

Potential Reasons of Increase in Acetochlor in Minnesota Surface Waters

Over the last decade, acetochlor monitoring in Minnesota has resulted in three surface waterbodies on the USEPA Impaired Waters List. In recent years, acetochlor has been detected more frequently and at increasing concentrations in Minnesota's rivers and streams (Figure 1). The application timing and chemical properties of acetochlor allow it to enter surface waterbodies through overland runoff, subsurface drainage systems, or attached to eroded sediment. Pre-emergent herbicides, including acetochlor, and other Group 15 herbicides, have become integral to corn and soybeans producer's weed management program to limit populations of tough to control weeds including waterhemp species and Palmer amaranth in Minnesota. The MDA (Minnesota Department of Agriculture) has identified several factors for the increase in detection frequency and concentration in Minnesota surface waterbodies:

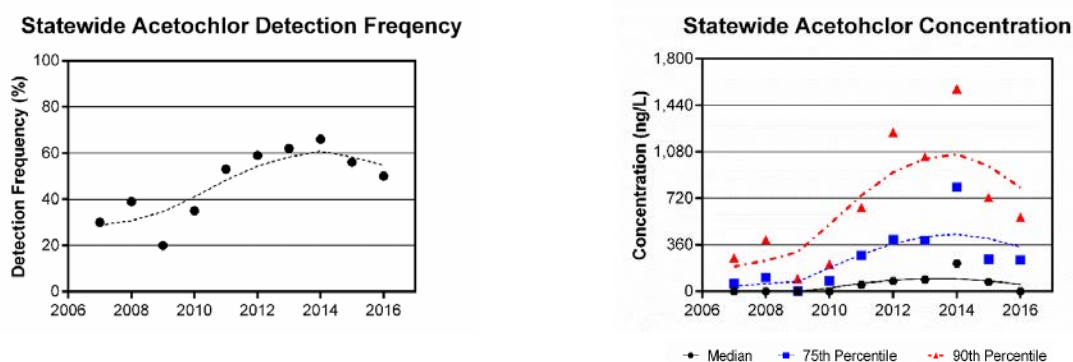


Figure 1. 2007-2016 Minnesota statewide acetochlor detection frequency (left) and concentration values (right).

- **Acetochlor is widely used in Minnesota.** Following glyphosate, acetochlor is the second most widely used herbicide on corn in Minnesota, and use has expanded to soybeans and sugar beets. Acetochlor sales have nearly doubled from 2005 (2,700,000 lbs) to 2015 (5,000,000 lbs).
- **Acetochlor is cost-effective relative to other Group 15 herbicides.** Acetochlor relatively costed less per acre than other Group 15 herbicides, including S-metolachlor. For example, average per acre price of solo acetochlor product is \$27.40 as compared to \$28.20 of solo S-metolachlor product and \$36.0 of solo pyroxasulfone product (2017 North Dakota State University Herbicide Compendium, <https://www.ag.ndsu.edu/weeds/weed-control-guides/nd-weed-control-guide-1/wcg-files/18.1-Herb%20Comp.pdf>).
- **April through June rainfall has increased.** The average amount of precipitation in corn growing regions has increased over time (April-June). For instance, total observed April - June rainfall at Lamberton (U of M SouthWest research and Outreach Center) have been above the 30 year normal (7.41 inches) every year since 2010 (Figure 2). Most burndown and preemergence herbicide applications in Minnesota occur from April - June.

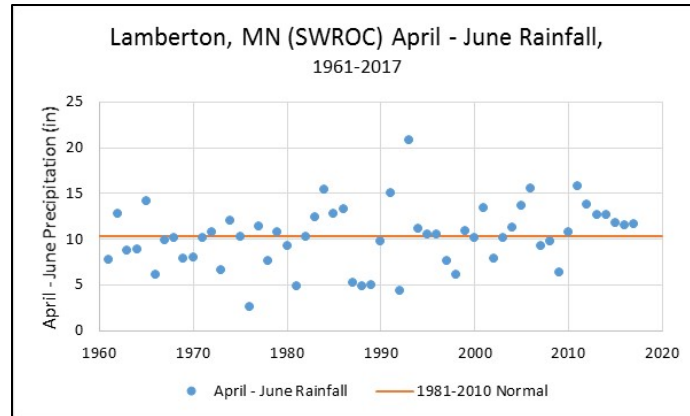


Figure 2. 1960-2017 April - June rainfall totals.

- **Acetochlor application timing is critical relative to observed rainfall.** Elevated acetochlor concentrations in surface waterbodies occurred after rainfall events following after a period that allowed field access for herbicide applications (Figure 3). Increases in river/stream discharge does not always result in elevated acetochlor concentrations, however, most elevated acetochlor concentrations are measured during runoff periods.

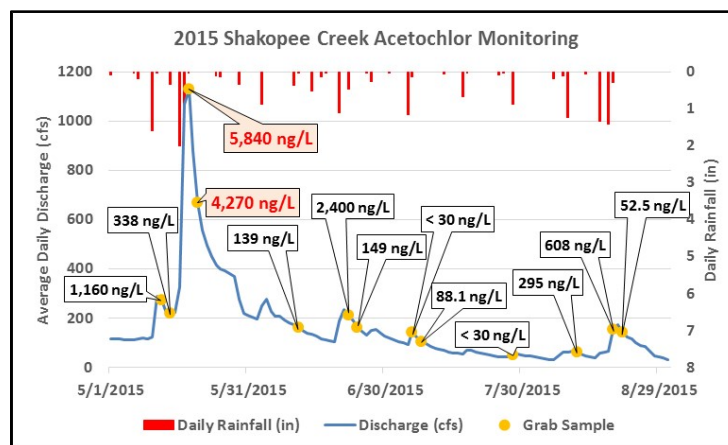


Figure 3. 2015 Shakopee Creek acetochlor concentrations with river discharge showing large increase in acetochlor concentration in late May during a runoff event following heavy rainfall. Acetochlor concentrations are low most of the year.

- **The prevalence of glyphosate-resistant weeds requires the use of pre-emergent herbicides.** Increased number of herbicide resistance (e.g. glyphosate resistance) weed cases in corn and soybeans growing regions has increased reliance on PRE herbicides including acetochlor (Figure 4, none of which are resistant to Group 15 herbicides). The University of Minnesota has identified 21 unique herbicide-resistant weed cases in the state (www.weedscience.org).

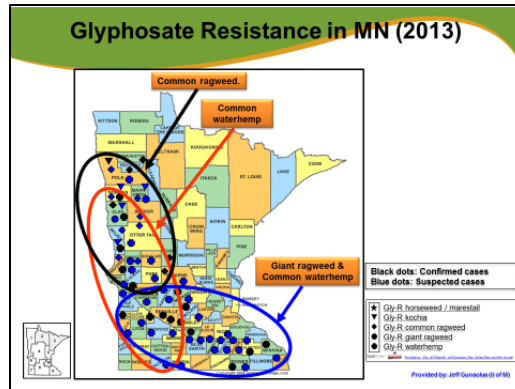


Figure 4. Glyphosate resistance cases in MN in 2013.

- **Fewer producers using reduced application rates.** Producers have been encouraged by the University of Minnesota to use full label application rate and rotate active ingredients to delay the evolution of herbicide resistance.
- **Follow MDA's Herbicide Best Management Practices.** The MDA encourages producers to follow All Ag herbicide and acetochlor Best Management Practices to protect MN surface waters from acetochlor and other herbicides.
<http://www.mda.state.mn.us/protecting/bmps/herbicidebmps/bmpdocs.aspx>