WATER QUALITY

Best Management Practices for *Atrazine*

Atrazine herbicide has been widely used in Kansas since the 1960's for selective control of broadleaf and grass weeds in corn and grain sorghum. It has become one of the most essential, yet controversial, weed control chemicals used today.

BENEFITS OF ATRAZINE

- Low-cost, effective control of a wide range of grass and broadleaf weeds. This helps keep food supplies inexpensive and abundant.
- Wide application flexibility. Can be applied early preplant, preplant incorporated, preemergence, or postemergence.

CONCERNS ABOUT ATRAZINE USE

- Relatively soluble in water. Can dissolve in runoff and enter surface water supplies, or leach into groundwater.
- Relatively long-lasting in soil. Can cause residual damage to susceptible crops such as wheat.

The Environmental Protection Agency (EPA) has established a maximum contaminant level (MCL) in drinking water for atrazine of 3 parts per billion (ppb). Testing of surface water indicates that several rivers and lakes in eastern and central Kansas routinely contain atrazine concentrations exceeding the MCL of 3 ppb for at least part of the year, usually the summer months following herbicide applications. In some cases, atrazine concentrations have averaged more than 3 ppb for the entire year. Testing of private wells indicates that very few water wells have atrazine levels above the MCL.

BEST MANAGEMENT PRACTICES

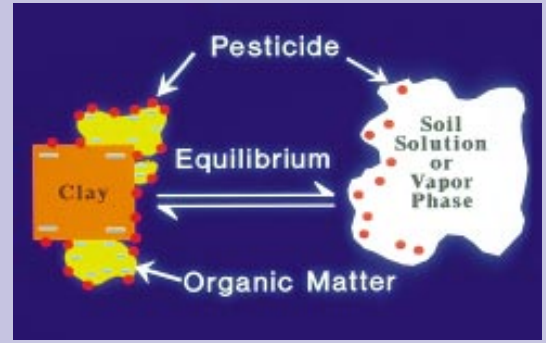
In response to surface water concerns, Kansas State University began research in the late 1980's to identify Best Management Practices (BMP's) that would help control the problem of atrazine runoff into drinking water supplies. As a result of this research, many effective BMP's have been identified (see chart).

10 BEST MANAGEMENT PRACTICES FOR ATRAZINE

Practice	Description	Benefit
1. Soil incorporation	Incorporation will reduce atrazine runoff losses by approximately **67 percent** compared to surface application without incorporation. Atrazine (or atrazine tankmix products) can be incorporated into the top two inches of soil with a field cultivator, tandem disc, or other implement.	Less atrazine is present at the soil surface, where it is most vulnerable to runoff. A good option for producers who use tillage prior to planting.
2. Application timing	The potential runoff of atrazine can be decreased by **50 percent** by applying atrazine prior to April 15 compared to applications in May and June, when rainfall intensity peaks. Early-applied atrazine is more likely to get moved down into the soil by gentle rains of early spring than swept off the field by runoff water during intense late spring and early summer storms.	Helps reduce runoff potential on no-till or reduced-till fields where soil applications of atrazine are used.
3. Split applications	Applying atrazine and tankmixes as split applications has the potential to reduce atrazine runoff by **25 to 33 percent** compared to applying all the product at planting time. Examples include applying half to two-thirds in March and the remainder just prior to or immediately following planting.	Reduces the amount of atrazine on the soil surface during periods of higher rainfall intensities.
4. Reduce soil-applied rates	Formulations with low atrazine content can still provide excellent control of pigweed and other small-seeded broadleaf weeds while reducing the amount of atrazine applied by as much as **33 percent.** For example, *Bicep Lite* herbicide is a premix of atrazine and *Dual* that at full rates contains only about one pound of atrazine per acre. *Dual, Lasso, Harness, Frontier,* and *Surpass* herbicides contribute substantially to pigweed control.	Maintains good weed control of small-seeded broadleaf weeds while reducing atrazine rates.
5. Postemergence applications of atrazine	Postemergence mixtures contain very low rates of atrazine yet provide excellent broadleaf weed control. Using postemergence mixtures results in **67 percent** less atrazine runoff compared to typical preemergence soil-applied atrazine applications.	By reducing the amount of atrazine applied to the soil, runoff potential is reduced.
6. Combine surface applications with postemergence atrazine	Applying reduced soil-applied rates of approximately one pound active ingredient of atrazine per acre at planting time followed, if necessary, by a postemergence atrazine application can reduce atrazine runoff by **25 percent** compared to applying all at planting. This two-step program often provides the best control of velvetleaf, cocklebur, and other tough broadleaf weeds.	Flexible option. Can maintain excellent broadleaf weed control while reducing runoff potential.
7. Alternative herbicides or nonchemical weed control methods	New herbicides containing no atrazine are now available. Examples include *Resolve, Exceed*, and others. Using these herbicides reduces atrazine runoff by **100 percent**. However, some of these herbicides do not control ALS-resistant weeds. The use of crop rotations, cultivation, and other nonchemical weed control methods may reduce or eliminate the need for herbicides.	Can remove atrazine from the picture entirely if alternative herbicides provide sufficient control or if nonchemical weed control methods alone are sufficient.
8. Vegetative filter strips	Vegetative filter strips that reduce water flow rate from the field can reduce atrazine loss up to **25 percent**. Removal of atrazine from runoff water by filter strips is directly proportional to the amount of runoff water that soaks down into the filter strip.	Can reduce atrazine loss without affecting weed control effectiveness or cost.
9. Band application	Banding atrazine over the row at planting or during cultivation reduces the total amount applied on a field by **50 to 67 percent**. As a result, less atrazine is available for possible runoff than when the herbicide is broadcast over the entire field.	When cultivation will be used, a good way to reduce atrazine use and still get good control.
10. Buffer zones	Avoid atrazine applications near water supplies and environmentally sensitive areas. For example, do not apply atrazine within 66 feet of inlets to tile outlet terraces.	Can reduce atrazine loss without affecting weed control effectiveness or cost.

