

Alternative Management Tool (AMT)

Increasing Continuous Cover: Cover Crops

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 time 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 consume 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 successive main crops or companion-planted into main crops. Cover crops often get planted in fields with short season crops that would otherwise have little or no vegetative cover, between growing seasons, to protect the soil from erosion and nutrient loss.

A primary purpose of cover crops, and therefore why they could be considered an AMT, is to capture left-over nutrients in the soil. Other purposes are forage production, to reduce water and wind erosion, minimize soil compaction, increase soil organic matter, improve soil moisture use efficiency, and improve overall soil health. In addition, 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. A winter cover crop is planted in late summer or fall to provide soil cover over winter and early spring. Depending on the species, the cover crop may winterkill or may resume growing in the spring. In Minnesota, winter cover crops are more easily established after the harvest of earlier 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 main crop. An emerging cover crop practice is a perennial crop such as Kura clover into which the main crop is seeded. The biggest challenge facing cover crops in Minnesota is getting a good stand established due to the short and generally cool growing season between harvest and freeze-up and again between thawing and planting of the subsequent row crop.

AMT substitution for a Nitrogen Fertilizer Best Management Practice (BMP)

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

This cover crop AMT will substitute for certain nitrogen fertilizer BMPs for a corn, potato or edible bean crop that follows termination of the cover crop. It does not generally allow for more nitrogen fertilizer to be applied¹. If the crop following termination of the cover crop is not corn, potato or edible bean, then the cover crop will substitute for nitrogen fertilizer BMPs for the corn, potato or edible bean crop that is immediately before the cover crop planting.

Water Quality Benefits

The agronomic and environmental benefits of cover crops including building soil organic matter and supporting soil health, suppressing weeds and pests, controlling erosion, minimizing soil compaction and retaining nutrients have been shown repeatedly. 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 generally shows that a well-established cover crop reduces the nitrate leaching losses to subsurface drainage water and groundwater by taking up excess soil nitrogen as soon as it's established.

The amount of nitrate leaching reduction from cover crops varies depending on many factors, mainly weather and biomass accumulation of the cover crop in the fall. Despite the variability, research has shown 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 with no-cover-crop treatment in the soybean phase of the rotation.

It is also useful to distinguish between different cover crop species as they have different abilities for scavenging nitrate from the soil. 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. Small grains, especially cereal rye is particularly effective in reducing nitrate leaching losses since it is cold tolerant and produces large quantities of biomass.
- Brassicas (e.g. mustard, rapeseed, radish, turnip) need a sufficient nitrogen supply provided by the soil (i.e. not nitrogen fertilizer) during establishment to get a good stand.

¹ Please note there is an exception in the Groundwater Protection Rule (MR 1573.0030 Subp 3 A. (6)) where nitrogen 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. In that case, a fall nitrogen fertilizer application is allowed but the production of the cover crop is not considered an AMT and it does not substitute for a nitrogen fertilizer BMP.

- Legumes are less effective in scavenging soil nitrogen, 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 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 yet.

The release of nitrogen from decaying cover crops can be rapid, especially from legumes. 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.
- Except as noted for starter fertilizer below, no nitrogen fertilizer should be applied for the purpose of growing the cover crop. Fertilizer applied for the following year's crop, such as incidental nitrogen applied with ammoniated fertilizer, such as 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. If the primary objective for the cover crop is water quality protection, no fall nitrogen fertilizer should be applied (except for incidental nitrogen applied with ammoniated fertilizer, such as MAP or DAP for the following year's crop). Cover crops that have supplemental nitrogen fertilizer applied are not considered an AMT unless the need for nitrogen is documented and justified for situations where rapid biomass accumulation in the fall is needed for weed or pest suppression or forage.

Documenting the need for additional N following a cover crop

Additional in-season nitrogen may be needed, in certain years, following a cover crop as some nitrogen is tied up by the decaying cover crop residue. If this is the case, in-season soil or plant testing or other adaptive management practices can be used to document and quantify this need and additional nitrogen fertilizer may be applied. Please visit www.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 should indicate what guidelines were used. Records documenting cover crop species, seeding rate, method and date, and timing of termination (if applicable) must be maintained and be in accordance with guidance listed above. Documentation of cover crop vigor and stand such as photos, above-ground biomass harvest or similar is encouraged, but not required.

Technical Resources

Resources available from the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS):

- Practice Standard 340: Cover Crops. Available at: efotg.sc.egov.usda.gov/references/public/MN/2017Cover_Crop_340Standard.pdf
- Minnesota Agronomy Technical Note 33: Cover Crop Seeding Guide. Available at: efotg.sc.egov.usda.gov/api/CPSFile/392/340_MN_GD_Agronomy_%20Technical_Note_2018
- Cover Crops and Soil Health. Available at: www.nrcs.usda.gov/wps/portal/nrcs/detail/national/climatechange/?cid=stelprdb1077238

Other resources

- University of Minnesota: Cover Crops. Available at: extension.umn.edu/soil-and-water/cover-crops
- Midwest Cover Crops Council: Cover Crop Decision Tool. Available at mccc.msu.edu/covercroptool/

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