater.

With time, current limits on atrazine use may lead to fewer wells with detectable atrazine contamination. Although groundwater quality has improved generally, monitoring projects and other studies show the current use of atrazine can lead to groundwater contamination. In some cases, this contamination exceeds the enforcement standard.

Background

The Atrazine Rule limits the amount of atrazine that can be used per acre on a statewide basis. The rule also restricts use to certain crops and specific times of the year. Under the rule, atrazine use is reduced to the lowest level that was determined to be effective for weed control and economically feasible for the farmer. Limiting atrazine use is accomplished through several rule restrictions:

- The amount of atrazine that can be applied per acre (application rate) is reduced from the federally allowed maximum of 2.5 pounds per acre to between 0.75 and 1.5 pounds per acre based on soil type and previous atrazine use on the field;
- Use is restricted to April 15 through July 31 each year;

- Use is limited to field corn, sweet corn and seed corn;
- Use with irrigation requires an irrigation management plan to prevent over-irrigation.

The purpose of these rule limitations is to reduce the amount of atrazine that can move through the soil and into groundwater.

In order to evaluate the atrazine use limitations, DATCP used several sources of information. The *Atrazine Rule Evaluation Survey* was the main tool used in the evaluation. The *Acetochlor Monitoring Project*, (DATCP unpublished data), pesticide use surveys, and a research project conducted at the University of Wisconsin provide additional information on reduced atrazine use. These projects are discussed below.

Atrazine Rule Evaluation Survey

Background

The *Atrazine Rule Evaluation Survey* was the main tool used to evaluate the limitations on statewide atrazine use. The purpose of this survey was to determine how levels of atrazine

and its metabolites in groundwater were changing three and five years after the rule was put in place. The survey was conducted in two phases: 1994 (Phase 1) and 1996 (Phase 2). All samples were analyzed for atrazine and its three metabolites as well as a number of other pesticides and nitrate. A total of 567 samples were collected from 429 wells (138 wells were sampled in both survey phases). Changes in atrazine levels in Wisconsin groundwater were determined by comparing the Phase 1 results with the Phase 2 results. As expected, similar detections of other herbicides and nitrate-nitrogen in Phase 1 and Phase 2 confirm that the survey design was sound and indicate that Phase 1 and Phase 2 sampled similar groundwater. The results from the two survey phases are shown in Table 1 on page 11.

Based on sample results for each phase, the department made statistical estimates of three atrazine properties in groundwater:

- The percent of Wisconsin groundwater containing a detectable amount of atrazine residues;

Table 1: Phase 1 and Phase 2 Results - Atrazine Rule Evaluation Survey

	Phase 1 1994	Phase 2 1996
Samples Collected	289	278
	Number of Wells with Detections	
Atrazine and metabolites	59	45
Alachlor ESA	39	32
Alachlor	4	3
Metribuzin	3	4
Metolachlor	0	1
Cyanazine	0	0
Prometon	0	1
Nitrate-nitrogen	198	211

- The percent of Wisconsin ground-water containing atrazine residues at or above the enforcement standard;
- The estimated concentration of atrazine and metabolites in those wells with detectable levels.

The statistical estimates of these three properties for the two survey phases are shown in Table 2 on page 12. Note that the enforcement standard (ES) for atrazine and its three metabolites is 3 ppb.

Results

These results show a significant decline in atrazine concentrations in Wisconsin groundwater between 1994 and 1996. The average atrazine, plus metabolite concentration in wells with detections declined from 0.96 to 0.54 ppb in the two year period, a 44% decrease. The department believes the rule limits on atrazine use is one reason for the improvement of groundwater quality. The percent of contaminated wells, however, did not show a significant decline in this study. Statewide, about the same percent of wells have atra-

Table 2: Statewide Estimates for Atrazine and Metabolites in Groundwater
(percentages in parentheses show 95% confidence interval)

Statewide Estimates				
Property Estimated		Phase 1 1994	Phase 2 1996	Have Atrazine Properties Changed?
1	Percent of groundwater with a detectable amount of atrazine residues	12% (8 to 16%)	8.5% (5.2 to 12%)	No significant change
2	Percent of groundwater with atrazine residues above the ES (more than 3 parts per billion)	1.7% (0.6 to 2.8%)	0.9% (0.2 to 1.5%)	No significant change
3	Concentration (in parts per billion) of atrazine residues in wells with detects	0.96 ppb (0.75 to 1.17)	0.54 ppb (0.35 to 0.73)	1996 level is significantly lower

zine contamination, but the average level in wells with atrazine contamination is less. More time is needed to determine if atrazine in groundwater will drop below detectable levels.

Copies of the complete *Atrazine Rule Evaluation Survey* which provides survey design and result details are available from the department.

Acetochlor Monitoring Well Project

Background

In 1994, the U.S. Environmental Protection Agency required the registrants of the corn herbicide acetochlor to monitor the effects of acetochlor use on groundwater in selected areas. In Wisconsin, monitoring wells were installed down-gradient from 25 corn fields first treated with acetochlor in 1995. Soil texture in the treated fields ranged from loamy sand to clay loam.

In addition to acetochlor, atrazine had been used at 15 of the 25 monitoring sites between 1992 and 1995. This provides the department with a good opportunity to study the effects on groundwater of atrazine use at current application rates. These monitoring sites cover the range of soil conditions where corn is grown in Wisconsin.

Results

Atrazine was detected in 12 of the 15 sites where it was applied between 1992 and 1995 under current application rates. Three of the 15 sites have exceeded the enforcement standard

for atrazine in at least one of four samples taken since April 1995. Two of these sites have sandy loam soil and groundwater at less than 50 feet below the ground surface. The other site has silt loam soil and groundwater at about five feet below the ground surface. These conditions are common in corn growing areas of the state and would be considered somewhat vulnerable to pesticide contamination of groundwater. The nine sites with atrazine detections below the

enforcement standard have soils ranging from sandy loam to clay loam. See Appendix B for complete atrazine results from this project.

This project provides additional evidence that current field use of atrazine can result in some groundwater contamination depending on a range of different site and soil conditions in

Wisconsin. In some cases, this use leads to contamination which exceeds the enforcement standard. But, it remains difficult to predict which specific characteristics of a site result in a greater likelihood that contamination will occur.

Since 1985, the number of acres treated with atrazine in Wisconsin has declined 46% and the amount of atrazine applied to corn has declined 73%.

