Revisions of Nitrogen BMPs and a report on Nutrient Management Projects funded by AFREC

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In The Past

- The original N BMPs were developed and published in 1993.
- Divided into Statewide, Regional, and Special situations.
- Corn based
- RESEARCH BASED
Revision Needed

- Updated with new research information since the last BMPs.
- Added information for wheat, sugarbeet, and dry beans.
- Region and special case divisions. New publication on why the BMPs different across the state.
New

Categories based on risk of N loss.
- Recommended
- Acceptable, but with Greater Risk
- Not Recommended.

The risks can be either economic or environmental.
- Economic can be either a consequence of added input cost without additional yield or a reduction in yield.
- Environmental can be the potential for loss of nitrogen to either ground water or surface water.
Statewide

- A general description of soils and climate of Minnesota as a justification for regional BMPs
Statewide

Authors: John Lamb, Gyles Randall, George Rehm, and Carl Rosen
Northwest Minnesota

Authors: Albert Sims, George Rehm, and John Lamb

BMPs for spring wheat
Southwestern and West-Central Minnesota

Authors: George Rehm, John Lamb, Jodi Dejong Hughes, and Gyles Randall

Corn and Sugarbeet Production
South-Central Minnesota

Authors: Gyles Randall, George Rehm, John Lamb, and Carl Rosen

Corn Production
Southeastern Minnesota

Authors: Gyles Randall, George Rehm, and John Lamb

Corn Production
Coarse Textured Soils - Special Case

Authors: George Rehm, John Lamb, Carl Rosen, and Gyles Randall

Corn and Edible Bean Production
Irrigated Potatoes - Special Case

Authors: Carl Rosen and Peter Bierman

Irrigated Potato Production Builds on the BMPs for Coarse Textured Soils
Examples of Corn BMPs
Corn

Recommended for corn

- Select the appropriate N fertilizer rate using U of MN guidelines, which are based on current fertilizer and corn prices, soil productivity, and economic risk. (SW, WC, SC, and SE)

- Total N rate should include any N applied in a starter, weed and feed program, and contributions from phosphorus fertilizers such as MAP and DAP. (SW, WC, SC, and SE)

- Take appropriate credit for previous legume crops and manure used in the rotation. (SW, WC, SC, and SE)
Recommended for corn (continued)

- Under rain fed conditions, apply sidedress N before corn is 12 inches tall (V7 stage). (SW, WC, SC, and SE)
- Spring preplant applications of ammonia and urea or split applications of ammonia, urea, and UAN are highly recommended. (SC and SE)
- Incorporate broadcast urea or preplant UAN within three days to a minimum depth of 3 inches. (SC and SE).
Corn

Recommended

- Use a soil nitrate test when appropriate, by collecting soil samples to a depth of 24 inches in 0 to 6 and 6 to 24 inch increments. Collect fall soil samples after soil temperature at 6 inches stabilizes below 50 degrees F. (WC and SW)

- For urea or anhydrous ammonia applied in the fall, delay application until after soil temperature at 6 inches stabilizes below 50 degrees F. (WC and SW)

- Incorporate fall applied urea as well as spring applied urea and UAN within 3 days to a minimum depth of 3 inches (WC and SW)
Corn

Recommended

- Inject or incorporate sidedress applications of urea or UAN into moist soil to a minimum depth of 3 inches. (SC and SE)
- When soils have a high leaching potential (sandy texture), a split application is preferred. Use a nitrification inhibitor with early sidedressed N applied to these soils. (WC and SW)
- When soils have a high leaching potential (sandy texture), nitrogen application in a split-application or sidedress program is preferred. Use a nitrification inhibitor with early sidedressed N. (SC and SE)
- Minimize direct movement of surface-water to sinkholes (SE)
Corn

**Recommended, but with greater risk**
- Late fall or spring preplant application of ESN. (WC, SW, SC)
- Spring preplant application of ESN. (SE)
- Spring preplant application of UAN. (SC and SE)
- Use of the products, Agrotain and N-Serve, with fall applied N. (WC and SW)
- Fall application of ammonia + N-Serve after soil temperature at the 6 inch depth is below 50 degrees F. (SC)
Corn

Not Recommended (WC and SW)
- Fall application of UAN or any fertilizer containing nitrate-nitrogen. (WC and SW)
- Fall application of urea, ammonia without N-Serve. (SC)
- Fall application of UAN. (SC)
- Fall application of ammonia, urea, and UAN, with or without a nitrification inhibitor. (SE)
- Fall N application of any N fertilizer to coarse textured (sandy) soils. (WC, SW, SC, and SE)
Corn

Not Recommended (SC)

- Winter application of nitrogen fertilizers including MAP and DAP to frozen soils. (WC, SW, SC, and SE)
- Shallow or no incorporation of urea applied in the fall. (WC and SW)
- Sidedressing all of N when corn follows corn. (SC and SE)
### N Timing-Source-Corn SW

