Water Quality ***Best Management Practices for ALL AGRICULTURAL HERBICIDES***

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In order to protect Minnesota's water resources, the Minnesota Department of Agriculture (MDA), along with University of Minnesota Extension and other interested parties, has developed a set of core voluntary Best Management Practices (BMPs). The core voluntary BMPs are provided on the opposite side of this page and should be adopted when applying all agricultural herbicides in Minnesota. The BMPs may also refer to mandatory label use requirements. Always read product labels. Additional information and references accompany the BMPs.

The MDA has also developed unique voluntary BMPs (on separate pages) for the use of specific herbicides due to their presence in Minnesota's groundwater or surface water from normal agricultural use. The herbicide-specific BMPs should be adopted when using herbicides that have been, or whose breakdown products have been, frequently detected in groundwater (acetochlor, alachlor, atrazine, metolachlor and metribuzin) or those detected at concentrations of concern in surface water (acetochlor and atrazine). If the BMPs are proven ineffective, mandatory restrictions on herbicide use and practices may be required. For information on monitoring results for herbicides in Minnesota's water resources, refer to the MDA's Monitoring and Assessment webpage: www.mda.state.mn.us/monitoring

Careful planning in the use of herbicides – as part of an Integrated Weed Management Plan – can help protect water resources from future contamination and help reduce the levels of herbicides currently in Minnesota's waters. Planning also promotes the efficient and economical use of herbicides and may result in reduced application rates that can save you money.

State and federal law can require that the use of a pesticide be limited or curtailed due to the potential for adverse impacts on humans or the environment. The Minnesota Pesticide Control Law (Minn. Stat. 18B) outlines state regulatory authority to prevent these impacts. The Minnesota Groundwater Protection Act (Minn. Stat. 103H) outlines a process that can lead to regulations on the use of herbicides frequently detected in groundwater. In addition, there are other state and federal laws that could lead to restrictions on the use of herbicides contributing to surface water impacts. Adopting these BMPs, and a cautious and respectful attitude regarding the proper use of herbicides, will help growers maintain access to a variety of herbicides that are important and diverse tools in the effort to control weeds and protect water resources.

Best Management Practices (BMPs) for herbicide use

- The purpose of voluntary BMPs is to prevent and minimize the degradation of Minnesota's water resources while considering economic factors, availability, technical feasibility, implementability, effectiveness, and environmental effects.

Integrated Weed Management
Reducing crop losses by combining *cultural*, *chemical* and *mechanical* techniques in ways that favor the crop and suppress weed populations and vigor.

See "Additional Information & References" for more details and practical examples.

- From a practical standpoint, these BMPs are intended to reduce the loss of herbicides to the environment and to encourage the efficient use of herbicides, chemistry-rotation, and non-chemical approaches to weed control as part of an Integrated Weed Management program to save costs, reduce development of herbicide resistant weeds and increase profitability.

The BMPs are provided as a series of options. Producers, crop consultants and educators should select options most appropriate for a given farming operation, soil types and geography, tillage and cultivation practices, and irrigation and runoff management. The MDA encourages development of Integrated Weed Management Plans for every Minnesota farm (see "Additional Information and References" for more information). **Always read the product label. Label use requirements and application setbacks are legally enforceable.**