Pesticide Use Surveys

Background

Comprehensive surveys of agricultural pesticide use in Wisconsin were conducted in 1978, 1985, 1990 and 1996 (Wisconsin Agricultural Statistics Service). Limited surveys are also available for 1991-1995. These surveys provide information on atrazine use patterns and how use has changed in relation to the Atrazine

Table 3: Atrazine Use History in Wisconsin

Year	Corn Acres Planted	Acres Treated (%)	Treated Acres	Average Rate (lbs. per acre)	Total Applied (lbs.)
1978	3,750,000	80	3,000,000	1.50	4,410,000
1985	4,300,000	77	3,296,000	1.60	5,165,000
1990	3,700,000	56	2,057,000	1.40	2,936,000
1991	3,800,000	52	1,976,000	1.00	2,048,000
1992	3,900,000	59	2,301,000	0.91	2,088,000
1993	3,400,000	48	1,632,000	0.89	1,477,000
1994	3,750,000	52	1,950,000	0.84	1,626,000
1995	3,650,000	51	1,860,000	1.02	1,897,000
1996	3,900,000	46	1,794,000	0.78	1,390,000

Rule. The information from all the available surveys is summarized in Table 3.

When studying trends in pesticide use, the important information that is usually considered includes: (1) “Treated Acres,” or the number of acres on which a compound is used and (2) “Average Rate” of application in pounds per acre per year. Multiplying treated acres and average rate supplies the “Total Applied” amount, or the overall amount of pesticide material used.

Trends in Atrazine Use

Based on data available in pesticide use surveys and shown in Table 3, the number of atrazine-treated acres in Wisconsin peaked in 1985 at just under 3.3 million acres. By 1990, the number of treated acres had declined significantly to just over 2 million acres. Between 1991 and 1996 the number of acres treated fluctuated between 1.6 and 2.3 million acres. The percentage of acres treated declined from 77% in 1985 to 46% in 1996. Overall there has been a 46% reduction in the number of acres treated with atrazine from 1985 to

1996. Some of this decline is related to differences in the number of corn acres planted.

The average atrazine application rate decreased from 1.6 pounds per acre in 1985 to 1.0 pounds per acre in 1991 and then remained relatively stable between 1991 and 1995. In 1996 the average rate dropped to 0.78 pounds per acre. Opportunities for reducing application rates include using atrazine in combination with other herbicides, applying atrazine in a band over the corn row, and using additional mechanical weed control practices. Many farmers have used these strategies to reduce their atrazine application rates.

The overall amount of atrazine applied in Wisconsin has declined considerably since the peak in 1985 based on the number of acres treated and the average application rates. The total amount applied in 1985 was 5.17 million pounds whereas by 1996 the total amount had fallen to 1.39 million pounds, a 73% decrease. A big decline in total volume applied took place between 1985 and 1990. Significant reductions also occurred in 1991 and 1993, which correspond to reductions in allowable application rates in the Atrazine Rule.

Farmers have reduced or eliminated their use of atrazine since 1985 for these reasons:

- Implementation of the department's Atrazine Rule;
- Concern about the tendency of atrazine to remain in the soil and damage the next year's crop if something other than corn is grown (carryover);
- Concern about the environment and groundwater and surface water contamination;
- Development of effective atrazine alternatives for weed control in corn;
- Changes in the crops being planted;
- Conversion to farming practices requiring fewer chemicals;
- Increasing problems with weeds that atrazine does not or cannot control.

An individual farmer's decision to discontinue or reduce reliance on atrazine may be based on any combination of these reasons.

University of Wisconsin Research

Background

In 1995, a DATCP-sponsored pesticide research project entitled *Influence of Application Rate on Atrazine Fate in Silt Loam Soil* (Stoltenberg, 1995), was completed by the University of Wisconsin Department of Agronomy. The purpose of this research project was to evaluate the relationship between atrazine application rates and atrazine movement in the root zone. Experiments were conducted for 180 days under controlled environmental conditions on silt loam soil columns receiving application rates between 0.5 and 4.0 pounds of atrazine per acre.

Results

Results of this study showed that the frequency of detection of atrazine and its metabolites and their average concentration in drainage water increased as the application rate increased. The amount of atrazine and metabolites recovered in drainage water also increased as the application rate increased. These results indicate that reduced atrazine application rates are associated with reduced movement of atrazine and metabolites through the root zone of Plano silt loam soil and suggest that reduced application rates are an appropriate approach to groundwater protection.

Chapter 2 - Evaluating Atrazine Prohibition Areas

Conclusions

Atrazine contaminates about 1% of the state's private drinking water wells at concentrations higher than the state's groundwater enforcement standard. To help address this contamination, the department has prohibited atrazine use on 1.2 million acres of land by creating Atrazine Prohibition Areas around wells found to be contaminated above the standard. Current groundwater testing may not be extensive enough to identify all areas of Wisconsin where contamination may exceed the standard. The *Exceedence Survey*, *Paired Well Survey* and *DATCP Groundwater Monitoring Well Project* were used to evaluate the effectiveness of existing prohibition areas in protecting groundwater. These studies show that atrazine levels in groundwater are generally decreasing within prohibition areas. Based on the time needed for water to move from the surface of an agricultural field to groundwater and subsequently to a well, it will take several more years to fully evaluate the impact of prohibition areas on groundwater quality.

Introduction

In addition to statewide limits on atrazine use, the Atrazine Rule creates areas where atrazine use is prohibited. Under the Wisconsin Groundwater Law, the department must prohibit the use of atrazine when concentrations in private wells exceed the 3 ppb groundwater enforcement standard if use of atrazine is contributing to the contamination. More than 300 private wells in Wisconsin have been found to contain atrazine and metabolites at levels that exceed the enforcement standard. By April 1, 1996, Wisconsin had created 91 Atrazine Prohibition

Areas (PAs). These PAs range in size from small, 2500-acre areas around a single contaminated well to larger, multi-well regional PAs that cover portions of several counties. In total there are over 1.2 million acres where atrazine use is prohibited in Wisconsin (see map of PAs in Appendix A).

The department used two private well and one monitoring well sampling projects to evaluate the atrazine prohibition area component of the rule. The *Exceedence Survey* resampled private wells that had previously

exceeded the atrazine enforcement standard. These wells are located in PAs. The *Paired Well Survey* further evaluated the prohibition areas by comparing changes in atrazine levels in private wells inside the PAs to paired wells outside the PAs. The *DATCP Groundwater Monitoring Well Project* uses monitoring wells next to agricultural fields to provide information on the impact of current atrazine use practices on groundwater.