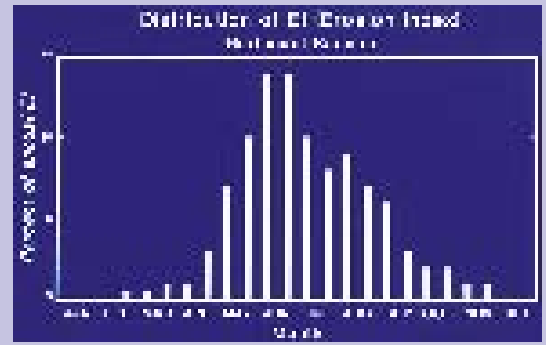
FACTORS THAT INFLUENCE ATRAZINE RUNOFF

Chemical properties of atrazine — Unlike many herbicides and nutrients, atrazine is only weakly adsorbed (attached) to soil particles. It is, however, relatively soluble in water. As a result, atrazine can be moved off crop fields in runoff water even if sediment loss is minimized by erosion control practices. Persistence is another important property. About half the atrazine will be broken down 60 days following application.



Atrazine is only weakly attached to soil particles.

Rainfall timing, intensity, and duration — The closer the rainfall occurs following atrazine application, the greater the atrazine runoff. The amount of atrazine available for runoff is greatest at the start of the runoff event. As rainfall intensity increases, the water runoff rate is increased and more atrazine is lost in runoff.



In Kansas, rainfall intensity peaks in May and June.

Soil texture — The sandier (more permeable) the soil, the less potential there is for atrazine runoff. For example, atrazine runoff is less likely on a sandy loam than a clay loam soil. This is because atrazine is more readily carried down below the soil surface with rainfall on sandier soils. On tighter, less permeable soils, infiltration rates are much lower and runoff is more likely.

Hydrologic soil group — Soils are categorized into four hydrologic groups (A, B, C, and D). These groupings are based on estimated water infiltration rates under field conditions. Group A soils have the lowest runoff potential and pose the least problem for atrazine runoff. Group D soils have the highest runoff potential and pose the greatest threat for atrazine runoff. The hydrologic soil group for your field(s) can be found in your county's soil survey.

EQUUS BEDS RESEARCH FINDINGS

An intensive two-year study assessed the potential leaching of atrazine into the Equus Beds aquifer in south central Kansas. The study was conducted by United States Geological Survey scientists, with funding through the Environmental Protection Agency and the Kansas Department of Health and Environment. Soil samples were collected in March and October-November from 27 dryland and 30 irrigated sites where atrazine had previously been applied. Atrazine concentrations in the top four feet of soil ranged from 0.5 to 12.2 micrograms per kilogram (parts per billion, or ppb). Atrazine concentrations at the 4- to 6-foot depth, with one exception, were less than 1.0 ppb. Below a depth of 6 feet, atrazine concentrations ranged from slight to undetectable.

These results, which confirm previous studies, indicate that atrazine generally stays in the upper portion of the soil profile. Atrazine does not readily leach through the soil and into groundwater.

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