Implementation of Nitrogen Fertilizer Management BMPs

Measure Background

Visual Depiction

Figure 1. Nitrogen fertilizer application rates on non-manured corn following different crops in 2009 by surveyed farmers reporting on an average field.

Figure 2. Statewide 2009 nitrogen fertilizer application timing on corn.
Figure 3. Statewide trends in nitrogen inhibitor use on corn

Figure 4. Use of additive and specialty formulations of urea and liquid nitrogen fertilizers applied to corn in 2009 by surveyed farmers reporting on average farm fields.
Measure Description
This measure is intended to communicate voluntary nitrogen fertilizer best management practices (BMPs) promoted through the Minnesota Department of Agriculture’s (MDA) Nitrogen Fertilizer Management Plan (NFMP). The key voluntary nitrogen fertilizer BMPs are nitrogen fertilizer application rates on corn, nitrogen fertilizer application timing on corn, nitrogen inhibitor use on corn, and use of additive and specialty formulations of urea and liquid nitrogen fertilizers applied to corn.

Nitrogen Fertilizer Application Rates. Figure 1 shows the nitrogen fertilizer application rates on non-manured corn following different crops in 2009 by surveyed farmers reporting on average farm fields. According to Figure 1, nitrogen fertilizer application rates on corn following corn in 2009 fall within the acceptable nitrogen application rate range of 120-165 pounds (lbs)/acre of nitrogen. For corn following soybean, the nitrogen application rates exceed the acceptable range of 95-120 lbs/acre of nitrogen.

Nitrogen Fertilizer Application Timing. Figure 2 shows the nitrogen fertilizer application timing on corn in 2009 by surveyed farmers reporting on average farm fields, with 58.8 percent of surveyed farmers applying nitrogen fertilizer during the spring and 8.7 percent of surveyed farmers applying as a sidedress; both of these practices are better than fall applications.

Nitrogen Inhibitor Use. Figure 3 shows the statewide trends in nitrogen inhibitor use on corn from 1996-2012, with a steady increase in use over time.

Use of Additive and Specialty Formulations. Figure 4 shows the use of additive and specialty formulations of urea and liquid nitrogen fertilizers applied to corn in 2009 by surveyed farmers reporting on average farm fields, indicating that 91.7 percent of surveyed farmers use urea or liquid nitrogen fertilizer alone.

Table 1 below shows the estimated percent nitrogen and phosphorus removal associated with the nitrogen fertilizer BMPs presented in this measure. These efficiencies were derived from a comprehensive literature review.

<table>
<thead>
<tr>
<th>Best Management Practice</th>
<th>Nitrogen Removal (%)</th>
<th>Phosphorus Removal (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Average&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Fertilizer Application Rates [From existing rates down to rates providing the maximum return to nitrogen value (133 lb/acre corn-soybean and 190 lb/acre on corn-corn)]</td>
<td>10</td>
<td>17</td>
</tr>
<tr>
<td>Fertilizer Application Timing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>From fall to spring pre-plant</td>
<td>6</td>
<td>NA</td>
</tr>
<tr>
<td>From fall to spring pre-plant/sidedress 40-60 split</td>
<td>5</td>
<td>NA</td>
</tr>
<tr>
<td>From pre-plant application to sidedress</td>
<td>7</td>
<td>NA</td>
</tr>
<tr>
<td>From pre-plant to sidedress – soil test based</td>
<td>4</td>
<td>NA</td>
</tr>
<tr>
<td>Nitrogen Inhibitor Use (From fall applied without inhibitor to fall applied with Nitrapyrin)</td>
<td>9</td>
<td>NA</td>
</tr>
<tr>
<td>Use of Additive and Specialty Formulations</td>
<td>Unknown</td>
<td>NA</td>
</tr>
</tbody>
</table>

<sup>a</sup>  MPCA, 2013
<sup>b</sup>  Iowa State, 2013
Associated Terms and Phrases
To better understand this measure, it is necessary to understand a few program specific terms and phrases.

Nitrogen Fertilizer Application Timing: By moving application timing closer to the actual use of the crop reduces the potential for nitrogen fertilizer loss. Spring application is better than fall, and side-dress is better than spring.

Nitrogen Fertilizer Rate: University of Minnesota recommended fertilizer rates strive to maximize nitrogen use efficiency. They are also based to utilize carry-over nitrogen from previous crops (soybeans, alfalfa) and manure.

Nitrogen Fertilizer Variable Rate: Precision agriculture, through the use of GPS technology, can adjust nitrogen fertilizer application rates according to soil type within a field or crop condition in order to increase nitrogen use efficiency.

Inhibitors: Nitrification inhibitor delay the conversion of ammonia, an immobile form of nitrogen, to nitrate, which can move freely with soil water, or be lost to the atmosphere.

Nitrogen Fertilizer Formulations: Some urea nitrogen fertilizers are formulated to release nitrogen slowly so it is available closer to when the crop needs it.

Sidedress: Fertilizer application technique where fertilizer is applied beside the row after plant emergence; a better nitrogen fertilizer application practice than spring or fall application

Target
There is no specific numeric target for this measure to date.