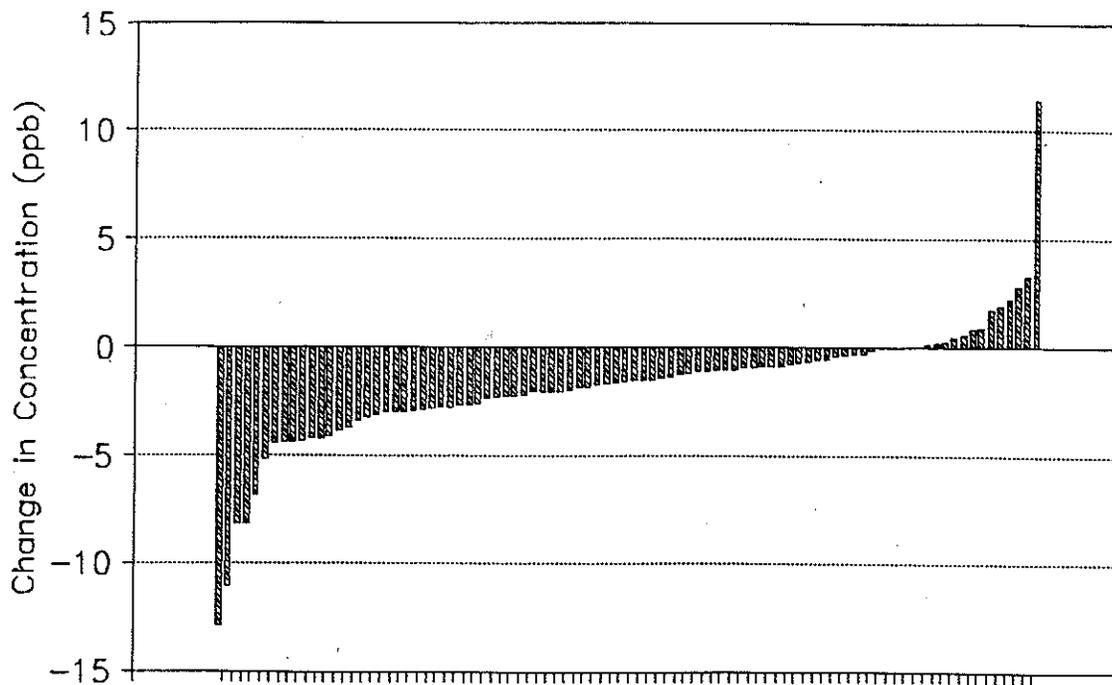
Exceedence Survey

Background

In 1995, DATCP conducted the *Exceedence Survey* to measure changes in pesticide concentrations in private drinking water wells that had previously exceeded a pesticide enforcement standard (Postle, 1995). Most of these wells had been in atrazine prohibition areas for one year or more.

As shown in Table 4, the department tested ninety wells for atrazine and compared the results to earlier tests

Table 4: Changes in Total Atrazine Concentrations - Exceedence Survey



90 Wells with Previous Results

on the same wells. The time interval between samples varied from 1 to 5 years.

Results

Atrazine and metabolite concentrations decreased in 76 (84%) of the 90 wells. Contamination levels increased in 14 (16%) of the wells. Forty-three percent of the wells were still contaminated above the atrazine enforcement standard and 57% were below the enforcement standard. These results indicate that atrazine levels in groundwater in most prohibition areas are declining.

Well owners with atrazine contamination above the enforcement standard were interviewed to determine what changes, if any, they had made to their water supplies in response to this contamination. About 50% of the well owners continued to use their contaminated well and about 25% had installed new wells at an average cost of \$6,300. The remainder were drinking bottled water, hauling water, or using water treatment.

Paired Well Survey

Background

The *Paired Well Survey* was designed to determine if atrazine concentrations in groundwater have responded to prohibitions on atrazine use. The study compared changes in atrazine levels between private drinking water wells located inside 17 randomly selected PAs and paired wells located nearby but outside the PAs. Samples were collected quarterly for one year starting in September 1995.

Results

Results from the Paired Well Survey show that sampling for one year was not enough time to identify changes in atrazine concentrations and determine if the PAs were protecting groundwater. Any changes in atrazine in groundwater that may have resulted from prohibiting atrazine use were not detected over the course of a single year of sampling.

Atrazine levels in the paired wells located outside of PAs were generally lower than in wells inside the PAs. However, some of the wells outside the PAs contained significant amounts of atrazine. Four of the 17 wells outside PAs exceeded the enforcement standard for atrazine. This

finding indicates that all the wells in Wisconsin that exceed the enforcement standard may not have been found. Additional well sampling may identify new areas where atrazine contamination exceeds the enforcement standard and may lead to the need for new or expanded atrazine prohibition areas.

DATCP Groundwater Monitoring Well Project

Background

The objective of this ongoing project is to determine the extent of groundwater contamination resulting from pesticide use in highly susceptible areas of Wisconsin. Susceptible areas are defined as having sandy soils, shallow depth to groundwater, and irrigation. This study uses monitoring wells located immediately down gradient from agricultural fields to evaluate the occurrence of pesticides in groundwater resulting from pesticide use.

One of the main areas of study in the monitoring project has been the Lower Wisconsin River Valley. Under the Atrazine Rule, atrazine use in the Lower Wisconsin River Valley has

been prohibited on irrigated fields since 1991 and in the entire area since 1993. This is one of the largest (137,000 acres) and oldest PAs in the state. Pesticide use information from the Lower Wisconsin River Valley indicates that some farmers now use the herbicides cyanazine and simazine as replacements for atrazine.

Results

The sampling results from the monitoring sites in the Lower Wisconsin River Valley can be used to evaluate effects of the PA on atrazine levels in groundwater. Appendix C shows that average atrazine levels have steadily declined in the Lower Wisconsin River Valley since 1991. The declining level of contamination is most likely the result of atrazine prohibition in the area. By 1996, atrazine levels are low or non-detectable in most monitoring wells. This indicates that little or no new atrazine residues are reaching groundwater at this time. Levels of deethylatrazine, a metabolite unique to atrazine, have also declined to low or non-detectable levels. However, deisopropylatrazine, a metabolite that can be produced by other triazine herbicides such as cyanazine and simazine, has remained fairly constant. This indicates that ongoing use of triazine

herbicides other than atrazine is probably resulting in groundwater contamination in the area.

