

Alternative Management Tool (AMT)

Increasing Continuous Cover: Perennial Vegetation

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Alternative Management Tools (AMTs) are specific agricultural practices and solutions, other than nitrogen fertilizer best management practices, that reduce nitrate loss to groundwater. AMTs are described in the Groundwater Protection Rule and are approved by the Commissioner of Agriculture.

Introduction

Extending the duration of vegetation on crop land is an effective strategy for reducing nitrate loss to groundwater. The Minnesota Department of Agriculture (MDA) encourages practices that increase continuous vegetative cover, including perennial vegetation as a stand-alone crop or in rotation with annual crops.

Perennial vegetation meets the definition of Alternative Management Tools (AMT) in the Groundwater Protection Rule (MR 1573.0010). Perennial vegetation may lower nitrate leaching losses compared to other crops by:

- increasing the overall uptake of nitrogen, especially during leaching-prone spring and fall periods,
- having lower nitrogen fertilizer requirements,
- absorbing soil moisture to reduce downward nitrate movement, and/or
- harvesting and removing some of the vegetation to further remove nitrogen.

The result is a reduced risk of nitrate leaching losses.

Description

Perennial vegetation lives and grows three years or longer without the need for replanting every year. Perennial vegetation grows back in the spring and after each harvest. Examples of perennials in Minnesota are alfalfa, pasture or hay with perennial grasses, clovers or other forbs, intermediate wheatgrass, silvopasture, bioenergy crops such as switchgrass and miscanthus, and shrub or tree crops such as poplar and hazelnuts. In some cases, such as in undulating terrain, strips of perennial vegetation are planted within fields or along field borders.

Perennial vegetation normally develops deeper and more dense root systems compared to annual crops. This enables them to effectively scavenge nitrogen from the soil, including nitrate residing below the root zone of annual crops. Vegetation removal through haying or harvest further removes nitrogen. Perennial vegetation has a longer growing season compared to annual crops and their uptake of nitrogen and water during the leaching-prone spring and fall periods reduces nitrate leaching losses. Since perennial vegetation is effective in taking up nitrogen and has lower overall nitrogen needs compared to annual crops such as corn and potatoes, less nitrogen is needed to be applied through fertilizer. This lower overall nitrogen rate reduces the risk of nitrate leaching losses.

Some perennial vegetation such as alfalfa are legumes and need no nitrogen fertilizer. If plant available nitrogen is available in the soil, alfalfa will take it up before producing its own, making alfalfa very effective in reducing nitrate leaching loss while it is actively growing.

Additional benefits of perennial vegetation may include wildlife and pollinator habitat, erosion control, improving soil structure and increasing soil organic matter.

Perennial vegetation is exempt from the fall nitrogen fertilizer application restrictions under the Groundwater Protection Rule (1573.0030 Subp. 3).

AMT substitution for a Best Management Practice (BMP)

See BMP/AMT matrix (www.mda.state.mn.us/nitrogenamts) for more information about how this AMT substitutes for nitrogen fertilizer BMPs.

Water quality benefits

In Minnesota and across the upper Midwest, studies have shown that perennials can reduce nitrate leaching compared to annual crops. Randall et al. (1997) measured nitrate-nitrogen concentrations in subsurface drainage water from row crops, alfalfa fields, and Conservation Reserve Program (CRP) lands over a four-year period. They found lower nitrate-nitrogen loss in drainage water under alfalfa (1.5 lb/ac/yr) and CRP (1 lb/acre/yr) than under a corn-corn (49 lb/acre/yr) or corn-soybean (45 lb/ac/yr) rotations. The flow weighted average nitrate-nitrogen concentrations were: Corn-corn = 32 mg/L, corn-soybean = 24 mg/L, alfalfa = 3 mg/L and CRP = 2 mg/L (Randall et al., 1997). Hussain et al. (2019) showed that even with moderate rates of nitrogen fertilization (50 lb N/ac/yr), perennial cropping systems can reduce nitrate leaching by 60- 80% once they develop their maximum productivity. Grasses and restored prairie leached less nitrate than corn (grasses = 3.9 ± 1.7 lb N/ac/yr, restored prairie = 2.1 ± 1.5 lb N/ac/yr, corn = 30.3 ± 1.2 lb N/ac/yr) (Hussain et al. 2019). Smith et al. (2013) found perennial vegetation quickly reduced nitrate leaching as well as concentrations and loads from the tile systems following conversion from row crop agricultural production.