Baseline
1996-2012 (nitrogen inhibitor only); statewide data reported during 2010 survey to reflect 2009 growing season

Geographical Coverage
Statewide

Data and Methodology

Methodology for Measure Calculation
These measures are based on information from the 2010 Survey of Nitrogen Fertilizer Use on Corn in Minnesota.

Data Source
Minnesota Department of Agriculture

Data Collection Period
2010 for 2009 growing season (Figures 1, 2, 4)
1996-2012 (Figure 3)
Data Collection Methodology and Frequency
The MDA has partnered with the USDA National Agricultural Statistic Service (NASS) and University of Minnesota researchers to collect information about fertilizer use and farm management at the statewide level. Partners have pioneered a survey tool for characterizing fertilizer use and associated management on a regional and statewide scale. Surveys are conducted over the phone. The statewide fertilizer use survey will alternate every other year. Much of the focus will be on corn production, where 70 percent of the commercial inputs are used. The first attempt using this technique was in 2010. NASS enumerators surveyed approximately 1,500 corn farmers from across the state to gather information about commercial fertilizer use.

Project personnel collaborated with the Minnesota Department of Agriculture (MDA) to develop survey questions and MDA worked with the USDA National Agricultural Statistics Service (NASS), Minnesota Field Office to conduct the survey.

Farmers in the survey were from a database of the Minnesota Field Office of NASS. An initial pool of 7,000 farmers was randomly selected by NASS from their database of about 31,000 Minnesota farmers who have recently grown corn. The survey was carried out through phone interviews conducted at the North Dakota Field Office of NASS in Fargo. Interview staff were the same experienced interviewers that are routinely used to perform the regular surveys conducted by NASS. The survey consisted of 42 questions and it took about one-half hour to complete the interview with farmers who were able to finish the entire survey. Interviews and follow-up calls necessary to clarify some of the responses were conducted between February and June of 2010.

Interviewers were able to contact 4,461 of the initial pool of 7,000 farmers. Those not contacted were called more than once, but failed to answer the phone. Of the farmers contacted, 3,358 grew corn in 2009. The 2,769 farmers who continued the interview grew corn on 656,312 acres in 2009. Manure had been applied to 32% of these acres in the previous five years. The focus of the survey was use of manufactured N fertilizers, so to avoid the complicating effects of previous manure application on N fertilizer rates the farmers were asked to report on an average field with no manure applied in the last five years. The 866 farmers who did not have a field where no manure had been applied in the last five years were eliminated. Also eliminated were 407 of the remaining farmers who did not have a field where they knew the total amount of N applied per acre. This left 1,496 farmers, who grew corn on 482,812 acres in 2009. The survey results reported below are from this subsample of Minnesota corn farmers.

Supporting Data Set

Table 1. Nitrogen fertilizer rates on corn following different crops in 2009 by surveyed farmers reporting on an average field (Bierman et al. 2011).

<table>
<thead>
<tr>
<th>Crop</th>
<th>N rate (lbs/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>145</td>
</tr>
<tr>
<td>Soybean</td>
<td>140</td>
</tr>
</tbody>
</table>

Caveats and Limitations
- The survey was restricted to nitrogen management on corn because corn is the most widely grown crop in Minnesota that requires nitrogen application and the majority of the nitrogen fertilizer applied in the state is used in corn production.
- Responses of individual farmers in this survey represent their “average” or “typical” nitrogen management practices. In some cases farmers may have strayed from the “average field”
restriction, especially as the interview progressed, and some of their answers may have reflected
the entire range of the nitrogen management options they employed.

- The average size of the corn fields reported on by farmers in this survey was 81 acres.
- Information reported in the survey report broke Minnesota into BMP regions by groups of
counties. Although the final survey report did report number of fields by county, it did not provide
acreage associated with the number of fields captured in the survey. Therefore, it is difficult to
analyze survey results at the 8-digit HUC scale.
- MDA does not track nitrogen load reductions associated with implementation of nitrogen BMPs.

**Future Improvements**

According to MDA, the next statewide nutrient fertilizer survey will include not only number of fields by
county, but also the associated acreage. This will allow nitrogen fertilizer survey results to be further
analyzed at the 8-digit HUC scale and included in an updated Strategy analysis.

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**Financial Considerations**

**Contributing Agencies and Funding Sources**

This survey was supported by the MDA using dollars provided by the Clean Water Fund (from the Clean
Water, Land and Legacy Amendment).

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**References**

Iowa State University. 2013. *Iowa Science Assessment of Nonpoint Source Practices to Reduce
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Department of Natural Resources, and Iowa State University College of Agriculture and Life Sciences.

MPCA. 2013. D1 Nitrogen Sources to Land and Waters - Results Overview. DRAFT 2013 (Dave Wall,

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**Measure Points of Contact**

**Agency Information**

Ron Struss  
Pesticide & Fertilizer Management Division  
Minnesota Department of Agriculture  
651-201-6269  
Ron.struss@state.mn.us

Bruce Montgomery, Manager  
Fertilizer Non-Point Section  
Minnesota Department of Agriculture  
651-201-6178  
Bruce.montgomery@state.mn.us
Denton Bruening  
Pesticide & Fertilizer Management Division  
Minnesota Department of Agriculture  
651-201-6399  
denton.bruening@state.mn.us