Although the atrazine results from these monitoring wells are very favorable, they represent the groundwater conditions near the water table. Shal-

low wells are generally the first wells to become contaminated and the first to show improvements. Testing results from many deeper private wells in the Lower Wisconsin River Valley that contain atrazine have not shown as dramatic improvements.

Chapter 3 - Compliance with the Atrazine Rule

Conclusions

The department has concluded that most farmers are complying with the Atrazine Rule. Few violations have been found.

Background

The department has used three main activities to determine if farmers are complying with the Atrazine Rule: inspections of pesticide dealer records, pesticide use observations, and complaint investigations. The department also co-sponsored a survey by the University of Wisconsin to determine whether farmers were aware of and complying with the rule.

Discussion

Atrazine is a restricted use pesticide that can only be sold by pesticide dealers licensed by the department. Dealers must maintain records of each sale of atrazine, and the department uses these records to target pesticide use observations. During the last two years the department has conducted 65 pesticide use observations in PAs. Investigators interview farmers in prohibition areas to determine which pesticides they are using. In most

cases soil samples are collected from cornfields to determine whether or not atrazine was used. These use observations have resulted in two (3%) cases (still under investigation) where atrazine may have been used in PAs. Overall, the department has found a high level of compliance with the Atrazine Rule.

The department also investigates complaints of possible atrazine use in PAs. Investigations of potential misuse of atrazine have been conducted in Juneau, Marquette and Rock Counties.

In Juneau County, two cases of atrazine use in PAs were found. In one case, a treated field was found to be on the border of a PA, with only a few acres within the PA. The investigation indicated the violation was the result of an error by the grower. This individual was issued a warning notice. In the second case, a grower was

found to have used atrazine on a number of fields within a prohibition area. This grower pled no contest to charges of misuse and paid a fine in Juneau County court.

In Rock County, five cases are pending involving commercial applications of atrazine to fields in PAs. Settlements have been reached in four of the cases and are in the District Attorney's office.

In Marquette County, the department became aware of atrazine use in a PA through a pesticide spill complaint from a Marquette County sheriff's deputy. This case has been settled with a monetary forfeiture.

Additional Research

In 1992, University of Wisconsin researchers Nowak, Wolf, Hartley and McCallister conducted a project entitled *Assessment of the 1992 Wisconsin Atrazine Rule* (Nowak et al, 1993). This project evaluated statewide compliance with the Atrazine Rule. The major conclusion was that the Atrazine Rule had achieved its objective of reducing atrazine use in Wisconsin. Over 98% of farmers

were found to be in compliance with the statewide maximum application rates. Farmers demonstrated their willingness to comply with the rule despite increased costs of production. Researchers viewed the level of compliance with the Atrazine Rule as "surprising" given the scope and complexity of the rule.

Chapter 4 - Public Awareness of the Atrazine Rule

Conclusions

The department, along with several other groups, effectively informs and continuously gathers ideas from the public on the Atrazine Rule and its requirements.

Background

Many people in Wisconsin work to keep groundwater clean. But it is up to Wisconsin farmers and their rural non-farming neighbors to assure the success of the Atrazine Rule. Many farmers have had to change their pesticide use practices to comply with the rule. Reaching these people can be difficult since some rule requirements affect small localized land areas while other restrictions affect all atrazine users in Wisconsin. Rural residents, both farmers and non-farmers, provide well water samples to determine what is happening with atrazine in groundwater. Reaching all the people affected by atrazine use requires a large public information effort.

The Atrazine Rule includes several approaches to reduce atrazine contamination of groundwater. Wisconsin farmers are willing to follow the atrazine regulations, but they need

good information in order to do this. Farmers get information about atrazine use and the Atrazine Rule from farm supply dealers, crop consultants, and University of Wisconsin Extension specialists. The department informs farmers and non-farmers of atrazine rule requirements and other issues through general news media and direct mailings.

Public Information Strategies

Each step in the rule making process needs a public information strategy. Public input, acceptance, and awareness of the Atrazine Rule determines whether it will be an effective tool to protect groundwater.

Atrazine Technical Advisory Committee

Each year, the department works with University of Wisconsin researchers

and Extension specialists, farmers, farm groups, crop consultants, farm supply dealers, and the atrazine manufacturer to develop changes to the Atrazine Rule. These groups provide recommendations to the department through their representatives on the Atrazine Technical Advisory Committee (ATAC). The ATAC also provides a means of informing the agricultural community about the Atrazine Rule.

Public Hearings

The Atrazine Rule is controversial. The department holds public hearings to explain the rule and rule changes and to receive ideas from Wisconsin citizens. Since 1990, the department has held 34 public hearings at various locations in the state. A total of 1,011 people have attended these hearings and about one-third have provided oral testimony. In addition, the department has received over 150 pieces of written testimony on the rule since 1991. This high participation rate in the hearing process reflects a high level of public awareness of atrazine issues.

Press Releases and News Stories

Each year the department issues several press releases announcing any changes being made to the Atrazine Rule. Press releases announce atra-

zine public hearings, public meetings of the Board of Agriculture, Trade and Consumer Protection where atrazine issues are discussed, and the publication of changes to the Atrazine Rule. In addition, the media, especially the agricultural press, present a variety of stories related to atrazine.

Maps

The department produces maps of well sampling results and atrazine prohibition areas. These maps help the public to understand and follow the rule.

Fact Sheets, Brochures, and Posters

The Atrazine Rule contains a number of provisions and complying with it requires detailed knowledge. Farmers receive a pocket sized card which briefly describes all rule provisions and includes a statewide map of atrazine prohibition areas. Farm supply dealers use informational posters, fact sheets and brochures supplied by the department at the point of sale.

Training

University of Wisconsin Extension conducts pesticide applicator training sessions several times per year in many locations across the state. This training provides another opportunity

to describe the provisions of the Atrazine Rule to the people that apply atrazine compounds.

Direct Mail

Reaching everyone affected by the atrazine rule requires multiple approaches. Rural non-farm residents do not often visit farm supply dealerships and not everyone listens to specific radio spots or reads public announcements in their local newspaper. To reach as many people as possible, the department now sends direct mail to residents within proposed atrazine prohibition areas. Utilizing geographic information system technology, department staff can target an area and send a fact sheet with a map of a proposed prohibition area to all potentially-affected residents.