Moving from perennial vegetation back to row crops needs special attention. Some perennial vegetation such as alfalfa may quickly release nitrate back to the soil upon termination so appropriate N credits should be taken. A guidance document from the University of Minnesota for managing the rotation from alfalfa to corn is listed under technical resources below. Huggins et al. (2001) showed that nitrate leaching increases when CRP is converted to annual crop production and that the beneficial effects of perennials on reducing nitrate loss were largely negated after 1 to 2 years of corn production. These results indicate that the main benefits of perennial crops occur while they are actively growing.

Requirements to qualify for Perennial Vegetation AMT

- After establishment, the perennial vegetation must remain in the field for at least three growing seasons,
- If used in rotation with annual crops, the perennial vegetation must be grown at least half the time. As an example, three years out of six.
 - o The MDA may verify if the requirements for the Perennial AMT are met. The approach the MDA will use for verification is described under the section “Recordkeeping” below.
- Seed bed preparation, seeding rate and spacing must be adequate to ensure good establishment of the perennial vegetation and be based on the technical resources listed below,
- Nitrogen inputs from fertilizer and manure must follow guidance from the University of Minnesota. If additional N beyond University of Minnesota recommendations is needed, in-season soil or plant testing or other adaptive management technologies verified by the MDA must be used to document and quantify this need and additional nitrogen can be added (see “AMT for Precision Agriculture: Precision Nitrogen Management” for information about verified technologies, available at www.mda.state.mn.us/pesticide-fertilizer/approved-amts),
- If used in a rotation with annual crops, nitrogen credit must be taken from the perennial vegetation. The University of Minnesota has recommendations for how much to credit at

extension.umn.edu/nutrient-management/crop-specific-needs. Select the crop you are planting after the perennial to access tables for nitrogen credits.

Recordkeeping

The cultural practices of growing perennial vegetation should follow published guidance from the University of Minnesota. Guidance from other organizations such as Minnesota Crop Improvement Association, Midwest Cover Crop Council, or Extension publications from states adjacent to Minnesota is acceptable provided it is based on documented demonstration projects or research.

Records must indicate what guidelines were used and include seeding date and rate, nitrogen fertilizer application timing, source and rate, and termination date. Supporting information such as photos, yield data, biomass estimation or similar are useful, but not required.

Technical resources

The MDA recognizes that research related to new or emerging perennial vegetation and the development of agronomic best management practices is ongoing. Farmers should adopt best management practices as they become available.

Information available from the University of Minnesota includes but not limited to:

- Crop-specific fertilizer guidelines from the University of Minnesota.
 - o Available at: extension.umn.edu/nutrient-management/crop-specific-needs
- Fertilizer guidelines for grasses and legumes.
 - o Available at: extension.umn.edu/nutrient-management/crop-specific-needs
- Establishing alfalfa-grass mixtures.
 - o Available at: extension.umn.edu/planting-forages/establishing-alfalfa-grass-mixtures
- Managing the rotation from alfalfa to corn.
 - o Available at: extension.umn.edu/corn-cropping-systems/managing-rotation-alfalfa-corn

Information from the USDA Natural Resources Conservation Service (NRCS):

- Herbaceous Vegetation Establishment Guide. Minnesota Agronomy Technical Note # 31.
 - o Available at (note the link below will automatically download the document as a pdf): www.nrcs.usda.gov/wps/cmیس_proxy/https/ecm.nrcs.usda.gov%3A443/fncmis/resources/WEBP/ContentStream/idd_3020447A-0000-CD34-884E-CD4D0717A81F/0/MNAgronomyTechNote_No_31_version1_7.pdf

References

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