Alternative Management Tool (AMT)
Increasing Continuous Cover: Cover Crops

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

Introduction

In areas with vulnerable groundwater and in highly vulnerable drinking water supply management areas (DWSMAs), an effective strategy for reducing nitrate-nitrogen (nitrate) leaching are those practices that extend the duration with growing vegetation on the land. The MDA supports practices to increase continuous vegetative cover, including the use of cover crops.

The following practices meet the definition of AMT in the Groundwater Protection Rule (MR 1573.0010) and have well-documented reductions for nitrate leaching. Specifically, they can increase overall uptake of nitrogen making it less available for leaching and/or utilize soil moisture thereby reducing downward nitrate movement. This reduces the inherent risk of nitrogen loss.

Description

Cover crops are grasses, legumes, or forbs planted for seasonal vegetative cover, established on an annual basis, between primary main crops and/or companion-planted into main crops. Cover crops are often planted in fields with crops that have little or no vegetative cover between growing seasons.

A primary purpose of cover crops is to capture left-over nutrients in the soil. Cover crops can also be used to reduce water and wind erosion, mitigate soil compaction, increase soil organic matter, improve soil moisture holding capacity, produce forage, and improve overall soil health. Several cover crop species may be used for weed suppression and soil fumigation.

In Minnesota, a common cover crop is cereal rye (*Secale Cereale L.*), although other single variety and multi-species cover crop mixes are also used. The cover crop is typically planted in late summer or fall to provide soil cover through the fall, over winter and early spring. Depending on the specie, the cover crop may winterkill or may go dormant during winter and resume growing in the spring. In Minnesota, winter cover crops are more easily established after the harvest of short season crops such as seed potatoes, silage corn, canning crops, and small grains. Cover crops can also be established following corn and soybeans and may include interseeding or aerial application to establish the stand during the growing season of the primary crop. Cover crops can also be a perennial crop such as Kura clover into which the main crop is seeded. One of the biggest challenges with cover crops in Minnesota is getting a good stand established in the fall due to the short and cool season between harvest and freeze-up and again between the spring thaw and planting of the subsequent primary crop the following year.

AMT substitution for a Nitrogen Fertilizer Best Management Practice (BMP)
Additional information on how this AMT substitutes for nitrogen fertilizer BMPs is found in the BMP/AMT matrix on the Alternative Management Tools webpage (mda.state.mn.us/nitrogenamts).

Water Quality Benefits
The agronomic and environmental benefits of cover crops include building soil organic matter and supporting soil health, suppressing weeds and pests, controlling erosion, minimizing soil compaction, and retaining nutrients. Winter grains seeded as cover crops can be used for grazing or forage (USDA-NRCS, 2018). Soil benefits of cover crops accrue over time, with gradual improvements to soil organic matter and the soil's ability to hold water and nutrients. In-field monitoring and modeling shows that a well-established cover crop reduces the nitrate leaching losses to subsurface drainage water and groundwater by taking up excess soil nitrogen starting as soon as it's established.

The amount of nitrate leaching reduction from cover crops depends on weather and biomass accumulation of the cover crop. Despite the variability, research shows that cover crops provide a nitrate reduction compared to no cover crops. Studies in Minnesota and Iowa showed reductions in nitrate loads in drainage water by over 60% with rye and oat cover crops (Lenhart et al., 2017). Strock et al. (2004) showed that subsurface (tile) drainage discharge was reduced 11% and nitrate loss was reduced 13% for a corn–soybean cropping system with a rye cover crop following corn compared to no rye cover crop. Mohammed et al. (2020) showed that winter rye decreased soil nitrate up to 76% compared to no-cover-crop treatment in the soybean phase of the rotation.

It is useful to distinguish between different cover crop species as they have different abilities for scavenging nitrate from the soil. For example, grasses and brassicas are better than legumes.