Evaluation of the Public Information Strategies

The main tool used to evaluate the public information strategy was a research project conducted at the University of Wisconsin called *Assessment of the 1992 Wisconsin Atrazine Rule*. This project evaluated farmer knowledge of and compliance with the 1992 Atrazine Rule. In 1991 and 1992 the Atrazine Rule contained a

three-tiered structure: statewide restrictions, atrazine management areas, and atrazine prohibition areas. Because of the scope of these restrictions and the large number of farmers affected, it was important to evaluate farmer understanding of the rule and how it was impacting them. Over 500 farmers participated in this project through a mail survey.

A major conclusion of this study was that the Atrazine Rule is achieving its objective of reducing the extent and intensity of atrazine use. Wisconsin farmers have demonstrated a willingness to comply with the rule even though compliance may lead to additional costs. The study also indicated that although atrazine use has decreased, low rates of atrazine remain a popular component of weed management strategies. The department's recent compliance activities discussed in Chapter 3 confirm that a very high percentage of Wisconsin farmers understand and comply with the Atrazine Rule.

Conclusions

Weed control without atrazine usually increases the costs of corn production. Many factors affect the choice of alternatives and the overall costs of controlling weeds. The department reviewed several sources of information on weed control without atrazine and found that additional costs can range from \$2 to \$30 per acre. Despite these cost differences, Wisconsin farmers chose to use alternatives to atrazine on about 50% of corn acres where atrazine use is permitted.

Background

Within PAs, corn producers who previously used atrazine have had to switch to alternative weed control methods. Alternatives include both the use of other herbicides and mechanical weed control practices. In many cases alternatives to atrazine can be more costly. In order to characterize these cost differences, the department reviewed several sources of information.

Findings

The 1991 Environmental Impact Statement for the Atrazine Rule included an economic assessment of weed control without atrazine. The department estimated that the average additional cost of weed control with-

out atrazine would be approximately \$10.50 per acre. Weed control costs varied depending on soil type, tillage, crop rotation and other factors.

In a University of Wisconsin research project entitled *Assessment of the 1992 Wisconsin Atrazine Rule* researchers surveyed 232 farmers about the costs of controlling weeds without atrazine. Average additional costs were projected to be \$11.48 per acre.

In November 1996, the department surveyed six farm supply dealers from different areas of the state to identify their corn herbicide recommendations with and without atrazine. Their recommendations and costs per acre are listed in Table 5 on page 28.

Table 5: Dealer Herbicide Recommendations, With and Without Atrazine

	Atrazine Recommendations	Non-Atrazine Recommendations
Dealer 1	1.5 lb atrazine + 2/3 oz. Accent or 3/4 oz. Beacon	2 qt. glyphosate + 3 qt cyanazine
Cost	\$30 to \$32 per acre	\$45 per acre
Dealer 2	metolachlor + atrazine or Accent + atrazine	metolachlor or acetochlor + dicamba
Cost	\$24 to \$28 per acre	\$28 to \$30 per acre
Dealer 3	dicamba + atrazine	metolachlor or acetochlor or alachlor + two applications dicamba or cyanazine or pendimethalin
Cost	\$20 to \$23 per acre	\$33 per acre
Dealer 4	glyphosate + atrazine	glyphosate + 2-4,D + metolachlor or dimethanamid, or cyanazine
Cost	\$26 to \$33 per acre	\$55 to \$63 per acre
Dealer 5	metolachlor + atrazine possibly 1/2 oz. Accent	glyphosate + Broadstrike
Cost	\$20 to \$33 per acre	\$46 per acre
Dealer 6	cyanazine or acetochlor + atrazine	Accent + Scorpion or dicamba + Accent or acetochlor + cyanazine + dicamba
Cost	\$16 to \$28 per acre	\$20 to \$31 per acre
Average Cost	\$26.50 per acre	\$42.40 per acre

Average additional cost of weed control without atrazine for these six dealers was \$15.90 per acre. The six dealers listed typical corn herbicide recommendations that they made in

their areas in 1996, and the range of costs for each recommendation. Differences in local weed problems and soils account for some of the variation in weed control recommendations.

Recommendations

Summary

Based on the findings in this report, the department has affirmed its strategy for protecting groundwater from atrazine contamination. The three recommendations for continued action by the department are:

- (1) Continue the current limits on atrazine use, including creation of atrazine prohibition areas around wells found to be contaminated above the state's health-based standard.
 - (2) Continue to research and monitor groundwater quality and identify areas where atrazine contamination exceeds the standard.
 - (3) Continue to evaluate our efforts to protect Wisconsin's groundwater through the Atrazine Rule.
-

Discussion

The department has found that atrazine levels in groundwater are declining statewide. The limitations on atrazine use and creation of use prohibition areas under the Atrazine Rule are resulting in improved groundwater quality and should be continued. A brief discussion of the department's recommendations follows:

Continue Limits on Atrazine Use

Levels of atrazine are declining in wells statewide. The Atrazine Rule is at least partially responsible for this

improvement. The reduced rates of atrazine use appear to be technically and economically acceptable. We do not recommend changing the current limitations on atrazine use.

Prohibition of atrazine use appears to be the only effective measure to adequately protect groundwater in certain areas. Sampling of drinking water wells should continue to identify additional areas where atrazine may exceed the enforcement standard.

Continue Groundwater Monitoring and Research

Research and monitoring efforts should continue to identify soil, geologic, and atrazine use conditions that lead to the exceedence of the enforcement standard. Atrazine, cyanazine and simazine are triazine herbicides used in corn production in Wisconsin. As these triazine herbicides break down in soil, they produce common metabolites that can leach to groundwater. Preliminary monitoring well results indicate that cyanazine and simazine may be contributing to groundwater contamination where they are used as alternatives to atrazine. Additional research and monitoring should be done to clarify the extent of this potential problem. Corn growers may be able to avert this situation by identifying and adopting voluntary weed control practices which limit the total amount of triazines used in a given year. If ground-

water problems with triazine herbicides worsen, a comprehensive triazine rule should be considered.

Continue to Evaluate the Atrazine Rule

This report documents **lower atrazine concentrations** in groundwater after the rule has been in effect for five years. It appears it will take a longer time to show **reduced numbers** of wells with detectable concentrations of atrazine. The *Atrazine Rule Evaluation Survey* should be conducted again to assess groundwater quality. The *Paired Well Survey* did not show changes in atrazine levels during one year of sampling. This study should also be revisited. The department should conduct a future evaluation, similar in scope to this report, to assure that the Atrazine Rule is working and to identify any needed changes.