Water Quality *Best Management Practices for All Agricultural Herbicides*

Core Practice*	Description	Benefit
1. Scout fields for weeds and match the management approach to the weed problem.	Scout for weeds, then map infestations throughout the year. Determine whether weed control will result in significant crop yield benefits. Carefully match weed control options – including non-chemical control – to weed pressures. Use herbicides only in situations where they are necessary and will be cost-effective. Use herbicides with long-lasting effect ("residual control") only in fields that have high densities of target weeds or in fields where weed information is lacking (e.g., newly rented or purchased acres). Consider post-emergent weed control alternatives.	Responding accurately to specific weed pressures, using post-emergent control and using alternative chemical and non-chemical (e.g., cultivation) controls can lower costs and prevent water resource impacts.
2. Evaluate reduced or split herbicide application rates.	Evaluate a reduced-rate herbicide program. Banding – especially in ridge-till rotations – can significantly reduce herbicide costs. Use split applications to reduce the amount of herbicide loss in runoff during early spring rains. Consider using the lowest label rate in a "rate range." Start on a small area to test what works best on your farm. Scout fields for weed escapes and be prepared for follow-up weed management including post-emergent herbicide application, rotary hoeing, or inter-row cultivation.	In many cases, banding and a carefully planned reduced-rate herbicide program can result in effective weed control, reduced costs, and a reduction in herbicide loss to the environment.
3. *For Surface Water protection:* Soil incorporate herbicides.	Evenly incorporate herbicides to the depth recommended on the product label. Improper incorporation, excessive crop residues, or poor soil tilth may result in erratic, streaked or otherwise unsatisfactory weed control. Combine soil incorporation of herbicides with another tillage operation to avoid additional field passes and loss of crop residue.	Incorporated herbicide is less vulnerable to being lost in runoff and reaching nearby streams, lakes and surface tile inlets.
4. *For Surface Water protection:* Evaluate surface drainage patterns in your field and install filter strips and establish buffer zones for streams, sinkholes and tile inlets.	Work with crop consultants and other ag professionals. Study Natural Resources Conservation Service (NRCS) listings for herbicides and soil properties that can lead to herbicide losses in runoff to surface waters (rivers, streams and lakes). Consider herbicides that NRCS lists as having low loss ratings for runoff from your soils, or consider non-chemical weed control methods in sensitive areas. Then, in addition to required label setbacks or buffers, install vegetative filter strips and establish buffers along vulnerable surface waters, karst features, tile inlets and sinkholes.	Filters and buffers reduce field runoff and setbacks eliminate applications where losses are most likely. Reducing use of herbicides known to move to surface water reduces the potential for surface water contamination.
5. *For Groundwater protection:* Determine the depth to groundwater in your fields and consider protective practices in vulnerable areas.	Work with crop consultants and other ag professionals. Study Department of Natural Resources groundwater pollution sensitivity maps and Natural Resources Conservation Service (NRCS) listings for herbicides and soil properties that contribute to herbicide losses by leaching. Consider herbicides that NRCS lists as having low loss ratings for leaching from your soils, or consider non-chemical weed control methods in sensitive areas. Follow label requirements or recommendations where water tables are shallow.	Reducing herbicide use in sensitive areas reduces the potential for groundwater contamination. Adhering to label groundwater advisories and exclusions reduces aquifer pollution.
6. Rotate herbicide sites of action (chemistry).	Avoid using herbicides with the same site of action over an extended period of time. Rotate or combine herbicides with different sites of action yet with equivalent effectiveness for target weeds. Evaluate this practice in the context of other effective weed control practices, such as field scouting, crop rotation (including rotation of herbicide-tolerant crops), and mechanical weed control.	In the long term, this practice can help reduce the total annual loss of particular herbicides to water resources and the environment. It may also slow the development of herbicide resistance in weeds or weed species shifts.
7. Use precision application methods.	Precision application of herbicides includes auto-steer, auto-boom shutoff, and variable application rate technology. Used by themselves or in combination, these practices can reduce needless herbicide use resulting from overspray, spray overlap, and higher than recommended application rates.	Precision applications can result in less total herbicide applied when compared to conventional application methods; this means less potential loss to the environment.
8. *For Groundwater protection:* Develop an Irrigation Water Management Plan.	If you irrigate, implement a water management scheduling plan that uses a soil probe, rain gauge, daily crop water use estimations and a soil water balance worksheet.	Effective irrigation management reduces leaching of chemicals to groundwater.

***For practices related to the use of specific herbicides refer to MDA's herbicide-specific Best Management Practices. All BMPs are available at *www.mda.state.mn.us/herbicidebmps* See "Additional Information & References" for access to detailed guidance on all recommended practices.**

ADDITIONAL INFORMATION & REFERENCES

This information accompanies the State of Minnesota's voluntary water quality best management practices (BMPs) for agricultural herbicides. The information and references are not additional BMPs; rather, they provide more detailed guidance to support a producer's management program for the proper use of all herbicides, and are provided in support of the voluntary BMPs.

Applied Weed Research

University of Minnesota Applied Weed Science Research program (weed and pesticide management information):
http://appliedweeds.cfans.umn.edu

"Herbicide Resistant Weeds" (information on rotating chemistries & herbicide sites of action) J. L. Gunsolus, 2008, U of M:
www.extension.umn.edu/distribution/cropsystems/DC6077.html

Herbicide Resistance Action Committee (international industry resource on managing weed resistance to herbicides):
www.hracglobal.com

International Survey of Herbicide Resistant Weeds (industry and academic collaboration to monitor herbicide resistance):
www.weedscience.org

Pesticide Use

Minnesota Department of Agriculture (MDA):
Best management practices for pesticide use, www.mda.state.mn.us/pesticides
Integrated pest management information, www.mda.state.mn.us/ipm
Pesticide sales and use information, www.mda.state.mn.us/pesticides