<table>
<thead>
<tr>
<th>Source</th>
<th>Continuous Corn</th>
<th>Corn/Soybean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>spring</td>
<td>fall</td>
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<tr>
<td>46-0-0</td>
<td>168</td>
<td>165</td>
</tr>
<tr>
<td>82-0-0</td>
<td>175</td>
<td>166</td>
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</tbody>
</table>

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N Rate = 120 lb./acre; 1994-2005 ave.
## N Rate – Time of Application
Soybean/Corn

<table>
<thead>
<tr>
<th>N Rate (lb./acre)</th>
<th>Fall Applied</th>
<th>Spring Applied</th>
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<tbody>
<tr>
<td>0</td>
<td>174</td>
<td>170</td>
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<tr>
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<td>207</td>
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<tr>
<td>180</td>
<td>193</td>
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</table>

Ave. Two locations West Central MN 2005-06
## N-Serve – Waseca 94-99 SC

<table>
<thead>
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<th>Time of Application</th>
<th>No</th>
<th>Yes</th>
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<tbody>
<tr>
<td>Fall</td>
<td>161</td>
<td>171</td>
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<tr>
<td>Spring</td>
<td>172</td>
<td>176</td>
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</table>

--- 6 Yr Avg. Yield (bu/A) ---
# Sidedress after V7 (SE)

<table>
<thead>
<tr>
<th>Time of Application</th>
<th>Total N Rate</th>
<th>Grain Yield</th>
<th>Rel. Leaf Chlorophyll</th>
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<tbody>
<tr>
<td>Preplant</td>
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<tr>
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<td>0</td>
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</table>
Coarse Textured Soils

Recommended

- For corn, select an appropriate rate using U of M guidelines, which are based on current fertilizer and corn prices, soil productivity, and economic risk.
- For edible beans, base N rate on expected yield and previous crop.
- Total N rate used for corn and edible beans should include any N supplied in a starter, in a weed and feed program, and contributions from phosphate fertilizers such as MAP and DAP.
- Use split applications of fertilizer N for both corn and edible beans.
Coarse Textured Soils

Recommended (continued)

- Use a nitrogen stabilizer (N-Serve) on labeled crops when early sidedress N is used.
- Take appropriate N credits for N in legumes and manure used in the crop rotation.
- If possible, apply N fertilizers below the soil surface or incorporate with light tillage or irrigation.
Coarse Textured Soils

Acceptable, but with greater risk

- Spring preplant application with a nitrification inhibitor.
- Single sidedress application of anhydrous ammonia or urea early in the growing season without a nitrification inhibitor.
- Spring preplant application of ESN.
Coarse Textured Soils

- NOT RECOMMENDED
  - Fall application of N regardless of source.
  - Disregard for N supplied by legumes in rotation or in the application of manure.
  - Spring preplant N for corn without a nitrification inhibitor.
  - N fertilizer applied to corn (fertigation) after tasseling.
  - Application of ESN to edible beans after planting.
Acknowledgements

The publication of these Best Management Practices for Nitrogen was possible by a grant for the Agricultural Fertilizer Research and Education Council (AFREC)
What is AFREC?

- A farmer-led program to advance soil fertility research, technology development, and education.
- Origins from the Agricultural Nutrient Task Force to the State Legislature.
- Legislature provided a one-time allocation of $600,000 to jump start the program and establish the Agricultural Fertilizer Research and Education Council.
Who is part of the Council.

Eleven members representing the following:

- MN Soybean Growers
- MN Grain and Feed
- MN Farm Bureau
- MN Wheat Growers
- MN Crop Production Retailers
- Farmers Union
- Certified Crop Advisors
- Potato Grower Industry
- MN Corn Growers
- MN Irrigators Association
- Sugar Beet Industry
What was funded?

9 Projects
- 8 research
- 1 educational
What was funded?

- Zinc and Sulfur Fertilization for High Corn Production – Jeff Vetsch SROC
  - Effects of sulfur and zinc applications in starter-band and broadcast application.

- Impact of Phosphorus Fertilization Strategies on Efficiency of Nitrogen Use by Corn Rotated with Soybean – Dan Kaiser - SWC
  - Examine how phosphorus management strategies affect nitrogen use and potential interaction with soil variability across the field.
What was funded?

- Minimizing Nitrate Loss to Drainage by Optimizing N Rate and Timing for a C-C-S Rotation – Gyles Randall - SROC
  - A long term study site at SROC will provide new fertilizer recommendations and information on the water quality percolating through the tile drains.

- Drainage Control to Promote High Crop Yields and Diminish Nutrient Losses from Agricultural Fields in Minnesota – Jeff Strock - SWROC
  - A field scale demonstration to learn about the impacts of controlled drainage techniques on yields and drainage losses.
What was funded?

- Fertilizer Requirements for Native Perennial Plants Harvested for Biomass. – Craig Sheaffer – Agronomy and Plant Genetics
  - This project will determine fertilizer requirements for native perennials in a number of locations across Minnesota

- Validating Topdressed K Fertilizer Recommendations in an Alfalfa-Corn Rotation – Michael Russelle - ARS
  - This project will determine the optimum K rate in the last year of alfalfa, and on both N and K fertilizer needs for the following corn crop.
What was funded?