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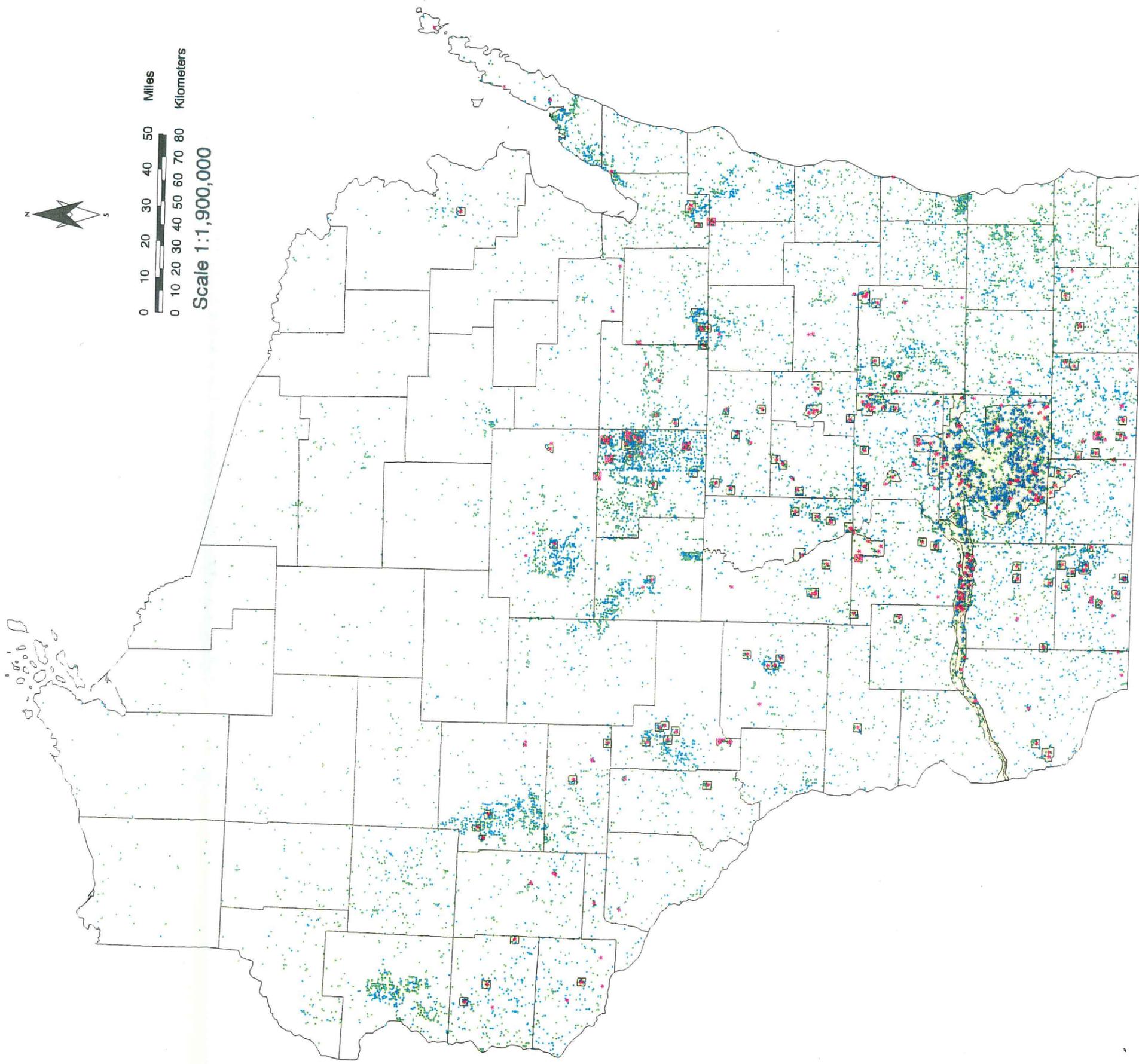
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ATRAZINE TEST RESULTS FOR WISCONSIN WELLS



Acetochlor Monitoring Well Program Atrazine Results

Well #	Atrazine Use				Atrazine Concentrations (µg/L) *				Soil Texture	Soil O.M. %	Depth to water (ft)
	1992	1993	1994	1995	4/20/95	11/8/95	6/15/96	11/15/96			
WI 01	--	--	--	--	0.45	0	0	0	LL	3.95	33.66
WI 03	--	BI	--	HA+	1.1	0.51	0.8	0.989	LL	1.7	51.54
WI 04	--	BI	--	HA+	1.77	1.15	4.2	3.448	SL	1.52	45.81
WI 05	--	--	--	--	2.2	0.99	0.98	0.782	LS	1.78	32.94
WI 06	AT	AT	AT	AT	1.33	0	0	0	SL	3.35	28.61
WI 07	--	AT	AT	AT	6.2	5.2	4.85	5.219	SL	2.4	27.25
WI 08	--	AT	AT	AT	0	0	0	0	LS	1.74	32.18
WI 09	--	MK	--	--	0.58	0	0	0	LS	2.45	6.85
WI 10	--	--	--	AT	1.17	0.77	1.29	1.244	SL	2.49	44.95
WI 11	--	--	--	S100	2.39	1.97	N.A.	1.933	LS	1.25	50.98
WI 12	EX	EX	EX	EX	0.74	2.43	N.A.	10.835	SI	2.86	5.53
WI 13	--	--	--	--	0	0	N.A.	0	SI	1.89	24.07
WI 14	--	--	--	AT	2.2	1.4	N.A.	1.34	CL	3.73	10.87
WI 15	--	--	--	AT	0	0	N.A.	0	SI	4.76	44.13
WI 17	--	--	--	MK	0	0	N.A.	0	SI	3.13	8.83
WI 18	--	--	--	--	0	0	0	0	SL	1.12	8.84
WI 20	MK	MK	--	MK	0.16	0.18	N.A.	0	SI	4.45	22.46
WI 21	--	--	--	MK	1.87	1.69	1.63	1.329	SI	4.37	23.15
WI 22	--	--	--	AT	2.27	2.19	N.A.	2.06	SI	2.7	31.25
WI 23	--	--	--	--	0	0	0	No sample	LS	5.06	5.96
WI 24	--	--	--	--	1.55	1.55	N.A.	1.732	SI	2.76	11.25
WI 25	--	--	--	--	2.1	1.89	1.77	0.318	SI	2.66	20.6
WI 26	N.A.	N.A.	N.A.	--	N.A.	N.A.	0	0	N.A.	N.A.	N.A.
WI 27	N.A.	N.A.	N.A.	--	N.A.	N.A.	0	0	N.A.	N.A.	N.A.
WI 28	N.A.	N.A.	N.A.	--	N.A.	N.A.	0	0.367	N.A.	N.A.	N.A.