University of Minnesota Extension:
Assistance with Integrated Weed Management Plan development, www.extension.umn.edu/offices
Pesticide Safety and Environmental Protection, www.extension.umn.edu/pesticides

USDA - Natural Resources Conservation Service (NRCS):
"Protecting Wisconsin's Resources through Integrated Weed Management" (includes the "Minnesota Insert")
Find the same publication without the insert at http://ipcm.wisc.edu/Publications/tabid/54/id/79/Default.aspx
NRCS - Minnesota Pest Management website, with information on pest management planning and policy, technical standards, pesticide information, and the WIN-PST tool, www.mn.nrcs.usda.gov/technical/ecs/pest/pest.htm

Iowa State University Extension:
"Eight Ways to Reduce Pesticide Use", www.extension.iastate.edu/publications/IPM59.pdf
"Understanding and Reducing Pesticide Losses", www.extension.iastate.edu/publications/PM1495.pdf

University of Wisconsin Extension:
"Reduced Herbicide Rates in Corn" #A3563, http://ipcm.wisc.edu/publications/tabid/54/default.aspx

Soils & Water

Local Soil and Water Conservation District (SWCD) offices (assistance with water table information and soil, groundwater and surface water maps): www.bwsr.state.mn.us/directories

USDA - Natural Resources Conservation Service (NRCS) (assistance with water table information, identification of vulnerable soils and sensitive areas, soil maps, and pest and weed management planning): www.mn.nrcs.usda.gov and click on "Technical Resources". To locate offices for local assistance, click on "Find a Service Center".

USDA - NRCS soil survey information is available on-line at: http://websoilsurvey.nrcs.usda.gov/app/

Minnesota Department of Natural Resources (MDNR) (information for some areas of the state on water table depth groundwater pollution sensitivity, and karst features): www.dnr.state.mn.us/groundwater/index.html

University of Minnesota Extension (assistance with soil and water information and development of irrigation plans): www.extension.umn.edu/offices See also "Tillage BMPs for Water Quality Protection in Southeast Minnesota", www.extension.umn.edu/distribution/cropsystems/DC7694.html and "Irrigation Water Management Considerations for Sandy Soils in Minnesota", www.extension.umn.edu/distribution/cropsystems/DC3875.html

Minnesota Department of Agriculture (MDA) (information about monitoring and assessment of water resources for pesticide impacts): www.mda.state.mn.us/monitoring See also "Irrigation Management", www.mda.state.mn.us/protecting/conservation/practices/irrigation.aspx

ADDITIONAL INFORMATION & REFERENCES

Integrated Weed Management

Use one or more of the following strategies to help you cost effectively manage weeds while protecting the environment. Develop an Integrated Weed Management Plan in consultation with University of Minnesota Extension Educators, Natural Resources Conservation Service and Soil & Water Conservation District personnel, certified crop advisors and local crop consultants.

- ✓ **Develop an Integrated Weed Management Plan for your field(s)** – The MDA encourages the development of Integrated Weed Management plans for every Minnesota farm *(see opposite side of this page for additional information and references)*.
  Start slow if you like . . . try the practices on a few fields and build from there!
- ✓ **Document recent chemical use.** This information is important when planning for rotating herbicide chemistries and establishing reduced rate programs.
- ✓ **Introduce a post-harvest cover crop, introduce a small grain or perennial forage,** and rotate among a wider variety of crops to disrupt weed life cycles and control weeds while using fewer chemicals.
- ✓ **Don't assume that more is better!** It may cost more to achieve 100% elimination of weeds than is gained through increased yield. Work with a crop consultant to determine the economic level of injury your field can sustain with reduced or no herbicide use.
- ✓ **Proper application timing.** Apply herbicides under optimal environmental conditions and at the appropriate time of year, crop growth stage, and weed growth stage specified on the label. Doing so can reduce the availability of herbicides for runoff or leaching.
- ✓ **Use a rotary hoe, harrow or cultivator** as part of integrated approaches to weed control. Mechanical weed control can reduce herbicide program costs and reduce herbicide environmental impacts.
- ✓ **Consider planned, periodic use of herbicide-resistant (HR) crops** into cropping sequences, but don't rely on this technology to solve all weed problems. HR crops should be considered as part of a planned rotation of herbicide chemistries (to avoid the buildup of herbicide resistant weeds or weed species shifts).
- ✓ **Apply herbicides as split applications** to reduce the amount of herbicide on the soil surface during periods of higher rainfall intensities.
- ✓ **Work with your local crop consultant and University Extension Educators** to determine where reduced rates or alternative weed control practices can be introduced.

MINNESOTA DEPARTMENT OF AGRICULTURE

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