- **Efficient Management of Nitrogen Fertilizer for Wheat Grown in Minnesota** – Dan Kaiser - SWC
  - Improved varieties and greater yield potentials create the need for updating the N recommendation for winter and spring wheat.

- **Tillage and Sulfur Management for Corn in Fine Textured Soils** – Jeff Strock - SWROC
  - This project will investigate the impacts of different tillage systems on sulfur mineralization and the need for supplemental S on corn.
What was funded?

  - The publication of the revised nitrogen BMPs.
What is Next?

- A Legislative report on the current projects is due in February.
- Push to make the funding reoccurring through a check – off on fertilizer sold in Minnesota.
- How much? 40 cents a ton.
- On average 9 cents an acre.
- What is the current expense per acre for fertilizer?
Questions
Northwestern Minnesota

Recommended (wheat)

- Base fertilizer N rate on expected yield, a general consideration of soil organic matter, and previous crop.
- Total N rate should include all fertilizer sources, including contributions from phosphate fertilizer, such as MAP or DAP
- For ammonium based products (AA or urea), apply when soil temperatures at 6 inches stabilize below 50 F either broadcast or banded at planting.
- Take credit for nitrogen supplied by previous legume crops in rotation.
Northwestern Minnesota

Recommended continued (wheat)

- Take credit for nitrogen supplied in manure or the nitrogen contained in sugarbeet tops based on leaf color prior to beet harvest.
- Adjust the nitrogen rate for measured residual nitrate-nitrogen in the surface 2 feet of the soil profile when wheat follows a non-legume crop in a rotation.
- Collect soil samples after soil temperature at a depth of 4 inches is less than 50 F.
- Collect soil samples in increments of 0 to 6 and 6 to 24 inches after soil temperatures at 6 inches stabilizes at 50 F.
- Any broadcast urea, should be incorporated to a depth of 3 inches.
Northwestern Minnesota

Acceptable, but at greater risk (wheat)

- Limit rate to 40 lb N/A if liquid source is applied to foliage at boot stage or later.
- Application of urea in a band either with the seed or near the seed when an air seeder is used for planting.
NOT RECOMMENDED

- Fall application of liquid nitrogen (28-0-0) or any fertilizer containing nitrate-nitrogen.
- Fall or spring application of urea without incorporation.
- Shallow (2 inches of less) application of 82-0-0 in either fall or spring.
- Foliar application of high rates of 28-0-0 (more than 40 lb N/A) at boot stage or later.
Northwestern Minnesota

- NOT RECOMMENDED
  - Application of any N fertilizers including MAP or DAP on frozen soils.
  - Fall application of N, regardless of source to sandy soils in the fall.
Northwest, Southwestern and West Central Minnesota

Recommended for sugarbeet

- Use a soil nitrate test by collecting soil samples to a depth of 4 feet after soil temperature at 6 inches stabilizes below 50 F.
- Apply ammonium based fertilizer N in the fall according to U of M guidelines. The N rate is a total of nitrate-N measured to a 4 foot soil depth plus fertilizer N.
- Apply fertilizer N in the fall after soil temperatures at the 6 inch depth stabilize below 50 F.
- Take first and second year credits for forage legumes that were part of the rotation.
Northwest, Southwestern and West Central Minnesota

Not Recommended for sugarbeet

- Fall application of UAN or any fertilizer containing nitrate-nitrogen.
- Shallow or no incorporation of urea applied in the fall.
- Fall N application of any N fertilizer to coarse textured (sandy) soils.
- Winter application of nitrogen fertilizers including MAP and DAP to frozen soils.
Specific BMPs for Potatoes
Selecting a Realistic N Rate

- Base N rate on variety, harvest date, and realistic yield goals.
- Account for nitrogen from previous crops.
- Test irrigation water for nitrogen content and adjust N fertilizer accordingly.
Specific BMPs for Potatoes
Timing of N Application

- Do not fall apply N on sandy soils.
- Do not use more than 40 lbs N/A in the starter for mid/late season varieties.
- Do not use more than 60 lbs N/A in the starter for early harvested varieties.
- Nitrogen applied through the hilling stage should be cultivated/incorporated into the hill.
- Plan the majority of soluble N inputs from 10 to 50 days after emergence.
- Use petiole analysis to aid in making post-hilling nitrogen applications.
Specific BMPs for Potatoes
Selecting Appropriate N Sources

- Do not use fertilizers containing nitrate in the starter.

- For mid to late season varieties, apply ESN no later than emergence.

- ESN for early harvested potatoes (vines killed or green dug before August 1) is not recommended due to slow release of N.
Specific BMPs for Potatoes

Water Management Strategies

- Follow proven water management strategies to provide effective irrigation and minimize leaching

Cover Crops Following Potatoes

- Establish a cover crop following potatoes whenever possible.