AT = Atrazine

MK = Marksman (Dicamba + atrazine)

BI = Bicep (Metolachlor + atrazine)

EX = Extrazine (Cyanazine + atrazine)

HA+ = Harness Plus (Acetochlor + atrazine)

S100 = Surpass 100 (Acetochlor + atrazine)

LS = Loamy Sands

LL = Loams

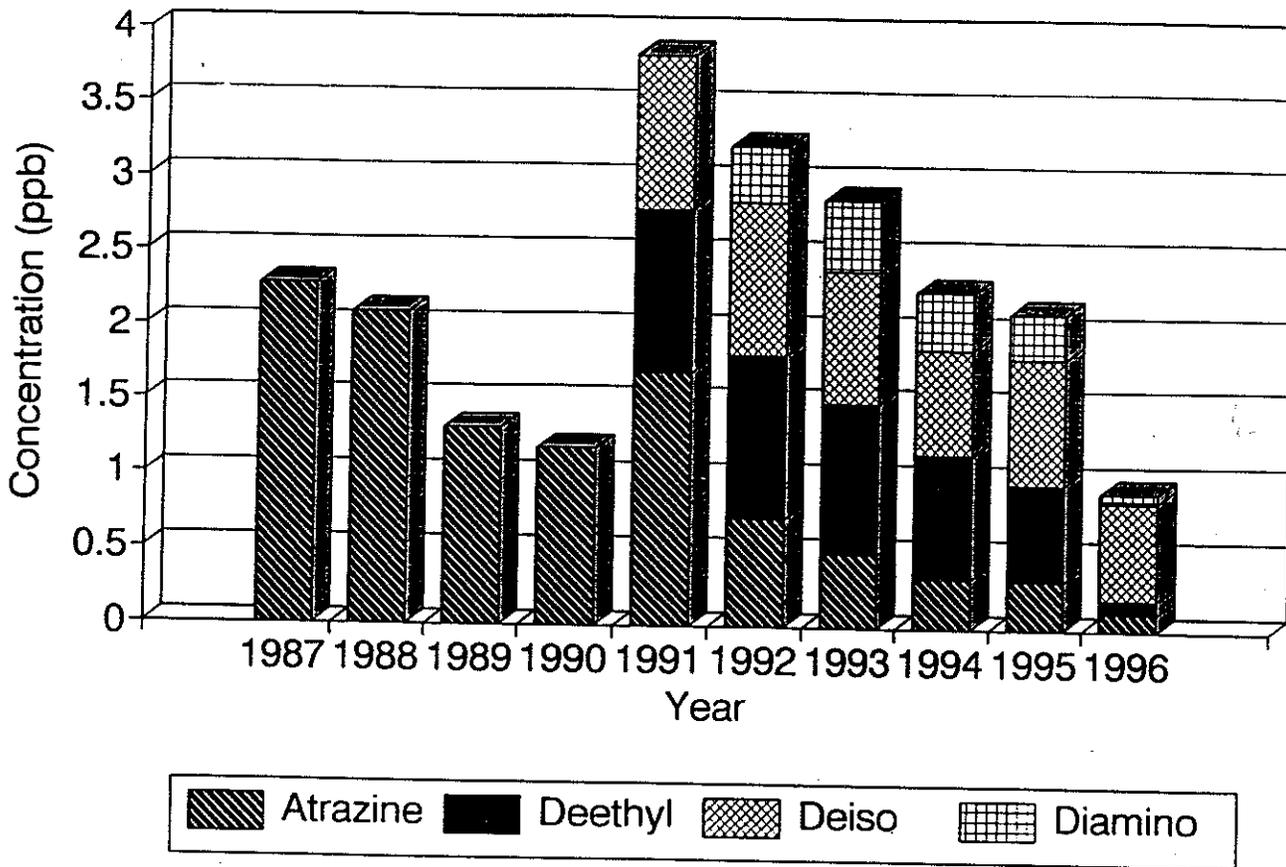
SL = Sandy Loams

SI = Silt Loams

CL = Clay Loams, including Silty Clays and Silty Clay Loams

* Includes Atrazine and its metabolites.

Figure 1. Mean Total Atrazine Levels at 16 Lower Wisconsin River Valley Monitoring Sites



1991 Lab analysis for deethyl and deisopropyl atrazine began
1992 Lab analysis for diamino atrazine began

Appendix D - Atrazine Related Pesticide and Groundwater Research Projects

DATCP, DNR and the University of Wisconsin funded research projects which provide relevant information to the atrazine rule evaluation. In many cases the issues surrounding the Atrazine Rule were the motivating factor in conducting these projects. Although these projects were not specifically designed to evaluate the Atrazine Rule, in many cases the results from these projects were used to design and revise the rule. An examination of the overall body of knowledge gained from these projects indicates that the Atrazine Rule is based on the best research information available. Full project reports and 2-page summaries are also available for each of these studies.

Effect of Soil Type on Atrazine and Alachlor Movement Through the Unsaturated Zone

By Tommy Daniel, Birl Lowery, and Kevin Fermanich, 1989-1993

The purpose of this research was to study and compare the leaching of atrazine and alachlor through typical sandy soils found in the Central Sands (CS) and the Lower Wisconsin River Valley (LWRV). These two areas seemed to have similar soil and cropping patterns, but the LWRV has had a higher incidence of groundwater contamination by atrazine and certain other herbicides. For part of this study, movement of atrazine was studied in five intact soil columns in a greenhouse. For much of the study, a seven acre irrigated field site was established in the LWRV near Arena Wisconsin.

This research showed that atrazine leached much more easily through the Sparta soil of the LWRV than the Plainfield soil of the Central Sands. This indicates that significant differences in herbicide movement can exist on sandy soils previously considered to be characteristically similar. These differences are probably due to differences in clay and organic matter content and water holding capacity. In addition this research showed that in the LWRV herbicides can move to groundwater in a matter of weeks and that it is not possible to use atrazine in the LWRV without risk of exceeding the groundwater enforcement standard.

This study together with groundwater sampling results led to differential regulations under the Atrazine Rule for the LWRV and the CS. The results of the study confirm that it was appropriate to implement an atrazine prohibition area in the LWRV and reduced rates in the CS.