- Grasses including winter grains are effective at scavenging soil nitrogen, have fibrous roots and are effective in reducing nitrate leaching. Grasses have high C:N ratio (>25) so nitrogen tends to be released slowly from the residue following termination. Cereal rye is particularly effective in reducing nitrate leaching losses since it is cold tolerant and can produce large quantities of biomass.
- Brassicas (e.g. mustard, rapeseed, radish, turnip) will utilize the existing N supply provided by the soil during establishment.
- Legumes are less effective in scavenging soil N, but since they can fix nitrogen from the air, they can provide a substantial amount of nitrogen (50 lb/N or more) to the subsequent primary crop. Legumes have low C:N ratios (<20) and nitrogen tends to be released quickly from the residue which can lead to leaching losses if there is no crop established. Residue from a grass/legume mix will have a higher C:N ratio than legume alone, slowing the release of nitrogen so it's less vulnerable to loss.

Requirements to Qualify for the Cover Crop AMT
The following requirements must be met for cover crops to qualify as an AMT:

- Planting of cover crops must meet the published technical requirements from: Practice Standard 340 of the MN-NRCS, the University of Minnesota-Extension, or the Midwest Cover Crop Council (references are listed under technical resources below). Cover crops established following guidelines from any of these organizations will be considered an approved AMT by the MDA. Producers, agronomists, businesses, and others can submit requests for other guidelines to be considered and adopted by the MDA in future updates to the program.

- Except as noted for starter fertilizer below, no nitrogen fertilizer will be applied for the purpose of growing the cover crop. Fertilizer applied for the following year's primary crop, such as incidental nitrogen applied with phosphorus or sulfur fertilizer, such as ATS, MAP or DAP is allowed.

Soil fertility and purpose of the cover crops should be considered when determining if a starter fertilizer nitrogen application for the cover crop is appropriate. When the primary objective for the cover crop is water quality protection, no fall nitrogen fertilizer can be applied (except for incidental nitrogen, as noted above). Cover crops that have nitrogen fertilizer applied are not considered an AMT unless the need for nitrogen is documented when rapid biomass accumulation in the fall is needed to reduce applications of soil fumigants or winter grains for forage production. There is an exception in the Groundwater Protection Rule (MR 1573.0030 Subp 3 A. (6)) where N fertilizer can be applied to a cover crop: when commercial nitrogen fertilizer is required for growing cover crops for the specific purpose of reducing commercial applications of soil fumigants to the subsequent potato crop.

Documenting the need for additional N following a cover crop

Additional in-season nitrogen may be needed, in some years, for the primary crop following the cover crop as some nitrogen is tied up by the decaying cover crop residue. An in-season pre-sidedress nitrate soil test will be needed to document this need. Additional nitrogen fertilizer may be applied based on the soil analysis results, not to exceed an additional 20 lb N/ac above the MDA-published N rate. The soil nitrate-N test must show soil nitrate levels below 20 ppm to allow for additional nitrogen. Please visit the Alternative Management Tools webpage (mda.state.mn.us/nitrogenamts) to view all AMT documents.

Recordkeeping

Planting of cover crops must meet the published technical requirements from: Practice Standard 340 of the MN-NRCS, the University of Minnesota-Extension, or the Midwest Cover Crop Council (references are listed under technical resources below). Records must indicate what guidelines were used and document cover crop species, seeding rate, method and date, and timing of termination. Records must also show soil test results if additional N was applied based on an in-season pre-sidedress nitrate soil test. Documentation of cover crop vigor and stand such as photos, drone imagery, above-ground biomass harvest or similar is encouraged, but not required.

Technical Resources

Resources for cover crops:

- Practice Standard 340: Cover Crops (efotg.sc.egov.usda.gov/api/CPSFile/390/340_MN_CPS_Cover_Crop_2017)
- Minnesota Agronomy Technical Note 33: Cover Crop Seeding Guide (efotg.sc.egov.usda.gov/api/CPSFile/392/340_MN_GD_Agronomy_%20Technical_Note_2018)
- Cover Crop Performance and Adaptation Trials (nrcs.usda.gov/wps/portal/nrcs/detail/national/climatechange/?cid=stelprdb1077238)
- University of Minnesota: Cover Crops (extension.umn.edu/soil-and-water/cover-crops)
- Midwest Cover Crops Council: Cover Crop Decision Tool (mccc.msu.edu/covercroptool/)

Resource for soil nitrate testing:

- Pre-sidedress nitrate test (PSNT). University of Minnesota has guidance for precision soil sampling. Available at Testing and analysis (extension.umn.edu/nutrient-management/testing-and-analysis).

References

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