Appendix D - Atrazine Related Pesticide and Groundwater Research Projects

Influence of Application Rate on Atrazine Fate in Silt Loam Soil

By David E. Stoltenberg et. al., 1995

Reduced application rates are a major component of DATCP's efforts to protect groundwater under the Atrazine Rule. The purpose of this research project was to evaluate the relationship between atrazine application rate and atrazine movement in the root zone. Experiments were conducted for 180 days under controlled environmental conditions on soil columns receiving application rates between 0.5 and 4.0 pounds of atrazine per acre.

Results of this study showed that the frequency of atrazine and its metabolites and their average concentration in drainage water increased as the application rate increased. The mass of atrazine and metabolites recovered in drainage water also increased as the application rate increased. These results indicate that reduced atrazine application rates are associated with reduced movement of atrazine and metabolites through the root zone of Plano silt loam soil and suggest that reduced application rates are an appropriate approach to groundwater protection.

Field Study of Atrazine Contamination of Groundwater in Dane County, Wisconsin

By Ken Bradbury and Robert McGrath, 1989-1991

The Farm Well Survey conducted by DATCP had indicated widespread atrazine contamination in Wisconsin groundwater and in particular in Dane County. The purpose of this research project was to help explain the findings in the Farm Well Survey by assessing the susceptibility of bedrock aquifers to contamination and by determining the sources of the contamination. The study consisted of a detailed hydrogeologic investigation of a small groundwater basin in Western Dane County where atrazine had been detected in several domestic wells.

Results of this study showed that atrazine was frequently detected in bedrock aquifers in western Dane County. This finding implies that many wells in Dane County and similar areas of southwestern Wisconsin are at risk from atrazine contamination. The frequency of detections in this study also strongly implies that field application of atrazine is a source of groundwater contamination to deep bedrock aquifers. By documenting widespread non-point source atrazine contamination in deep bedrock wells, this study affirmed DATCP's strategy of reducing atrazine application rates statewide.

Appendix D - Atrazine Related Pesticide and Groundwater Research Projects

Hydrogeologic and Land-Use Controls on Atrazine Detections in Dane County, Wisconsin

By Wisconsin Geologic and Natural History Survey, 1991-1993

Groundwater sampling programs have shown that approximately 50% of rural wells in Dane County contain detectable levels of atrazine. The primary objective of this project was to determine the soils, geologic, and land use factors that affect atrazine contamination of domestic wells. In order to examine the factors controlling the distribution of atrazine detections, the land area that contributes water to the sampled wells was determined and land-use practices in the areas were identified. GIS and statistical analysis was used to examine the relationships between hydrogeologic factors, land-use patterns, and atrazine detections.

The relationship between atrazine detections and the variables describing soils, geologic, and land-use factors were difficult to identify and quantify. This study identified land use (corn production), presence of shale, clay and certain types of dolomite, and location in a groundwater discharge area as predictors of atrazine detections for domestic wells in Dane County. This difficulty in modeling and predicting atrazine contamination patterns adds credence to DATCP's strategy of basing components of the Atrazine Rule on mapping of actual detections and analysis of empirical patterns of contamination. This and other studies also indicate that land use (intensive corn production and atrazine use) can be more important than susceptibility and can lead to contamination even in areas not traditionally thought to be highly susceptible to contamination.

Sources and Extent of Atrazine Contamination of Groundwater at a Grade A Dairy Farm in Dane County, Wisconsin

By Gordon Chesters et al., 1989-1991

This project was initiated to further study the atrazine detections in some of the early DATCP groundwater sampling programs. At this time, little site-specific atrazine research had been conducted outside of the Lower Wisconsin River Valley and the Central Sands. The specific objectives of this study were to characterize the extent and distribution of atrazine in groundwater at a dairy farm in the glaciated portion of Dane County and to determine the sources of the contamination. To accomplish these objectives, 55 groundwater sampling points were installed at 25 locations and sampling was conducted monthly or bimonthly.

Appendix D - Atrazine Related Pesticide and Groundwater Research Projects

Atrazine was detected at 19 of the 25 sampling locations in this study and in 5 of 6 private wells monitored in the area. Some evidence suggested that atrazine arrived at shallow monitoring wells 3 to 7 months after application. Atrazine contamination was documented from both point sources and normal field use. The point sources (from atrazine handling) produced higher concentrations, but the majority of detections were attributed to field use at 2-3 pounds of atrazine/acre. Documentation that contamination could come from both point and non-point sources was important in allowing the department to proceed with the Atrazine Rule and other measures to reduce point-source contamination.

Assessment of the 1992 Wisconsin Atrazine Rule

By Peter Nowak et al, 1993

In 1991 and 1992 the Atrazine Rule contained a three-tiered structure: statewide rules, Atrazine Management Areas, and atrazine prohibition areas. Because of the scope of these rules and the large number of farmers affected, it was important to evaluate how well the rule was working and how it was impacting farmers. Specific objectives were to measure changes in corn production techniques resulting from the Atrazine Rule and to measure farmer knowledge of the rule. A mail survey was used to contact 1062 corn growers and 51.3% were returned.

A major conclusion of this study was that the Atrazine Rule was achieving its objective of reducing the extent and intensity of atrazine use. Wisconsin farmers demonstrated a willingness to comply with the rule even though compliance may lead to additional costs. The study also indicated that although atrazine use was decreasing, low rates of atrazine remained a popular component of weed management strategies.

Appendix E - History of the Atrazine Rule

Year	Total Number of Atrazine Prohibition Areas	Actions
1990	0	- 6 special orders in Lower Wisconsin River Valley to prohibit atrazine use in certain areas
1991	6	- First year of atrazine rule, statewide application rates lowered to 2.0 pounds per acre from federal label rates of 4.0 pounds per acre - Lower Wisconsin River Valley designated as an atrazine management area (MA) where maximum atrazine application rates are 0.75 pounds per acre - 6 atrazine prohibition areas (PAs) replace special orders
1992	11	- 5 new MAs (located in Columbia, Dane, Green, Lafayette, St. Croix Counties) where maximum atrazine application rates are 1.0 pounds per acre - 8 new PAs
1993	52	- 45 new PAs - 9 expanded PAs (incorporated 2 existing PAs) - statewide maximum use rates set at 0.75 to 1.5 pounds per acre (with the new statewide application rates, atrazine management areas are no longer needed)
1994	71	- 19 new PAs - 3 expanded PAs - 2 repealed PAs
1995	81	- 10 new PAs - 3 expanded PAs
1996	91	- 10 new PAs - 2 expanded PAs
1997	96	- 6 new PAs - 2 expanded PAs - 1 repealed PA



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